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Mary Condon

Mary,

Per your request, I have prepared the attached comments on the deficiencies of the proposed Bottlehill Landfill to protect public health, environment, groundwater resources, air quality and the interests of those within the sphere of influence of the proposed landfill. While I cannot attend the December 10, 2002, hearing because of previous commitments, I will be happy to answer questions on these comments.

Sincerely,

***Fred***

G. Fred Lee, PhD, PE, DEE

# Comments on the Potential for the Proposed Bottlehill Landfill in County Cork to be a Threat to Groundwater Resources, Air Quality, Public Health, the Environment and the Interests of those in the Sphere of Influence of the Landfill

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December 9, 2002

I have been asked by Mary Condon to review the potential impacts of the proposed Bottlehill Landfill on public health, environment and the interests of those in the sphere of influence of the proposed landfill. I have used the Environmental Impact Statement (EIS) prepared by Patrick J. Tobin & Co. Ltd./TES and the "Inspectors Report" as sources of information on the characteristics of this landfill. In addition, the report herein provides information on the deficiencies of this EIS in accurately describing the potential public health, environmental and other problems of this landfill.

I find that the EIS prepared by Patrick J. Tobin & Co. Ltd./TES for the proposed Bottlehill Landfill in County Cork does not adequately and reliably discuss the potential problems of this landfill in protecting ground and surface water quality, air quality and other potential impacts of the landfill on the health and welfare of those in the vicinity of the landfill and the waters downstream of the proposed landfill. This EIS is designed to support the development of the landfill, without reliably discussing the long-term problems that the proposed landfill will cause to public health and the environment in the vicinity of the landfill.

**Qualifications to Undertake this Review**

My qualifications to undertake this review are presented on Dr. Jones-Lee (my wife) and my website, www.gfredlee.com. A summary of these qualifications is appended to these comments. I have been involved in landfill impact evaluations for over 30 years. I have been involved in reviewing Environmental Impact Statements and reports on proposed landfills and landfill expansions for over 15 years. I am, therefore, familiar with a properly-developed environmental impact statement for a proposed landfill that adequately and reliably informs the public and decision-makers about the potential impacts of a proposed landfill and the ability of proposed mitigation measures to adequately mitigate these impacts.

**Overall Findings**

The Bottlehill site is not a suitable site for a landfill of this type. The landfill containment system and groundwater monitoring systems to detect leakage through the liner system when it occurs will not be reliable for preventing offsite groundwater pollution, and pollution of the

surface waters in the vicinity of the landfill that are hydraulically connected to the groundwaters under the landfill.

The environmental impact statement prepared by Patrick Tobin & Co. Ltd/TES and its associates does not present a credible discussion of the potential impacts of the proposed Bottlehill Landfill and the mitigation measures provided to protect public health, the environment, and the interests of those within the sphere of influence of the landfill.

**Specific Comments**

Presented below are comments on the "Non-Technical Summary" that was presented by Patrick J. Tobin & Co. Ltd./TES. A non-technical summary of an EIS is an important document in that it is one of the primary bases by which the public and decision-makers are informed about the potential impacts of a proposed landfill. A credible non-technical summary must reliably present in non-technical terms a discussion of the potential impacts of the proposed landfill and how effective the landfill developers' proposed mitigation measures will be in addressing/ controlling these impacts. As documented below, the Patrick Tobin, *et al.*, "non-technical summary" falls far short of providing reliable information on the proposed Bottlehill Landfill impacts.

Page ii, paragraph 7 states, *"The proposed landfill will be fully contained and will be designed in order to provide for both leachate and landfill gas collection."* While this can be true during the operating life and initial post-closure (aftercare) period, provided that high quality construction and proper waste placement in the landfill occurs, the design of this landfill and its hydrogeological setting is such that, over time, the landfill liner system will fail to prevent leachate from passing through it and polluting the groundwaters of the area. It is well-understood in the technical literature that landfill liners of the type proposed for the Bottlehill Landfill at best only postpone the pollution of groundwaters by landfill leachate for a short period of time compared to the time that the waste in the landfill will be a threat. The polluted groundwaters will contain a number of hazardous and non-hazardous/deleterious chemicals which are a threat to the health of those who use groundwater polluted by leachate, and will destroy the use of the polluted groundwaters for domestic water supply purposes.

Page iii, first paragraph states,

> *"The finished phases will be capped with a low permeability capping system, which will serve to prevent the uncontrolled migration of landfill gas and the infiltration of rainfall into the waste body thereby minimising the quantity of leachate generated."*

The proposed landfill capping system will not prevent the uncontrolled migration of landfill gas. It can collect some of the gas, but not all of it. There will be gas released from the landfill through the cap that will not be collected by the landfill gas-collection system. This gas will contain hazardous chemicals that can be a threat to the health of people and wildlife for considerable distances from the landfill. Further, the proposed landfill cap will not <u>prevent</u> infiltration of rainfall into the waste body for as long as the wastes in the landfill will be a threat to produce leachate. The wastes in this landfill will be a threat, effectively, forever. The cap, as proposed, has a finite period of time until its low-permeability characteristics deteriorate, leading

to significant infiltration of rainfall, which will generate leachate that will pass through the deteriorated liner system into the underlying groundwaters.

A landfill liner and cap design should be developed in such a way as to properly consider the hydrogeology of the area underlying the landfill. It is obvious that a single composite liner, consisting of plastic sheeting and compacted soil, of the type proposed for the Bottlehill Landfill, cannot protect groundwaters from pollution by landfill leachate for as long as the wastes in the landfill will be a threat. These issues are discussed in detail in the papers and reports on landfills that Dr. Jones-Lee and I have developed over the years that are available on our website.

Page iii, paragraph 3 discusses the *"potential nuisances such as odours, dust, noise, …"* and states that, *"… landfilling will be carried out in a controlled manner minimising the possibility of these nuisances."* The siting and proposed method of operation, closure and post-closure care are such that this landfill will be a significant threat to the health, welfare and interests of those who own or use properties near the landfill. There is grossly inadequate buffer land owned by the landfill between where wastes are deposited and adjacent property. It is well-known that at least several kilometers of land are needed between where wastes are deposited and adjacent property owners' property lines to prevent the trespass of odor and hazardous gases released from the landfill onto adjacent properties, even with gas collection systems of the type proposed for the Bottlehill Landfill.

Those who own adjacent and nearby properties to landfills should be entitled to full protection of their health, welfare and interests from the landfilling operation and the wastes that are deposited in the landfill, for as long as the wastes represent a threat. They should be able to utilize all of their property without detrimental effects of the landfill. Failure to achieve this level of protection means that those responsible for developing the landfill and those who deposit waste in the landfill are practicing solid waste disposal at cheaper than real cost. Much of the real costs of landfilling are being passed on to those who own or utilize properties near the landfill. This proposed landfill does not have adequate buffers to provide this level of protection from releases from the landfill.

Page iii, paragraph 4 states,

> *"The proposed facility at Bottlehill will be operated within the conditions of any Waste Licence granted by the EPA. It is the aim of Cork County Council to employ 'Best Available Technology Not Entailing Excessive Costs' in all aspects of the management of the site."*

The site is not a suitable site for the proposed landfill. The design, which supposedly is governed by the *"Best Available Technology Not Entailing Excessive Costs,"* using a single composite liner, is not adequate to protect groundwater quality from landfill leachate for as long as the wastes in the landfill will be a threat. This landfill's proposed design and monitoring falls far short of the readily available engineering practices that can be used for solid waste management. The increased cost to utilize true best available technology represents a few U.S. cents per person per day additional cost over what will need to be charged to them for waste disposal in this landfill, should it be constructed at this site. The proposed technology and

landfill design can be suitable at appropriate locations. At this location it is not adequate, because of the high groundwater table, the fractured rock aquifer, etc. Eventual failure of the cap to prevent moisture from entering the landfill and the unreliability of the groundwater monitoring system that is proposed for this landfill to detect leachate-polluted groundwater before the groundwater migrates under adjacent properties or to the surface water systems of the area means that offsite groundwater pollution by this landfill is inevitable.

While, according to the EIS developed by Patrick J. Tobin & Co. Ltd./TES, this proposed landfill represents the Ireland EPA's assessment of "Best Available Technology Not Entailing Excessive Costs," if this is the Ireland EPA's policy, then landfills of this type that represent this level of technology can be sited at only certain areas where there is natural protection of groundwater by the geology. The Bottlehill site is not one of them. With respect to the "Best Available Technology Not Entailing Excessive Costs," there are 10 states (or parts thereof) in the United States where this landfill could not be sited at all, because the state regulatory agencies have determined that this level of technology is not protective of groundwaters from pollution by landfill leachate.

Page v, paragraph 3 states,

> *"… the site is acceptable for the development of a landfill in accordance with the national guidelines, namely the Groundwater Protection Response Matrix for Landfills as published by the EPA/GSI/DoELG (1999)."*

There has not been a reliable evaluation of the adequacy of the proposed groundwater monitoring system to detect, with a high degree of reliability, the leachate that will pass through the liner system into the underlying groundwaters before offsite pollution of groundwaters occurs. The fractured rock transport of leachate-polluted groundwaters, as well as the deterioration of the plastic sheeting layer in the liner leading to finger-like plumes of leachate that will pass between the monitoring wells and not be detected by them, causes a groundwater monitoring system of the type proposed to be unreliable.

An issue of particular concern, which is a significant deficiency in this EIS, is the discussion of the post-closure care that will be provided. There is mention in the EIS about a 30-year post-closure care period. While details are not provided on what this means, it appears to have been copied from the US EPA's regulations, which are well-known to be deficient in providing for post-closure care. The state of California requires post-closure care to be provided for as long as the wastes in the landfill are a threat. The US EPA, in Subtitle D regulations, does not limit the period of post-closure care. They specify a minimum period for which funding must be available. It is understood, however, that additional funds will be needed in year 31 and beyond after landfill closure, in order to protect and/or clean up the polluted groundwaters that will occur at improperly designed, constructed or sited landfills.

**Specific Comments on Bottlehill Residual Landfill EIS**

Page 3, paragraph 5 states,

*"The site will be progressively capped on closure of each phase, with ongoing landscaping taking place throughout the lifetime of the site. On final closure it is proposed that the site will be returned to native woodland and an amenity usage. In this respect it is proposed to develop a number of nature trails at the finished site and to make this amenity available to the local population and general population of Cork."*

This is an unreliable assessment of the future use of the closed landfill area. In order to maintain the integrity of the cap, it will be necessary to control the type of vegetation that develops on the landfill effectively forever. It can never be allowed to become a site with native woodland vegetation without destroying the cap's ability to control infiltration of moisture.

Page 7, first bulleted item states,

*"Polluter Pays Principle – this states that the full costs of the management of waste (i.e. collection, recovery and disposal) should be levied on, and paid by, the producer. Such an approach will provide adequate funds to ensure that the landfill does not adversely effect the environment either during the construction, operation, or aftercare phases…"*

The proposed Bottlehill Landfill will violate the European Commission March 1992 EU Polluter Pays Principle. Because of the unsuitability of the site and the inadequate design of the landfill, a part of the cost of landfilling the wastes that could be deposited at the Bottlehill Landfill will be borne by those who own or use properties near the landfill, through a threat to their health and degradation of their property.

Page 16 paragraph 1 (below the table) states,

*"Landfill gas is generated on all landfill sites and can be a cause of odour as well as being a fire risk and a contributor to greenhouse gas. It is therefore planned to install a landfill gas collection and flaring system, which will collect gas from the waste body. Landfill gas will be collected and safely vented and/or flared during operation as well as after the cessation of landfilling as gas production can continue for some years post-closure."*

The information provided in this EIS is repeatedly unreliable on landfill gas collection mitigation reliability and landfill gas impacts. At no place in this EIS is there a discussion of the hazardous gases present in municipal solid waste landfill gaseous releases that are a threat to the health of people and wildlife within the sphere of influence of the landfill. This sphere of influence for landfill gas migration can be several kilometers from the landfill. Landfill gas also contains highly obnoxious odorous compounds which are documented to cause people to become ill as a result of breathing them. Further, as discussed in a subsequent section, the period of time that landfill gas production will occur is in error.

Page 30, Section 2.1.2, beginning with paragraph 3 states,

*"Reference to the drawing shows that there is one farm building but no residential dwelling within the 500m radius of the landfill footprint while there are five farm buildings and one residential dwelling within the 1,000m radius of the landfill footprint.*

*"The nearest residential dwelling is located approximately 700m to the northwest of the landfill footprint while the next nearest dwelling is 1,100m to the northwest of the landfill footprint.*

*"The largest concentration of houses close to the proposed facility is to the southwest of the site where there are 16 houses and a public house, all located within 400m of the boundary of the Bottlehill forestry site, but the nearest of which is in excess of 2,600m from the proposed landfill footprint. There is a farmhouse on the existing main entrance road to the southwest of the site, which is approximately 1,800m from the proposed footprint. There are an additional 4 houses along the western boundary of the site, the nearest of which is situated in a small area of land which encroaches into the forest site which is approximately 1,360m from the landfill footprint. The dwelling located on this road just north of the forest boundary is the nearest house to the landfill footprint."*

Based on the above quotes in the EIS, there is a substantial population of residences within the sphere of influence of the landfill. The people and property owners in the area of the landfill will be adversely impacted by this landfill. This leads to appropriate, justified NIMBY ("not in my back yard").

While those who oppose landfills in their area are often called NIMBYs, I have yet to find anyone who would welcome experiencing the odors of a landfill on their property, the threat to their health through waterborne and airborne pollutant transport, etc. As discussed in our writings, the only way to address NIMBY situations is through proper landfill siting, design, operation, closure, and post-closure care. These issues must be addressed in such a way as to ensure to a very high degree of probability that the landfill is not a threat to those who are within the landfill sphere of influence. Since landfill operations have hazardous and deleterious chemicals and materials released from them, there must be substantial buffer lands between where wastes are deposited in the landfill and adjacent property owners' property lines. It is totally inappropriate to site a landfill of this type at the proposed Bottlehill Landfill site, based on the documented large number of people that can be impacted by landfill releases.

Page 60, paragraph 1 states, *"The bedrock is fractured and the fractures dip steeply with some quartz infill."*

Further, page 63, paragraph 4 states, *"The fractured and weathered core identifies the geology intersected by borehole MW22 as having a higher permeability than all other cored boreholes on site."* As quoted above and as discussed elsewhere in the EIS, an additional reason why the proposed Bottlehill site is an unsuitable site for the proposed landfill is the underlying hydrogeology of the site. The fractured bedrock, where some of the fractures have high permeability, means that it is virtually impossible to reliably monitor groundwater pollution by landfill leachate.

Page 67 table 2.4.7 shows that the groundwaters in the area are of generally good quality.

Page 70, paragraph 1 states, *"Forty wells (39 bored and 1 dug well) and 12 springs, which are used for domestic and/or agricultural purposes, were confirmed within 1km of the forestry site."*

Further, page 70, paragraph 5 states,

> *"Private residences and farms abstract water from boreholes and springs within a 1km radius of the Bottlehill forestry site. The proposed landfill footprint is situated within the portion of the site that forms part of the River Bride catchment (Figure 11). The catchment drains westwards from Bottlehill to the Toor and Coom Rivers, which are tributaries to the River Bride."*

It is my experience that landfills can pollute groundwaters within several kilometers of a landfill under well-defined homogeneous aquifer systems. In fractured rock systems, the distance can be considerably greater. Further, as discussed, since there are a number of springs in the area, polluted groundwaters can be transported to high-quality surface waters leading to their pollution and the associated impacts on aquatic life.

Page 144, paragraph 1 states,

> "*As outlined in Section 3.5 above the landfill will be constructed in eight Phases with each phase encompassing a basal liner consisting of a HDPE liner overlaying a compacted clay layer. The lined cells to be constructed in accordance with the EPA Landfill Design Manual (2000) allow for the isolation of the deposited waste at the proposed site."*

The statement that the landfill liner allows for "isolation of the deposited waste" is misleading. This landfill liner design unfortunately is copied from the US EPA Subtitle D regulations. As discussed in our writings on our website, the US EPA, in developing these regulations in the late 1980s, stated that a minimum Subtitle D liner of the type that is proposed for the Bottlehill Landfill will eventually lead to groundwater pollution as a result of liner deterioration. It is well-recognized that a minimum Subtitle D single composite liner of the type that is proposed for the Bottlehill site is a fundamentally flawed technology for groundwater protection when the landfill is sited at an unsuitable site such as the Bottlehill site.

Page 155, table 3.7.2 presents "Typical Leachate Quality." Review of this table reveals that typical solid waste leachate in Ireland is similar in chemical composition to municipal solid waste leachate in the USA. This means that the Bottlehill Landfill leachate can be expected to have a high potential to pollute groundwaters. The data presented in Table 3.7.2 is deficient in providing information on some of the most hazardous chemicals in municipal solid waste leachate in the USA. The greatest concern for municipal solid waste landfill leachate pollution in the USA is for volatile organic chemicals (VOCs) such as chlorinated solvents. Some of these chemicals will degrade in the landfill to vinyl chloride. Vinyl chloride is a known human carcinogen with a high potential to cause cancer at low concentrations. There is reason to

believe that small amounts of chlorinated solvents and other VOCs will be present in the Bottlehill Landfill leachate which will pollute groundwaters.

Beginning on page 160 is a discussion of the landfill gas extraction system proposed for the Bottlehill Landfill. This system is of conventional design, which is well-known to allow some landfill gases to escape through the cover. Page 165, Figure 15 presents the estimated gas production for the Bottlehill Landfill. These estimates are likely to be in error from several perspectives. As discussed in our writings, landfill gas production rates are dependent on the moisture content of the waste. The higher the moisture content, the greater the gas production rate. The estimated gas production rates shown in Figure 15 ignore the fact that when one of the landfill cells is closed with a low-permeability cover, the gas production rate will drop off very rapidly. At the time in the future when the landfill cover is no longer effective in preventing significant amounts of moisture from entering the landfill through the cover, gas production will start again and can proceed at a high rate.

Another problem with Figure 15 is that it ignores the fact that substantial amounts of municipal solid waste are deposited in landfills in plastic bags. Unless the bags are shredded, which is not proposed for the Bottlehill Landfill, the ability of the moisture that enters the landfill before it is covered, or afterward through the cap, to interact with the waste to lead to landfill gas production is limited until such time as the plastic bags degrade. This degradation can take many decades. A third factor to consider is that some of the waste to be placed in the proposed landfill is to be baled. Baled waste will have a significantly different gas production rate than unbaled waste. The net result is that Figure 15 does not present a reliable estimate of expected landfill gas production. Gas production will extend over a much longer period of time than is projected by this figure. This is of concern since the gas collection system will deteriorate and lose its ability to collect gas effectively. As a result, much of the delayed landfill gas production compared to that projected in Figure 15 will likely escape through the cover which by then, will be highly deteriorated with respect to maintaining a low permeability. This gas will then become a hazard to those within the sphere of influence of the landfill.

Page 167, Table 3.8.2 presents typical landfill gas composition. Listed in this table are halogenated compounds. The EIS fails to discuss the fact that, even though the halogenated compounds represent a small part of the total gas volume produced, they contain a number of highly hazardous VOCs that are a threat to human health and animal life.

Page 168 presents a discussion of the capping system proposed for the landfill. One of the bulleted items is *"minimize infiltration of water into the waste."* Another is *"control gas migration."* There is no discussion in this EIS, however, that, while, when the cap is first constructed (if high-quality construction is achieved), it can accomplish these objectives, over time the low-permeability characteristics of the cap, which are based on the integrity of the LLDPE plastic sheeting layer, will deteriorate and allow moisture that penetrates into the surface layers of the cap to infiltrate into the waste, generating leachate. This situation will also allow for significant gas escape through the cap. Further, no mention is made that the typical inspection of the cap, involving visual observation of problems, is unreliable for detecting deterioration of the low-permeability layer that is located below the topsoil and drainage layer of the cap.

Page 173 presents a discussion of restoration and aftercare. This discussion is grossly deficient in presenting information on what aftercare will be provided and how it will be funded for as long as the wastes in the landfill will be a threat. Without this information, it is impossible for the public and decision-makers to reliably evaluate several important aspects of the proposed landfill's ability to protect public health and the environment for as long as the wastes in the landfill will be a threat.

Page 189 discusses how odor emissions from the landfill site will be reduced and controlled, where four bulleted items are listed as mitigation measures. These are standard approaches that are often claimed by landfill applicants to be effective in controlling odorous emissions from landfills. However, it is well-established that high levels of implementation of these measures, while reducing the magnitude of offsite odor migration, do not prevent it. The fact that there are grossly inadequate buffer lands between where wastes are to be deposited and adjacent properties means that the adjacent properties will be significantly adversely impacted by odors released from this proposed landfill.

Page 195 presents Table 3.15.4 "Proposed Analysis for Groundwater Samples." The list of chemicals proposed to be monitored to detect groundwater pollution by leachate does not include the low-molecular-weight organochlorine compounds, such as vinyl chloride, that are the greatest threat to pollute groundwaters, rendering them hazardous for use for domestic water supply. Also, no information is provided on the analytical method detection limits that will be used. The other groundwater quality data presented in the EIS has been obtained using analytical methods that are inadequate to detect the constituents at concentrations of concern.

Page 195, second paragraph mentions that the landfill gas monitoring will be conducted for methane, carbon dioxide, hydrogen sulfide and oxygen. Landfill gas monitoring should include a much larger list of parameters, including the VOCs that are hazardous to the health of people and animals.

Page 198 lists the parameters that will be monitored in landfill leachate. This list is inadequate to properly characterize the leachate with respect to causing potential problems for groundwater pollution for the part of the leachate that leaks through the liner, as well as to the surface waters downstream of where the leachate is transported to a local wastewater treatment plant for disposal. Some of the components of landfill leachate can pass through a wastewater treatment plant with little or no treatment, causing downstream water quality problems. This has become such an important issue that some wastewater treatment plant operators will not accept landfill leachate.

Page 202, Table 3.15.8 lists the "Proposed Analyses for Surface Water Samples." Aquatic life toxicity and the potential for bioaccumulation of hazardous chemicals in fish should be included in this list. Further, the analytical detection limits should be specified.

Page 212 begins a discussion of the potential impacts of odors. Section 4.1.3.2 lists proposed mitigation measures to control odors. These mitigation measures, coupled with the

inadequate buffer distance between the footprint of the landfill and adjacent properties, will not prevent odors from trespassing onto adjacent properties.

Pages 214-215 present information on landfill gas production. As discussion above, the estimates of landfill gas production will be in error. Landfill gas production will extend for a much longer period of time than that projected.

Page 217 presents information on landfill gas flaring. As discussed in our backup documents to these comments (see attached references), no mention is made in the EIS that it has been reported by a British engineer that landfill gas flaring can lead to dioxin formation. The landfill gas flare should be monitored for incomplete combustion and dioxin formation.

Page 221 presents information on the permeability and leakage rate of the liner for the landfill and the lagoon. The EIS is deficient in discussing the fact that it is well-known that, in time, the plastic sheeting layer, which is the primary basis for preventing leachate from passing from the landfilled waste into the groundwater, will deteriorate and allow much higher leakage rates than those discussed in the EIS. This situation is well-known, in that it is only a matter of time until this occurs. Meanwhile, some of the wastes in the landfill will still be a threat to pollute groundwaters when this occurs.

Page 222 discusses the potential for leachate that passes through the liner to enter high-permeability fracture zones underlying the landfill. It lists five mitigation measures that will prevent groundwater pollution, should this occur. A critical review of these mitigation measures shows that they will not be effective in preventing groundwater pollution by landfill leachate when it penetrates through the landfill liner.

Page 222 states,

> *"Monitoring wells will be located down-gradient of the waste disposal area and sampled regularly to confirm the continuation of the observed baseline conditions. In particular monitoring will be located in close proximity to any high permeability zones encountered."*

This statement is highly misleading, in that monitoring wells located close to high-permeability fractures may not detect the passage of leachate-polluted groundwater down the fracture, because of the low-permeability layer between the fracture and the monitoring well. The facts are that there is no reliable method, using vertical monitoring wells, to detect leachate-polluted groundwaters in a fractured rock groundwater aquifer system. These issues are discussed in the references cited at the end of these comments and in papers on our website.

Page 223 states in section 4.3.3,

> *"Considering the mitigation measures proposed for the development, as described above, the likely significant effects on the geological and hydrogeological environment are expected to be insignificant."*

This statement is designed to support approval of the development of the landfill, ignoring the unsuitability of the site for a landfill of this type; the gross inadequacies of the landfill liner design, closure and expected aftercare; and the inadequacies of being able to reliably monitor for leachate-polluted groundwaters when they occur.

# Comments on Inspector's Report
# Waste Licence Register Number 161-1
# Bottlehill Landfill

The Inspector's Report contains a recommendation "*That the proposed decision as recommended to the Board be approved.*" This is a non-credible recommendation on the suitability of the proposed Bottlehill Landfill to protect the public health, environment, welfare, and interests of those in the sphere of influence of this landfill if it is developed as proposed.

Page 1, paragraph 2 states *"The proposed facility is an engineered landfill for the disposal of non-hazardous municipal, commercial and industrial wastes…"* It should be understood that the so-called non-hazardous wastes that will be permitted for deposit in this landfill will contain a wide variety of highly hazardous chemicals from households, commercial, and industrial sources.

Page 1, paragraph 3 states that the buffer land around the proposed landfill ranges from 75 m to 250 m. This is a grossly inadequate buffer land to dissipate the hazardous and deleterious chemical releases that will occur from this landfill. If this landfill is approved, it will be on the basis where the Cork County Council is knowingly depriving adjacent property owners from the use and enjoyment of their lands in order that those who generate the wastes deposited in the landfill can have cheaper than real cost garbage disposal.

Page 3, paragraph 1 states,

> *"Condition 3.12 requires that the standard 1m of engineered clay is overlain by a geocomposite layer as well as a HDPE layer, rather than using 1.25m of clay and HDPE, as proposed by the applicant. It is however my opinion that, due to the extreme vulnerability of the site, from a groundwater protection point of view (i.e. subsoil thickness of <3m in places), that the existing ground level should not be lowered in order to reach formation level. In other words the existing natural barrier should be left undisturbed. The geology and hydrogeology of the site are further discussed in section 5 below."*

The inspector recognized the unsuitability of this site with respect to the geological strata providing for groundwater quality protection. However, the inspector's recommendation of leaving the subsoil thickness in place will only at best delay when groundwater pollution occurs; it will not prevent it.

Page 3, last paragraph, and page 4, first full paragraph provide information on the landfill cap and landfill gas collection systems. The inspector indicates that these are standard approaches. The inspector fails to indicate that these standard approaches will not prevent infiltration of rainfall into the landfill to generate leachate for as long as the waste in the landfill will be a threat. Further, the inspector fails to indicate that the standard approach for landfill gas collection that is proposed to be allowed at this landfill will allow significant amounts of gas to escape from the landfill through the cover.

Page 4, paragraph 2 states, *"The licensee is required to submit a detailed Restoration and Aftercare Plan (Condition 4.1), which will incorporate these proposals."* The detailed restoration and aftercare plan should be available to the public for review before the landfill is reviewed for approval. Without this information the public is unable to comment on any deficiencies in aftercare maintenance and funding for as long as the waste in the landfill will be a threat. The wastes in this landfill will be a threat to cause groundwater pollution effectively forever. Adequate funding should be established at the time of landfill development so that funds will be available for as long as the wastes in the landfill will be a threat, for effective landfill cap maintenance, comprehensive groundwater monitoring, and the cleanup of polluted groundwaters when the pollution occurs.

Page 4, paragraph 3, devoted to nuisance control, needs to indicate that all odors generated by this landfill shall not trespass onto adjacent property owners' lands. If trespass occurs more than twice, then the landfill should be immediately shut down, and all wastes removed from it. Failure to adopt this approach will mean that the Cork County Council is planning to use adjacent property owners' lands to dissipate the gaseous releases from the waste.

Page 6, paragraph 2 states, *"Due to the distance of properties from the facility boundary (farm building at 500m) and from the landfill footprint (residence at 700m) it is not thought that activities at the proposed facility will result in odour nuisance."* It is clear that the inspector is not familiar with how far odors can travel. There is substantial evidence that, under certain conditions, this can be several kilometers. Further, the issue should be not how far it is from the landfill to the nearest existing residence or farm building. The issue should be whether the odors can be controlled at the adjacent property owners' property lines. An adjacent property owner should be able to use his property at the property line without experiencing landfill odors.

Beginning on page 7, the inspector's report presents information on emissions to groundwater. This report correctly identifies the unsuitability of this site for a landfill with respect to the underlying geology and hydrogeology by the statement, *"The groundwater vulnerability in the area is described as extreme…."* The inspector fails, however, to discuss the fact that the recommended approaches for addressing the vulnerability to groundwater pollution by landfill leachate that passes through the liner have a high probability of failing to prevent offsite groundwater pollution. The statement is made on page 8, *"With regard to (1) above, it is clear from the site investigation work that secondary permeability in the form of fracturing has produced localised higher permeability zones in the bedrock in the vicinity of the proposed landfill. The risk of leachate movement to these zones is controlled by the lining system, as described above…."* The inspector has made a significant error in proposing that the liner will control leachate movement into higher permeability zones. At best, with high-quality construction, the liner will only delay when leachate will move into these zones; it will not prevent it.

Page 9 paragraph 1 states, *"As described in section 5 above all groundwater flow from the landfill footprint area will ultimately reach the Coom and Toor Rivers."* Since the groundwaters underlying the landfill will be polluted by landfill leachate, this means that some of the surface waters near the landfill will be polluted by landfill leachate. This is yet another reason supporting the unsuitability of this site for the landfill.

## Primary References

Listed below are the primary references that support the technical issues discussed in these comments.


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Lee, G. F., and Jones-Lee, A., "Practical Environmental Ethics: Is There an Obligation to Tell the Whole Truth?," Published in condensed form as "Environmental Ethics: The Whole Truth" Civil Engineering 65:6 American Society of Civil Engineers (1995).

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

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

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

Dr. Lee obtained a PhD degree specializing in environmental engineering from Harvard University in 1960. As part of this degree work he obtained further formal education in the fate, effects and significance and the development of control programs for chemical constituents in surface and groundwater systems. An area of specialization during his PhD work was aquatic chemistry which focused on the transport, fate and transformations of chemical constituents in aquatic and terrestrial systems as well as in waste management facilities.

For a 30-year period, he held university graduate-level teaching and research positions in departments of civil and environmental engineering at several major United States universities, including the University of Wisconsin-Madison, University of Texas at Dallas and Colorado State University. During this period he taught graduate-level environmental engineering courses in water and wastewater analysis, water and wastewater treatment plant design, surface and groundwater quality evaluation and management, and solid and hazardous waste management. He has published over 850 professional papers and reports on his research results and professional experience. His research included, beginning in the 1970s, the first work done on the impacts of organics on clay liners for landfills and waste lagoons.

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

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

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

In the 1980s while he held the positions of Director of the Site Assessment and Remediation Division of a multi-university consortium hazardous waste research center and a Distinguished Professorship of Civil and Environmental Engineering at the New Jersey Institute of Technology, he was involved in numerous situations concerning the impact of landfilling of municipal solid waste on public health and the environment. He has served as an advisor to the states of California, Michigan, New Jersey and Texas on solid waste regulations and management.

Beginning in the 1960s, while a full-time university professor, Dr. Lee was a part-time private consultant to governmental agencies, industry and environmental groups on water quality and solid and hazardous waste management issues. His work included evaluating the impacts of a number of municipal solid waste landfills.

In 1989, he retired after 30 years of graduate-level university teaching and research and expanded the part-time consulting that he had been doing with governmental agencies, industry and community and environmental groups into a full-time activity. A principal area of his work since then has been assisting water utilities, municipalities, industry, community and environmental groups, agricultural interests and others in evaluating the potential public health and environmental impacts of proposed or existing hazardous, as well as municipal solid waste landfills. He has been involved in the review of approximately 65 different landfills in various parts of the United States and in other countries.

Dr. Anne Jones-Lee (his wife) and he have published extensively on the issues that should be considered in developing new or expanded municipal solid waste and hazardous waste landfills in order to protect the health, groundwater resources, environment and interests of those within the sphere of influence of the landfill. Their over 40 professional papers and reports on landfilling issues provide guidance not only on the problems of today's minimum US EPA Subtitle D landfills, but also how landfilling of non-recyclable wastes can and should take place to protect public health, groundwater resources, the environment, and the interests of those within the sphere of influence of a landfill. They make many of his publications available as downloadable files from his web site, www.gfredlee.com.

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

In addition to teaching and serving as a consultant in environmental engineering for over 40 years, he is a registered professional engineer in the state of Texas and a Diplomate in the American Academy of Environmental Engineers (AAEE). The latter recognizes his leadership roles in the environmental engineering field. He has served as the chief examiner for the AAEE in north-central California and New Jersey, where he has been responsible for administering examinations for professional engineers with extensive experience and expertise in various aspects of environmental engineering, including solid and hazardous waste management.

His work on landfill impacts has included developing and presenting several two-day short-courses devoted to landfills and groundwater quality protection issues. These courses have been presented through the American Society of Civil Engineers, the American Water Resources Association, the National Ground Water Association in several United States cities, including New York, Atlanta, Seattle and Chicago, and the University of California Extension Programs at several of the UC campuses, as well as through other groups. He has been and continues to be an American Chemical Society tour speaker, where he is invited to lecture on landfills and groundwater quality protection issues, as well as domestic water supply water quality issues throughout the US.

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## EDUCATION

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

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

B.A. Environmental Health Science, San Jose State University 1955

## ACADEMIC AND PROFESSIONAL EXPERIENCE

**Current Position:**

Consultant, President, G. Fred Lee & Associates

**Previous Positions:**

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

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

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

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

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

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

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

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

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

## PUBLICATIONS AND AREAS OF ACTIVITY

Published over 850 professional papers, chapters in books, professional reports, and similar materials. The topics covered include:

Studies on sources, significance, fate and the development of control programs for chemicals in aquatic and terrestrial systems.
Analytical methods for chemical contaminants in fresh and marine waters.
Landfills and groundwater quality protection issues.
Impact of landfills on public health and environment.
Environmental impact and management of various types of wastewater discharges including municipal, mining, electric generating stations, domestic and industrial wastes, paper and steel mill, refinery wastewaters, etc.

Stormwater runoff water quality evaluation and BMP development for urban areas and highways.

Eutrophication causes and control, groundwater quality impact of land disposal of municipal and industrial wastes, environmental impact of dredging and dredged material disposal, water quality modeling, hazard assessment for new and existing chemicals, water quality and sediment criteria and standards, water supply water quality, assessment of actual environmental impact of chemical contaminants on water quality.

## LECTURES

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

## GRANTS AND AWARDS

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

## GRADUATE WORK CONDUCTED UNDER SUPERVISION OF G. FRED LEE

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

## ADVISORY ACTIVITIES

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

# Municipal Solid Waste Landfills and Groundwater Quality Protection Issues Publications

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

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

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|---|---|
| **Arizona** *(State Landfilling Reg.)* | Verde Valley - Copper Tailings Pile Closure |
| **California** *(State Landfilling Reg.)* | Colusa County - CERRS Landfill<br>San Gabriel Valley - Azusa Landfill<br>City of Industry - Puente Hills Landfill<br>North San Diego County, 3 landfills<br>San Diego County - Gregory Canyon Landfill<br>El Dorado County Landfill<br>Yolo County Landfill<br>Half Moon Bay - Apanolio Landfill<br>Pittsburg - Keller Canyon Landfill<br>Chuckwalla Valley - Eagle Mountain Landfill<br>Barstow - Hidden Valley and Broadwell Hazardous Waste Landfills<br>Cadiz - Bolo Station-Rail Cycle Landfill<br>University of California -Davis Landfills<br>LEHR Superfund Site Landfills<br>San Marcos - San Marcos Landfill<br>Placer County - Western Regional Sanitary Landfill<br>Imperial County - Mesquite Landfill |
| **Colorado** (*State Landfilling Reg.)* | Last Chance/Brush - Hazardous Waste Landfill<br>Denver - Lowry Hazardous Waste Landfill<br>Telluride/Idarado Mine Tailings |
| **Florida** (*State Landfilling Reg.*) | Alachua County Landfill |
| **Illinois** (*State Landfilling Reg.*) | Crystal Lake - McHenry County Landfill<br>Wayne County Landfill |
| **Indiana** (*State Landfilling Reg.*) | Posey County Landfill<br>New Haven-Adams Center Landfill (Hazardous Waste) |
| **Michigan** (*State Landfilling Reg.*) | Menominee Township - Landfill<br>Ypsilanti- Waste Disposal Inc. (Hazardous Waste - PCB's) |
| **Minnesota** | Reserve Mining Co., Silver Bay - taconite tailings<br>Superior FCR Landfill, Wright County |
| **Missouri** | Jefferson County - Bob's Home Service Hazardous Waste Landfill |
| **New Jersey** (*State Landfilling Reg.*) | Meadowlands - Landfill<br>Fort Dix Landfill<br>Scotch Plains Leaf Dump |
| **New York** | Staten Island - Fresh Kills Landfill<br>Niagara Falls - Hazardous Waste Landfill,<br>New York City - Ferry Point Landfill |
| **Ohio** | Clermont County, Ohio - BFI/CECOS Hazardous Waste Landfill,<br>Huber Heights - Taylorville Road Hardfill Landfill |
| **Rhode Island** | Richmond - Landfill |
| **South Carolina** | Spartanburg - Palmetto Landfill |

| | |
|---|---|
| **Texas** (*State Landfilling Regulations*) | Dallas/Sachse - Landfill<br>Fort Worth - Acme Brick Hazardous Waste Landfill,<br>City of Dallas Jim Miller Road Landfill |
| **Washington** (*State Landfilling Reg.*) | Tacoma - 304th and Meridian Landfill |
| **Wisconsin** | Madison and Wausau Landfills |
| **Ontario, Canada** (*Prov. Landfilling Reg.*) | Greater Toronto Area - Landfill Siting Issues<br>Kirkland Lake - Adams Mine Site Landfill<br>Pembroke - Cott Solid Waste Disposal Areas |
| **Manitoba, Canada** (*Prov. Landfilling Reg.*) | Winnipeg Area - Rosser Landfill |
| **New Brunswick, Canada** (*Prov. Landfilling Reg.*) | St. John's - Crane Mountain Landfill |
| **Mexico** (*Haz. Waste Landfilling Reg.*) | San Luis Pontosi - Hazardous Waste Landfill |
| **Puerto Rico** | Salinas - Campo Sur Landfill |
| **Hong Kong** | Three New MSW Landfills |
| **Korea** | Yukong Gas Co. - Hazardous Waste Landfill |
| **Belize** | Mile 27 Landfill |
| **New Zealand** | North Waikato Regional Landfill |
| **England** | Merceyside Waste Disposal Bootle Landfill |
| **Ireland** | Balleyduff beg Co. Clare, Inagh - Central Waste Management Facility |

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

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

- **$** Landfills and Groundwater Quality Protection

- **$** Water Quality Evaluation and Management for Wastewater Discharges, Stormwater Runoff, Ambient Waters and Pesticide Water Quality Management Issues

- **$** State Stormwater Quality Task Force Activities

- **$** Impact of Hazardous Chemicals -- Superfund, LEHR Superfund Site Reports

- **$** Contaminated Sediment -- Aquafund, BPTCP

- **$** Domestic Water Supply Water Quality

- **$** Excessive Fertilization/Eutrophication

- **$** Reuse of Reclaimed Wastewaters

- **$** Watershed Based Water Quality Management Programs:
  Sacramento River Watershed Program,
  Delta -- CALFED Program, and
  Upper Newport Bay Watershed Program
  San Joaquin River Watershed DO and OP Pesticide TMDL Programs

  Stormwater Runoff Water Quality Science/Engineering Newsletter