Review of the Potential Public Health and Environmental Impacts of the Proposed City of Grand Forks, ND Balefill Landfill Facility in Turtle River Township

G. Fred Lee, PhD, PE, DEE and Anne Jones-Lee, PhD
G. Fred Lee & Associates
27298 E. El Macero Drive, El Macero, CA 95618
Ph: (530)753-9630 Fx: (530)753-9956 Em: gfredlee@aol.com
www.gfredlee.com

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Introduction

The Grand Forks Concerned Citizens Coalition requested that we (Drs. G. Fred Lee and Anne Jones-Lee) conduct a review of the potential public health, groundwater and surface water resource quality, and environmental quality impacts of the Grand Forks Balefill landfill facility proposed by the city of Grand Forks, North Dakota, that is to be located in Turtle River Township, Grand Forks County, North Dakota. This report presents information that can be used by the Township Zoning Commission and Board of Supervisors to evaluate the potential impacts of the proposed landfill on public health, groundwater and surface water resources, the environment, and other interests of the Township for as long as the municipal solid wastes in the proposed facility are a threat. It is based on a review of project-related documents listed in Appendix A and on Dr. G. F. Lee's more than 40 years of work devoted to evaluating the impacts of municipal solid waste landfills located in many areas of the US and in other countries. A summary of our expertise and experience in conducting reviews of existing and proposed landfills is provided in Appendix B and summarized in a subsequent section of this report.

Requirements for Environmental Impact Statement

Turtle River Township requires, in its Township Land Development Code, Zoning Ordinance & Subdivision Regulations (August 30, 2004), that as part of proposing to locate a municipal landfill in the Township, the landfill proponents provide the following:

> *"C. Miscellaneous 2. Environmental Impact Statement – A full and complete Environmental Impact Statement compliant with the National Environmental Policy Act, Environmental Protection Agency and the North Dakota Department of Health regulations shall be provided to the Turtle River Township Zoning Commission before a permit hearing shall be granted."*

The Council on Environmental Quality PART 1502--ENVIRONMENTAL IMPACT STATEMENT Sec. 1502.24 Methodology and Scientific Accuracy requirements state, with regard to providing Environmental Impact Statements,

> "*Agencies shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements. They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement. An agency may place discussion of methodology in an appendix."*

In addressing the Turtle River Township requirement for an environmental impact statement that conforms to National Environmental Policy Act (NEPA, 1969 and updates) requirements, the city of Grand Forks, ND, Department of Public Works prepared a "Draft Environmental Impact Study for the Grand Forks Municipal Solid Waste Balefill Facility," dated September 2003. That draft EIS (DEIS) was released for public comment; all comments received by November 30, 2003, were considered in the Final Environmental Impact Study (FEIS) that was released by the Grand Forks Department of Public Works on May 7, 2004. The Turtle River Township Zoning Commission has scheduled a public hearing on December 2 and 3, 2004, to review this DEIS/FEIS and the Conditional Use Permit application for developing the balefill landfill that is proposed to be located in Turtle River Township.

Overall Finding on the Adequacy of the DEIS/FEIS

The DEIS states,

> "*The Draft Environmental Impact Study (EIS) analyzes the environmental effects of the Grand Forks Municipal Solid Waste Balefill Facility.*"

We have had considerable experience in reviewing the adequacy of environmental impact studies/statements and California environmental impact reports for proposed landfills and other proposed projects; we have been involved in review of over a dozen such statements/reports. **We find that the Draft EIS and Final EIS for the Grand Forks Municipal Solid Waste Balefill Facility are significantly deficient in providing Turtle River Township with reliable full-disclosure information on the potential impacts of the proposed municipal solid waste balefill landfill facility that Grand Forks proposes to construct in Turtle River Township.** The DEIS and FEIS fail to meet the Turtle River Township's requirement of providing *"A full and complete Environmental Impact Statement compliant with the National Environmental Policy Act."*

Contrary to the image that the Grand Forks DEIS/FEIS portray of Turtle River Township being a suitable site for this proposed landfill and of the proposed design of the landfill being adequate to protect the health, water resources, air quality and other interests of those in the Township,

- The site is unsuitable for a landfill, with high groundwater and an unstable base
- The site has been inadequately investigated by Grand Forks as part of site selection
- Groundwaters at the site have value that can be destroyed by landfill leachate (garbage juice) pollution
- A minimum design Subtitle D landfill of the type proposed by Grand Forks is not protective for as long as the wastes in the landfill would be a threat to release hazardous and deleterious chemicals to the groundwater, surface waters or air
- Inadequate buffer lands are proposed between the landfill and adjacent properties
- Turtle River Township zoning governing the siting of a landfill is reasonable and justified.

Basically, Grand Forks needs to start over to properly select a site for a new landfill. These issues and others are discussed below.

As discussed below, some sections of the DEIS and FEIS reflect a lack of understanding of the ability of minimum design Subtitle D landfills to provide public health and environmental quality protection for as long as the wastes in the landfill will be a threat. There is a substantial literature on the potential impacts of Subtitle D-type landfills that is not referenced, much less presented and discussed, in the DEIS and FEIS. The Township Zoning Commission, Board of Supervisors and residents, as well as those in Grand Forks, are entitled to know the full range of potential impacts and consequences of the proposed landfill. Further, the DEIS and FEIS fail to provide the required identification of methodology, adequate footnotes and references to the literature that should be considered in evaluating the potential impacts of the landfill. **The unreliability of this DEIS and FEIS should cause Turtle River Township to reject the FEIS provided by the Grand Forks Department of Public Works on the basis that it fails to comply with the Township's requirement for a "full and complete" EIS for a landfill that is proposed for location in the Township.**

The sections of the DEIS and FEIS quoted below are examples of the unreliable information presented in these reports. Often, the same unreliable statements are repeated in several sections of these reports.

Organization of Report

This report is organized into three major sections. The first addresses the primary focus of this report, which is a review of some aspects of the Grand Forks Department of Public Works' Draft and Final Environmental Impact Studies relative to providing reliable, full disclosure of the potential impacts of the proposed landfill.

Another section of this report is devoted to a review of selected aspects of the North Dakota Health Department's landfill regulations relative to controlling the short-term and especially the long-term impacts of the proposed landfill on public health, water resources, air quality and the interests of those in Turtle River Township potentially impacted by the landfill.

The third section is devoted to providing justification for the Township's establishing additional requirements for developing the proposed landfill, in order to protect the Township's interests.

Lack of Protection by Subtitle D Landfilling Regulations

A review of the state of North Dakota Health Department's landfill regulations, Article 33-20 Solid Waste Management and Land Protection provided on the Department's website shows that North Dakota has adopted, in principal, the US EPA Subtitle D regulations (40CFR258, US EPA 1991) as the State's regulations governing the landfilling of municipal solid wastes (MSW). North Dakota has provided additional specificity in some sections governing the design and operation requirements of the landfill containment system. The DEIS and FEIS contain numerous sections that state that the proposed landfill will conform to minimum prescriptive design and closure/postclosure requirements set forth in Subtitle D. As quoted below, the DEIS and

FEIS repeatedly claim that these regulations are protective. However, a critical review of Subtitle D regulations shows that they fall far short of providing protection of public health, groundwater resources, air quality and the interests of those in the sphere of influence of a minimum design Subtitle D landfill for as long as the municipal solid wastes in the landfill are a threat. It is recognized that Subtitle D landfills, at best, only provide control of some of the releases from landfills for a short period of time compared to the time that the wastes will be a threat to release hazardous and deleterious chemicals to the air and groundwaters/surface waters associated with the landfill.

Page ES-8 of the FEIS states,

> *"Assuming the facility is designed, constructed, operated, and closed according to the required permits and state and federal laws, impacts to surface water quality and beneficial uses downstream from the facility are not anticipated."*

The characterization of the proposed landfill provided in the DEIS and FEIS should enable this landfill to be located in downtown Grand Forks with only 0.3 mile of buffer land from adjacent properties owned by others without significant adverse impacts, or with impacts that are readily mitigated. The city of Grand Forks Department of Public Works' approach for developing a new landfill rather than landfilling the wastes generated by the residents of Grand Forks in Grand Forks, proposes to place the landfill in Turtle River Township where the adverse impacts on health, water resources, air quality and other interests of those in the sphere of influence of the landfill are imposed on Turtle River Township residents and future land uses near the proposed landfill, rather than on the primary waste generators.

Background and Experience in Reviewing Landfill Impacts

As summarized in Appendix B, Dr. G. F. Lee obtained a bachelors degree in environmental health sciences from San Jose State College, San Jose, California, in 1955 and a Master of Science in Public Health degree from the University of North Carolina, Chapel Hill, in 1957. Both of these degree programs included education on the impact of solid wastes, including landfills. In 1960 he was awarded a PhD degree in Environmental Engineering from Harvard University. For 30 years he held university graduate-level teaching and research positions at several major US universities. Dr Lee became involved in the review of the impact of municipal solid waste landfills beginning in the 1960s while he held the position of Professor of Water Chemistry and Director of the Water Chemistry Program at the University of Wisconsin, Madison. During the 13 years that Dr. Lee held this position he was involved in investigating several situations of groundwater pollution by MSW landfills.

In 1973 Dr. Lee was appointed to the position of Professor of Engineering and Director of the Institute of Environmental Sciences at the University of Texas at Dallas. While holding this position he conducted research on the stability of landfill liners for the US EPA National Groundwater Research Center located in Ada, Oklahoma. In the 1980s Dr. Lee was appointed to the position of Distinguished Professor of Environmental Engineering and Director of a multi-university hazardous waste research center Site

Assessment and Remediation Division. During this time he continued research on landfill liner stability issues.

Throughout the 30 years that Dr Lee held university graduate-level teaching and research positions he conducted over $5 million in research and published over 500 papers and reports. He was also a part-time consultant to governmental agencies and industry on environmental protection issues, including municipal and hazardous waste landfills. He has been involved in the review of over 80 landfills. Beginning in the 1980s Dr. Lee has been a consultant to several states on developing landfilling regulations, including California, Michigan, Texas, Colorado and New Jersey.

In 1989 Dr. Lee retired from university teaching and research and expanded his part-time consulting activity into a full-time activity. He was joined by Dr. Anne Jones-Lee in this activity. Over the past 15 years Drs. Lee and Jones-Lee have worked with water utilities, municipalities and public groups in evaluating the potential impacts of proposed and existing landfills. They have published extensively on their work; their papers and reports are on their website, www.gfredlee.com. Their papers and reports provide guidance on how to reliably evaluate the potential impacts of landfills and, most importantly, provide guidance on how to develop landfills that are protective for as long as the landfilled wastes are a threat to generate both leachate that can pollute groundwater and surface waters, and landfill gas (including odors), and how to address justified NIMBY (not in my back yard) issues.

One of the areas of particular relevance of Drs. G. F. Lee and Anne Jones-Lee's expertise is their work on evaluating the long-term impacts of minimum Subtitle D dry tomb type landfills during the period that the wastes in the landfill will be a threat to generate leachate and landfill gas that can pollute the environment. Their publications provide guidance on the issues that must be addressed to properly evaluate the full range of impacts over the very long period of time that the wastes in the landfill will be a threat. They have determined that it is extremely important, as part of developing a landfill, that full consideration be given to properly addressing the postclosure activities that will have to be addressed when the landfill is closed. Recently, the Pottstown Landfill Closure Committee representing Montgomery and Berks Counties in Pennsylvania, the city of Pottstown, PA, and several other communities have selected Dr. Lee to be an independent peer reviewer on the closure of the Pottstown Landfill. In this capacity Dr. Lee will be advising the counties and communities on the issues that should be adequately addressed in developing a final closure plan for this municipal solid waste landfill to render it as protective as possible for as long as the wastes in the landfill will be a threat. This activity has already demonstrated the need to address as many of these issues as possible as part of landfill permitting to better prepare for the eventual closure of a landfill. This report addresses these issues relative to protecting the near-term and long-term interests of Turtle River Township in controlling the impacts of the Grand Forks landfill that is proposed to be located in Turtle River Township.

The Grand Forks proposed landfill must at least conform to US EPA (1991) Subtitle D regulations. Dr. Lee has been involved in the review of Resources Conservation and

Recovery Act (RCRA) landfilling regulations, including Subtitle C (hazardous waste) and Subtitle D (municipal solid waste). In the early 1980s he and Dr. Jones (Lee and Jones, 1984) published a paper, "Is Hazardous Waste Disposal in Clay Vaults Safe?" This paper discussed the long-term problems of the "dry tomb" landfilling approach, where there is an attempt to isolate the wastes from water by encasing the wastes in thin plastic sheeting and compacted clay liners and a landfill cover. Our paper pointed out that this approach postponed the decay of the wastes and could result in a landfill that would forever be a threat to pollute groundwater and generate landfill gas. This paper was judged by the Water Resources Division of the American Water Works Association (AWWA) as the best paper published in the Journal of the AWWA in 1984.

In 1989 Drs. Lee and Jones-Lee provided detailed comments on the then proposed RCRA Subtitle D landfill regulations. These comments supported the US EPA's conclusion that the minimum prescriptive liners allowed in Subtitle D landfills will eventually fail to prevent groundwater pollution. The US EPA, as part of adopting the RCRA Subtitle D regulations, stated in the draft regulations (US EPA, 1988a),

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

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

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

With this background of the ultimate long-term failure of the landfill containment system, it is appropriate to inquire as to why the US EPA adopted a fundamentally flawed approach for landfilling of wastes. This situation arose out of the fact that environmental groups had filed suit against the US EPA for failure to develop municipal and industrial "nonhazardous" solid waste landfilling regulations within the timeframe established by Congress. This led the Agency to promulgate the Subtitle D regulations (US EPA, 1991), incorporating a minimum prescriptive design of a single composite liner and equivalent landfill cover, even though it was understood in the late 1980s that, at best, this approach could only postpone groundwater pollution by landfill leachate.

As discussed by Lee and Jones-Lee (2004), the basic problem with developing regulations that will ensure, with a high degree of certainty, that a municipal solid waste landfill will be protective, is that developing such a landfill will increase the cost of garbage disposal. In developing Subtitle D regulations, the federal administration made it clear that it did not want to face the political ramifications of substantially increasing the cost of household garbage disposal. As long as the wastes from population centers are disposed of in other locations, there is little incentive for people to support increased disposal fees for additional public health and environmental protection from the landfilled wastes. Less densely populated areas have less political power to be effective in opposing landfills forced on them by urban areas. This attitude led to the 1991 Subtitle

D regulations that are still in effect today. At that time it was understood that, with very few exceptions, a minimum prescriptive design Subtitle D landfill can postpone, for a period of time, groundwater pollution problems. However, eventually the minimum prescriptive design allowed by these regulations, of a single composite liner of the type that Grand Forks proposes to use in the landfill to be sited in the Turtle River Township, will not prevent groundwater pollution and surface water pollution in areas where the surface waters are connected to the groundwater.

The minimum Subtitle D dry tomb landfilling approach allows those who generate solid wastes to dispose of these wastes at an expense that is cheaper than the real cost, and thereby pass the impacts and part (possibly a substantial part) of the real costs of the landfilling to those within the sphere of influence of the landfill and future generations. Basically, the approach of the Grand Forks Department of Public Works for developing a new landfill is to propose to site a minimum Subtitle D landfill in the Turtle River Township, thereby keeping the costs to the Grand Forks waste generators, at least initially, artificially low. This situation is understood, as demonstrated by the fact that there are at least a half-dozen states in the US that do not allow a minimum prescriptive design Subtitle D landfill of the type that Grand Forks proposes to locate in Turtle River Township. Those states require the development of a much more protective landfill than the minimum prescriptive design of Subtitle D.

Over the years since Subtitle D landfilling was first proposed, Drs. Lee and Jones-Lee have developed a series of papers and reports on potential problems with Subtitle D landfills. In November 2004 they released a comprehensive synthesis report on the "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste" (Lee and Jones-Lee, 2004). That report provides numerous references to the literature, including peer-reviewed publications discussing the problems of Subtitle D landfills that could and should have been discussed in a credible, full-disclosure EIS for the proposed Grand Forks landfill. Much of the Lee and Jones-Lee (2004) report has direct relevance to understanding the near-term and especially the long-term impacts of the proposed Grand Forks landfill that is proposed to be located in Turtle River Township. The Abstract and Table of Contents of Drs. Lee and Jones-Lee's "Flawed Technology" review is provided in Appendix C, with a link to their website where the complete report is available for review. Specific reference to pertinent sections of this review and to other literature is discussed below.

Characteristics of Proposed Landfill

According to the FEIS with regard to the proposed landfill,

> "*The City anticipates the new balefill facility would dispose of approximately 86,500 tons of MSW per year. The proposed landfill would be wholly owned and operated by the City. The proposed project consists of constructing and operating a MSW balefill facility on a 760.5-acre site owned by the City. The 760.5-acre site consists of 613.5 acres in Section 19 (T 154 N, R 51 W), where the majority of the MSW balefill facility would be constructed, and an additional 147.0 acres in the southeast quarter of Section 18 (T 154 N, R 51 W) that would be used to collect soil borrow material to obtain adequate cover material for*

reclamation of the MSW balefill facility. When completed, the balefill footprint would occupy approximately 242 acres of the 760.5-acre site with a total capacity of 5.5 million tons. The total estimated active life of the landfill would be 69 years (assuming that the waste stream quantities would be relatively constant over this period). Individual cells would be covered and reclaimed prior to, or during, final closure. The MSW would be processed at the City's existing baling facility located approximately 1 mile north of the existing landfill. The baled waste would be placed onto flatbed tractor-trailers and covered for transport to the proposed balefill facility. The bales would be stacked to a maximum height of 40 feet and the final side slopes would be approximately 4:1 (horizontal to vertical)."

Information on the design of the proposed landfill is provided in the DEIS/FEIS (DEIS pages 2-7 through 2-12, beginning with section 2.2.2 Containment System Design) and in a series of Design Memoranda developed by Burns & McDonnell submitted during 2002 and 2003 to the city of Grand Forks. The EISs at several locations and these memoranda specify that the proposed landfill will conform to US EPA Subtitle D requirements with respect to landfill liner and cover design. This establishes that the proposed landfill will be of minimum prescriptive design for a dry tomb type landfill.

Review of the Adequacy of the DEIS/FEIS

This section presents a review of some of the inadequate and unreliable information presented in the DEIS and FEIS.

Landfill Liner Reliability

This section presents representative discussions of landfill liner reliability as presented in the DEIS and FEIS relative to the current state of knowledge on the ability of the single composite liner that the city of Grand Forks proposes to use in the proposed landfill to prevent groundwater pollution.

The FEIS on page ES-6 states, *"The liner and leachate collection and recovery system (LCRS) are designed to meet or exceed design standards intended to minimize the potential for release of landfill leachate."*

Page 3-133 of the FEIS states,

"Under Performance and Design Criteria for Municipal Waste Landfills, (Section 33-20-06.1-02-2a. of the North Dakota SWMR), 'the liner and leachate removal system must maintain its integrity for the life of the facility and the postclosure period.' The rules also stipulate that the flexible liner must consist of high-density polyethylene (HDPE) at least 60 mil thick. HDPE liners are recommended and approved by the EPA for landfills because testing and experience has demonstrated that HDPE liners are resistant to degradation by chemicals in MSW landfills. An HDPE liner overlying a low-permeability compacted 24-inch clay soil to create a composite liner (as proposed for the project) is considered an acceptable design to minimize the potential for leachate release. Leakage through HDPE liners can occur through pinholes, cracks,

holes, and faults in seams. Careful installation of the plastic liner would minimize potential leachate pathways. However, as stated in Section 3.2.2.1 of the DEIS, since the site sediments consist of silts and clays with low permeability and the groundwater gradients are gentle, any leachate that leaks through the liner system would migrate at very slow rates (estimated to average approximately 0.2 foot per year). Considering (1) the composite liner and leachate collection system design, (2) the groundwater monitoring requirements, (3) the responsibility of the landfill owner to undertake remedial action if a leak is detected, and (4) the favorable site conditions that would serve as an impediment to leachate migration, significant impacts to groundwater quality down gradient of the facility are not anticipated."

These statements could lead someone not knowledgeable in the long-term ability of a plastic sheeting liner composed of HDPE and compacted clay/soil to prevent groundwater pollution, to believe that the liner system for the proposed landfill would prevent groundwater pollution for as long as the wastes in the landfill would be a threat. However, as quoted above, the US EPA (1988a,b) concluded that eventually the HDPE liner will deteriorate and fail to prevent leachate produced in the landfill from polluting groundwater. Lee and Jones-Lee (2004) discuss the variety of mechanisms that impact the short-term and long-term integrity of the plastic sheeting liner. While it is possible through high quality assurance/quality control during liner construction to develop an HDPE liner in the landfill that will leak at only minimal rates for a period of time, ultimately this liner will deteriorate and fail to collect the leachate that is generated in the landfill during the time that wastes in the landfill will be a threat. Lee and Jones-Lee (2004) discuss the fact that in the dry tomb landfill of the type proposed by the city of Grand Forks, the wastes in the landfill can **forever** be a threat to generate leachate that can pollute groundwater.

There are two processes that tend to stabilize MSW components: landfill gas formation and the leaching (dissolving) of the waste components. Both landfill gas formation and leaching require water. In a dry tomb landfill where there is an attempt to keep the wastes dry, once the landfill cover is installed the infiltration of water from precipitation on the landfill surface is greatly curtailed/stopped. This leads to drying out of the wastes in the landfill. As long as the landfill cover is effective in preventing precipitation from entering the landfill, the wastes in the landfill remain dormant but still a threat. At some time in the future when the plastic sheeting in the landfill cover deteriorates sufficiently and water again enters the landfill, landfill gas formation starts again and leachate is again produced. This situation can occur during the minimum 30-year postclosure period or 50, 100, 500 or 1,000 years or more after the landfill has been closed. It is for this reason that Subtitle D landfills will have to monitored and maintained for the very long time that the wastes in the landfill will be a threat, effectively forever. The DEIS and FEIS should have discussed this situation, since it has been known since the late 1980s. Without this discussion, decision-makers are misled to believe that the proposed landfill will be protective for as long as the wastes in the landfill will be a threat, which is certainly not the case.

Lee and Jones-Lee (2004) have discussed the literature that shows that a clay liner of the type proposed for the Grand Forks MSW Balefill landfill will allow the passage of leachate that penetrates the HDPE liner, based on its inherit permeability. Further, as discussed by Lee and Jones-Lee (2004), there are several mechanisms which will allow the rate of penetration of leachate through the clay liner at a much greater rate than the design permeability.

With respect to the statement quoted above

> *("However, as stated in Section 3.2.2.1 of the DEIS, since the site sediments consist of silts and clays with low permeability and the groundwater gradients are gentle, any leachate that leaks through the liner system would migrate at very slow rates (estimated to average approximately 0.2 foot per year).")*,

recently Dr. Frank Beaver conducted a study of the potential rate of lateral movement of near-surface groundwater near the proposed landfill site. Beaver (2004) has found rates of groundwater movement at a location near the proposed landfill much higher than those presented in the DEIS. He has recently observed that the near-surface soils which would be in contact with the landfill liner system contain fractures that have significant groundwater flow through them.

The DEIS states on page 3-105, *"The HDPE liner material is essentially impervious to solvents, paints, fertilizers, and most types of other household hazardous waste."* As discussed by Lee and Jones-Lee (2004), organic solvents used for cleaning and other purposes, which are known human carcinogens and which can be purchased by the public in a hardware store can pass through an intact (no holes) HDPE liner within a few days. This process, called permeation, is well known in the landfill liner literature (see Haxo and Lahey, 1988; Sakti et al., 1991; and Park et al., 1996). This issue of permeation should have been discussed in the DEIS/FEIS.

Impact of Groundwater Pollution. Not only should the DEIS and FEIS have discussed the eventual failure of the proposed landfill liner to prevent leachate from passing through the liner while the wastes in the landfill are a threat, but also the DEIS and FEIS are highly deficient in providing the Township with reliable information on the impact of the liner failure on groundwater quality. The FEIS on page ES-6 states,

> *"The ambient groundwater quality is brackish and not suitable for use as a domestic water supply, livestock, or agricultural practices. Therefore, a release of leachate would not result in degradation of a fresh water aquifer (i.e., less than 1,000 milligrams per liter [mg/L] of total dissolved solids [TDS]), or impact water supply wells located downgradient of the project."*

The data presented in the FEIS on the composition of the groundwater that could be impacted by the eventual failure of the landfill liner system show that the groundwater has elevated TDS compared to the 1,000 mg/L value that the Department of Public Works chose to use to justify their claim that the groundwater underlying the landfill can be polluted by leachate and not cause any loss of water resource. However, some of the groundwater underlying the proposed landfill could be an important resource to the Township at some time in the infinite future that people in the Township may want to use

the groundwater resources. North Dakota Water Quality Rules, (Standards of Quality for Waters of the State, Section 33-16-02.1-10 Ground water classifications and standards) state, *"1. Class I ground waters. Class I ground waters shall have a total dissolved solids concentration of less than 10,000 mg/l."*

In Appendix A of the DEIS, Table 1 presents background concentrations of various chemicals in the groundwater at the proposed City of Grand Forks Balefill Facility. Burns and McDonnell (2003) collected groundwater samples from 16 locations which were to provide background concentrations of chemicals in groundwater in the vicinity of the proposed landfill. A review of those data shows that only two of the samples collected had TDS concentrations greater than 10,000 mg/L. Four of the samples had TDS concentrations less than 3,000 mg/L, which is often considered to be an upper limit for use of groundwater with limited treatment for domestic and other purposes. The technology for treating elevated TDS is rapidly evolving so that it is becoming more economically feasible to use elevated-TDS waters of the type reportedly found under the proposed landfill location as a water supply source for some purposes. Those familiar with water treatment processes know that there is a significant difference between the cost of treating waters with an elevated TDS that have been polluted by MSW leachate, and treating the same water without leachate pollution. These issues should have been discussed in the DEIS and FEIS. Without this discussion those documents do not conform to full disclosure requirements of NEPA.

North Dakota Water Quality Rules Section 33-16-02.1-08 states that all waters of the state shall be,

> *"(4). Free from substances attributable to municipal, industrial or other discharges or combinations which are toxic or harmful to humans, animals, plants or resident biota. For surface water, this standard will be enforced in part through appropriate whole effluent toxicity requirements in North Dakota pollutant discharge elimination system permits."*

"Waters of the state" are defined in North Dakota Century Code Chapter 61-28 "Control, Prevention, and Abatement of Pollution of Surface Waters" in section 61-28-02 "Definitions" as follows:

> *"11. 'Waters of the state' means all waters within the jurisdiction of this state including all streams, lakes, ponds, impounding reservoirs, marshes, watercourses, waterways, and all other bodies or accumulations of water on or under the surface of the earth, natural or artificial, public or private, situated wholly or partly within or bordering upon the state, except those private waters that do not combine or effect a junction with natural surface or underground waters just defined."*

The leachate pollution of groundwater or surface water would be in violation of the requirements of Section 33-16-02.1-08, since the waters of Turtle River Township are waters of the state. This is another issue that should have been discussed in the DEIS/FEIS.

Groundwater Monitoring

The FEIS on page ES-6 states,

> *"Groundwater monitoring and remediation measures required under State and Federal regulations are expected to detect and trigger remediation for possible escape of leachate and to prevent impacts to groundwater quality downgradient of the project site."*

The FEIS states in the Appendix A Monitoring and Mitigation Measures section on page A-1,

> ***"2.0 Groundwater Resources Groundwater Monitoring.*** *A groundwater monitoring system shall be established to effectively detect the migration of contaminants. The location of the piezometers shall be determined based on a site characterization, including groundwater gradient, flow path, and velocity. The groundwater monitoring shall meet or exceed the requirements of 40 CFR subpart E and SWMR 33-20-13. A groundwater monitoring plan shall be submitted to the North Dakota Department of Health for approval and implemented as part of the permitting process. As specified in SWMR 33-20-13-02, the piezometers network shall be installed and sampled a minimum of four times in order to establish background water quality upgradient and downgradient of the facility before waste can be placed in the facility. In addition, the monitoring well network shall be sampled at least semiannually during the operation, closure, and postclosure period."*

Page 3-127 of the FEIS states,

> *"The City would be required by the North Dakota Department of Health to establish a network of groundwater monitoring wells located both upgradient and downgradient of the site to ensure that waters of the state are not adversely impacted. Monitoring for landfills is typically conducted prior to operation, during operation and closure, and into the postclosure period until the operator can demonstrate that the site no longer poses a threat to the environment. The North Dakota Department of Health would be responsible for periodically reviewing the results of the monitoring. A summary of the groundwater monitoring requirements is provided in Section 3.2.3 of the DEIS. The City also would be required to mitigate any release detected by the monitoring wells such that the release would not adversely impact waters of the state."*

Also, page 3-118 of the FEIS states,

> "*Groundwater monitoring would be required during operation and postclosure to detect contaminate migration. In the event that concentration is detected at a statistically significant level exceeding the groundwater quality standards during operation or postclosure, the City would be required to implement remedial measures as approved by the North Dakota Department of Health to mitigate the groundwater contamination. These regulatory procedures are intended to mitigate potential impacts to groundwater quality."*

These statements on the groundwater monitoring system that would be required/used could lead someone not familiar with the current approaches that are used by landfill owners and allowed by regulatory agencies to believe that the groundwater monitoring systems used at minimum design Subtitle D landfills are highly reliable for detection of landfill-leachate-polluted groundwaters when they first reach the point of compliance for groundwater monitoring. Such monitoring systems employ a few vertical monitoring wells, hundreds to a thousand or more feet apart, at the point of compliance down-groundwater-gradient of the landfill. Each monitoring well has a zone of capture of about a foot around the monitoring well, leaving hundreds to a thousand or more feet between the monitoring wells through which finger-plumes of leachate-polluted groundwater can pass without detection. Therefore, as discussed by Lee and Jones-Lee (2004), the typical groundwater monitoring systems for minimum design Subtitle D landfills are highly **unreliable** for meeting the requirements of Subtitle D -- i.e., detection of leachate-polluted groundwater when it first reaches the compliance point for groundwater monitoring. At best, the current groundwater monitoring allowed by regulatory agencies for minimum Subtitle D landfills is cosmetic, with little or no reliability in detecting pollution before offsite production wells are polluted. As discussed by Lee and Jones-Lee (2004), some states such as Michigan recognize the unreliability of typical groundwater monitoring at single composite lined landfills and do not allow this type of landfill to be developed in the state. Michigan requires that MSW landfills be double composite lined with a leak detection layer between the two composite liners. This approach addresses many of the issues associated with the unreliability of groundwater monitoring at single composite lined landfills.

The Grand Forks DEIS and FEIS should be rejected based on the unreliable and inadequate discussion of the reliability of the groundwater monitoring at the proposed landfill.

Pages A-1 and A-2 of the FEIS state,

> ***"Corrective Action Program.*** *In the event that a breach in the liner system occurs (determined by detection of leachate constituents in piezometers), a corrective action program shall be implemented as necessary to prevent contaminants from migrating off the project site in accordance with SWMR 33-20-13-05. Remedial responses will depend on the site-specific conditions and magnitude of the release. Possible remedial measures could include one or more of the following:*
>
> - *Eliminating the source of leachate by repairing the liner system*
> - *Installing an interceptor trench (or closely spaced wells) to collect contaminated groundwater*
> - *Constructing a grout curtain or slurry wall to intercept or direct flow, followed by withdrawing groundwater from an interceptor trench or closely spaced wells."*

Basically, this section claims that a Superfund-like groundwater remediation program would be implemented when groundwater pollution is found. While this approach is required by Subtitle D, the likelihood of being able to implement such a program before

pollution of groundwaters has occurred offsite on adjacent properties is small because of the unreliability of groundwater monitoring at minimum design Subtitle D landfills. Further, the statement quoted above with regard to "repairing the liner" reflects a complete lack of understanding of landfills. There is no possibility of "repairing" the liner underlying the landfill since it would necessitate excavation of the garbage overlying the liner.

Shallow Groundwater Issues

The FEIS on page ES-6 states,

> *"Shallow groundwater conditions occur over large portions of the proposed project site. High seasonal groundwater conditions could result in the discharge of high TDS groundwater into unlined sediment ponds, particularly the proposed ponds located in the southeast portion of the site. In addition, the combination of high groundwater conditions and settlement of the balefill is likely to increase the amount of leachate that would be captured and treated, and thereby increase the operating cost for the balefill."*

Page 3-27d of the FEIS Appendix B states,

> "*High ground water conditions could occur that are periodically within 2 feet of the ground surface (see Groundwater Resources, Section 3.2). These high seasonal groundwater conditions could result in the discharge of high TDS groundwater into unlined sediment ponds, particularly the proposed ponds located in the southeast portion of the site. Additionally, borrow excavations in the northeast corner of the site (Figure 2.2-1) would extend as much as 10 to 15 feet below the ground surface and, therefore, would intercept groundwater, creating a pond or ponds of poor quality water. Mitigation will be required to prevent the discharge of this water into the surface water system."*

Page ES-9 of the FEIS states,

> "*High groundwater conditions could occur that are periodically within 2 feet of the ground surface. These high seasonal groundwater conditions could result in the discharge of high TDS groundwater into unlined sediment ponds, particularly the proposed ponds located in the southeast portion of the site."*

Page 3-18 of the DEIS states,

> *"**Leachate Collection and Recovery System (LCRS).** The LCRS shall be designed to address the possible increased volume of leachate that could occur as a result of groundwater seepage into the LCRS."*

Page A-2 of the FEIS states,

> *"**Groundwater Control and Disposal.** Before construction begins, the City shall develop a plan for controlling, collecting, and disposing of excess groundwater that may be encountered during construction and operation of the facility. The plan shall include measures to minimize groundwater mounding which could cause difficulties with landfill construction and operation, and minimize deposition of salts in adjacent properties. The borrow excavations should be*

considered as a backup for groundwater infiltration, if necessary. The plan shall be incorporated into the plan of operations for the facility and submitted to the North Dakota Department of Health for approval as part of the permitting process."

The Corps of Engineers' review of the proposed landfill site (Hamborg, 2004) stated, "*Groundwater could be an issue – especially with the drainage ditch just south and across the road from the proposed site.*"

The North Dakota Department of Health states in its Guideline 25 –Preliminary Landfill Selection Criteria, *"4. Areas such as gravel pits, sloughs, and areas having a high groundwater table are seldom acceptable."*

The DEIS Table 2.3-1 Summary of Disposal Alternatives Initially Considered in the City of Grand Forks, Solid Waste Disposal Study (Burns & McDonnell, 1994) indicates that a *"New landfill located within seven miles of the existing landfill"* was rejected because *"High groundwater conditions require above ground construction and importation of cover soils."*

The high groundwater table at the proposed Turtle River Township site should have caused the Grand Forks Department of Public Works to reject this site for the proposed landfill. The high groundwater table makes this site unsuitable for a landfill. In other states where we have been involved in review of landfills, the regulatory agencies require that the landfill owner develop a subsurface drain and/or pump the groundwater to lower the groundwater table. Grand Forks could have to pump groundwater to artificially lower the groundwater table and manage its disposal with elevated TDS, forever. Further, failure to lower the groundwater table below the landfill bottom will cause Grand Forks to have to manage much larger amounts leachate due to groundwater infiltration into the landfill during the infinite postclosure period.

Another issue that could become important in regulating the groundwater table is that Grand Forks' consultant predicts that the landfill will settle about eight feet in the subsurface strata due to its weight. This will further aggravate the management of the groundwater table in order to keep groundwater out of the landfill. These issues should have been more adequately discussed in the DEIS and FEIS.

Final Landfill Cover

Page 3-14 of the DEIS states,

"The Hydrologic Evaluation of Landfill Performance (HELP) model was used to provide estimates of water balance, including leachate generation, for the proposed balefill (Burns & McDonnell 2003a). The HELP model predicts that leachate would be generated and migrate downward into the leachate collection and removal system (LCRS)."

Table 2.2-2 Estimated Maximum Leachate Quantities to be Managed indicates that *"estimated leachate generation in inactive cell with final cover"* would be *"150 gal/yr."*

This estimate is based on an unreliable use of the HELP model over the period of time that the waste in the landfill will be a threat to generate leachate. This estimate applies only to the condition when the landfill cover is new, provided high quality construction of the landfill cover is achieved. It does not estimate the amount of leachate that will be produced when the low permeability layer of the landfill cover deteriorates. The actual amounts of leachate produced will be much larger than this amount.

Lee and Jones-Lee (2004) have discussed the problems of trying to comply with Subtitle D requirements of maintaining a landfill cover that has a permeability no greater than the landfill bottom liner. As they point out, the typical approach of installing a plastic sheeting layer in the cover to comply with this requirement provides only temporary compliance with the regulatory requirements. In time, the plastic sheeting layer of the cover will deteriorate and allow moisture to enter the landfill, which will produce leachate that will lead to groundwater pollution when the plastic sheeting layer of the bottom liner deteriorates. While landfill owners and their consultants claim that the cover can be inspected and repaired as needed, such claims fail to point out that the low permeability layer (plastic sheeting) of the landfill cover is buried several feet below the landfill cover surface. Visual inspection of the landfill cover surface will not detect when the low permeability layer in the cover allows significant infiltration of water into the wastes. These issues should have been discussed in the DEIS and FEIS.

Page A-4 of the FEIS states,

> *"**Justification for Final Cover Design.** An analysis shall be conducted to demonstrate that the final cover design will minimize infiltration and erosion and optimize drainage and evapotranspiration of precipitation falling on the landfill. This analysis also shall demonstrate that estimated soil losses will comply with North Dakota Department of Health requirements. The analysis shall be conducted using tools or models that are commonly used to evaluate disturbed areas that are reclaimed. An example of the type of model proposed is SEDCAD, a hydrology and sedimentology routing model that simulates peak flows, drainage volumes, and sediment yields from disturbed watersheds. The analysis shall consider the effects of surface treatments (e.g., vegetation type and density, mulch cover, rock cover, surface roughening, contour furrowing), slope lengths and shapes, and numerous other BMPs (such as berms and terraces). The analysis shall provide design information on berm and terrace spacing, widths, heights, and gradients (if included in the design), downdrain sizes, shapes, and riprap requirements (if included in the design), and any other specifications regarding slope lengths and gradients, water conveyance channels, and BMPs."*

The DEIS and FEIS should have discussed the fact that Grand Forks will have to perform maintenance of the landfill cover for as long as the wastes in the landfill will be a threat (forever). Failure to perform this maintenance will allow the cover to deteriorate and allow precipitation to enter the landfill that will lead to groundwater pollution.

Surface Water Pollution

The FEIS on page ES-6 states,

"*The primary issues associated with surface water resources include, … (4) degradation of surface water quality from project construction, operation and closure.*

* * *

The runoff is collected via a network of roadside ditches, conveyed to a series of large drainage channels, and ultimately outfalls to the Turtle River."

Page ES-8 of the FEIS states,

"The primary sources of surface water contaminants at the proposed balefill facility include landfill leachate and contaminated storm water. Areas of a landfill that may produce contaminated storm water include the open face of an active landfill with exposed waste that has not been covered with soil. Releases of leachate or contaminated storm water from the proposed site could degrade water quality or impair beneficial uses downstream of the site. According to state and federal regulations, both leachate and contaminated storm water must be controlled and treated to specific treatment standards prior to release to surface water.

* * *

Under normal operating conditions, the facility design and permit requirements for controlling and treating leachate and contaminated storm water runoff and non-contaminated storm water runoff should prevent or effectively minimize degradation of surface water quality downstream from the project."

Page 3-21 of the DEIS states, under ***3.3.1.4 Water Quality,***

"*No perennial, intermittent, or ephemeral streams, ponds or springs exist within or immediately adjacent to the proposed project facility area. Any rainfall or snowmelt runoff generated from the proposed project area would enter roadside ditches that parallel the north and south boundaries of the facility. The roadside ditches convey water to the Turtle River. The Turtle River is classified by the North Dakota Department of Health (NDDH) as a Class II stream that is tributary to the Red River of the North. A Class II stream is considered a cool water fishery, and capable of supporting growth and propagation of nonsalmonid fishes and marginal growth of salmonid fishes and associated aquatic biota (NDDH 2001).*"

Pages 3-27b and 3-27c of Appendix B of the FEIS states in the ***Water Quality*** section,

"The primary sources of surface water contaminants at the proposed balefill facility include landfill leachate and contaminated storm water. Landfill leachate is a liquid that has passed through or emerged from the MSW and contains soluble, suspended, or miscible materials derived from the waste. Contaminated storm water is storm water that comes in direct contact with landfill wastes or waste handling and treatment areas. Areas of a landfill that may produce contaminated storm water include the open face of an active landfill with exposed waste that has not been covered with soil. Releases of leachate or contaminated storm water from the proposed site could degrade water quality or impair beneficial uses downstream of the site.

According to state and federal regulations, both leachate and contaminated storm water must be controlled and treated to specific treatment standards prior to release to surface water. The proposed design of the leachate collection system is summarized in Section 2.2.3. Water that infiltrates the waste would be collected at the base of the balefill in the LCRS. The composite liner system would serve to contain the leachate in the LCRS. Leachate recovered in the LCRS would be pumped into a lined leachate pond and later trucked to the City's wastewater treatment facility for treatment.

Although not specified in the conceptual design information for the Proposed Action, all contaminated storm water must be controlled and segregated from uncontaminated storm water. Contaminated storm water is subject to the same retention and treatment standards as leachate (EPA 2002). Therefore, as summarized in the proposed Monitoring and Mitigation Measures (FEIS Appendix A), the design would include a plan to control, capture, and treat contaminated storm water.

Another potential source of pollutants to surface water is the non-contaminated storm water released from the site. Non-contaminated storm water, as defined by the EPA (EPA 2002) is, 'storm water that does not come in direct contact with landfill wastes, the waste handling and treatment areas, or wastewater that is subject to the limitations and standards. Non-contaminated storm water includes storm water which flows of the cap, cover, intermediate cover, daily cover and/or final cover of the landfill.' Storm water runoff would be managed and controlled according to state and federal regulations pertaining to storm water management and pollution prevention.

Specifically, the proposed facility would be required to operate under the requirements of a North Dakota General Industrial Storm Water Discharge Permit (or Individual Permit) in compliance with Chapter 33-16-01 of the North Dakota Department of Health rules (North Dakota 2002). To obtain this permit, the City would be required to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP). The goal of the plan is to develop procedures to minimize or eliminate pollutants in storm water discharge from an industrial site."

In Section **6.0 IRREVERSIBLE / IRRETRIEVABLE COMMITMENT OF RESOURCES** on page 6-1, the DEIS states in section **6.2 Groundwater Resources,**

"With implementation of the proposed design and monitoring and mitigation measures to control potential groundwater quality impacts, the proposed project would not result in unavoidable significant adverse impacts to groundwater resources. Therefore, there would be no irreversible or irretrievable commitment of groundwater resources under the Proposed Action."

Section **6.3 Surface Water Resources** states,

> "*With implementation of the proposed design and monitoring and mitigation measures to control potential surface water quality impacts, the proposed project would not result in unavoidable significant adverse impacts to surface water resources. Therefore, there would be no irreversible or irretrievable commitment of surface water resources under the Proposed Action.*"

While the DEIS and FEIS mention that there could be water quality problems associated with stormwater runoff from the landfill site, they fail to adequately discuss the magnitude of the problems of preventing significant offsite surface water impacts due to the landfill. The DEIS and FEIS should have discussed that the allowed design of stormwater management systems at landfills only requires management of runoff from storms up to a certain magnitude (24-hour 25-year storms). Stormwater runoff and its associated landfill-derived pollutants associated with storms of larger magnitude are not required to be controlled. This means that properties downstream of the surface runoff from the landfill could be impacted by landfill-derived pollutants.

Air Quality Impacts

In the section on **Air Quality** in the Executive Summary, page ES-9 of the FEIS, it is stated,

> "*Air quality issues center on the major criteria pollutants regulated by the EPA and the State of North Dakota, as well as the potential creation of objectionable smells from the proposed balefill facility.*"

Page ES-10 of the FEIS states,

> *"The primary constituents of landfill or balefill gas are methane (CH_4) and carbon dioxide (CO_2). In addition, balefill gas also contains non-methane organic compounds (NMOCs) that may be comprised of volatile organic compounds (VOCs), hazardous air pollutants (HAPs), greenhouse gases (GHG**s**), or ozone depleting compounds. For the purpose of this analysis, the focus was on CH_4 and NMOC generation as a result of balefill operations. Although CH_4 and CO_2 are often tracked by regulatory agencies, they are not criteria pollutants that would be subject to regulatory thresholds. For the purpose of this analysis, NMOCs were conservatively assumed to be comprised of both VOC**s** and HAP**s**, which are subject to regulatory standards.*
>
> *Methane and NMOC emissions are the gases typically associated with landfill odors. Control of these emissions would translate directly to a reduction in potential odors. Odor is sometimes difficult to quantify, particularly since it is highly subjective and also variable by person. Regardless, there are ways to reduce potential landfill odors. As noted, the proposed project is a balefill facility that would reduce the size of the working face and thus reduce potential fugitive emissions as compared to a traditional landfill. In addition, the project would employ a gas collection system (described below) to control methane and NMOC emissions. Other methods that may be employed include deodorizers or*

other chemical odor suppressants; however, at this time there is no expectation that such methods would be necessary.

Based on EPA-developed emissions data for landfill operations, it is estimated that uncontrolled landfill emissions would be the greatest after approximately 60 years of operation. Maximum CH_4 generation and uncontrolled emissions to the atmosphere are projected to be 5,410 tons per year. Maximum NMOC generation and uncontrolled releases are projected to be 34.6 tons per year.

The Proposed Action includes the use of a passive gas collection system to control landfill gas releases to the atmosphere. The proposed collection system would use piping to collect the landfill gas generated within the waste piles and convey it to flares. The flares would combust the landfill gas, resulting in reduced CH_4 and NMOC releases, but would also introduce additional emissions, including NO_x, CO, and PM. Based on available information, a conservative collection efficiency of 75 percent was used for the gas collection system. Flares are typically assumed to have better than 99 percent control efficiency. Based on these assumptions, the maximum uncontrolled fugitive emissions of CH_4 and NMOC would be 1,354 tons and 8.65 tons, respectively, and the maximum annual controlled emissions from the landfill in the peak year would be 13.53 tons of CH_4 and 0.087 ton of NMOC."

The section in Appendix A of the FEIS devoted to **4.0 Air Quality** states,

"*The Proposed Action would produce minimal incremental emissions at and around the project area. Since no adverse effects to air quality are expected from the Proposed Action, monitoring has not been included as a component of proposed project activities. Further, mitigation measures will not be necessary since* projected emissions would not exceed national or North Dakota Ambient Air Quality Standards*."*

Section **6.4 Air Quality** on page 6-1 of the DEIS states,

"The Proposed Action would produce no residual adverse effects on air quality. Therefore, there would be no irreversible or irretrievable reduction in air quality under the Proposed Action."

L. David Glatt, Chief of the Environmental Health Section of the North Dakota Department of Health, in an October 2, 2003, letter to Todd Feland of the Grand Forks Department of Public Works, states,

"*5. The proposed project appears to have the potential to be a source of emissions to the air capable of causing or contributing to air pollution and is required to have an Air Pollution Control Permit to Construct/Operate as required by Chapter 33-15-14 of the North Dakota Air Pollution Control Rules. The applicant should contact the Department's Air Pollution Control program at 701-328-5188 prior to commencing construction.*"

The passive gas collection system proposed for this landfill will likely prove to be inadequate to control landfill gaseous emissions. Such systems often fail to function as described in the DEIS/FEIS, with the result that offsite hazardous gases and odors occur near landfills. Further, it is frequently found that landfill gas flares do not achieve the control efficiency claimed in the DEIS/FEIS. The DEIS and FEIS are at best superficial in discussing the magnitude of the landfill odor problems that will occur on offsite properties. As discussed below, Grand Forks' proposed approach for siting this landfill provides only 0.3 mile of buffer lands between where wastes will be deposited and established residences on adjacent property. While the DEIS and FEIS try to minimize the concern about odor problems that will occur at this site, they should have discussed the fact that often landfill odors occur several miles downwind from the landfill. The grossly inadequate buffer lands provided for with the proposed landfill will mean that Grand Forks could face frequent justified complaints from nearby residents and regulatory agency fines for failing to control odorous emissions from the landfill.

Landfill Closure and Postclosure

The FEIS on pages ES-3 and ES-4 states,

> *"The balefill facility would be closed according to the closure criteria specified in SWMR 33-20-06.1-03. As part of the proposed plan, completed cells would be periodically closed and revegetated. The final cap would consist of low permeability layers covered by soil used as a growth medium. The types of vegetation used to reclaim the balefill would be determined during final design and after consultation with local experts to identify appropriate plant species for this application. The cap would also incorporate the gas venting system described in Section 2.2.5 of the Draft EIS (DEIS). During the post-closure period (extending 30 years or more after final closure), balefill facility erosion would be controlled and the vegetation cover would be maintained. In accordance with SWMR 33-20-14-01, the City would be required to prepare cost estimates, adjusted for inflation, to fully implement closure and post-closure plans. The City would also be required to provide financial assurance for closure and post-closure maintenance of the balefill. Financial assurance mechanisms (such as a reserve account, trust fund, surety bond, irrevocable letter of credit, financial test, or insurance policy) must be approved by the North Dakota Department of Health and must equal the total cost estimate for closure and postclosure activities."*

Table 3-2 of the FEIR, on page 3-118, states,

> *"As stated in Section 2.2.10 of the DEIS, as part of the landfill permitting and operating requirements, the North Dakota Department of Health would require the City to provide adequate financial assurance as specified in North Dakota SWMR 33-20-14-0. This financial assurance must cover the estimated cost for closure and postclosure care over the entire postclosure period. In addition, these costs would need to be updated if there is any change in operating plans or facility design that could affect closure or postclosure. The North Dakota SWMR mandate that a postclosure plan must be approved by the North Dakota Department of Health as part of the permitting process to address facility*

maintenance and monitoring activities for a postclosure period of 30 years. The North Dakota Department of Health also has the ability to require the owner of the facility to extend maintenance and monitoring beyond this 30-year postclosure period (Steven Tillotson, Personal correspondence 2004). Groundwater monitoring would be required during operation and postclosure to detect contaminate migration. In the event that contamination is detected at a statistically significant level exceeding the groundwater quality standards during operation or postclosure, the City would be required to implement remedial measures as approved by the North Dakota Department of Health to mitigate the groundwater contamination. These regulatory procedures are intended to mitigate potential impacts to groundwater quality."

As quoted above, throughout the DEIS and the FEIS there are misleading statements and implications regarding the postclosure period of the landfill, which will be only the minimum required by Subtitle D and the North Dakota Health Department (i.e., 30 years). This is highly misleading in that, as quoted by Lee and Jones-Lee (2004), numerous authorities (such as the US Congress General Accounting Office; US EPA Inspector General; Dr. J. Skinner, Executive Director and CEO of the Solid Waste Association of North America (SWANA) and former US EPA official in the Office of Solid Waste and Emergency Response; and L. Hickman, former Executive Director of SWANA; as well as others) have discussed the fact that dry tomb type landfills will require postclosure monitoring and maintenance for very long periods of time, likely forever. As noted by John Skinner on page16 of the July/August 2001 *MSW Management* Journal,

"The problem with the dry-tomb approach to landfill design is that it leaves the waste in an active state for a very long period of time. If in the future there is a breach in the cap or a break in the liner and liquids enter the landfill, degradation would start and leachate and gas would be generated. Therefore, dry-tomb landfills need to be monitored and maintained for very long periods of time (some say perpetually), and someone needs to be responsible for stepping in and taking corrective action when a problem is detected."

Thirty years is a very small part of the time that postclosure care will be needed. Rather than 30 years, an adequate postclosure care period would likely be 1,000 or more years. Both Subtitle D and North Dakota regulations allow for an extension of the postclosure care period for as long as the wastes in the landfill will be a threat to release pollutants to the environment. As discussed above, the unsuitability of the proposed Turtle River site for a landfill, with its high groundwater table and inadequate buffer lands, means, provided that the regulations are enforced, that Grand Forks will be facing much higher postclosure costs than would occur if a more suitable site had been selected.

There is justified concern by those who have a landfill forced on them by a city, that the city will not provide adequate postclosure funding for as long as the wastes in the landfill will be a threat. Hickman (1992, 1995, 1997, 1998), in a series of articles ("Financial Assurance-Will the Check Bounce?", "Ticking Time Bombs?", "No Guarantee," "A Broken Promise Reversing 35 Years of Progress"), has discussed the inadequate

approaches for postclosure funding under Subtitle D regulations. Additional discussion of these issues is provided in Lee and Jones-Lee (2004) and in references cited therein. These issues should have been discussed in the DEIS and FEIS.

Page 2-2 of the FEIS, in Table 2-1 Text Revisions, under DEIS Location "p. 2-18, line 17," states,

> "*Add the following to the end of the paragraph:*
> *In addition to the financial assurance required by the state permit, the City of Grand Forks would also commit to maintaining the site during the post closure to control erosion and stability of the reclaimed facilities, and prevent release of contaminated surface or groundwater for the foreseeable future (or as long as the site is owned or controlled by the City).*"

The Grand Forks commitment for postclosure monitoring and maintenance "for the foreseeable future" has no legal definition. The commitment must be for as long as the wastes in the landfill have a potential to generate leachate and/or landfill gas. Further, there is concern that Grand Forks may attempt to sell the closed landfill to an entity that will not have the financial resources necessary to ultimately pay for both the cleanup of the groundwater pollution that will occur at this site and the litigation settlements that will arise out of the lawsuits that could occur from pollution of offsite properties' groundwaters. It will be important that Grand Forks be financially obligated to pay for the Superfund-like cleanup that will have to be performed at this site when the landfill liner system fails to prevent leachate from polluting groundwaters.

Inadequate Buffer Lands

Page ES-18 of the FEIS states,

> *"The perimeter of the balefill project, as presently projected is within the 0.5-mile separation required by the Grand Forks County zoning resolution with respect to up to three residences. The residence to the west of the site is approximately 300 feet from the perimeter boundary of the site as measured according to the ordinance. There is a second residence approximately 0.5 miles south of the southeast corner of the site and a third just under 0.5 mile north-northwest of the site. Conflicts with the County separation standards could be resolved by either (1) obtaining waiver signatures from affected property owners; (2) purchasing the affected properties either through negotiation with a willing seller, or by exercising the City of Grand Forks' powers of eminent domain; or, (3) reconfiguring the perimeter of the site, or providing an easement permanently preventing development of the portions of the parcel within 0.5 mile of the residences and obtaining a variance consistent with the easement.*
>
> *The proposed project does not comply with the requirement in the Turtle River Township Land Development Code that it be separated from residences by at least 2 miles. There are 18 residences within 2 miles of the site, mostly to the northwest and southeast. The Director of Public Works for the City of Grand Forks has indicated that application of the 2-mile separation to each of the existing residences in the township would effectively prohibit development of a*

landfill anywhere in the township. As such, the City has indicated that it may contest the enforceability of the 2-mile standard if that were to be the basis of a denial of its application. Under North Dakota law, if an appeal to the District Court by a property owner shows that a rule, restriction, or decision of the Township Supervisors is "unreasonable under the circumstances" of the situation, the rule, restriction, or decision may be set aside or reversed. If a court should determine the township's zoning requirements are reasonable, the proposed balefill facility would have to meet them. In that case, options for developing the proposed balefill facility would include obtaining waiver signatures from property owners , purchasing affected residential properties, either by negotiation with a willing seller or by exercising the City of Grand Forks' powers of eminent domain, by reconfiguring the perimeter of the site, or by providing an easement permanently preventing development of the portions of the parcel within 0.5 mile of the residences and obtaining a variance consistent with the easement."

Page ES-19 of the FEIS states,

"*Except for the residential separation standard, the proposed balefill project would meet the siting standards of the Turtle River Township regulation governing waste disposal sites."*

Page A-7 of the FEIS states,

"9.0 Land Use and Access

Buffering for the residence west of the project site shall be maximized to the degree possible. Planting a dense and extensive grove of trees along the west, northwest, and southeast edges of the site early in the project life would provide a mature screen by the time operations reached their closest point to residences some years in the future.

Conflicts with the County 0.5 mile separation standards shall be resolved by either (1) obtaining waiver signatures from affected property owners; or (2) purchasing the affected properties either through negotiation with a willing seller, or by exercising the City of Grand Forks' powers of eminent domain; or (3) reconfiguring the perimeter of the site; or (4) providing an easement permanently preventing development of the portions of the parcel within 0.5 mile of the residences and obtaining a variance consistent with the easement. If the township 2-mile buffer ordinance is found to be reasonable and enforceable, options for developing the proposed balefill facility would be the same as (1) and (2) above."

Lee and Jones-Lee (2004) have discussed justified NIMBY issues associated with inadequate buffer lands between the landfill and adjacent properties. Basically, those who generate the garbage consider people who object to having a landfill located near them to have a "NIMBY" mentality. However, it is indeed rare that there is anyone who does not justifiably possess a NIMBY mentality when a landfill is proposed to be sited next to them. The problem that occurs is that landfill developers, such as the Grand

Forks Department of Public Works, attempt to locate a landfill without adequate buffer lands between where the wastes will be deposited and adjacent properties. Grand Forks purchased only enough land in Turtle River Township to hold the landfill and its required supporting lands. Those responsible for this approach assumed that they could follow the practices of the past of developing a landfill and largely ignoring the real impacts of the landfill on nearby property owners, and did not acquire the necessary buffer lands to dissipate the releases of hazardous and deleterious chemicals to the groundwater and air and other impacts that occur even at well-managed landfills. Hirshfeld et al. (1992) of Duke University, in a paper entitled, "Assessing the True Cost of Landfills," Lee et al. (1994) and Lee and Jones-Lee (2004) have summarized the potential impacts of landfills that lead to justified NIMBY. Table 1 presents a listing of these impacts.

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

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

From Lee et al. (1994)

As discussed below, the Township is highly justified in requiring additional landfill buffer lands beyond those which have been proposed by Grand Forks. Justified NIMBY issues discussed by Lee and Jones-Lee (2004) should have been discussed in the DEIS and FEIS.

Noise Impacts

Page ES-23 of the FEIS states, in the **Noise** section,

> "*The principal identified noise issue is the potential for balefill operation noise to affect nearby residences. Describing the existing environment potentially affected by noise from the proposed project involves identifying noise-sensitive receptors and existing noise sources in the vicinity, characterizing terrain features that may affect noise transmission, and determining existing noise levels.*"

Hirshfeld et al. (1992) discuss landfill noise as part of their discussion of "Social Impacts" of landfills. They stated, "*Noise at landfills can be noticeable in nearby*

residential areas. The USEPA (1975) notes that excessive noise can have many undesirable effects on those exposed to it. In most cases, however, the noise is simply regarded as an annoyance."

The potential for offsite noise that is adverse to those within the sphere of influence of the landfill is another example of the highly inadequate approach that the city of Grand Forks Department of Public Works has adopted in developing this proposed landfill. There is inadequate buffer land to dissipate noise and other impacts of the landfill so that these conditions do not trespass onto adjacent properties.

Management of Hazardous Wastes/Hazardous Chemicals

Pages ES-26 and ES-27 of the FEIS, in the **Hazardous Waste** section, state,

> "*Under the Proposed Action, the City would operate the balefill facility to exclude hazardous waste in accordance with state and federal regulations. The City also has implemented procedures to ensure that loads entering the baled waste stream do not contain regulated hazardous waste. The City's plan follows the state guidelines for excluding undesirable materials from municipal landfills and was approved by the North Dakota Department of Health. Regardless of the level of screening, small amounts of incidental household hazardous waste, or other prohibited waste gets past the screening and sorting at the baling facility. Some of these wastes may have the potential to leach hazardous substances. However, the composite clay and synthetic liner system and LCRS included in the design are intended to prevent this leachate from contaminating the environment or endangering public health and safety."*

The statement that the liner proposed for the landfill will prevent leachate pollution of the environment is highly inaccurate. As discussed above and by Lee and Jones-Lee (2004), the single composite liner proposed for the Grand Forks landfill will only postpone when groundwater pollution occurs; it will not prevent it for as long as the wastes in the landfill will be a threat to generate leachate.

While the EIS mentions that current US EPA Subtitle D regulations allow household hazardous wastes to be deposited in a Subtitle D MSW landfill, the DEIS and FEIS fail to discuss the fact that the way that the US EPA defines hazardous wastes allows substantial amounts of hazardous chemicals to be legally deposited in MSW landfills. The household hazardous wastes, the hazardous chemicals that are not classified as hazardous wastes but are highly hazardous to humans and wildlife, and illegal dumping of hazardous wastes by industry and commercial establishments contribute to making MSW leachate and landfill gas emissions hazardous to humans and wildlife.

The DEIS/FEIS should also have discussed the fact that the current regulatory approach for investigating the pollution by landfills only considers about 100 or so chemicals in the analytical program, compared to the many thousands of chemicals that are in MSW and leachate. Dr. C. Daughton (2004a,b), Chief, Environmental Chemistry Branch, US EPA National Exposure Research Laboratory has indicated that one of the routes of environmental exposure to the large number of unregulated chemicals is through

municipal solid waste landfills in the garbage that is placed in these landfills. He specifically singles out leaching from municipal landfills as an origin of waste pharmaceuticals and personal care products (PPCPs) (potentially hazardous chemicals) in the environment. He characterizes municipal landfills as *"pollution postponement."* Lee and Jones-Lee (2004) have discussed these issues further.

Analysis of Alternatives

NEPA requires that a comprehensive review of alternatives to a proposed project be presented in an EIS. The Grand Forks DEIS/FEIS review of alternatives is grossly inadequate with respect to discussing alternative approaches for the landfill design, closure and postclosure care. As discussed by Lee and Jones-Lee (2004), there are several states that would not allow a minimum design Subtitle D MSW landfill to be developed in the state. The DEIS and FEIS should have discussed this situation, pointing out the significant increase in protection of public health and the environment provided in those states that require more than the minimum Subtitle D landfill design, closure and postclosure care.

Review of the ND Department of Health Assessment of the EIS

The North Dakota Department of Health submitted a letter to Grand Forks on November 28, 2003, that was signed by S. Tillotson and K. Solie. This is letter 2 in the FEIS comment letters. This letter stated, *"In conclusion, the Department finds the EIS to be well completed and accurate."* It is clear that the ND Department of Health staff's conclusion on the completeness and accuracy of the EIS is based on inadequate and unreliable information. Tillotson and Solie accepted the Grand Forks Department of Public Works' consultant's statement regarding the "inherent low hydraulic conductivity of the sediments" underlying the landfill. However, the recent studies of Beaver (2004) have shown that the near-surface soils that would be in contact with the landfill contain groundwaters that are moving at a rapid rate through fractures. Further, the Department staff ignored the ND Department of Health Guideline for not establishing a landfill in areas with a high groundwater table. In addition, they have not adequately considered the potential impact of the landfill's settling by its own weight eight feet into the sediments. While the Grand Forks consultant claims that this settlement will not place any significant stress on the landfill liner, such claims could readily be in error.

Another significant deficiency in the Department of Health staff's review of the proposed landfill is the failure to adequately and reliably assess the ability of the landfill containment system (liner and cover) to function as designed over the 1,000 or more years that the wastes in the landfill will be a threat. They have also failed to adequately consider the unreliability of the typical groundwater monitoring approach in detecting leachate pollution of groundwaters in accordance with regulatory requirements. Overall, the Department of Health staff's conclusion on the completeness and accuracy of the EIS is based on unreliable and inadequate information.

Review of Selected North Dakota Health Department Landfill Regulations

North Dakota's Solid Waste Management Rules, Chapter 33-20-06.1 Municipal Waste Landfills, in section 33-20-06.1.02 Performance and Design Criteria, establishes several criteria that are applicable to the proposed Grand Forks landfill in Turtle River Township. These include several minimum design and performance requirements that cannot be achieved by the landfill that has been proposed for the Turtle River Township for as long as the waste in the landfill will be a threat. These include, *"2.a. The liner and leachate removal system must maintain its integrity for the life of the facility and postclosure period."*

The key issue of concern is the length of the postclosure period. Since the Health Department can and almost certainly will need to extend the postclosure period for the proposed landfill for a very long period of time, such as for as long as the wastes that would be placed in this landfill are a threat, the proposed landfill liner system cannot comply with this requirement because of the eventual deterioration of the HDPE component of the liner and the inability to repair it. If, however, the North Dakota Department of Health should allow Grand Forks to be responsible only for the minimum 30 years specified in Subtitle D and the Health Department regulations, or for some other period less than the period that the wastes in the dry tomb landfill are still a threat to generate leachate, then the Department of Health should explain to the Township who will be responsible for postclosure monitoring and maintenance, as well as groundwater remediation, for the thousand or more years that this landfill will be a threat to produce leachate, and the very long period of time that there will be a potential for landfill gas production.

North Dakota's Solid Waste Management Rules, Chapter 33-20-06.1 Municipal Waste Landfills, in section 33-20-06.1.02 Performance and Design Criteria, number 2.c. states, "*The leachate removal system must have a collection efficiency of 90 % or better and be capable of maintaining a hydraulic head of twelve inches [30.5 centimeters] or less above the liner."*

While it is possible to design and construct a leachate removal system that will achieve this level of leachate collection efficiency when it has just been constructed, over time the collection efficiency of the leachate removal system will decrease due to deterioration of the HDPE liner that forms the base of this system. Since the leachate removal system cannot be repaired since it is buried under the solid wastes, the proposed landfill cannot comply with this requirement for as long as the wastes in this landfill will be a threat to generate leachate.

Number 2.e. states, "*The drainage layer of the leachate removal system must have a hydraulic conductivity of 1 x 10^{-3} centimeters per second or greater throughout."*

While it is possible to develop a drainage layer that can comply with this requirement, due to plugging of landfill drainage layers by chemical precipitation, biological growths and accumulation of fines derived from the wastes, this level of hydraulic conductivity

will not be achieved throughout the period that the wastes in the proposed landfill will be a threat.

Performance and Design Criteria number 3 states, "*The liner and leachate removal system in combination with the final cover must achieve a site efficiency of ninety-five percent or better for rejection or collection of the precipitation that falls on the site."*

It is possible, with high quality construction, to develop a landfill cover that contains a plastic sheeting layer to achieve 95% rejection of precipitation that falls on the site. Also it is possible to construct a liner and leachate removal system that will collect 95% of the leachate that is generated in the landfill. Achieving this level of rejection and collection can occur when the cover and liner are new. However, as discussed by Lee and Jones-Lee (2004), this level of performance will not be maintained for as long as the wastes in the landfill can generate leachate, unless a leak detectable cover is installed on the landfill to indicate when the plastic sheeting layer of the cover has deteriorated to the point that it allows moisture to enter the landfill that will generate leachate.

Number 4.b. states, "*The concentration of methane gas must not exceed the lower explosive limit for methane at the facility boundary."*

Since municipal solid waste landfill gas contains hazardous levels of a variety of volatile chemicals that are a threat to the health of humans and wildlife, this requirement allows potentially hazardous levels of chemicals in landfill gas that migrates offsite.

Turtle River Township's Justification for Additional Protection

The Turtle River Township Land Development Code, Zoning Ordinance & Subdivision Regulations of August 2004 contain the requirements under Waste Disposal Sites:

> *"At a minimum the following described waste disposal sites shall comply with all applicable state, federal, local laws, rules and regulations. In addition, the Township Board may require compliance to other conditions.*
>
> * * *
>
> *C. MISCELLANEOUS*
>
> * * *
>
> *3. Additional Monitoring - The Turtle River Township Board of Supervisors may, in addition to the standards and requirements set forth in these regulations, additional conditions which the Board of Supervisors considers necessary to protect the public health, safety and welfare. This shall include additional monitoring if the possibility exists that groundwater or surface water quality or air quality may be compromised.*
>
> * * *
>
> *D. REQUIRED SETBACK AND SEPARATION DISTANCES*
>
> *Established Residences 2 miles*
> *Adjoining Property Lines 500 feet"*

The Turtle River Township is justified in requiring considerable additional protective measures for the siting, operation, closure and postclosure monitoring and maintenance of a landfill located in the Township. As discussed herein, the current federal US EPA and state of North Dakota Department of Health landfill regulations can be significantly deficient in providing the necessary protection of public health, water resources, air quality, and other interests of those in the sphere of influence of an MSW landfill. The federal and North Dakota landfill regulations essentially ignore the long-term properties of plastic sheeting and compacted clay liners and landfill covers to perform as designed for as long as the wastes in the landfill will be a threat to generate leachate and landfill gas. Further, as discussed by Lee and Jones-Lee (2004), the minimum Subtitle D landfill groundwater monitoring systems typically permitted by state regulatory agencies are of limited reliability in detecting polluted groundwater before offsite private or public wells are polluted.

Most importantly, the North Dakota landfilling regulations do not establish a reliable source of funding for the 1,000 or more years that the wastes in the landfill will be threat to pollute the environment. In order to protect the health, welfare and interests of the Township residents from the near-term and especially the long-term impacts of the proposed Grand Forks landfill, the Board of Supervisors must establish an extensive set of additional requirements as conditions for issuing a permit for this proposed landfill. These additional requirements should address the issues that Lee and Jones-Lee (2004) have discussed in their review of the deficiencies in minimum Subtitle D landfills.

One of the areas of particular concern is the inadequate buffer lands between the landfill waste deposition area and adjacent properties. The setback required by the Township of only 500 feet to an adjacent property is significantly deficient in protecting the rights of adjacent property owners to use their properties as they could if the landfill were not located next to them. Since MSW landfills have been documented to cause adverse impacts at over several miles from the landfill, under the current Township-allowed setback of 500 feet, there will be several miles of land adjacent to the proposed landfill that will be adversely impacted by it.

The Township's requirement of allowing a landfill to be sited no closer than two miles from an existing residence is highly justified. There can readily be odorous/hazardous conditions within two miles and possibly further than this from the proposed landfill. Even at two miles the homeowner's property value will likely be decreased by the proposed landfill.

The city of Grand Forks' Petition for Issuance of Conditional Use Permit of March 4, 2000, contains information on the process used by Grand Forks in selecting the Turtle River Township site for a city landfill. The approach used by the Grand Forks Department of Public Works to select this site was fundamentally flawed in that the city assumed that, in order to provide garbage disposal for its residents at cheaper than real costs, it could locate a landfill in the Turtle River Township at a geologically unsuitable site with grossly inadequate buffer lands between waste deposition areas and adjacent properties. Basically, Grand Forks is attempting to provide cheaper than real cost

garbage disposal for its residents at the expense of the health and welfare of current and future residents and property owners of Turtle River Township.

The adverse impacts of dry tomb type minimum Subtitle D landfills have been discussed in the literature since the late 1980s when this landfilling approach was first suggested. The Grand Forks Department of Public Works chose to ignore these issues and now is attempting to force a landfill into Turtle River Township that will be a significant threat to the Township's interests for a thousand or more years. Grand Forks needs to start over in developing an MSW landfill that not only will comply with the minimum prescriptive design standards but also will fully protect the interests of all of those who could be impacted by the landfill. The Grand Forks Public Works Department should work toward developing a landfill that it could develop, operate and close in downtown Grand Forks. Adopting this approach would result in the development of a landfill that would be protective, no matter where it is located.

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Appendix A
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Appendix B

Summary of
G. Fred Lee's
Academic Background and Professional Experience

Dr. G. Fred Lee is President of G. Fred Lee & Associates, which consists of Drs. G. Fred Lee and Anne Jones-Lee as the principals in the firm. They specialize in addressing advanced technical aspects of water supply water quality, water and wastewater treatment, water pollution control, and solid and hazardous waste impact evaluation and management.

After obtaining a bachelor's degree at San Jose State University in 1955, a Master of Science Degree in Public Health from the University of North Carolina in 1957 and a PhD from Harvard University in 1960 in Environmental Engineering and Environmental Sciences, Dr. Lee taught graduate level university environmental engineering and environmental science courses for 30 years at several major U.S. universities. During this time, he conducted over $5 million of research and published over 500 papers and reports. Dr. Anne Jones-Lee was a university professor for a period of 11 years in environmental engineering and environmental sciences. Their combined environmental engineering, aquatic chemistry, aquatic biology, toxicology and public health expertise and experience enable them to address complex problem areas in water quality and solid and hazardous waste impact evaluation and management.

Dr. Lee was active as a part-time consultant during his 30-year university teaching and research career. Drs. G.F. Lee and A. Jones-Lee have been full-time consultants since 1989. Dr. Lee has extensive experience in developing approaches that work toward protection of water quality without significant unnecessary expenditures for chemical constituent control. He has been active in developing technically valid, cost-effective approaches for the evaluation and management of chemical constituents in domestic and industrial wastewater discharges and urban stormwater runoff since 1960.

Dr. Lee has extensive experience in developing water quality criteria for a variety of inorganic and organic constituents. He served as a peer reviewer for the National Academies of Science and Engineering for the Bluebook of Water Quality Criteria, published in 1973. He was a member of the American Fisheries Society review panel for the critique of the US EPA Redbook of Water Quality Criteria of 1976. During the early 1980s, he was a US EPA peer reviewer for the Agency's current approach for developing water quality criteria, as well as for several of the criterion documents. He is frequently involved in the review of water quality criteria in connection with their application to specific situations.

Further information on Dr. Lee's experience and expertise is available at http://www.gfredlee.com.

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Surface and Groundwater Quality Evaluation and Management
and
Municipal Solid & Industrial Hazardous Waste Landfills
http://www.gfredlee.com

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

- Landfills and Groundwater Quality Protection

- Water Quality Evaluation and Management for Wastewater Discharges, Stormwater Runoff, Ambient Waters and Pesticide Water Quality Management Issues, TMDL Development, State Stormwater Quality Task Force – 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,
  Upper Newport Bay Watershed Program,
  San Joaquin River Watershed DO and OP Pesticide TMDL Programs

Stormwater Runoff Water Quality Science/Engineering Newsletter

SUMMARY BIOGRAPHICAL INFORMATION
G. Fred Lee, PhD, PE, DEE

ADDRESS: 27298 E. El Macero Dr.
El Macero, CA 95618-1005

DATE & PLACE OF BIRTH:
July 27, 1933
Delano, California, USA

TELEPHONE: 530/753-9630 (home/office)

FAX: 530/753/9956 (home/office)

E-MAIL: gfredlee@aol.com

WEB PAGE: http://www.gfredlee.com

EDUCATION

PhD Environmental Engineering & Environmental Science, Harvard University, Cambridge, MA, 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, San Jose, CA, 1955

ACADEMIC AND PROFESSIONAL EXPERIENCE

Current Position:

Consultant, President, G. Fred Lee and Associates

Previous Positions:

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

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

Coordinator, Estuarine and Marine Water Quality Management Program, NJ Marine Sciences Consortium Sea Grant Program, 1986-1988

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

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

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

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

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

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

Diplomate American Academy of Environmental Engineers

PUBLICATIONS AND AREAS OF ACTIVITY

Published over 1,025 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 760 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 and industries. Summary list attached.

PROFESSIONAL SOCIETIES

American Chemical Society
American Fisheries Society
American Public Works Association
American Society for Civil Engineers
American Water Works Association
Aquatic Plant Management Society

California/Nevada Section American Waterworks Association
California Water Environment Association
NorCal SETAC
Societas Internationalie Limnologiae
Society of Environmental Toxicology and Chemistry
Water Environment Federation

Member, Editorial Advisory Board, Environmental Science & Technology, published by American Chemical Society, 1966-1970

Member, American Water Works Association Committees on Organic Contaminants in Water, 1964-1970; Iron, and Manganese, 1965-1970; and Chairman, Quality Control in Reservoirs, 1978-1981

Reviewer, National Academy of Sciences & Engineering Panel on Water Quality Criteria, 1971

Member, Water Pollution Control Federation Committee on Biodegradation and Nitrogen-Phosphorus, 1965-1970; Standard Methods Committee, 1972-1982; Sediment Water Quality Task Force, 1992-present; Water Quality Criteria Task Force, 1993-present

Chairman, ASTM Committee on Environmental Chemistry-Fate Modeling in the Environment, 1977-1979

Reviewer, American Fisheries Society-US EPA Water Quality Criteria, 1977

Chairman, Water Pollution Control Federation Standard Methods Subcommittee, "Interpretation and Application of Bioassays," 1979-1988

Member, Editorial Board Journal, Society for Environmental Toxicology and Chemistry, 1982-1984

Member, Editorial Board Journal, Ground Water, 1989-1991

Chief and Associate Chief State Examiner, American Academy of Environmental Engineers, New Jersey, 1986-1989

Member, Hazardous Waste Committee, New Jersey Water Pollution Control Association, 1985-1989

Member, ASCE Committee on Solid Waste Engineering 1991-1994

Member, ASCE Committee on Groundwater Recharge 1992-

Member, Natural Resources Committee, Greater Sacramento Chamber of Commerce, 1990-1993

Member, Air and Waste Committee and Water Resources Committee CA Chamber of Commerce, 1990-1993

Chief Examiner of the American Academy of Environmental Engineers, North Central California, 1991-

Led development of California Groundwater Resources Association, 1992-1993

Chairman, ACWA Groundwater Quality Subcommittee, 1992-1993

Chairman, Groundwater Quality Subcommittee of the Source Water Quality Committee of the CA/NV AWWA Section, 1993-1995

Member, California Environmental Protection Agency Comparative Risk Project Human Health Committee, 1993-1994

Member, WEF Urban Stormwater Quality Task Force, 1994-1997

Member, California DTSC Committee on Hazardous Waste Classification, 1996-

Member, Water Environment Federation Research Foundation Subcommittee on Nitrogen Management Protocols for Biosolids Beneficial Use 1996-
Member, American Water Works Association Source Water Quality Committee, 1999-
Member, Water Environment Federation Committee on Domestic Wastewater Reuse, 1996-
Chair, California State Stormwater Quality Task Force Stormwater Science Workgroup, 1998-99

HONORS AND AWARDS

Elected member of the following:

Sigma Xi
Delta Omega, Honorary Public Health Scholastic Society
Phi Lambda Upsilon, Honorary Chemistry Scholastic Society
Diplomate, American Academy of Environmental Engineers

Tied for first place for best paper presented at the Fifth Annual ASTM Aquatic Toxicology meeting in Philadelphia, PA, October, 1980

Charles B. Dudley Award - American Society for Testing and Materials award for contribution to Hazardous Solid Waste Testing, "Application of Site-Specific Hazard Assessment Testing to Solid Wastes," published (1984)

J AWWA paper selected by the Resources Division of the AWWA as the best paper published in the Journal during the year, 1984

US Representative, World Federation of Engineering Organizations First World Congress on Engineering and the Environment, Buenos Aires, Argentina, November, 1981

Received Certificate of Appreciation from the Corps of Engineers for work on the Dredged Material Research Program, 1978

Received Certificate of Appreciation from the Lubbock County Water Control and Improvement District No. 1 for work in Water Quality Management of Buffalo Springs Lake, 1982

Areas in Which G. Fred Lee has Conducted Studies

Alabama - Mobile Bay

California - San Francisco Bay; Los Angeles Harbor; State's Ground Waters; Lake Tahoe; San Diego County; Sacramento-San Joaquin Rivers Delta; San Gabriel Valley Basin; Half Moon Bay; Pittsburg; North Coast; Colusa County; Upper Newport Bay; San Diego Bay; Salinas; Orange County; Sacramento River; Davis; El Dorado County; Placer County

Colorado - Numerous rivers and lakes in the Colorado Front Range and Rocky Mountains

Connecticut - Bridgeport and Stamford Harbors; Norwalk River; Lake Lillinonah

Florida - Apalachicola-Intercoastal Waterway; Kissimmee River Basin - Lake Okechobee; Lakeland

Georgia - Sapelo Island

Illinois - Lake Michigan-Waukegan, Zion; City of Chicago; Mississippi River and Illinois Ship Channel, McHenry County; Wayne County; Sauget

Indiana - Indiana and Calumet Harbors; Lakes Monroe and Michigan; other selected lakes and reservoirs; Hammond-Grand Calumet River; Fort Wayne

Iowa - Stream near Cherokee; Mississippi River

Kansas - Olathe

Maryland - Potomac Estuary

Michigan - Menominee River; Menominee County; South Shore of Lake Superior; Lake Erie; Ypsilanti Township

Minnesota - Mississippi River near St. Paul-Minneapolis; Lake Superior - western arm including Duluth Harbor and Silver Bay; North Shore of Lake Superior; selected lakes near Albert Lea; Lake Shetek; Lake Sallie; Wright County

Missouri - St. Louis

New Jersey - Perth Amboy Harbor, Fort Dix, Rockaway Township, Coastal and Estuarine Waters-Hudson/Raritan Estuary and New York Bight

New York - Lake Ontario; Niagara, Genesee, Oswego, and Black Rivers; Bay Ridge Channel; New York Bight; Niagara Falls; Hudson Raritan Estuary

North Carolina - Lumber River

Ohio - Muskingum River; Ashtabula Harbor-Lake Erie, Clermont County

Pennsylvania - Upper Ohio River near Pittsburgh; Delaware Estuary near Philadelphia; Lake Erie

Puerto Rico - Reservoirs and coastal waters, south coast groundwaters

Rhode Island - Atlantic Ocean near Newport; Richmond Township

South Carolina - Spartanburg

South Dakota - Belle Fourche Reservoir

Tennessee - TVA impoundments

Texas - Gulf of Mexico near Galveston, Port Aransas, Port Lavaca and Corpus Christi; Galveston Bay; Texas City and Houston Ship Channels; Trinity River near Dallas; Lake Ray Hubbard near Dallas; Garland; Mineral Wells; Red River, Lubbock, Lake Meredith, South Bend

Vermont - Lake Champlain; state streams and rivers

Virginia - James River and Bailey Creek near Richmond and Hopewell; North Landing River; Intercoastal Waterway

Virgin Islands - St. Thomas

Washington - Duwamish River and Elliott Bay of Puget Sound near Seattle; Hylebos Waterway;

West Virginia - Kanawa River

Wisconsin - Numerous lakes and impoundments in South Central and Northern Wisconsin; Wisconsin, Yahara, and Rock Rivers; Milwaukee River and Harbor; Upper Fox River; Green Bay; Lake Michigan; Black Earth Creek; Mississippi River near Prairie du Chien; Lake Michigan - Point Beach; Milwaukee

Wyoming - Bighorn Lake

Antarctica (Dry Valleys - Lake Vanda), McMurdo Sound

Argentina, Canada (Ontario, Manitoba), Columbia, Dominican Republic, Egypt, Hong Kong, India, Israel, Italy, Japan, Jordan, Korea, Mexico, The Netherlands, New Zealand, Norway, South Africa, Spain, Swaziland, Tunisia, USSR,

Examples of Governmental Agencies, Consulting Firms, Citizens' Groups, and Industries for Which G. Fred Lee Has Served as an Advisor

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

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

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

RR&C Development Co. - City of Industry, CA
American Dental Association - Chicago, IL
Emerald Environmental - Phoenix, AZ
Clayton Chemical Company - Sauget, IL
Stanford Ranch - Rocklin, CA
S.P. Manning, Esq. - Spartanburg, SC
Public Liaison Committee - Kirkland Lake, Ontario
Miller Brewing Company
ASARCO Inc., Tacoma, WA
CALAMCO, Stockton, CA
Coyote Flats, Del Mar, CA
Yunkong Gas Company, South Korea
Sutherlands, Pembroke, Ontario
Silverado Constructors, Irvine, CA
Agricultural Interests in Puerto Rico
City of Winnipeg, Manitoba
Strain Orchards, Colusa, CA
Davis South Campus Superfund Oversight Committee, Davis, CA
Monterrey County, California Housing Authority, Salinas, CA
Hong Kong Government Environmental Protection Department
CROWD, Tacoma, WA
SOLVE, Phoenix, AZ
Sports Fishing Alliance, San Francisco, CA
Caltrans (California Department of Transportation)
Citizens Group near St. John's, New Brunswick
Colonna Shipyards, Norfolk, VA
Clermont County, OH
Wright County, MN
Waikato River Protection Society, New Zealand
Drobac & Drobac, Attorneys, Santa Cruz, CA
Phelps Dunbar, L.L.P., Houston, TX
Walters Williams & Co, New Zealand
Mobile, AZ

Appendix C
Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste

G. Fred Lee, PhD, PE, DEE and Anne Jones-Lee, PhD
G. Fred Lee & Associates
27298 E. El Macero Drive, El Macero, CA 95618
Ph: (530)753-9630 Fx: (530)753-9956 Em: gfredlee@aol.com www.gfredlee.com
November 2004

Abstract

This report presents a review of the information available pertinent to public health and environmental quality protection issues for proposed Subtitle D landfills. Based on this review it is concluded that this type of landfill will at most locations cause groundwater pollution by landfill leachate and be adverse to the health, welfare and interests of nearby residents and property owners. As discussed, there is normally significant justification for those near a proposed Subtitle D landfill to oppose the development of the landfill.

Typically landfilling regulations require that,

> *(a) the solid waste facility shall not pose a substantial endangerment to public health or safety or the environment;*
> *(b) the solid waste facility shall not cause an environmental nuisance.*

Frequently in the review of a proposed landfill, the regulatory agency staff do not adequately or reliably evaluate the potential for a proposed landfill to endanger public health, safety and the environment, and cause nuisance on adjacent properties.

Subtitle D landfills have the potential to generate leachate (garbage juice) that will pollute groundwater with hazardous and deleterious chemicals that are a threat to human health and the environment for thousands of years. These landfills have the potential to generate landfill gas that will contain hazardous and obnoxious chemicals for a long period of time well beyond the current 30-year funded postclosure period. Specific deficiencies in the siting, design, operation, closure and postclosure care provisions for Subtitle D landfills include:

- a single composite landfill liner that will eventually fail to prevent leachate pollution of groundwater,
- a landfill cover that will eventually allow rainfall to enter the landfilled wastes which will generate leachate that will pollute groundwater,
- a grossly inadequate groundwater monitoring system that has a low probability of detecting leachate-polluted groundwater before it leaves the landfill owner's property,
- inadequate postclosure funding for landfill monitoring, maintenance and remediation of polluted groundwater for as long as the wastes in the landfill will be a threat,
- inadequate buffer lands between where wastes will be deposited and adjacent properties which will result in adverse impacts on nearby property owners/users from landfill releases including odors, dust, vermin, and noise and lights from landfill activities,
- decreased property values for owners of nearby properties.

In addition, at some locations there is an environmental justice issue associated with the development of a landfill that will be adverse to minority communities.

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The complete 50-page report is available as a downloadable file from, www.gfredlee.com in the Landfills Groundwater section Overall Problems with Dry Tomb Landfills subsection at http://www.members.aol.com/apple27298/SubtitleDFlawedTechnPap.pdf.
Also available in this section of the website are many other papers that provide additional details on these issues.