Review of the Wright County Board of Commissioners' Justification for Denying Superior FCR's Request to Rezone 40 Acres for Expanded Landfilling Activities

Comments Submitted by

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On April 6, 1999, the Wright County Board of Commissioners denied Superior FCR Landfill's petition to rezone 40 acres of property more or less south of their existing sanitary landfill in Monticello Township, Wright County, Minnesota. I have been asked to review the technical justification for the Board of Commissioners' action in determining the unsuitability of allowing expanded landfilling of solid wastes at the Monticello Township, Wright County, Minnesota, Superior FCR landfill site. The comments presented herein include as reference the various literature citations, including those appended to these comments.

In denying the proposal for expansion of the Superior FCR landfill, the Wright County Board of Commissioners acted on findings of the Wright County Planning Commission that had been adopted on March 18, 1999. In its "General Findings" the Wright County Planning Commission concluded:

> *"2. The proposed rezoning is in conflict with the stated 'goals,' 'policy considerations,' and 'purposes' found within the WCZO* [Wright County Zoning Ordinance] *and the Wright County Land Use Plan. For example:*
>
> *a. The establishment of a new or expanded WHD* [Waste Handling and Disposal district] *within the area designated in the Wright County Land Use Plan for long term agricultural use, conflicts with the 'major goal' of the County's Plan to 'protect agricultural lands from encroachment by incompatible uses.'*
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> *b. The proposed rezoning would 'jeopardize the County's goal of protecting and promoting commercial agriculture.'*
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> *c. The proposed rezoning would not, as proposed by the first stated purpose for the WHD, 'prevent public nuisances, and prevent contamination of air, soil, surface water and other environments in Wright County by controlling the location and operation of waste management activities.'"*

Within the "Specific Findings" of the Wright County Planning Commission, reference is made to the following items:

"2. Continuation of past and present problems with odors, noise and litter that pose an unacceptable public nuisance. Landfills inevitably have extraneous odors, noise and some uncontrollable litter. The area of the existing landfill manifests these problems already. Substantially expanding the landfill will necessarily compound the existing odor, noise and litter problem, which is not consistent with existing rural uses in the surrounding area."

"5. Unreasonable threat to the environment, including potential groundwater contamination, ozone destruction and related concerns about surface water and air quality.

"6. Ultimate liability for the environmental risk could lie with local County residents. There may be short term economic benefits for Superior, but all the long term economic problems lie with the residents of Wright County. The risk is forever, while the landfill's main environmental defense – i.e., the synthetic bottom liner – is relatively new, untested in real world conditions and has a limited guarantee for, at most, only 20 years (installation warranty is only guaranteed for 1 year). Superior's closure liability extends just 30 years."

"8. Potential threat to physical health and well-being of nearby residents. The local area is primarily agricultural with a rural residential population."

My review of these issues is based on my review of several documents, including:

Administrative Record for the Superior FCR Landfill Expansion, which includes the June 1997 Environmental Impact Assessment for the Superior FCR Landfill Expansion, Wright County, Minnesota, prepared by Camp, Dresser and McKee,

March 2000 Revised Application for Permit Modification, Partial Horizontal Expansion, Superior FCR Landfill, Permit No. SW-60, prepared by Barr Engineering,

1997, 98, and 99 Superior FCR Landfill Incorporated, SW-60 Annual Reports,

Miscellaneous correspondence between Superior FCR Landfill, Inc. and Minnesota Pollution Control Agency,

Other documents, as cited in the text.

This review focuses first on an overview assessment of the deficiencies in the proposed design, operation, closure, and post-closure care for the proposed Superior FCR landfill expansion, with particular reference to landfill siting, design, evaluation of protective nature of the landfill containment system, operation, closure, and post-closure care. This discussion provides support for the Wright County Board of Commissioners' determination that the proposed landfill expansion will not protect public health, groundwater resources, and the

environment from pollution by landfill-derived wastes for as long as the waste in the proposed landfill expansion will be a threat. The next section is devoted to specific comments on inadequate or unreliable information contained in the various documents that have been reviewed as part of conducting this review. This section is followed by a literature review of key aspects of these deficiencies. A statement of my qualifications and experience devoted to landfill impact evaluation and management is included.

Summary of Qualifications

My qualifications include a bachelor's degree in environmental health sciences from San Jose State University in 1955, a Master's Degree in Public Health from the University of North Carolina in 1957, and a PhD in Environmental Engineering from Harvard University in 1960. For 30 years I held university graduate-level teaching and research positions at several major US universities. During that time I conducted over $5 million in research and published over 500 papers and reports. The research included evaluation of landfill liner properties.

My work on municipal solid waste landfills began in the 1950s. I have been active in evaluating the impact of municipal solid waste landfills over the past 40 years. I have been involved in review of over 60 landfills located in the US and in other countries. I have published extensively on landfill impact evaluation and management. Since 1989 I have been a full-time consultant, in which a substantial part of my activities have been devoted to landfill impact evaluation and management. On behalf of various universities and professional organizations, I have presented numerous short courses and lectures on municipal and hazardous waste landfill management issues. Additional information on my qualifications is appended to these comments.

Overall Comments

The landfill expansion proposals submitted by CDM in 1997 and subsequently by Barr Engineering (Barr) in March 2000 claimed that the proposed landfill expansion would be over 99 percent effective in preventing leakage of leachate through the landfill liner system. Leachate is the liquid containing waste-derived constituents that is formed when the wastes come in contact with water. The approach used by CDM and Barr involving the US EPA HELP Model for calculating landfill cover leakage rates, landfill liner leakage rates, and the dilution of the leachate that leaks through the liner that will occur, is fundamentally flawed and unreliable. The unreliability arises from considering only the initial (design) characteristics of the landfill waste containment system (cover and liner), where it is assumed that these characteristics will prevail for as long as the waste in the landfill will be a threat.

The CDM/Barr analysis ignores the fact that many of the components in the waste in the proposed landfill expansion will be a threat effectively forever. The CDM/Barr assessment of liner reliability also ignores the well-known facts that the plastic sheeting layer in the landfill cover and liner will deteriorate over time and allow much greater amounts of water to enter the landfill and generate leachate and allow leachate to pass through the liner into the underlying groundwaters. A reliable evaluation of the ability of the landfill liner system to prevent groundwater pollution by leachate must consider the properties of the landfill cover and liner that

will likely exist over the period of time that the waste will be a threat to public health, groundwater resources, and the environment, i.e., effectively forever.

The US EPA (1988a) stated, as part of promulgating RCRA Subtitle D (municipal solid waste) regulations in which the Agency proposed to adopt as the minimum landfill liner design, a single composite liner of the type that is being proposed for the Superior FCR landfill expansion,

> *"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's "Criteria for Municipal Solid Waste Landfills" (US EPA, 1988b) 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."*

The US EPA's 1988 assessment of the inability of a minimum Subtitle D single composite liner to prevent groundwater pollution by landfill leachate is still applicable today to Subtitle D landfill liner systems of the type proposed by Superior FCR for the proposed landfill expansion. If anything, today there is more widespread recognition that single or double composite-lined landfilling will not protect groundwaters from pollution by landfill leachate for as long as the wastes in the landfill will be a threat. In 1991, and again in 1998, I checked with the US EPA administration regarding their current views on the ultimate ability of a single composite liner to prevent groundwater pollution by landfill leachate for as long as the waste in the landfill will be a threat. Clay (1991) Assistant Administrator, US EPA Office of Solid Waste Emergency Response, and Dellinger (1998), Director, US EPA, Office of Solid Wastes, indicated that the US EPA still finds that a single composite liner will eventually leak leachate into underlying groundwaters.

One of the most significant deficiencies associated with the Superior FCR proposed landfill expansion that was of concern to the Wright County Board of Commissioners is the fact that Superior plans to only provide minimum post-closure care for 30 years after landfill closure. Issues such as who is going to maintain the landfill cover, operate and maintain the landfill gas collection system, remove leachate from the landfill, operate the groundwater monitoring well system, and eventually, when significant offsite groundwater pollution occurs, remediate the contaminated groundwaters, justifiably is of concern to the County, since no provisions are made to address these issues for as long as the wastes in the landfill will be a threat. Since no provisions are made, it is possible that these necessary activities will become a burden to the County. Since the wastes in the proposed landfill will effectively be a threat forever (certainly, for thousands of years), and since Superior is not proposing to provide adequate funding for landfill monitoring and maintenance over the period that the waste in the landfill will be a threat, the County Planning Commission and Board of Commissioners were justified in expressing

concern about the long-term threat that the proposed landfill expansion represents to County interests.

Basically, Superior and its consultants have provided unreliable/inadequate information on the long-term threat that the proposed landfill expansion represents to public health, groundwater resources and the environment. This situation provided significant justification for the County Planning Commission and the County Board of Commissioners to deny the proposed expansion of the Superior FCR landfill. Wright County already faces pollution of groundwater resources by the original unlined landfill. The currently approved expansion of that landfill vertically means that the County faces the impacts and costs not only of the original landfill, but also of the expanded landfill. The County is certainly justified in preventing the approval of rezoning of an area adjacent to the existing landfill, based on the fact that the additional landfill expansion will contribute to additional public health, groundwater resource, and environmental threats.

A summary of some of the specific deficiencies in the proposed landfill expansion, is presented below. Additional details on these issues are provided in a subsequent section of these comments.

- **The Containment System Design Is Inappropriate for the Geology of the Site.** The Superior FCR Landfill site is a geologically unsuitable site for the proposed design of the landfill expansion. This landfill containment system will, at best, only postpone for a short period of time the pollution of groundwater by landfill leachate, compared to the time that the wastes in this landfill will be a threat. The Superior landfill site does not provide for natural protection of groundwaters from pollution by landfill leachate.

- **Landfill Wastes Will Be a Threat to Public Health and the Environment Forever.** Many of the components of the wastes in the proposed Superior FCR landfill expansion will be a threat to public health, groundwater resources and the environment for a very long period of time, well beyond the expected reliable functioning of the landfill liner system.

- **Inadequate Buffer to Dissipate Waste Releases.** The proposed Superior FCR Landfill expansion does not have adequate buffer lands between the areas where wastes are to be deposited and adjacent properties to dissipate the gaseous, air- and water-borne release of wastes from this landfill on the landfill property. This situation will almost certainly lead to trespass of waste component releases to adjacent properties, which will be a threat to public health, groundwater quality, air quality, the environment, and those within the sphere of influence of this landfill.

- **Unreliability of Landfill Liner System to Prevent Groundwater Pollution by Landfill Leachate for as Long as the Wastes in the Landfill Expansion Will Be a Threat.** The plastic sheeting liner and compacted soil liner that are proposed for the

proposed Superior FCR Landfill expansion have limited periods of time, compared to the time that the wastes are a threat, when they can be expected to effectively collect the leachate generated in the landfill and convey the leachate to a sump where it can be removed.

- **Unreliable Predictions of Groundwater Pollution by Landfill Liner Leakage.** The CDM/Barr approach for estimating the amount of pollution of groundwaters by landfill leachate that leaks through the liner system fails to consider the long-term deterioration of the landfill liner system's ability to prevent leachate from passing through it for as long as the waste in the landfill will be a threat. By only considering the initial design characteristics of the liner system in predicting leachate leakage rates, CDM/Barr/Superior have provided unreliable/inadequate information on the pollution of groundwaters that will occur by the proposed Superior FCR Landfill expansion.

- **Unreliable Groundwater Monitoring.** The proposed groundwater monitoring system is inadequate to detect groundwater pollution by leachate before offsite pollution occurs. As discussed herein, the initial leakage through the landfill liner system will occur through holes, rips, tears, and points of deterioration in the plastic sheeting layer of the liner. These will initially produce limited areas of groundwater pollution that may not be detected by the monitoring well array that is proposed.

- **Unreliable Estimates of Leachate Generation.** The estimates of the amount of infiltration that will occur into the proposed Superior FCR landfill expansion through the cover for as long as the wastes in the landfill will be a threat are unreliable. The estimates that were made of the amount of infiltration that will occur into this landfill are based on a new cover with high- quality construction. There are a well-known variety of factors that can cause the cover to develop cracks, points of deterioration, etc., over the long period of time that the wastes in the landfill will be a threat. Far greater amounts of leachate will be generated in this landfill than predicted based on the calculations presented.

- **Unreliable Estimates of Landfill Gas Production Rates.** The gas production estimates were unreliable. Since the rate of landfill gas production is dependent on the amount of moisture that enters the wastes, it is not possible to reliably predict either the rate of landfill gas production or the duration over which landfill gas production will occur. The long-term landfill gas production will be controlled by the rate of deterioration of the plastic sheeting layer in the landfill cover. The plastic sheeting layer in the cover will deteriorate and allow water to enter the wastes and generate landfill gas and leachate; the rate of deterioration cannot be estimated.

- **Dioxin Production.** The Superior FCR application for landfill expansion mentions the use of a flare for managing landfill gas that will be produced. The flaring of landfill gas has been found to lead to dioxin formation, which is a threat to public health and the environment.

- **Inadequate Post-Closure Care Funding.** Adequate assured post-closure funding is not available to maintain the landfill cover, monitor surface and groundwaters, and eventually remediate the "superfund"-like conditions that will likely develop when widespread groundwater pollution occurs by landfill leachate.

Comments on the Administrative Record Superior-FCR Landfill Application to Rezone Forty Acres of Property More or Less South of Their Existing Sanitary Landfill in Monticello Township, Wright County, Minnesota

In June 1997, Superior FCR Landfill, Inc., had Camp, Dresser and McKee (CDM) prepare a series of technical work papers on the proposed landfill expansion that was being considered at that time. The technical work papers prepared by CDM contain information that is pertinent to an evaluation of the currently proposed Superior FCR landfill expansion's ability to protect public health, groundwater resources and the environment for as long as the waste in the landfill will be a threat.

As background to these comments, Dr. Anne Jones-Lee and I have published several reviews on the problems with Subtitle D landfills for municipal solid wastes and industrial "nonhazardous" waste of the type that Superior proposes to construct in their landfill expansion. These include:

Lee, G.F. and Jones, R. A., "Municipal Solid Waste Management in Lined, `Dry Tomb' Landfills: A Technologically Flawed Approach for Protection of Groundwater Quality," (1992a).

Lee, G.F. and Jones-Lee, A., "Municipal Landfill Post-Closure Care Funding: The 30-Year Post-Closure Care Myth,"(1992b).

Lee, G.F. and Jones-Lee, A., "Assessing the Potential of Minimum Subtitle D Lined Landfills to Pollute: Alternative Landfilling Approaches," Proc. of Air and Waste Management Association 91st Annual Meeting, San Diego, CA, (1998a).

Lee, G.F. and Jones-Lee, A., "Deficiencies in Subtitle D Landfill Liner Failure and Groundwater Pollution Monitoring, Presented at the NWQMC National Conference Monitoring: Critical Foundations to Protect Our Waters, US Environmental Protection Agency, Washington, D.C., (1998b).

These, as well as other papers and reports published by the authors and referenced herein, provide the technical base of information upon which the comments made in the following sections are based.

Comments on Technical Work Paper 1: Project/Site Description, Superior FCR Landfill Expansion, Wright County, Minnesota, prepared by CDM, June 1997

Superior FCR Landfill, Inc., applied to the Minnesota Pollution Control Agency (MPCA) for a permit to expand an existing landfill to a total of approximately 78 acres, of which 36 acres would cover the existing landfill, and the remainder would occur over unfilled land area. According to the project/site description, the 1997 proposed landfill expansion would add 6.3 million cubic yards of waste capacity and would have an elevation approximately 137 feet above the permitted final elevation of the existing landfill.

According to the project/site description, *"Groundwater near the site ranges from 18 to 40 feet below existing surface grade and the water table aquifer is used extensively for domestic water supply."* This situation is of concern, since it means that the pollution of groundwaters by landfill leachate could result in destruction of the use of the groundwater for domestic purposes.

On page 3-3 in section "3.2.5 Groundwater," the statement is made, *"At two points, the MSW and combustor ash leachate sumps, the base of the liner lies below the water table."* Locating the base of the liner and leachate sumps below the water table is dangerous, since it can lead to additional groundwater pollution.

Another statement is made in that same section, *"Private water wells located within a one-mile radius of the landfill and high-capacity wells located within a three-mile radius have been identified."* The fact that existing private water wells are located near the proposed landfill expansion is of concern, since it means that the groundwaters of the region are used for domestic purposes and existing wells as well as new wells are subject to pollution by landfill leachate.

Part of the area where the landfill is located was a former gravel mining area. This is of concern since gravel pits are poor sites for landfill since the leakage through the liner system can have a pathway through sand and gravel strata for rapid offsite transport of leachate-polluted groundwater.

On page 3-4, in section "3.3.4 Existing Wells," it is noted that there are two domestic water wells directly impacted by the proposed expansion, but that the two residences would be removed and the associated wells would be abandoned. It is also stated that eight new monitoring wells were installed in 1996 for the existing landfill; one was slated for removal in 1997, leaving 27 monitoring wells reportedly at the site. An examination of the location of the monitoring wells that are down gradient of the proposed landfill expansion shows that there is an insufficient number of monitoring wells to reliably detect the leachate polluted groundwaters before offsite pollution occurs.

Page 4-1, under section "4.1.1 Liner," states, *"MSW combustor ash cells would be underlain by a continuous double liner."* Figure 4-1 shows the proposed design for the MSW combustor ash cells, as well as the landfill liner cells. Examination of Figure 4-1, which was reported to show the design of the proposed "double liner," shows that it is actually a single composite liner, consisting of an HDPE plastic sheeting layer and a compacted clay layer. The

single composite liner is overlain by a 12-inch-thick granular drainage layer. As discussed herein, such a liner at best, with high-quality construction, only postpones for a short period of time compared to the time that the waste will be a threat, when groundwater pollution will occur.

The design of the landfill cover for the 1997 proposed landfill expansion is shown in Figure 4-3. This is a conventional (US EPA 1991) Subtitle D-type landfill cover consisting of a topsoil layer, a drainage layer, and an HDPE plastic sheeting layer. There is no mention of the manner by which holes will be detected when they develop in the plastic layer of the landfill cover. These holes will not necessarily be manifested in the surface soil layer, and therefore could go undetected for many years while admitting water into the landfill.

A gas extraction system would be constructed as part of the final cover for the purpose of collecting landfill gas. No mention is made that landfill gas will be generated in this landfill long after Superior FCR Landfill, Inc., has terminated its operation and maintenance of the landfill gas collection system.

Table 5-1 presents *"typical composition and characteristics of leachate from existing FCR landfill."* The data presented in this table, while incomplete with respect to the parameters analyzed and inadequately presented, show that the leachate from the existing landfill, and that which is expected from the proposed landfill expansion, has a significant potential to cause groundwater pollution. The inadequate presentation of these data stems from the fact that many of the parameters analyzed are reported to be "ND" (not detected), but no information is provided on the detection limits. Without this information, it is not known whether adequate analytical methods were used to determine the characteristics of the leachate. Also, a number of parameters which are typically analyzed in characterizing leachate are not included in this table.

Page 5-2, under section "5.3 Hazardous Waste," states, *"Hazardous wastes will not be accepted at the proposed expansion facility. Other unacceptable waste streams include tires, free liquids, and batteries."* It should be understood that there is no way to keep hazardous chemicals (which cause waste to become hazardous) out of municipal solid waste landfills. While there may be no attempt to accept what are classified as "hazardous wastes" at this landfill, there will be hazardous chemicals including batteries in the solid waste stream, which are a threat to public health and the environment. It should also be noted that, since the primary waste stream for the proposed landfill expansion is industrial "nonhazardous" waste, appreciable quantities of hazardous chemicals can be deposited in the landfill and still comply with this regulatory requirement.

The basic problem is that the US EPA, as part of developing its hazardous waste classification approach, adopted a definition of hazardous waste that allows substantial amounts of hazardous chemicals to be present in a waste that is classified as "nonhazardous." Waste can leach 100 times the drinking water standard for a regulated waste constituent and be classified as a "nonhazardous" waste. Further, the US EPA only regulates a very small number of the potentially hazardous chemicals present in industrial waste. There are many thousands of chemicals in industrial waste which are not regulated under hazardous waste regulations which

could legally be placed in the Superior FCR landfill expansion. Lee and Jones (1981, 1982) provide additional discussion of the problems with the US EPA's classification of industrial waste as "nonhazardous."

Page 5-4, second paragraph, discusses the approach that will be used to inspect the industrial so-called "nonhazardous" waste that is accepted at the landfill. This inspection program will not prevent deposition of hazardous waste or hazardous chemicals derived from industrial operations in the landfill.

Page 5-5, section 5.4.3 discusses *"Nuisance Control."* No mention is made, however, of offsite odors. Offsite odors have been a severe problem at the existing landfill and can readily be a significant problem at the proposed landfill expansion.

Comments on Technical Work Paper 2: Ground and Surface Water Impacts, Superior-FCR Landfill Expansion, Wright County, Minnesota, Prepared by CDM, October 1997

This section presents part of the Environmental Impact Statement (EIS) for the proposed landfill expansion.

Page ii of the Executive Summary presents the conclusions and recommendations from this EIS. In the first bulleted paragraph the statements are made,

> *"Land usage in the vicinity is primarily agricultural, and water wells are generally used for irrigation or domestic consumption."*
>
> * * *
>
> *"The downgradient direction from the landfill appears to be generally toward the southeast-east. Future agricultural and residential development will need to be evaluated so that landfill monitoring remains adequately protective of any new water supply wells near or downgradient from the landfill."*

These statements indicate that Superior-FCR plans to try to use groundwater monitoring to detect the inevitable failure of the landfill liner system that will result in groundwater pollution underneath the landfill. This pollution, according to the information available, will be transported downgradient to the southeast-east, and is a threat to the water quality of domestic and agricultural wells.

Page ii, third bulleted item states, "*The groundwater quality in the upper outwash aquifer at the site has been impacted by contaminants from the unlined Closed Landfill."* This means that, since the leachate from the proposed landfill is expected to be similar to that from the previous landfill, when the liner system failure occurs, there will be pollution of groundwater, which can eventually lead to groundwater pollution offsite.

Page iii, the first bulleted item states,

> *"Groundwater quality impacts from the proposed expansion are expected to be relatively small due to the presence of the composite liner, leachate collection system,*

and final cover system. Upgradient groundwater flowing beneath the site is expected to dilute any leachate that leaks through the liner system."

This statement is overly optimistic with respect to providing for groundwater quality protection from the proposed landfill expansion for as long as the waste in the landfill will be a threat. As discussed in these comments, the waste in this landfill will be a threat for very long periods of time B hundreds to thousands of years. The liner system that is proposed for this landfill will fail to prevent sufficient leachate from migrating through it that will lead to groundwater pollution. While the rate of leakage for a new liner with high-quality construction can be low, eventually, the rate of leakage through this liner can be sufficient to overcome any dilution that is occurring.

Page 2-1, section "2.1 Solid Waste Facility Regulations" states,

"*State of Minnesota Solid Waste Facility Rules (7035.2565) state that solid waste management facilities 'must be located, designed, constructed, and operated to contain sediment, solid waste, and leachate and to prevent pollution of groundwater and surface water.'"*

This requirement is not restricted with respect to the applicable time-frame or the minimum funded post-closure care period.

Page 3-1, under section "3.1 Proposed Expansion Design and Design Alternatives" states in the first paragraph that the proposed landfill provides for 8 acres of buffer. Eight acres of buffer lands owned by the landfill owner around the landfill are inadequate to protect adjacent property owners from adverse impacts of the landfill during its active life and post-closure period. This proposed landfill is being developed without adequate buffer lands to protect the health, welfare and interests of those who own, use, or could use properties within the sphere of influence of the landfill These issues are discussed in Lee and Jones-Lee (1993a) and Lee and Jones-Lee (1994a,b).

Page 3-5 presents a discussion of the characteristics of the proposed landfill cover. While such a cover may be allowed by current regulatory approaches, it is well-understood that it is significantly deficient in its ability to prevent moisture from entering the landfill over the period of time that the wastes in the landfill represent a threat. As discussed herein, the low permeability plastic sheeting layer in the cover that is the primary barrier to moisture entering the landfill is buried below the topsoil and drainage layers and is, therefore, not subject to inspection that can detect holes, rips, tears or points of deterioration that develop in it over the period of time that the wastes in the landfill are a threat. The moisture that enters the landfill will generate leachate and landfill gas, which will be a threat to public health and the environment.

Also, page 4-5, section "4.3.2 Leachate Generation After Closure" does not discuss the long-term problems associated with the landfill cover's not being able to prevent large amounts of moisture from entering the wastes and generating leachate and landfill gas. Lee and Jones-Lee (1995a) and Lee and Jones-Lee (1998a) have discussed these issues.

In the next section, "4.3.2.1 MSW Leachate," a statement is made about the proposed landfill cover's being *"… estimated to be 99.88 percent efficient in terms of preventing percolation of surface water through the geomembrane."* That statement is misleading when considered over the period of time that the waste in the landfill will be a threat, and the inevitable degradation of the geomembrane (plastic sheeting layer) which will allow moisture to pass through the landfill cover at a greater rate than that discussed. It is well-known that the HELP Model, which was used for these calculations, is applicable in these calculations only at the time of construction of the landfill cover.

Page 4-6, paragraph 4.3.2.2 provides unreliable information on the rate of leachate generation over the period of time that the landfill will be a threat to cause groundwater pollution. The information provided pertains to a relatively short period of time when the landfill cover system is new; it does not consider the ultimate deterioration of the plastic sheeting layer in the cover, the inability to observe this deterioration because this layer is buried below a topsoil and drainage layer, as well as the lack of funding for landfill cover maintenance for as long as the waste in the landfill will be a threat.

Page 4-6, section "4.4.1 Liner Leachate Leakage" presents language commonly used by landfill applicant consultants on behalf of landfill applicants regarding landfill liner leakage rates. As discussed herein, such discussions fail to address the long-term properties of the wastes and the characteristics of the liners for as long as the waste will be a threat to public health, groundwater resources and the environment. These are issues that are of concern to the County.

The EIS also does not address the issue of the permeation of the liner by organic solvents. The existing landfill leachate analysis shows that there are a variety of organic solvents present in the leachate which can pass through an HDPE liner in a few days. The process governing passage of leachate through the liner, called "permeation," has been known since the late 1980s and is well-described in the landfill literature (Haxo and Lahey, 1988; Sakti, *et al.*, 1991; Buss, *et al.*, 1995; Park, *et al.*, 1996a,b).

Page 4-7, in section 4.4.3, the information provided on the combustor ash liner system is highly misleading. The information provided applies only to the time when the liner is new; it is not applicable to the entire period of time during which the waste in the landfill will be a threat. Over time, this system will leak at a much higher rate than indicated in this section.

Pages 5-4 through 5-7 present information on the site geology and site hydrogeology. A review of this information shows that the groundwater system hydraulically connected to the base of the proposed landfill will not provide natural protection from pollution by landfill leachate of offsite groundwater production wells.

Page 6-3 describes the pollution of the groundwater that has occurred from the existing landfill. If the proposed landfill expansion is approved as proposed, at some time in the future,

reviewers of this situation will be writing a similar discussion for the plastic-sheeting and compacted clay-lined landfill.

On page 6-4, at the end of the first paragraph, the statement is made that,

> *"These results* [of groundwater monitoring] *are as expected based on our knowledge of the prevailing groundwater flow direction. It is apparent that deep in the outwash aquifer, contaminants are migrating from the Closed Landfill area in easterly and southeasterly directions."*

It is clear that there will eventually be offsite groundwater pollution associated with the inevitable leakage of leachate through the liner of the proposed landfill expansion.

Figure 21 presents a map of the proposed groundwater monitoring system and shows the position of the monitoring wells. It also shows the direction of groundwater flow, which, as mentioned above, is to the southeast-east from the site. Despite the fact that according to the figure, the monitoring wells along the east side of the site are typically spaced hundreds of feet apart, the EIS states (page10-3), *"Figure 21 presents the optimum locations for the new wells and the monitoring wells included in the monitoring program."* There is no discussion of the fact that the new landfill section will leak leachate initially through holes, rips or tears in the landfill liner, producing finger-like plumes of leachate which can be from a few feet to a few tens of feet wide at the point of groundwater monitoring compliance along the eastern side of the landfill. As it stands now, the proposed design of this landfill virtually ensures that offsite groundwaters (groundwaters under adjacent properties) will eventually be polluted by landfill leachate generated within the landfill. Cherry (1990), Lee and Jones-Lee (1994c), Lee and Jones-Lee (1996a), Lee and Jones-Lee (1998b), and Parsons and Davis (1992) discuss the problems with trying to reliably monitor lined landfills with vertical monitoring wells of the type proposed for the Superior FCR landfill expansion.

The characteristics of the geology/hydrogeology at the site and its environs, and the fact that the existing landfill has polluted groundwater, mean that the site is vulnerable to pollution by landfill leachate-associated constituents. The groundwater monitoring system proposed is inadequate to prevent offsite migration of leachate-contaminated groundwater for as long as the wastes represent a threat. The conclusion, therefore, is that this is not a suitable site for this type of landfill.

Page 7-1 is devoted to groundwater usage in the vicinity of the landfill and documents that there are domestic water supply wells in the vicinity of the landfill that can be polluted by landfill leachate.

Section 8 on groundwater impacts attempts to estimate the rate of the pollution of groundwater by leachate leakage through the liner system. Again, as in other locations in this application in support of the landfill development, unreliable information has been provided on

the issues of concern with respect to the rates of leakage through the liner for as long as the waste in the landfill will be a threat.

Page 8-4, the first full paragraph states, *"The more conservative scenario allows for a leakage rate up to 0.8 gallons per acre per day based on the expectation of an imperfect liner with pinholes present ..."* While this rate of leakage can be achievable for a new landfill liner with high-quality construction and appropriate waste placement, it is certainly not representative of what is expected over the period of time that the waste in the landfill will be a threat to pollute groundwater, which is, effectively, forever. Over time, the plastic-sheeting liner for this landfill will become ineffective in preventing leachate that is produced within the landfill from polluting groundwaters underlying the landfill and to the southeast-east of the landfill.

Page 8-5, the second paragraph of section "8.1.6 Dilution Modeling Results", states, *"In summary, the dilution model predicted that the expansion area will not, by itself, cause violations of the IL standards for the liner permeability leak scenario."* It is further stated in the paragraph, *"The model is conservative because the estimated leachate concentrations used in the model are maximum values detected and are notably high (manganese 20,200 µg/L and vinyl chloride 17 µg/L)."* The information provided is unreliable. As discussed herein, far from being conservative, the dilution model grossly underestimates the actual pollution that will occur by this landfill as a result of failing to consider the deterioration of the plastic sheeting layer in the liner over the time that the waste in the landfill will be a threat.

Page 9-10, section "9.4.7 Groundwater Discharges to Surface Water," acknowledges the potential for leachate-contaminated groundwater to contaminate surface waters. However, the EIS claims in the last sentence of the last paragraph on page 9-10, *"Therefore, the surface water bodies that receive groundwater discharge, are not likely to be impacted."* That conclusion is based on the fundamentally flawed estimates of the rates of leakage through the liner for as long as the wastes in the landfill will be a threat. Contrary to the indications made in the EIS, there is a very real potential for the transport of leachate-polluted groundwaters to surface waterbodies of the region. This, in turn, can lead to adverse impacts on aquatic life and wildlife in or associated with the surface waterbodies receiving the leachate-polluted groundwaters.

Section 10 presents an inadequate and fundamentally flawed discussion of the groundwater and surface water monitoring systems that are proposed for the landfill expansion. That discussion fails to discuss the leachate leakage patterns and the groundwater pollution patterns expected to be associated with a lined landfill system of this type. A credible engineering report on the ability of a groundwater monitoring system for a proposed landfill would have included an analysis of the probability of detecting leachate leakage from holes, rips or tears or points of deterioration that occur in the landfill liner system over the time that the wastes would be a threat. Such an analysis would have shown that the groundwater monitoring system proposed is inadequate.

Appendix B presents "Subtitle D Monitoring Requirements," and includes a letter, dated December 14, 1993, from James L. Warner, Division Manager, Ground Water and Solid Waste

Division, Minnesota Pollution Control Agency to Mr. Wayne Yonak, Forest City Road Solid Waste Landfill. That letter states on page 3, item 8, *"Postclosure care and monitoring must continue for 30 years unless a decreased period can be approved by the MPCA."* The state of Minnesota at that time, and today, is only requiring funding for 30 years of post-closure monitoring and maintenance. This is the typical minimum US EPA Subtitle D requirement. It is well-understood in the technical community that such a landfill will be a threat for hundreds to possibly a thousand or more years. Failure to monitor this landfill over the entire period during which it is a threat, especially as the plastic sheeting layers in the landfill cover and in the landfill liner deteriorate, virtually ensures that there will be offsite groundwater pollution, which could impact domestic water supplies on adjacent properties. Further, because of the hydraulic connection to surface waters in the region, there will likely be surface water pollution by landfill leachate as well.

Comments on Technical Work Paper 5: Air Quality Impact Evaluations, Superior-FCR Landfill Expansion, Southern Expansion, Wright County, Minnesota, prepared by CDM, October 1997

Page 1-2 of the Executive Summary mentions in the first paragraph,

> *"The landfill gas collection system, when in place, is estimated to collect about 75 percent of the gas generated, and to destroy in the flare about 85 percent of the VOCs collected. However, the flare itself emits small amounts of pollutants as products of combustion: the criteria pollutants carbon monoxide (CO), nitrogen oxides (NO_x), and sulfur dioxide (SO_2), and the toxic air pollutant hydrogen chloride (HCl)."*

No mention is made about the fact that landfill gas flares have been reported by Eden (1993) to be a source of dioxins. The combustion conditions within landfill gas flares are such that dioxins are formed in landfill gas flares.

"Section 4 – Air Quality Impacts" on estimating landfill gas production, is deficient with respect to the pattern of landfill gas production that will occur in the proposed landfill, should it be permitted as proposed. The predicted "Landfill Air Emissions Estimation Model" output (AP-42 results) for the "new generation" landfill ignores the fact that once the landfill is closed, landfill gas production rates will decrease significantly for a period of time, due to the fact that the landfill cover will reduce the moisture entering the landfill. Since landfill gas production rates are dependent on the moisture of the waste (Christensen and Kjeldsen, 1989), there will be a period of time when the wastes could be reasonably dry, assuming that leachate recycle is not practiced. However, at some time in the future, as the plastic sheeting layer in the landfill cover deteriorates, moisture will enter into the landfill, and the landfill will start generating landfill gas again. The reliable prediction of the rates of landfill gas generation from this type of situation cannot be accomplished, since it depends on the rate of deterioration of the plastic sheeting layer in the landfill cover and the amount of moisture that enters through the holes associated with this deterioration (Lee and Jones-Lee, 1999).

"Section 6 – Odors and Wind-Blown Trash" fails to discuss that offsite odors and wind-blown trash are severe problems associated with the existing landfill. Further, this section fails to discuss the fact that odors such as those derived from landfills, in addition to being a nuisance (offensive), have also been reported by Shusterman (1992) as significant health threats.

An appendix to this report contains a letter from Nola Bryant to Tom Salkowski, dated February 8, 1998, which discusses the blowing paper, trash/garbage problem associated with the existing landfill. It is certainly reasonable to assume that, since the current owner of this landfill is proposing to expand the landfill, the future expanded landfill will have the same problems. This is to be expected, since there is insufficient buffer land owned by the landfill owner around the facility to keep fugitive emissions such as odors, dust, garbage, paper, etc., from being transported onto adjacent properties.

In a letter to Rod McGillivray, General Manager for Superior FCR Landfill, Inc. dated October 6, 1998, Curt Hoffman, Pollution Control Specialist with the Minnesota Pollution Control Agency (MPCA), discussed problems with the way in which the existing landfilling operation was being conducted by Superior, which was resulting in fugitive emissions of waste from the landfill. By that letter Superior FCR was notified that the MPCA was considering taking enforcement action for these violations.

Neighbors of the existing facility have also reported that there are significant offsite odors from the existing landfill. Letters submitted to the County on the existing landfill and the potential impacts of the proposed landfill on property values demonstrate a well-known situation that landfills, without adequate buffers and proper maintenance can be significantly adverse to property values. This situation is documented in a paper by Hirshfeld, *et al.* (1992).

The operating problems with the existing landfill in protecting the health, welfare and interests of those who own or use properties near this landfill provides justification for not allowing this landfill to expand, since the past operations are likely an indication of what the future operations would be.

Comments on Technical Work Paper 6: Alternatives Analysis, Superior FCR Landfill Expansion SW-60, Southern Expansion, Wright County, Minnesota, prepared by CDM, July 17, 1997

Section 4 discusses alternate designs for the proposed landfill. No discussion is provided on alternate designs for the landfill liner system which could, if implemented, provide for groundwater quality protection at this site. It should be noted that this landfill would not be allowed to be constructed in at least ten other states, since it is a minimum Subtitle D landfill, which a number of other states have found to be deficient in their ability to protect groundwater.

Comments on the Phase II/Phase III Hydrogeologic Investigation Report, Superior FCR Landfill, Inc. - Southern Expansion, Permit No. SW-60, Prepared by Barr, November 1996

While this report discusses the proposed vertical landfill expansion that was approved by the Minnesota Pollution Control Agency and is currently being implemented, it provides information pertinent to the proposed landfill expansion currently under review.

The statement is made on page 1 of the Introduction, in the second paragraph,

"Based on the results of the Phase II investigation, as presented and discussed herein, it is concluded that the existing monitoring resources at the site are sufficient for site monitoring. Therefore, no Phase III fieldwork is necessary."

That statement is highly unreliable, since the existing monitoring program in 1996, as well as today, is grossly deficient, compared to that needed to properly monitor for the pollution of groundwaters by the existing landfill expansion.

The statement is made on page 16 that,

"Groundwater velocity in the upper till ranged from 0.11 to 34 feet per year. Groundwater velocities in the upper outwash water table aquifer ranged from 1.4 to 79 feet per year with a mean of 20 feet per year. Calculated groundwater velocities for the upper portion of the lower confining unit ranged from 0.03 to 7.8 feet per year (Foth & VanDyke, 1992).

"This investigation calculated groundwater velocities for the upper outwash water table aquifer only. Calculated velocities range from approximately 3 to 290 feet per year with a mean of approximately 30 feet per year."

These velocities indicate that there is potential for rapid movement, on the order of a foot per day of leachate-polluted groundwaters underlying the existing and proposed landfill expansions.

Page 17, the second paragraph states,

"Depth to groundwater from bottom of liner is approximately 10 feet, so a release could affect groundwater quality in a short time."

The statement is made in the last paragraph on page 17,

"At the average groundwater velocity, it would take approximately 130 years for groundwater to flow from the landfill to this well." "

The well referred to is located approximately 4,000 feet downgradient from the landfill. This statement is misleading in that it attempts to portray the situation of offsite groundwater pollution not occurring for a long period of time. The County and the adjacent property owners are interested in the greatest velocity (shortest time) to reach an adjacent property owner's well

that could be constructed at some time in the future at the Superior FCR Landfill adjacent property owner's property line. Presenting groundwater velocities as an average velocity is deceptive.

This is especially true, since on page 21, under "6.1 Conclusions," item 3, it is stated that, *"Groundwater velocity ranges from 3 to 300 feet per year, averaging about 30 feet per year."* This means that the estimated average velocities are a factor of 10 lower than the maximum velocities. Therefore, if leachate enters a high permeability layer underneath the landfill, rather than taking 130 years to reach the well located almost a mile (4,000 feet) from the landfill, it would only take 13 years.

The tactic of reporting average velocities by landfill applicant consultants is typically done in order to mislead the reviewers and the public into believing that the landfill is, in fact, safer than it really is. This approach, however, is strongly contrary to the principles of public health protection, where a worst case based evaluation is used to assess public health threats.

Adjacent property owners should have the ability to construct production wells at the property line at any time in the future, without pollution by landfill leachate. This is the issue that should have been addressed, not the misleading calculation of "130 years." In fact, it is because of the inadequate buffer lands that exist between where landfilling will occur and adjacent properties and the potential for high-velocity transport, that offsite groundwater pollution can occur within a few years after leachate either permeates through the plastic sheeting liner and/or passes through holes, cracks, etc., that occur in the liner system.

Specific Comments on March 20, 2000, Revised Permit Application

Superior FCR Landfill, Inc., and its consultants have developed a number of reports and/or have responded to MPCA comments since March 18, 1999, when the Wright County Board of Commissioners denied the proposed expansion of the existing landfill. I have reviewed the additional materials which provide information on the proposed landfill expansion, for the purpose of determining whether Superior FCR Landfill, Inc., has addressed the issues that the County raised in their denial of the proposed landfill expansion.

On page 1 of the Introduction, the statement is made, *"The proposed expansion will accept for disposal industrial solid waste, rejects and residuals from MSW processing and demolition debris."* On page 3 of the "Permit Application Form" is a listing of the anticipated year 2000 waste streams for each of these types of wastes. Superior is proposing to accept approximately 150,000 tons/year of industrial waste, 18,000 tons/year of processed MSW and 47,000 tons/year of demolition debris at the proposed landfill expansion. It is concluded that the waste stream for the proposed landfill expansion will be similar to the waste stream that the County considered in denial of the proposed landfill expansion.

Engineering Report Accompanying Application

On page 4, in Section 3 "Phasing Plan," Subsection 3.1 "Facility Data," the first sentence states, *"The partial horizontal expansion will provide approximately 435,700 cubic yards of waste volume."* On page 5, it is stated that this will *"... add approximately 2 years of site life based upon the projected airspace consumption rate."* On page 6, it is stated that the expansion volume is anticipated to be filled by 2004. This additional waste, when added to the waste that are already deposited at this site, will further add to the problems that the County will face over the time that the waste in the existing landfill and proposed landfill expansion will be a threat.

Throughout the discussion of the cell design and construction, statements were made that the partial horizontal expansion cell will be constructed in accord with MPCA solid waste rules. It is important to note that the MPCA solid waste rule specifies a minimum design. It does not specify that this minimum design will be protective of public health, groundwater resources and the environment for as long as the waste in the landfill will be a threat. This is one of the primary issues of concern to the Wright County Planning Commission and Board of Commissioners.

Beginning on page 7, in section 4.0 "Cell Design and Construction," is an overview discussion of the proposed design of the landfill expansion. Basically, the proposed landfill liner system is a single composite liner consisting of a 60-mil HDPE geomembrane (plastic sheeting) overlying a compacted clay layer. Above the liner is a leachate collection system, consisting of a 12-inch thick granular drainage layer and associated plumbing to collect leachate that enters this layer from the overlying solid wastes and convey it to a sump, where it can be pumped out. This design is the same as that considered by the County in its denial of the proposed landfill expansion.

Page 9, section 4.5.6 "Leak Detection Lysimeter" states that a leak detection lysimeter will be installed beneath the sump. This lysimeter is intended to be a monitoring point for leakage from the sump into the underlying groundwater system. There is no leak detection lysimeter under most of the landfill liner system. It is highly inappropriate to assume that the only place that the landfill will leak for as long as the wastes in the landfill will be a threat is under the sump. Eventually, with blockage (clogging) of the leachate collection system, there will be head buildup on the liner at various locations which will lead to increased leakage through the liner. Keller (1994) has discussed how to develop a reliable vadose zone monitoring system to detect leakage through liners.

On page 10, sections 4.6 "Leachate Conveyance System" and 4.7 "Leachate Holding Tank" indicate that the leachate will be pumped from the sump to a holding tank, from which it will be transported offsite for treatment. Although this landfill will produce leachate for far more than 30 years after closure, there continue to be no provisions made to attempt to collect/pump the leachate that will be generated from the landfill that is transported by the liner system to the sump, for as long as the waste in the landfill will be a threat.

On page 10, section 4.8 "Liner Performance" states,

"The same liner and cover designs will be used for the partial horizontal expansion as were previously evaluated. The previous evaluations concluded that, in terms of preventing percolation of leachate, the efficiency of the liner is 99.99 percent. The maximum head on the liner was calculated to be 7.7 inches. The efficiency and head have been calculated using the HELP Model, which includes consideration of the physical properties of the liner, drainage layer, waste, and design and performance of the leachate collection system. HELP Model results are contained in the referenced reports."

As discussed in these comments, the approach used previously by CDM and by Barr in the application for proposed landfill expansion for calculating rates of leachate generation, leachate collection, liner efficiency and pollution of groundwater, which rely on HELP Model calculations are fundamentally flawed with respect to addressing the expected performance of the landfill cover and liner for as long as the waste in the landfill expansion will be a threat to cause adverse public health, groundwater resource, and environmental impacts. Barr Engineering has assumed in these calculations, as did CDM, that the design characteristics of the liner, which are potentially achievable with high-quality construction and careful waste placement, will prevail throughout the thousands of years that the wastes in this landfill will potentially be a threat to generate leachate that can cause groundwater pollution.

Page 11, Section 5.0 "Final Cover Design and Construction" states in the first paragraph, *"Final cover will consist of a single geomembrane barrier layer with a granular drainage layer and appropriate buffer and cover soils."* Also on page 11, Section 5.3 "Geomembrane Barrier Layer" indicates that the geomembrane barrier is a thin plastic layer consisting of 40-mil thick linear low-density polyethylene. The buffer/gas venting layer would be a 6-inch thick soil layer placed over the waste. There is no discussion of the fact that this plastic sheeting layer and cover are subject to significant stresses due to differential settling of the wastes in the landfill. These stresses can cause cracks to develop in the cover plastic sheeting layer that are not detected by visual inspection of the landfill topsoil layer. These cracks and points of deterioration in the plastic sheeting can allow much greater amounts of moisture to enter the landfill wastes than predicted by Barr using the HELP Model.

Page 12, section 5.5 "Cover Soils" states, *"Six-inch-thick rooting soil and topsoil layers will be placed over the drainage layer to promote and sustain vegetative growth on the final cover surface."* While only six inches of topsoil may be allowed in Minnesota, that depth is known to be inadequate to maintain cover vegetation on landfills during periods of drought, because of the inadequate moisture reservoir.

Page 12, section 5.7 "Final Cover Performance" states, *"The performance of the final cover system, in terms of preventing percolation of surface water through the geomembrane barrier, is estimated to be 99.88 percent."* This estimation is based on HELP Model calculations, which assume that the landfill cover, and especially the plastic sheeting layer in the cover, will function as designed with optimum construction, over the thousands of years that the waste in this landfill will potentially be a threat to groundwater quality. This is more of the

fundamentally flawed assumptions and approaches that have been used in the design of the Superior FCR landfill expansion that provides justification for the County Planning Commission and Board of Commissioners to deny the proposed expansion of this landfill.

Page 14, section 6.3 "Surface Water Hydrology" states, *"The 25-year, ½-hour through 24-hour rainfall events were considered in the design of surface water control features."* While the State of Minnesota MPCA may allow this type of design, this design will not prevent the kinds of problems that occurred over the past year which led Superior to be caught pumping stormwater runoff from its infiltration ponds onto adjacent properties. Since stormwater runoff from landfills of this type can contain landfilled waste-derived constituents through breakouts of leachate through the aboveground sides of the landfill, the stormwater runoff, at some time in the future, could become polluted by landfilled wastes which are a threat to public health and the environment.

Page 17, section 7.4 "Blower/Flare Station" states that a flare will be used to burn the collected landfill gas. No mention is made, however, that Eden (1993) reported that landfill gas flares have been found to produce dioxins.

Table 1 presents the distances to nearby residences and businesses. It includes information on the approximate distance from the edge of the landfill site. Examination of this information shows that Superior proposes to continue to have inadequate buffer land at the landfill site to prevent offsite odors, waste paper, and the effects of seagulls and other birds from being adverse to the adjacent property owners at the property line.

Appended to the March 2000 application is a copy of the current SW-60 Superior FCR Landfill, Inc., Solid Waste Management Facility permit that authorizes the vertical expansion of the lined landfill cells. This permit was authorized on October 26, 1999, by the MPCA Citizens' Board. This permit is relevant to the review of the proposed landfill expansion, since it could receive a similar permit to this permit. The existing permit, on page 4, under "Design and Construction Criteria," section 1.3.4 states,

> *"The permittee must locate, design, and construct the facility to prevent pollution of ground water and surface water, minimize the contamination of soils from solid waste, and maintain the facility in conformance with MPCA air pollution control rules in accordance with Minn. R. 7035.2565."*

There are no limitations on this requirement **"to prevent"** pollution of surface and ground water. That requirement is also set forth on page 6, under "Operating and Maintenance Criteria," section 1.4.22. Contingency Action Plan - Vertical and Partial Horizontal Expansion and Unlined Area.

Table 5 "Contingency Action Cost Estimate Summary" shows the *"1999 total worst case contingency action cost estimate"* for the listed items to be $943,500. The discussion of this table on page 12 (Section 6.0 Estimated Costs for Contingency Actions) states,

"The cost estimates include the capital expenditure required to implement the contingency action, and, where appropriate, the first year operation and maintenance costs of the contingency action. Operating and maintenance costs for subsequent years are provided for an estimated period of operating time."

In reality, the estimates provided reflect a small portion of the total cost that will need to be paid over the time that the waste in this landfill will be a threat.

Page 5, first paragraph of Section 3.0 "Postclosure Care Plan" states, *"The postclosure period begins on the date of MPCA approval of final closure certification and continues for a period of 30 years from the date of final closure."* Thirty years is a small part of the time that the waste in this landfill will be a threat to cause groundwater and surface water pollution. The County is justifiably concerned that Superior only proposes to provide for the minimum 30-year post-closure care funding and fails to provide funding to protect the interests of the County for as long as the waste in the landfill will be a threat.

Table 4 of this section presents the estimated annual costs of $76,500 for post-closure care. This is a small part of the total cost that will ultimately have to be paid associated with this site to stop offsite groundwater pollution. As discussed in my writings, the approach that should be followed to develop post-closure care funding is to evaluate a worst-case based failure scenario for the proposed landfill over the period of time that the waste in the landfill will be a threat, then estimate the reliability with which the failure will be detected with the monitoring systems used. From this, an estimate of the potential costs for monitoring, maintenance, and remediation of polluted groundwaters can be developed. The landfill owner/operator (Superior) then needs to develop a dedicated trust during the active life of the landfill that insures that adequate funds will be available to address the plausible worst-case failure scenario for as long as the wastes in the landfill will be a threat. The amount of funds needed for this approach will greatly increase the magnitude of the post-closure funding compared to that currently being proposed, and will likely greatly increase tipping fees that will have to be charged by Superior. Failure to follow this approach will almost certainly result in a situation where Wright County could become responsible for having to control the pollution of its groundwater and surface water resources by the Superior FCR landfill and the proposed landfill expansion.

Table B-1 of the Closure/Postclosure Care section indicates two inspections per year will be performed. There is no discussion of the fact that the inspection of the surface of the landfill will not detect failure of the HDPE plastic sheeting layer in the cover to prevent moisture from entering the landfill and generate leachate. In addition, these inspections will not detect the leakage of leachate through the liner that leads to groundwater pollution under the landfill that will eventually pollute offsite groundwaters. Further, these inspections will take place for a relatively short period of time (30 years) compared to the time that the waste in the proposed landfill expansion will be a threat to public health, groundwater resources and the environment.

Superior FCR Landfill 1999 Annual Report

On page 4 of the 1999 annual report is an updated cost estimate for the existing Superior FCR landfill. As discussed elsewhere, these estimates, while allowed by the MPCA, are far from adequate to insure that, even during the 30-year post-closure period, there will be adequate funds to properly monitor and maintain the existing landfill, much less the expanded landfill.

Appendix E "Groundwater Monitoring Summary"

The statement is made that the current groundwater monitoring network for Superior FCR Landfill includes 28 monitoring wells and piezometers and four private water supply wells. Water quality samples are collected from 11 monitoring wells and four private water supply wells. Page 3 of Appendix E lists the purpose of each of these wells. Four of these wells are associated with "assessment monitoring" for the pollution of the groundwaters near the original unlined portion of the landfill.

The current groundwater monitoring system that Superior FCR Landfill, Inc., is using continues to be grossly deficient, compared to the monitoring program that is needed to detect, in accord with MPCA and Subtitle D requirements, the pollution of groundwaters by landfill leachate when it first reaches the point of groundwater monitoring compliance ("point of compliance").

Examination of Figure 1, which is the January 2000 Groundwater Contour Map Water Table 10/11/99, shows the direction of groundwater flow based on groundwater table contours. It is basically to the east of the existing original landfill as well as the vertical and "new generation" landfill expansions. The three wells MW-17, MW-18 and MW-19 are in the down groundwater gradient path from the vertical expansion and "new generation" landfill.

The downgradient of the landfill distance between monitoring wells MW-17 and MW-18, which are the primary monitoring wells for the current landfill expansion, is about 200 feet. Also, monitoring wells MW-25 and MW-25B are downgradient from the landfill expansion, but no data have been presented for this pair of monitoring wells. There are also about 200 feet of horizontal distance across the landfill face between MW-18 and MW-25.

MW-25 is not listed as a "water level" or "routine monitoring" well, and, therefore, there are really only three monitoring wells truly downgradient of the existing landfill expansion.

MW-26, and MW-27 would be considered to be downgradient of the proposed so-called "southern" landfill expansion that is being reviewed as part of the current landfill expansion permit application. It appears from the information provided that Superior FCR is continuing to propose to try to monitor the pollution of groundwater for the southern expansion, basically using two monitoring wells which are downgradient from the landfill. Since each of these monitoring wells is expected to sample about one foot on each side of the well as part of purging three volumes of water from the well, there are approximately 700 feet across the downgradient edge of the proposed landfill expansion which will not be monitored, through which leachate

plumes could pass and not be detected by the proposed monitoring wells. This is grossly inadequate monitoring for the proposed landfill expansion.

Page 3, next to last paragraph states that the samples for heavy metal analyses were filtered before analysis was conducted. The filtration of groundwater samples, especially for heavy metals, can lead to an underestimate of the actual heavy metal concentration in the samples, due to sorption of dissolved heavy metals which are present in the aquifer that are removed on suspended solids which are present in the sampled water due to the purging of the well. As discussed by Lee and Jones (1983) groundwater sampling for constituents that tend to sorb (attach) onto particulates should be based on total concentrations to assess whether there are constituents in the aquifer which could represent pollutants in downgradient production wells.

Page 4, at the top of the page, lists the VOCs that were detected in groundwater samples which are downgradient from the original landfill. One of the VOCs which has been detected at concentrations that represent a potential health risk to those who would use the groundwater for domestic purposes is vinyl chloride. Vinyl chloride is a known human carcinogen. Page 4, the second paragraph states, *"It is believed that the vinyl chloride may be due to gas migration and/or the breakdown of chlorinated products associated with the closed landfill portion of this facility."* While that may be the case, it still does not in any way relieve Superior from the responsibility of having to clean up the polluted groundwaters, or lessen the threat to offsite groundwater users associated with the vinyl chloride-polluted groundwaters. Prosser and Janechek (1995) provide a discussion of the frequent problems associated with landfill gas pollution of groundwaters that appears to be relevant to the Superior FCR landfill situation.

Further, as discussed herein, it should be noted that there is a potential for a significant number of hazardous chemicals to be present in the polluted groundwaters which are not analyzed by the current groundwater monitoring program. One of the significant deficiencies with the current groundwater monitoring program is the failure to measure TOC as part of the routine parameters. TOC is an indication of the total organics present in the water which could indicate pollution by non-measured constituents.

Pages 9 through 13 present a discussion of the VOC data. While the discussion focuses on these VOCs being derived from the "unlined" part of the landfill, it should be noted that these VOCs can pass through the HDPE liner within a few days, due to permeation of low molecular weight organics through HDPE (which is discussed in another section of these comments). Whether the landfill is lined or not will not necessarily stop VOC pollution by landfill leachate containing VOCs.

Page 14, under the "Discussion" of the Groundwater Monitoring Summary, the last paragraph states that, *"FCR Landfill has constructed a geomembrane cover over the closed landfill and installed a gas extraction system."* It further states that, *"These actions will help improve the long-term water quality at the facility by reducing impacts from leachate and landfill gas."* While, as discussed herein, the installation of a plastic sheeting layer across the former landfill will, for a period of time, reduce the rate of moisture infiltration into the landfill if

high-quality construction of the landfill plastic sheeting layer is achieved, over time the plastic sheeting layer will deteriorate, and since it cannot be reliably inspected by the procedure proposed by Superior FCR Landfill, Inc., since the waste in the original landfill will be a threat to cause groundwater pollution for hundreds to a thousand or more years, and since there is no provision to monitor and maintain the plastic sheeting layer for as long as the waste in the landfill will be a threat, the plastic sheeting layer will only delay when further groundwater pollution occurs for a short period of time, compared to the time that the waste in the landfill will be a threat.

While information is provided on the horizontal and vertical gradients that exist in the groundwater adjacent to the existing landfill, the traditional approach of providing actual estimates of the velocity of groundwater movement is not provided.

Appendix F "Gas Probe Monitoring Data Summary"

Appendix F presents the Gas Monitoring Data. It appears from these results that there has been no monitoring of the composition of the landfill gas that is being produced, with respect to the VOCs that are common constituents in landfill gas. This is a significant deficiency in the existing monitoring program. It also appears, based on a lack of data in this report, that there is no monitoring of the landfill gas condensate characteristics. The condensate from municipal solid waste landfills is often classified as a hazardous waste and has to be handled as such.

While landfill gas flaring is mentioned, evidently there are no analyses of the composition of the flared landfill gas. Of particular concern is the production of dioxins in the landfill gas flare (Eden, 1993). Routine monitoring of this landfill gas flare for its composition should be conducted, in order to develop a proper risk assessment of the hazards to the property owners at the adjacent property line represented by the management approach that Superior FCR is using for landfill gas for the existing as well as the proposed expanded landfill.

Appendix G "Leachate Monitoring Summary"

Appendix G presents the results of the leachate monitoring. Page 2, under "Analytical Results - Inorganic Parameters," discusses the COD data, which is presented in Table 2. These data show that the expanded existing landfill leachate contains high concentrations of uncharacterized organics, many of which could be a significant threat for ground and surface water pollution. Further, the TDS (total dissolved solids) concentrations of about 5,000 mg/L indicate that this landfill contains large amounts of various types of inorganic salts, which, combined as well as individually, represent significant threats to groundwater quality.

An examination of Table 2 for heavy metals shows that several of the heavy metals, such as arsenic, chromium and lead, are present at times at concentrations that represent a threat to groundwater quality.

Page 2, under "Analytical Results - Organic Parameters," indicates that there are a number of VOCs that are *"... most consistently detected compounds in the past two to three*

years." Many of these VOCs can, through permeation, pass through the HDPE liner within a few days.

One of the aspects of Table 2 which is of concern is the tetrahydrofuran data, where the data are reported as 1.500, 2.100, 2.100 and 750 µg/L. Because of the problems Superior's contract laboratories are having with reliably using decimal points versus commas, it is not clear whether the tetrahydrofuran is being reported correctly, and, if so, why there has been an excessive number of significant figures used in this report, compared to the analytical reliability. This appears to be more of the inaccurate, unreliable reporting of data that is used in these reports that are filed by Superior FCR Landfill, Inc.

Minnesota Pollution Control Agency Letter of March 15, 2000, to Rod McGillivray, General Manager, Superior FCR Landfill, Inc.

The Minnesota Pollution Control Agency sent a letter to Mr. Rod McGillivray, General Manager, Superior FCR Landfill, Inc., regarding deficiencies in the 1999 Annual Monitoring Report for the Superior FCR landfill. This letter covered the fact that the sampling technicians for Superior FCR landfill could not find one of the monitoring wells in the fall of 1999. Also, there were errors in the tables presented in this report. Further, there were deficiencies in the report, compared to the requirements of the MPCA.

Basically, it appears that the groundwater monitoring sampling program that is being conducted is being loosely conducted, compared to the program that should be conducted to insure that adequate monitoring is being done to protect public health, groundwater resources and the environment. Situations such as sending technicians to the field to sample monitoring wells who are not familiar with the monitoring well locations or who are not accompanied by individuals who know these locations, is inexcusable.

Overall, it can be concluded that the Wright County Planning Commission and Board of Commissioners are highly justified in expressing concern about expanding the existing landfill, based on the characteristics of the landfill leachate, the design of the proposed landfill expansion and the unreliability of the groundwater monitoring system that is proposed for this landfill expansion. It is also clear that Superior FCR Landfill, Inc., has made no attempt in its fall 1999 and winter/spring 2000 reports, correspondence, etc., to address the issues that the Wright County Board of Commissioners raised in April 1999, which served as a basis for the Board concluding that the proposed rezoning which would allow for the landfill expansion should be denied. Basically, Superior FCR Landfill, Inc., proposes to continue to practice landfilling in the proposed expanded landfill which will ultimately lead to groundwater pollution, adverse impacts on nearby property owners/users and could readily become a significant financial burden to the County associated with the proposed expanded landfill.

MPCA February 17, 2000, Letter

In a February 17, 2000, letter from John Elks, Staff Hydrogeologist, Waste Management & Wastewater Sector Unit, Regular Facilities Section, Metro District, Minnesota Pollution Control Agency, to the Honorable Ken Jude, the landfill facility is characterized as follows:

"Total property area = 195 acres.
Unlined landfill area = 28 acres.
Lined area = approximately 24 acres.
Final cover was placed over the unlined area 1994."

It is stated that the direction of groundwater flow at the water table is east to east-southeast, with the water table being located approximately 30 feet below existing grade. The average groundwater velocity is listed as 20 feet per year, the water table aquifer consisting of sands and gravels with some interbedded silts and clay lenses. The water table aquifer is characterized as 50 to 70 feet thick. Below the sand and gravel unit is a till unit which is 10 to 30 feet thick. This unit is composed of sandy to silty clay and is continuous across most of the site, but absent in the extreme southwest and northwest portions of the site. Below the till is another sand aquifer.

Based on the information provided by the MPCA, the hydrogeology of the Superior FCR landfill site causes this site to be an unsuitable site for a solid waste landfill. This hydrogeology can allow for rapid transport of leachate-polluted groundwaters offsite and causes the monitoring of the groundwaters that are polluted by leachate to be even more difficult than occurs at many landfills.

Technical Background to Comments on the Deficiencies in the Proposed Superior FCR Landfill Expansion

Presented in this section is a summary of the literature that is pertinent to comments on the justification for the Wright County Board of Commissioners to deny the rezoning of 40 acres for the Superior FCR landfill expansion.

Duration of Leachate Generation

Freeze and Cherry (1979) of the University of British Columbia and the University of Waterloo, respectively, in their book, Groundwater, discuss that landfills developed in the Roman Empire about 2,000 years ago are still producing leachate. Belevi and Baccini (1989), two Swiss scientists who have examined the expected contaminating life span of Swiss landfills, have estimated that Swiss landfills will leach lead from the waste at concentrations above drinking water standards for over 2,000 years. As discussed in the referenced materials which summarize the literature on this topic, the proposed solid waste landfill expansion will be a threat to groundwater resources for long periods of time, effectively forever. These issues are discussed further in the papers, "Landfilling of Solid & Hazardous Waste: Facing Long-Term Liability" (Lee and Jones-Lee, 1994d),"Landfill Leachate Management," (Lee and Jones-Lee, 1996b) and "Groundwater Pollution by Municipal Landfills: Leachate Composition, Detection and Water Quality Significance" (Jones-Lee and Lee, 1993).

Expected Performance of the Superior FCR Landfill Liner

While it is possible to construct a single composite landfill liner system that will not leak sufficient leachate at the time of construction at a rate to pollute large amounts of groundwaters, ultimately the plastic sheeting layer of a landfill liner will deteriorate to the point where it will be ineffective in collecting leachate to enable its removal from the landfill. This deterioration will eventually allow transport of leachate through the liner on its way toward the groundwater resources hydraulically connected to the landfill that could be used for domestic water supply purposes. Further, compacted soil (clay layers) used in landfill liners are well-known to experience increased permeability with time over that originally designed and constructed.

Lee and Jones (1992a) and Lee and Jones-Lee (1996a, 1998a) have presented reviews of the literature on what is known about the properties of flexible membrane liners (FML) and clay liners to prevent landfill leachate from passing through them for as long as the wastes in the landfill will be a threat. Peggs (1998) has discussed the inevitable failure of plastic sheeting layers used in landfill covers and liners. Shackelford (1994) has presented a comprehensive review of the potential for waste and compacted soil interactions that alter the hydraulic conductivity of liners. Table 1 summarizes some of the causes of landfill plastic sheeting and clay liner failure.

Table 1
Causes of Liner Failure

Plastic Sheeting FMLs	Soil/Clay Liners
Holes at Time of Liner Construction	Desiccation Cracks
Holes Developed in Waste Placement	Differential Settling Cracks
Stress-Cracks	Cation Exchange Shrinkage (for Expandable-Layer Clays)
Free-Radical Degradation	Inherent Permeability
Permeable to Low-Molecular-Weight Solvents – Permeation	Interactions between leachate and the clays
Inherent Diffusion-Based Permeability	
Finite Effective Lifetime – Will Deteriorate and Ultimately Become Non-Functional in Collecting Leachate and as a Barrier to Prevent Groundwater Pollution	*Highly Permeable – Allow Large Amount of Leakage under Design Conditions and Subject to Cracking and Other Failure Mechanisms*

Lee and Jones-Lee discuss each of the failure mechanisms presented in Table 1. They conclude that landfill liners of the type proposed for the Superior FCR landfill expansion, while possibly providing short-term protection of groundwater quality, are not reliable for long-term protection and will ultimately fail to prevent leachate from passing through them.

Hsuan and Koerner (1995) have reported on the initial phase of long-term (10-year) studies that are underway devoted to examining the rates of deterioration of flexible membrane liners. The focus of the Hsuan and Koerner work is on the breakdown of the polymers in the plastic sheeting liners. They predict that this breakdown will occur due to free radical polymer chain scission in 40 to 120 years. These estimates are indicated by Koerner to consider only some of the mechanisms that could cause breakdown. It is possible that breakdown could begin much earlier. Even if the breakdown of the plastic sheeting polymers took 100 years or so, there is still no question that ultimately the plastic sheeting in the flexible membrane liners will break down, leading to an inability to prevent large amounts of leachate from passing through the liner, causing groundwater pollution in the landfill area.

Lee and Jones-Lee (1998a), as part of preparing an updated review of their 1992 "flawed technology" report, contacted the US EPA administration to ascertain if this administration had changed the conclusion reached by the US EPA 1988 administration that a single composite liner would, at best, only delay when groundwater pollution occurs by landfill leachate. Dellinger (1998) who heads the Office of Solid Waste for the US EPA indicated that the Agency still concludes that a single composite liner will ultimately fail to prevent leachate transport through it.

An area of growing concern with respect to plastic sheeting-lined landfills is that dilute aqueous organic solvents of the type present in Superior FCR landfill leachate can rapidly permeate through an intact, without holes, HDPE liner. This is a chemical transport process in which the low molecular weight organics dissolve into the liner and exit on the downgradient side. Sakti, *et al.* (1991) and Park, *et al.* (1996a,b) have reviewed the available information on this topic and have conducted extensive research on it. They found that an HDPE liner would have to be over three inches thick to prevent permeation of certain organics through it within a period of 25 years. Buss, *et al.* (1995) have reviewed the information on the mechanisms of leakage through synthetic landfill liner materials. They discuss the importance of permeation of organics through plastic sheeting liners as a landfill liner leakage mechanism that does not require deterioration of the liner properties.

Inherent Permeability (Leakage) of Landfill Liner Systems

A critical review of the literature and other information associated with the development of the compacted soil/clay and plastic sheeting layers that are used as landfill containment liners and caps shows that the currently used materials in landfill liner cells have not been found and would not be expected to prevent hazardous and other deleterious constituents present in the wastes from penetrating through the liner and causing groundwater pollution. Clay liners were selected in the 1970s as liners for hazardous chemical waste ponds without consideration of their potential to interact with certain waste constituents or their inherent design permeability (leakage rates). A landfill clay liner with one foot of head that has a design permeability of 10^{-7} cm/sec will allow the passage of many waste components through the liner at the rate of about one inch per year. That translates to about 100 gallons/acre/day.

Workman and Keeble (1989), who at the time of publication of a paper, "Design and Construction of Liner Systems," were two BFI (a private garbage company) employees, presented a nomograph that shows that a three-foot-thick clay liner with the permeability of 10^{-7} cm/sec with about one foot of head (leachate depth) that functions as designed can be expected to have breakthrough in about eight years. The Superior FCR landfill expansion liner system is proposed to have a clay liner that will have a permeability of 10^{-7} cm/sec at the time of construction; however, it is well-known that permeabilities of clay liners of this type increase significantly within a few years after construction.

A review of the history of the development of liners for landfills shows that when it was realized that clay-lined landfill cells had a finite period of time before they failed to prevent the leakage of hazardous waste components into underlying groundwaters, plastic sheeting liners (flexible membrane liners-FMLs) were introduced instead of clay liners. Again, the situation was one of there not being a body of literature that demonstrated that plastic sheeting of the type that was being used in the early 1980s (or, for that matter, today) as landfill liners would be expected to perform in such a manner as to prevent groundwater pollution by landfill leachate for as long as the waste components in the landfill would be a threat.

Basically, the situation that has evolved in selecting liner materials is that compacted soil ("clay") was initially selected as a landfill liner system because it was the next cheapest thing to nothing, i.e., no liner. Compacting soil as a liner for a landfill cell is relatively inexpensive compared to other approaches for lining solid waste landfill cells. When it was evident that clay liners would not function effectively to prevent groundwater pollution, the US EPA and other regulatory agencies adopted the next cheapest thing to nothing (plastic sheeting layers) as a landfill liner. While there are other materials that could have been selected to line waste management cells, they were more expensive.

It was soon found in the early 1980s that plastic sheeting liners had a number of significant problems, such as stress cracks, that made them unreliable as a landfill liner system that would prevent groundwater pollution for as long as the wastes in the landfill would be a threat. This led to the development of a composite liner where both compacted soil and plastic sheeting are used. While composite liners if properly constructed have a low rate of initial leakage compared to either clay liners or plastic sheeting liners, they have many problems that cause them to leak at a rate higher than ideally predicted. This led the US EPA to recommend a double composite liner system for hazardous waste landfills. Even the double composite liner, however, will ultimately fail to prevent leachate-associated constituents from passing through the liner into the underlying groundwater system, leading to groundwater pollution.

Daniel and Shackelford (1989) have reviewed the inherent leakage rates of plastic sheeting layers and clay liners. They point out that even though plastic sheeting layers have low permeabilities to water on the order of 10^{-12} cm/sec compared to clay liners which have a permeability of about 10^{-7} cm/sec at the time of construction, the thin layer of plastic that is used, coupled with its inherent chemical diffusion coefficients, causes plastic sheeting liners of the type proposed for the Superior FCR landfill expansion to have diffusion controlled breakthrough

times for waste components of about two to three years. The clay liner, however, in the landfill cells would be expected to have diffusion controlled breakthrough times of about 10 years.

The diffusion of solid waste components through plastic sheeting liners discussed by Daniel and Shackelford occurs through a different mechanism than the permeation of organic solvents (VOCs) through HDPE liners discussed herein. As stated by Daniel and Shackelford (1989), *"No material is impervious, and the question of which liner is more effective, like most questions, is ultimately related to one of economics and the realities of construction practices."* Basically, regulatory agencies, such as the US EPA which has set the national landfilling minimum standard, have been adopting landfill liner systems that will, in time, obviously fail to prevent groundwater pollution. The US EPA stated this fact in their 1988 discussion of the ultimate failure of composite liners quoted above.

In order to address this situation, the US EPA has established regulatory requirements for RCRA Subtitle D landfill monitoring that require detection of landfill liner leakage at the point of compliance for groundwater monitoring. The basic problem with this approach is that the administration of the RCRA requirements is left up to state regulatory agencies in establishing the groundwater monitoring system that is to be used. As discussed herein, the groundwater monitoring systems that are being allowed fail to consider how the landfill liner systems will leak and the ability to reliably detect this leakage by a few vertical monitoring wells, each with one foot radius zone of capture spaced 200 or more feet apart. This is obviously a fundamentally flawed approach that does not comply with regulatory requirements for protection of groundwater quality, public health and the environment.

Reliable Reporting on FML Properties

One of the problems with addressing the inherent leakage and ultimate breakdown of the liner system is the failure of landfill applicants and their consultants to reliably report on the long-term stability problems with flexible membrane liners. There are several examples in the literature such as Fluet *et al.* (1992), Tisinger and Giroud (1993) and Flood (1994) where individuals who primarily work for landfill applicants inadequately and/or unreliably report on the ultimate breakdown of flexible membrane liners. As discussed by Lee and Jones-Lee (1993b, 1995b) and Lee (1994), a common approach used by landfill consultants is to claim that the liner system will be "protective." However, they fail to discuss their definition of the duration of time in which the liners will be protective and fail to mention the fact that, ultimately, this protective definition that they use will result in groundwater pollution beyond the time that they are considering to be of significance. Often this time is considered to be only 30 years beyond the closure of the landfill.

Long-Term Integrity of Proposed Superior FCR Landfill Expansion Cover

Waste landfill cells are required to be covered by a low permeability layer which is to function as an effective barrier that can minimize moisture from entering the landfill and thereby generating leachate that can lead to groundwater pollution. Superior FCR Landfill, Inc., proposes to use a plastic sheeting layer as the low permeability cover system for landfill expansion cells. As discussed by Lee and Jones (1992a) and Lee and Jones-Lee (1995a,c;

1998a) as well as in references cited therein, it is extremely difficult to construct a landfill cover that will maintain its integrity as originally constructed for as long as the wastes in the landfill will be a threat.

The basic problem is that a landfill cover is subject to severe stresses associated with differential settling of the waste components. These stresses cause cracks in the low permeability layers of the cover. Ultimately, the plastic sheeting layer in the cover will develop cracks which will allow moisture to penetrate into the wastes and generate leachate. Further, the plastic sheeting layers in the landfill cell covers will deteriorate over time and fail to prevent precipitation that passes through the topsoil layer from entering the cell and generating leachate. These cracks and points of deterioration of the landfill cell cover low permeability layer will not be detectable by the visual inspection methods being used as part of the post-closure monitoring and maintenance of the landfill.

Inadequate Consideration of the Range of Potential Pollutants in Solid Wastes

Those familiar with groundwater monitoring near landfills understand that today's chemically-based approach, where a few regulated chemicals are monitored compared to the thousands to tens of thousands of chemicals that are present in the wastes that are a threat to public health, groundwater resources and the environment is significantly deficient and not protective of public health and the environment. Lee and Jones-Lee (1994e), in a paper, "Does Meeting Cleanup Standards Mean Protection of Public Health and the Environment?" have discussed this issue.

The US Congress General Accounting Office (GAO) has indicated that there are in excess of 75,000 chemicals used in US commerce today. The current US EPA and state regulatory agency laundry list of chemicals that are analyzed associated with a solid waste landfill represents 100 to possibly 200 of these chemicals. There are thousands to tens of thousands of chemicals present in industrial "nonhazardous" waste, of the type that could be disposed of at the Superior FCR landfill expansion, that need to be monitored, either directly or by their impacts, through biological assessment techniques in order to protect public health and the environment.

Inadequate Post-Closure Care Funding

One of the issues of considerable concern to the Wright County Board of Commissioners in denying the expansion of the Superior FCR landfill is that Superior proposes to only fund post-closure care (monitoring and maintenance) for the minimum 30 years. There will be waste components in the proposed landfill expansion which will be a threat long after there are no funds available for post-closure care. The deficiency in current RCRA Subtitle D requirements for post-closure care funding are well-understood. Hickman (1992, 1995, 1997), former executive director of the Solid Waste Association of North America, and Lee and Jones-Lee (1993c) have published a number of reviews on the need for longer term post-closure care, as well as the use of more reliable financial instruments to provide funding during post-closure care than is typically provided today.

GAO (1990) discussed this same situation with respect to hazardous waste landfills. While this deficiency is well-understood, the past and current US EPA administrations, as well as state administrations/legislatures, have been unwilling to address this issue in terms of requiring that adequate funds will be available to address failure of the landfill liner system and the unreliability of the groundwater monitoring system to detect failure before offsite groundwater pollution occurs. This leaves the situation to the local governmental agencies, such as the county boards of commissioners, to develop approaches that will provide for protection of the county's interests. This is what the Wright County Board of Commissioners has done in denying the rezoning of the land adjacent to the existing Superior FCR landfill. Without adequate long-term funding to address future potential problems, the County has no alternative but to restrict the development of landfills at inappropriate sites.

In a November 24, 1999, letter from Jeff Ubl, of Barr Engineering Company to Mr. Tom Salkowski, Planning and Zoning Administrator for Wright County, Mr. Ubl states,

> *"**County Comment:***
> *Section 770.3(2)(c) Contingency Planning In the narrative report required, there is little or no description of contingency planning for post closure events. Please provide a report or specific reference to where we may find this data."*

The Response submitted by Ubl:

> ***"Response:***
> *As required by Minnesota rules, the contingency action plan, including financial assurance for contingency actions, will remain in effect throughout the post-closure period. Therefore, the contingency action plan will be used while the facility is open and throughout its postclosure period."*

As stated elsewhere, Superior FCR Landfill, Inc., plans to only provide for the minimum required post-closure monitoring and maintenance of the landfill and does not plan to address the issues of concern to the County, namely, the period of time that the waste in the existing as well as proposed landfill expansion will be a threat to public health, groundwater resources and the environment. The County understands that the 30-year post-closure period that Superior FCR Landfill, Inc., proposes to follow represents a very small part of the total period of time that the waste in this landfill will be a threat. Without financial assurance for plausible worst-case scenario failures of this landfill, the County has, and should, reject any proposed landfill expansion, since the County could become a responsible party to bear the brunt of the offsite pollution that will occur, and ultimately have to spend funds to clean up this pollution to prevent further pollution.

Superior FCR Landfill, Inc., Compliance with Regulatory Requirements

An issue of particular concern to the County is how well Superior FCR Landfill, Inc., obeys regulations. The MPCA on December 3, 1999, issued a press release which stated that MPCA had fined Superior FCR Landfill, Inc., $29,500 for improperly operating gas flare,

improper management of the landfill's leachate, inadequate daily cover and failure to evenly grade the east slope of the landfill. Because of the inadequate, unreliable operations of the existing landfill, the County should be provided with funds by Superior to independently monitor the existing Superior landfill expansion to insure that the kinds of problems that have existed in the past will not go undetected in the future.

On October 6, 1998, the Minnesota Pollution Control Agency sent a letter to Mr. Rod McGillivray, General Manager, Superior FCR Landfill, Inc., regarding *"Violations from Pumping Stormwater Off-site, Lack of Intermittent Cover, Lack of Intermediate Cover at the Superior FCR Landfill, SW-60,"* signed by Curt Hoffman, Pollution Control Specialist. In this letter, Mr. Hoffman states that the MPCA has identified the following violations:

"Pumping of surface water:

- *Minn. R. 7035.2815, subp. 5, item F. The owner or operator must provide a sediment settling pond if run-off would otherwise carry excessive sediment off the facility property.*
- *Permit application dated March, 1995, an approved document in the 1996 permit, Part 8.1 Surface Water Management...The sedimentation basins will control sediments and provide runoff detention which will reduce and eliminate discharge from the site.*
- *Permit dated July 18, 1996, Part 1 E 5. Surface Water Control System...The NGLF and Expansion cover system must incorporate diversion berms, drainage terraces, spillways, and ditches, to divert surface water to the three infiltration basins designed to handle the run-off volume from a 25-year, 24-hour storm event.*

Lack of intermittent and intermediate cover:

1. Minn. R. 7035.2815, subp. 6. Intermittent, intermediate, and final cover system. The owner or operator...must design and maintain a cover system capable of minimizing infiltration of precipitation into the fill areas, preventing surface water ponding on fill areas, controlling gas movement, preventing erosion of surface and side slopes, reducing wind erosion and wind blown litter...
2. Minn. R. 7035.2815, subp. 6, item A. The owner or operator must place an intermittent cover upon all exposed solid waste in accordance with the approved operation and maintenance manual for the site...
3. Minn. R. 7035.2815, subp. 6, item B. The owner or operator must place intermediate cover on all filled surfaces of the facility where no additional solid waste will be deposited within 30 days...
4. Permit application dated March 1995, an approved document in the 1996 permit, Part 10.6.3. Windblown Paper Control...Placing and compaction of six inches of cover soil at the end of each day of operation or more often if required, will help control blowing papers...
5. Permit dated July 18, 1996, Part II G. Facility Cover Requirements."

Further, in a June 3, 1999, letter from Curt Hoffman of the MPCA to Ms. Karen Duke, Assistant General Counsel, Superior Services, Inc., Mr. Hoffman states that, as part of a stipulated agreement, *"This requirement has not been completed and as stated in Part 8 of the Agreement, is being assessed a penalty of $250.00 for each day of failure."*

The record is clear that Superior FCR Landfill, Inc., has been cited for landfill operation violations in such areas as the pumping of water from the infiltration basin onto adjacent properties, inadequate intermittent daily cover and inadequate intermediate cover. This situation demonstrates the unreliability of Superior FCR Landfill, Inc., in operating the landfill in accord with regulations.

Signed: _____ Dated: _____
G. Fred Lee

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Dr. G. Fred Lee, PE, DEE
Expertise and Experience in Landfill Impact Assessment

My work on municipal landfill impact matters began in the mid-1950s while I was an undergraduate student in environmental health sciences at San Jose State College in San Jose, California. My course and field work involved review of municipal solid waste landfill impacts on public health and the environment.

I obtained a Master of Science in Public Health degree from the University of North Carolina, Chapel Hill in 1957. The focus of my masters degree work was on water quality evaluation and management with respect to public health and environmental protection from chemical constituents and pathogenic organisms.

I obtained a PhD degree specializing in environmental engineering from Harvard University in 1960. As part of this degree work I obtained further formal education in the fate, effects and significance and the development of control programs for chemical constituents in surface and groundwater systems. An area of specialization during my PhD work was aquatic chemistry.

For a 30-year period, I 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 I taught graduate-level environmental engineering courses in water and wastewater analysis, water and wastewater treatment plant design, surface and groundwater quality evaluation and management, and solid and hazardous waste management. I have published over 850 professional papers and reports on my research results and professional experience. My research included, beginning in the 1970s, the first work done on the impacts of organics on clay liners for landfills and waste lagoons.

In the 1980s, I 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.

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

In the 1980s while I held the positions of Director of the Site Assessment and Remediation Division of a multi-university consortium hazardous waste research center and a

Distinguished Professorship of Civil and Environmental Engineering at the New Jersey Institute of Technology, I was involved in numerous situations concerning the impact of landfilling of municipal solid waste on public health and the environment. I have served as an advisor to the states of California, Michigan, New Jersey and Texas on solid waste regulations and management.

In the early 1980s while holding a professorship in Civil and Environmental Engineering at Colorado State University, I 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, Dr. Jones-Lee (my wife) and I 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 1989, I retired after 30 years of graduate-level university teaching and research and expanded the part-time consulting that I had been doing with governmental agencies, industry and community and environmental groups into a full-time activity. A principal area of my 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. I have been involved in the review of approximately 60 different landfills in various parts of the United States and in other countries.

Dr. Anne Jones-Lee and I 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. Our over 85 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 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. We make many of our publications available as downloadable files from our web site, www.gfredlee.com.

In the early 1990s, I was appointed to the 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 I developed a report, "Impact of Municipal and Industrial Non-Hazardous Waste Landfills on Public Health and the Environment: An Overview" (1994), that served as a basis for the human health advisory panel to assess public health impacts of municipal landfills.

In addition to teaching and serving as a consultant in environmental engineering for over 40 years, I am a registered professional engineer in the state of Texas and a Diplomate in the American Academy of Environmental Engineers (AAEE). The latter recognizes my leadership

roles in the environmental engineering field. I have served as the chief examiner for the AAEE in north-central California and New Jersey, where I have 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.

My 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. I have been and continue to be an American Chemical Society tour speaker, where I am invited to lecture on landfills and groundwater quality protection issues, as well as domestic water supply water quality issues throughout the US.

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 University 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, 197

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 850 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).

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Examples of Landfills Evaluated by G. Fred Lee and A. Jones-Lee

Arizona *(State Landfilling Reg.*)	Verde Valley - Copper Tailings Pile Closure
California *(State Landfilling Reg.)*	Colusa County - CERRS Landfill San Gabriel Valley - Azusa LandfillCity of Industry - Puente Hills LandfillNorth San Diego County, 3 landfillsSan Diego County - Gregory Canyon LandfillEl Dorado County LandfillYolo County LandfillHalf Moon Bay - Apanolio LandfillPittsburg - Keller Canyon LandfillChuckwalla Valley - Eagle Mountain LandfillBarstow - Hidden Valley and Broadwell Hazardous Waste LandfillsCadiz - Bolo Station-Rail Cycle LandfillUniversity of California-Davis Landfills and Radioactive Waste Disposal Pits San Marcos - San Marcos LandfillPlacer County - Western Regional Sanitary LandfillTurkey Carcass Waste Burial PitsImperial County - Mesquite Landfill
Colorado (*State Landfilling Reg.)*	Last Chance/Brush - Hazardous Waste LandfillDenver - Lowry Hazardous Waste LandfillTelluride/Idarado Mine Tailings
Florida (*State Landfilling Reg.*)	Alachua County Landfill
Illinois (*State Landfilling Reg.*)	Crystal Lake - McHenry County LandfillWayne County Landfill
Indiana (*State Landfilling Reg.*)	Posey County LandfillNew Haven-Adams Center Landfill (Hazardous Waste)
Michigan (*State Landfilling Reg.*)	Menominee Township - LandfillYpsilanti-Waste Disposal Inc. (Hazardous Waste - PCB's)
Minnesota	Reserve Mining Co., Silver Bay - taconite tailingsSuperior FCR Landfill Wright Co.
Missouri	Jefferson County - Bob's Home Service Hazardous Waste Landfill
New Jersey (*State Landfilling Reg.*)	Meadowlands - LandfillFort Dix Landfill Scotch Plains Leaf Dump
New York	Staten Island - Fresh Kills LandfillNiagara Falls - Hazardous Waste Landfill
Ohio	Clermont County, Ohio - BFI/CECOS Hazardous Waste Landfill

Rhode Island	Richmond - Landfill
South Carolina	Spartanburg - Palmetto Landfill
Texas(*State Landfilling Regulations*)	Dallas/Sachse - LandfillFort Worth - Acme Brick Hazardous Waste Landfill
Washington (*State Landfilling Reg.*)	Tacoma - 304th and Meridian Landfill
Wisconsin	Madison and Wausau Landfills
Ontario, Canada(*Prov. Landfilling Reg.*)	Greater Toronto Area - Landfill Siting IssuesKirkland Lake - Adams Mine Site LandfillPembroke - Cott Solid Waste Disposal Areas
Manitoba, Canada(*Prov. Landfilling Reg*.)	Winnipeg Area - Rosser Landfill
New Brunswick, Canada (*Prov. Landfilling Reg*.)	St. John's - Crane Mountain Landfill
Mexico (*Haz. Waste Landfilling Reg.*)	San Luis Pontosi - Hazardous Waste Landfill
Puerto Rico	Salinas - Campo Sur Landfill
Hong Kong	Three New MSW Landfills
Korea	Yukong Gas Co. - Hazardous Waste Landfill
Belize	Belize Mile 27 Landfill
Ireland	Central Waste Management Facility at Ballyduff Beg, Co. Clare Inagh

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
- State Stormwater Quality Task Force Activities
- Impact of Hazardous Chemicals -- Superfund, LEHR Superfund Site Reports
- Contaminated Sediment -- Aquafund, BPTCP
- Domestic Water Supply Water Quality
- Excessive Fertilization/Eutrophication
- Reuse of Reclaimed Wastewaters
- Watershed Based Water Quality Management Programs:
  - Sacramento River Watershed Program,
  - Delta -- CALFED Program, and
  - Upper Newport Bay Watershed Program
  - San Joaquin River Watershed DO and OP Pesticide TMDL Programs

Stormwater Runoff Water Quality Science/Engineering Newsletter

List of Enclosures

Water Quality and Solid & Hazardous Waste Landfills Evaluation and Management Drs. G. Fred Lee and Anne Jones-Lee's Web Site Announcement

"Assessing the Potential of Minimum Subtitle D Lined Landfills to Pollute: Alternative Landfilling Approaches"

"Municipal Solid Waste Management in Lined, 'Dry Tomb' Landfills: A Technologically Flawed Approach for Protection of Groundwater Quality"

"Geosynthetic Liner Systems for Municipal Solid Waste Landfills: An Inadequate Technology for Protection of Groundwater Quality?"

"Detection of the Failure of Landfill Liner Systems"

"Questions that Regulatory Agencies Staff, Boards and Landfill Applicants and Their Consultants Should Answer About a Proposed Subtitle D Landfill or Landfill Expansion"

"Deficiencies in Subtitle D Landfill Liner Failure and Groundwater Pollution Monitoring"

"A Groundwater Protection Strategy for Lined Landfills"

"Environmental Impacts of Alternative Approaches for Municipal Solid Waste Management: An Overview"

"Dry Tomb Landfills"

"Groundwater Pollution by Municipal Landfills: Leachate Composition, Detection and Water Quality Significance"

"Landfill Leachate Management"

"Landfill Post-Closure Care: Can Owners Guarantee the Money Will Be There?"

"Landfilling of Solid & Hazardous Waste: Facing Long-Term Liability"

"Municipal Landfill Post-Closure Care Funding: The '30-Year Post-Closure Care' Myth"

"Overview of Landfill Post Closure Issues"

"Stormwater Runoff Water Quality Evaluation and Management Program for Hazardous Chemical Sites: Development Issues"

"Environmental Ethics: The Whole Truth"