# Comments on

# Revised Report of Waste Discharge Azusa Land Reclamation Landfill Prepared by GeoSyntec Consultants, October 1994 on Behalf of BFI

Submitted by

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Presented below are comments on the technical aspects of the revised Report of Waste Discharge (ROWD) that has been submitted by BFI to the Los Angeles Regional Water Quality Control Board in October 1994.

## Overall Comment

Overall I find that the revised ROWD is a highly superficial, inadequately prepared document that repeatedly misrepresents the minimum regulatory requirements governing the landfilling of municipal solid waste (MSW) in California today. The existing 80-acre Azusa Landfill (Zone I) has been polluting groundwater since it was first established. There is documentation of this pollution since the mid-1980's based on groundwater monitoring. The continued operation of this 80-acre landfill represents a significant additional threat to groundwater resources in the San Gabriel Basin which should be prevented. Further, the Regional Water Quality Control Board should now take action to require that BFI immediately begin the Chapter 15, Article 5 Evaluation Monitoring to determine the degree and extent of groundwater pollution by the existing landfill and to enter into a program designed to not only stop further pollution of groundwater by the existing landfill, but also to clean up to the maximum extent practicable those groundwaters which have been polluted.

The continued operation of the Azusa Landfill in which so-called inert wastes are placed in Zones II-V will result in additional groundwater pollution. The so-called inert wastes that BFI has placed and proposes to continue to place in the landfill will leach soluble components that exceed water quality objectives and therefore are not truly inert wastes. The liner system that BFI used in Zone II and proposes to use in the remainder of the sand and gravel pit (Zones III-V) will only postpone when groundwater pollution occurs; it will not prevent it. The groundwater monitoring program that BFI has been using and proposes to use in the future does not conform to the minimum monitoring requirements set forth in Chapter 15.

## Specific Comments

In the cover letter by L. Bittenson, Vice President of BFI of California, it is stated that,

*"The Revised ROWD was prepared in accordance with the California Code of Regulations (CCR), Title 23, Division 3, Chapter 15 and the requirements of California Regional Water Quality Control Board (CRWQCB) Order No. 93-062."*

However, as discussed below, this revised ROWD falls far short of conforming to Chapter 15's requirements governing the landfilling of municipal solid wastes.

**Section 1 Introduction**

On page 1-1 the last sentence of Section 1.2, "Overview," states that,

*"The objective of this document is to provide the information required by the CRWQCB for the classification of the Azusa Landfill as a Class III sanitary landfill pursuant to the provisions of §2510.(d,e) and §2591.(c) of Chapter 15."*

Chapter 15 §2510.(d,e) refers to, among other things, the monitoring requirements set forth in Article 5 of Chapter 15. As discussed below, this is an important topic area that has not been adequately addressed in this revised ROWD.

Page 1-2, under Section 1.3, third paragraph, states that the original 80-acre landfill is permitted for Class III MSW and inert wastes. The remaining 185 acres of the landfill is currently permitted for disposal of inert waste into Zones II through V. As discussed below, Zone I has been polluting groundwaters and Zones II through V are lined in such a way so that it is only a matter of time until these areas of the landfill will pollute groundwaters with leachable components from the so-called inert wastes that have been or that are proposed to be placed in these areas.

**Section 2 Waste Characteristics**

Page 2-1, under Section 2.2, "Waste Composition," first paragraph, states that the Azusa Landfill will not accept "hazardous waste." It is important to note that while it will not accept hazardous waste, large amounts of hazardous materials that make hazardous waste hazardous will be accepted at this landfill. It is important to understand that the definition of hazardous waste used by the US EPA and the state of California allows large amounts of hazardous chemicals to be disposed of in municipal landfills (Class III landfills). Further, the wastes that will be accepted contain large amounts of non-conventional pollutants whose hazard to public health and the environment is unknown since these chemicals are not now regulated. The issue of non-conventional pollutants is discussed in the enclosed paper by Jones-Lee and Lee (1993).

Page 2-2, mid-page, states,

*"Inert waste, as defined in §2524. of Chapter 15, includes waste which contains an insignificant portion of decomposable or soluble waste."*

It further states,

*"At the Azusa Landfill, acceptable inert waste contains less than five percent decomposable waste."*

However, a review of the remainder of the discussion of the inert waste which is covered through pages 2-5 shows that the revised ROWD does not discuss the most important characteristic of inert waste, namely the exclusion of wastes that have soluble components.

A review of Chapter 15 §2524., "Inert Waste," shows that

*"(a) Inert waste does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives, and does not contain significant quantities of decomposable waste."*

In the early 1980's the author was asked by the State Water Resources Control Board staff to review the then-proposed Sub-chapter 15 requirements that were eventually adopted by the Water Resources Control Board in 1984. At that time the author was teaching in the University of Texas system. He conducted a comprehensive review of the then-proposed regulations. He also met with the State Water Resources Control Board staff to discuss various aspects of Sub-chapter 15 prior to its adoption and therefore became familiar with not only the content of these proposed regulations, but also the intent of the staff who is responsible for developing Sub-chapter 15. He was asked to testify in support of Sub-chapter 15 should the staff feel that this was necessary. In addition, at the request of the staff the author provided a short-course on various aspects of monitoring landfills to the State and Regional Water Quality Control Board staff.

The author knows that the primary staff with whom he was working in the development of Sub-chapter 15 wanted to develop a regulation that would, in fact, protect the groundwater resources of the state of California from further pollution by landfill leachate, including any leachable components from what are called inert wastes. In 1989 when the author returned to California and saw how Sub-chapter 15, which became Chapter 15 without change in its content, was being implemented by the regional water quality control boards, it became obvious that protection of the groundwater resources of the state from pollution by soluble components of inert waste and by Class III municipal solid wastes was not occurring in accord with the requirements and intent of Chapter 15. The approaches being allowed by the regional boards for managing MSW and inert wastes will lead to groundwater pollution. This point is discussed further in a subsequent section.

With respect to the definition of inert waste, several years ago the author discussed the situation with the State Board staff as well as contacting each of the regional boards concerning the approach that they are using to implement the inert waste definition calling for no soluble components of the inert wastes above water quality objectives. He found that neither the State Board nor the regional boards have been implementing that

requirement of Chapter 15. No leaching tests were developed by which inert wastes could be determined to be inert by the Chapter 15 definition. There is no doubt that appreciable amounts of inert waste have been deposited on land since 1984 in violation of Chapter 15's requirements for no soluble components above applicable water quality objectives. Many of the inert waste sources listed on pages 2-2 and 2-3 will contain components which will leach materials at concentrations above applicable water quality objectives and therefore will be in violation of Chapter 15 requirements. **Effective immediately, the LA Regional Water Quality Control Board should require that BFI and, for that matter, all other dischargers of inert waste comply with Chapter 15's mandatory definition concerning soluble components.**

The revised ROWD is significantly deficient in failing to discuss whether the inert waste that BFI has accepted and plans to accept in the future at this landfill will comply with Chapter 15's requirements of no soluble components above water quality objectives.

It is stated on page 2-6 in Section 2.3, paragraph two, that Zones I and II of the landfill contain approximately $23.8 \times 10^6$ $yds^3$ of MSW and inert wastes. This amount of waste represents a highly significant potential for pollution of groundwater in the San Gabriel Basin.

Page 2-7, second paragraph, states,

*"Daily cover is placed over exposed wastes at the end of each day in a layer at least 6-in. (150-mm) thick."*

Further, in the next paragraph it states,

*"Intermediate cover is placed over waste in areas that are inactive for a period of over 180 days."*

The above-quoted sections are the current minimum regulations. A review of the LEA records for the inspection of the Azusa Landfill for the past several years should be conducted to determine if BFI has complied with this requirement. It is important that daily cover be applied as required by the regulations to ensure that odors are controlled from the deposited wastes and that birds, insects, rodents, etc. are not allowed to gain entry to the waste. In addition to causing obnoxious conditions, their entry into the waste can lead to potentially significant public health problems. The recent finding of hantavirus in many locations throughout the US reinforces the importance of requiring landfill owner/operators to vigorously pursue daily cover development so that mice do not gain entrance to food within the landfill. Hantavirus is a significant public health threat associated with various types of rodent populations. Landfills can be significant stimulators of rodent populations in their vicinity. The hantavirus has now been recognized as causing death in many people due to unknown respiratory problems. Approximately 50 per cent of the people who acquire this virus from being in contact with areas where rodents, including mice, are or have been recently present, die. This problem has been misdiagnosed for many years. It points to the extreme importance of

controlling mice and other rodent populations near landfills in order to protect the public health of those who own or use properties near the landfills.

Page 2-8, Section 2.5.1 discusses the so-called processes that occur in waste decomposition within a landfill where it is indicated that when oxygen is present it is claimed that aerobic decomposition occurs for a few days to a few weeks. The impression that there is any significant aerobic decomposition of municipal solid wastes is erroneous; the oxygen demand of waste is so great that oxygen in any liquids associated with the waste is depleted almost immediately. It would be indeed rare, if ever, that the aerobic decomposition of the wastes would proceed for weeks as claimed by BFI.

With respect to anaerobic decomposition, it is stated at the end of the paragraph that this *"...process may continue for several years (i.e. 20 or more) after waste placement, depending on the aforementioned conditions."* While the author has not checked the original reference to see what was said with regard to this topic area, it is certainly incorrect to assert that anaerobic decomposition of wastes would only occur for 20 years. Anaerobic decomposition of wastes in a MSW landfill proceeds for long periods of time which may include a thousand or more years. The wastes that have been placed in the Azusa Landfill and any wastes that are placed there in the future will be a threat to groundwater quality effectively forever, not just for a few tens of years.

While waste decomposition is of concern because it can, to some extent, lead to landfill gas formation, of even greater importance is the leaching of hazardous or otherwise deleterious components of the waste to produce leachate which ultimately will pollute the groundwaters of the San Gabriel Basin. As discussed in the enclosed papers, it is important to not assume that when a municipal solid waste landfill stops producing gas, i.e. is said to be "stabilized," that this landfill no longer represents a threat to the groundwater resources in the vicinity of the landfill. The landfill gas production arising from some of the anaerobic decomposition processes that occur in landfills is just one set of reactions that occur. Waste solubilization leading to leachate formation is another set. While there may be some interplay between the two general types of reactions in terms of the products formed, in many cases, products are formed from solubilization which occur in leachate which have nothing to do with waste decomposition as it is classically viewed, leading to landfill gas formation.

It is also now widely recognized that municipal solid waste in a landfill, such as the Azusa Landfill, will for all practical purposes be a threat to groundwater quality forever. Any planning for acceptance of additional wastes of any type, Class III or inert, at the Azusa Landfill must be based on the assumption that the wastes currently in the landfill as well as those placed in the landfill in the future will be a threat to the groundwater resources of the San Gabriel Basin forever.

The revised ROWD is highly deficient in providing reliable information on the potential threat that the wastes that BFI proposes to accept in the landfill under the revised ROWD represent to the groundwater resources of the San Gabriel Basin. Further, the acceptance of additional wastes at the landfill will increase the magnitude of this threat.

Page 2-10 mentions in the first paragraph, third line, the use of flares for management of landfill gas at the Azusa Landfill. At the Sardinia '93 conference held in Sardinia, Italy one year ago, Eden (1993), a British engineer, reported that landfill gas flares of the type being widely used tend to produce dioxins in potentially significant amounts. BFI should be required to immediately reliably monitor all flares that it is using for landfill gas management to determine the extent of dioxin formation and the hazards that such formation presents to public health and the environment in the vicinity of the landfill.

Pages 2-10 through 2-12 discuss BFI's views on landfill gas composition. This discussion is highly deficient in that it fails to mention the potentially significant amounts of hazardous or otherwise deleterious components in landfill gas. A properly developed ROWD would have included a reference to Hodgson *et al.* (1992) California Air Resources Control Board's studies on the hazardous nature of landfill gas emissions in California. Hodgson *et al*. state,

*"The Landfill Gas Testing Program of the State of California has demonstrated that landfills typically contain toxic VOC regardless of the type of waste they are designated to accept and that off-site migration of landfill gas is a fairly common occurrence."*

Appendix B, page D-3, lists an analysis of the Azusa Landfill gas. A discussion of the potential implications of the wide variety of carcinogens present in this gas should have been presented in the revised ROWD and not relegated to an undiscussed table in the Appendix.

Page 2-13, Section 2.6, "Leachate," first bulleted item, *"amount of surface-water infiltration, if any;"* is designed to mislead the reviewers of the revised ROWD to believe that it will be possible to produce a landfill cover with BFI's proposed approach which will allow no surface water infiltration to the Azusa Landfill. Certainly from the type of cover that is proposed, this will not be the case. Similarly, the third bulleted item, *"waste moisture retention capacity (i.e. the capacity to hold moisture);"* is another misleading statement. There is a common misconception that is often portrayed by landfill owner/operators that leachate is not generated in the wastes unless the moisture-holding capacity is exceeded. Such an approach ignores unsaturated transport of leachate that occurs in waste where waste that may appear to be dry will produce leachate that can pollute groundwaters.

In the last two lines of page 2-13, mention is made *"of a variety of alkaline earth and heavy metals..."*. Alkaline earths are a particular type of chemicals that are designated in the Periodic Table. The alkali metals, such as sodium, are of equal, if not greater, importance because of the potential threat that they represent to public health. They should have been mentioned here.

On page 2-14, second paragraph, the statement is made,

*"Leachate generated at the Azusa Landfill, if any, is collected in the liquid collection and recovery system (LCRS)."*

This is a highly misleading statement since the Zone I, 80-acre portion of this landfill is not underlain by a leachate collection removal system. Yet BFI proposes to continue to add wastes on top of the Zone I part of the landfill. As discussed in a subsequent section, such wastes will lead to additional groundwater pollution beyond that which has already occurred. Further, even for the part of the landfill that does have a liner system, the leachate collection and removal system will only be effective in collecting leachate for a finite period of time. As discussed in the enclosed materials, municipal solid wastes such as those that BFI proposes to accept at this landfill will be a threat to groundwater quality forever. However, the plastic sheeting liners have finite periods of time over which they will be effective in serving as a barrier to leachate transport through them, i.e. in leachate collection.

A proper description of the leachate collection and removal system in this revised ROWD would have included a discussion of the fact that there is only a limited period of time over which the liners will be effective compared to the length of time that the wastes will be a threat. The current discussion of the efficacy of the leachate collection and removal system is more of the distorted presentation that is made by BFI in this revised ROWD concerning the potential impact of this proposed landfill's continued operation on the groundwater resources of the San Gabriel Basin.

The above quote tries to give the erroneous impression that there may be no leachate generated in this landfill for as long as the municipal solid waste and inert waste represent a threat. There is no question that leachate has and will continue to be generated in this landfill. While BFI may for a period of time reduce the amount of leachate generation, it cannot eliminate it with the proposed approach.

Overall, the discussion of the potential emissions for the existing Azusa Landfill as well as any continued operation from it have been understated by BFI. Enclosed is a report which Dr. Jones-Lee and I prepared for the state of California Environmental Protection Agency Comparative Risk Project concerned with the emissions from municipal solid waste landfills (Lee and Jones-Lee, 1994a). While this report is generic in nature, it has considerable applicability to the existing as well as proposed continued operations of the Azusa Landfill.

This revised ROWD is also highly deficient in describing the characteristics of leachate. BFI knows the composition of leachate in the existing landfill; why did it not report it in this revised ROWD? As discussed in the enclosed report, typical municipal solid waste leachate contains a wide variety of hazardous or otherwise deleterious chemicals, small amounts of which can render groundwater unusable for domestic water supply purposes.

**Section 3 Waste Management Unit Characteristics**

Pages 3-18 through 3-42 present discussions of the seismic - tectonic setting for the Azusa Landfill. While this section goes into in-depth discussions of the estimated stability of the various components of the landfill containment system, it is well-known that, at best, these are estimates for which there is little practical experience on their

reliability. Further, and most importantly, the way Chapter 15 and Subtitle D are set up, earthquakes of a greater magnitude than those designed for in the regulations can and do occur. A properly developed revised ROWD would have discussed what would happen if an earthquake greater than the design seismic activity occurred and there was disruption of the landfill containment - monitoring systems due to this seismic activity. Would BFI be required to exhume all the waste to make repairs on the landfill containment - monitoring system or would it be concluded that the system failed because an earthquake greater than that for which the landfill was designed occurred with the result that "it is too bad" for the groundwater resources in the San Gabriel Basin?

Since this is a seismically highly active area, and because of the uncertainties of the reliability of the various estimates that are made on the ability of the designed system to withstand seismic activity greater than that designed for, it is essential that BFI be required to develop a dedicated trust fund of sufficient magnitude to allow BFI to exhume all of the wastes that it places in this landfill, including the existing wastes in Zones I and II. This dedicated trust must be set aside in perpetuity for this purpose, since the wastes placed in this landfill will be a threat forever.

Page 3-57, Section 3.5.3.4, "Organic and Inorganic Ground Water Chemistry," is inappropriately labeled. There is no discussion of the groundwater chemistry; there is discussion of the groundwater chemical composition. Composition is not chemistry.

Pages 3-57 through mid-3-58 discuss the so-called organic groundwater contamination. This a superficial, highly inadequate discussion of what is readily known about the organic contamination of groundwaters in the vicinity of the Azusa Landfill. BFI has only discussed a limited number of the organics (a few of the VOC's) and has failed to discuss the highly significant widespread contamination of groundwaters by the existing Azusa Landfill. The quarterly monitoring data that BFI has been submitting to the Regional Water Quality Control Board for the downgradient well, No. 1, clearly shows that the existing landfill has, as was expected, been polluting groundwaters since the mid-1980's and that at least through 1992 which was the last time that the author examined the monitoring data, this pollution has continued at a high rate. This revised ROWD should be rejected as being deficient because of its failure to reliably discuss the groundwater pollution by organics associated with the existing 80-acre landfill.

Page 3-58, third paragraph, presents BFI's highly distorted discussion of so-called inorganic contaminants in the areas upgradient and around the site. The discussion is restricted to nitrate in which BFI is again presenting more of its so-called "cowdung" theory, covering groundwater pollution in the vicinity of the Azusa Landfill. Examination of the groundwater quality data immediately downgradient of the landfill shows that the existing landfill has been polluting groundwater with a variety of inorganics that would impair the use of these waters for domestic water supply purposes at least since the mid-1980's. This situation was reported to the LA Regional Water Quality Control Board about two years ago in connection with BFI's opposition to the Board's proposed adoption of a ban covering the construction of landfills in sand and gravel pits in the LA Basin.

In order to eliminate any ambiguity about groundwater pollution by the existing landfill, BFI should be required to undertake horizontal drilling under the existing landfill at various depths and locations within the unsaturated zone and the groundwater table as well as constructing an array of vertical wells drilled at various locations, generally downgradient from the landfill to begin to determine the extent of groundwater pollution by the existing landfill. No further wastes should be accepted at this landfill since any additional wastes would add to the ultimate magnitude of the problem that has to be addressed as part of managing the water quality impairment that has occurred from the existing 80-acre landfill. Article 5 of Chapter 15 enables the Regional Board to take action against BFI from the groundwater pollution by the existing landfill. The Regional Board should immediately start such action.

Overall, BFI has again presented a highly unreliable discussion of the groundwater pollution that has occurred from the existing 80-acre landfill. A substantial plume of polluted groundwater exists downgradient from this landfill that according to Article 5 of Chapter 15, BFI should have been required several years ago to initiate a more thorough investigation of the degree and extent of pollution and then start corrective action on the groundwater pollution which would include prevention of further pollution. If BFI cannot prevent further pollution, then it should be required to exhume the wastes in Zones I and II which have already been placed in the landfill.

BFI's efforts to try to continue the operation of the Azusa Landfill through all five Zones should be the impetus needed by the Regional Board to start to take action against BFI for the existing groundwater pollution which would include stopping the spread of this pollution and to try to restore these groundwaters' quality to the maximum extent practicable.

Page 3-60 mentions,

*"The closed site may be used for a park, golf course, commuter parking, open space, storage, or for commercial gas use."*

This statement is highly misleading since the closed landfill has to have a low-permeability cap maintained on it forever. The likelihood of being able to use this site for many of these purposes, such as park, golf course, etc., is extremely remote. Enclosed is a discussion of these issues which points out that what has been done in the past with respect to reuse of landfill cover space where there was no attempt to maintain a low permeability cover will not be possible in the future where such covers have to be maintained according to Chapter 15 and Subtitle D.

**Section 4 Landfill Design**

Page 4-1, Section 4.1, "Overview," states in the first sentence,

*"The Azusa Landfill is designed in accordance with federal and state requirements set forth in Subtitle D, Chapter 15, Title 14, and CRWQCB Order No. 93-062 as well as general local requirements."*

A review of Chapter 15, Article 4, §2540 states under section (c),

*"Class III landfills shall have containment structures which are capable of preventing degradation of waters of the state as a result of waste discharges to the landfills if site characteristics are inadequate."*

There is no question about the fact that the wastes in the existing 80-acre landfill, Zone I and II, as well as any wastes that are added to these Zones and any wastes, including inert wastes, that are placed in the landfill in Zones III, IV and V, will be a threat to groundwater resources forever. As discussed below, Chapter 15 is explicit in requiring that the overall performance standard of prevention of groundwater impairment of use applies throughout the active life and post-closure period for landfills. The post-closure period for landfills is defined as the period of time that the wastes represent a threat. This means that the overall performance standard for the existing as well as any expansion of the existing landfill is one of prevention of all impaired use of groundwaters in the vicinity of the landfill for as long as the landfill will exist. This is an explicit overall, over-riding performance standard set forth in Chapter 15 that must be met. As discussed below, the proposed design for the landfill expansion will not comply with the overall performance standard set forth in Article 4, §2540.(c) of protecting groundwaters from impaired use for as long as the wastes are a threat.

The State Water Resources Control Board members at the June 1993 meeting where they adopted the state's current Landfilling Policy explicitly stated that the overall groundwater quality protection requirements of Chapter 15 of preventing impaired use of groundwaters due to landfill-derived constituents for as long as the wastes represent a threat took precedent over any minimum design requirements set forth in the Policy.

A properly developed revised ROWD would have in the first paragraph set forth the performance standards established in Chapter 15 for this landfill. It is understandable why BFI did not do this since it does not want these standards known. Obviously the proposed landfill design cannot achieve these standards.

Page 4-11, Section 4.3, "Ground-Water Barrier Drain (GWBD)," as discussed elsewhere, this groundwater barrier drain should be used as a means of detecting leakage through the upper composite liner. If leachate is detected in this drain, then the upper composite liner should be determined to have failed which requires corrective action.

Page 4-12, first paragraph, states,

*"The double liner system has a level of waste containment superior to that prescribed by state and federal requirements for liner systems (see Section 4.4.)"*

While that statement is somewhat correct for Subtitle D, it is not correct for Chapter 15. As stated above, Chapter 15 requires prevention of impairment of groundwater use for as long as the wastes represent a threat. The composite liner coupled with the groundwater drain system that BFI has been allowed to construct under Zone II of its landfill expansion will, at best, only postpone when groundwater pollution occurs; it will not protect groundwaters in the vicinity of the landfill from pollution by landfill leachate.

Page 4-15, last paragraph, BFI discusses the so-called excellent containment capabilities of the so-called synthetic composite liner. A critical review of this issue shows that these excellent containment capabilities may occur at the time that the liners are new, provided they are installed properly. A properly developed ROWD would have discussed what is known today about the long-term performance of these materials.

Haxo and Haxo (1988) reported that the US EPA HWERL Ad Hoc Technical Committee concluded in a discussion of "Service in Landfills of Flexible Membrane Liners and Other Synthetic Polymeric Materials of Construction,"

*"The polymers that were discussed and first-grade compounds based on these polymers should maintain their integrity in landfill environments for considerable lengths of time, probably in terms of 100's of years.*

*Nevertheless, when these polymers or compounds are used in products such as FML's, drainage nets, geotextiles, and pipe, they are subject to mechanical and combined mechanical and chemical stresses which may cause deterioration of some of the important properties of these polymeric products in shorter times."*

In a discussion of "areas of concern," Haxo and Haxo state,

*"The combined mechanical and chemical stresses under which the liner system functions may cause cracking and breaking of the components due to environmental stress-cracking or possibly mechanical fatigue under long service."*

*"Seams of FML's continue to be an area of concern, as none of the test methods truly assess the effects of long-term exposure in landfills."*

*"Clogging of drainage and detection systems continues to present a problem. The clogging can be by biological clogging due to growth or sedimentation or through precipitation of dissolved constituents."*

The long-term stability situation today for plastic sheeting liners is no different than in 1988. The same issues still exist. No one knowledgeable of the properties of these systems reports that the plastic sheeting liners of the types used today will function perfectly forever in a landfill environment. Since some components of the waste will be a threat forever, it is only a question of time until the liners fail to prevent leachate from passing through them and polluting groundwaters in the vicinity of the landfill.

Beginning on page 4-17 through 4-19, BFI presents in the revised ROWD a discussion of so-called state requirements. The requirements set forth in this section are the minimum design and related requirements required by the state in Chapter 15. Chapter 15, however, is explicit in requiring the protection of groundwaters from impaired use for as long as the wastes represent a threat. This is an overriding performance standard that must be met by all containment systems. The information provided in this section by BFI is more of the misinformation that BFI fosters on the Regional and State Board in connection with this Azusa Landfill. There is no statement in Chapter 15 that says that meeting the minimum design requirements will conform to the overall performance requirements of protecting groundwaters from impaired use for as long as the wastes represent a threat. It is obvious to anyone who understands the properties of liners and municipal solid wastes that meeting the minimum requirements of either Subtitle D or Chapter 15 will not protect groundwaters from pollution by landfill leachate, thereby impairing their use in an Azusa Landfill setting.

A mistake was made by the Regional Water Quality Control Board and, for that matter, the State Board in 1988 and 1989 in approving the design for the expansion of the Azusa Landfill. The State Board staff who are knowledgeable in these areas recommended against this approval as did a number of consultants who were working with the Watermaster on this matter, including the author. It was obvious then that BFI's proposed composite liner with the groundwater drain system would not conform to Chapter 15 requirements of protecting groundwater from impairment for as long as the wastes are a threat. Since 1989, it has become increasingly clear now to many of those knowledgeable in the topic area that this is the situation. At least half a dozen states in the US now recognize the deficiencies of a single composite liner or even a single composite liner backed with an additional plastic sheeting layer as BFI proposes for the Azusa Landfill as not being able to protect groundwater resources. These states require double composite liners as the minimum for groundwater quality protection from municipal solid wastes.

Page 4-24, Section 4.4.4, "Side-Slope Synthetic Composite Liner," presents information on the proposed design for the side slopes of this landfill for Zones II through V. It is stated mid-page that, the modified synthetic composite liner design will consist of

*"• a GCL with a saturated hydraulic conductivity of 5 x $10^{-9}$ cm/s or less."*

A GCL is a geosynthetic clay liner. This is a thin layer of bentonite clay encased in a woven fabric. While such systems are being used in lieu of low-permeability soil, such systems are not without significant problems. As discussed in the enclosed materials, to quote the advective permeability characteristics of these thin clay layers without discussing the diffusional transport through them, is highly misleading. As discussed by Dr. Gray (1988, 1993) of the University of Michigan, such layers have relatively high transport through them due to diffusion. Therefore these thin layers, when new, will transport leachate through them much more rapidly than predicted based on advective hydraulic permeability of $10^{-9}$ cm/sec.

Further, these thin layers of clay have poor structural properties and can be expected to encounter significant problems where there is not an adequate base under them, such as in parts of the side slope areas of the landfill expansion. A third deficiency with these thin layers is that they are subject to shrink/swell cracking or at least increased transport through them due to substitution of calcium and magnesium in the leachate for sodium at the clay ion exchange sites. This leads to a shrinkage and possible cracks developing, or at least higher permeabilities through the clay than the design specification. The geosynthetic clay layers should not be used as a substitute for compacted soil. They could be used in addition to the compacted soil layers, but never as a substitute.

The information provided by BFI in the sections on the properties of the landfill containment materials is highly inadequate and the ROWD should be rejected until it properly discusses their characteristics.

The bottom of page 4-18, Section 4.4.5.2, "Compacted Low-Permeability Soil Liner," discusses the low permeability soil liner drying where it is stated that this liner will be protected from drying by periodic wetting, etc. during construction. While this can, if properly done, maintain the near-optimum moisture density for the compacted soil layer to achieve design specifications at the time of construction, it will not address the significant long-term problem of desiccation cracking of compacted soil layers where through unsaturated transport, moisture will move out of the layer leading to cracking of the compacted soil layer. A properly developed ROWD would have discussed this issue.

Page 4-31, Section 4.5.1, "General," discusses the so-called regulatory requirements for the leachate collection and removal system (LCRS). It is stated on page 4-33, last two lines that,

*"The LCRS for the Azusa Landfill will continue to be constructed to meet these minimum state requirements."*

BFI once again has misstated the state requirements for leachate collection removal systems. First, the minimum design requirements are not necessarily adequate to prevent groundwater pollution by landfill leachate at all sites where landfills could be located. The leachate collection and removal system is the key component of the landfill containment system to prevent groundwater pollution. If properly constructed and maintained, such a system can, for a period of time, prevent leachate from entering the groundwater systems associated with the landfill for the expanded part of the landfill. This does not, however, address the problems associated with the original 80-acre landfill and any additional wastes that are added to this part of the landfill, i.e. Zone I. However, it is clear to anyone who objectively examines this system that BFI's proposed leachate collection and removal system for the Azusa Landfill will not comply with minimum Chapter 15 requirements of preventing pollution for as long as the wastes represent a threat. All this system will do is postpone when groundwater pollution occurs. In light of this situation, BFI should not be allowed to construct the proposed leachate collection and removal system in Zones III, IV and V. If BFI is allowed to use Zones III, IV and V for truly inert wastes, it should be required to use a double composite lined system in which

the lower composite liner is a leak detection system for the upper composite liner. BFI should be explicitly informed that if they cannot stop leachate from passing through the upper composite liner at any time in the future, i.e. for as long as the wastes represent a threat, then BFI will be required to remove all wastes from the landfill and properly manage them.

Further, since the long-term future financial stability of BFI as with all other waste management companies is highly uncertain because of the long term liabilities that they are developing by current waste disposal practices, BFI should be required now to develop a dedicated trust which will ensure that funds will be available *ad infinitum* to address failure of the leachate collection and removal system to function as stated in this revised ROWD. If BFI is so certain that this leachate removal and collection system will function perfectly forever, then it should have no trouble agreeing to the requirements set forth herein and developing a dedicated trust fund.

Page 4-50, under item (9), BFI should not be allowed to have any off-site odors from the Azusa Landfill. Detection of odorous conditions on adjacent lands would constitute a nuisance and public health hazard which would require that this landfill be shut down if BFI cannot control this situation, i.e. if it occurs more than once.

Page 4-53, Section 4.8.3, "Gas Recovery and Combustion," should include a periodic measurement of dioxin in the flares used for gas combustion using high sensitivity methods that will ensure that dioxin emissions will not cause an increase cancer risk to those who use properties in the vicinity of the landfill.

**Section 5 Construction Quality Assurance**

Section 5 presents a discussion of the construction quality assurance (CQA). Great detail is presented on the quality assurance for the construction of the liners, etc. However, the most important issue that should have been addressed in any credible revised ROWD is that of the properties of the materials and their expected performance that are used in the containment system. The key issues are the ability of the plastic sheeting and compacted clay that are used as part of the containment system to prevent leachate generated in the landfill from passing through these components and polluting groundwaters, impairing their use for as long as the wastes in the landfill will be a threat. Since these wastes will be a threat forever, these liner and cover components must function perfectly forever if the expanded landfill is to not contribute to the existing groundwater pollution that has occurred from the 80-acre unlined part of the landfill.

As discussed in the enclosed materials, those familiar with the properties of compacted soil - clay liners know that they have a finite, limited period of time where they can be effective in preventing leachate transport through them. Leachate passage through the liners is governed by the advective transport which can be estimated from Darcy Law calculations which is based primarily on the permeability of the compacted layer. As discussed above, for the side slope areas, the diffusional transport of leachate through the GCL must be considered.

The behavior of the plastic sheeting liner and so-called groundwater barrier is dependent on the integrity of the plastic sheeting. Holes, rips, tears, etc. and ultimately points of degradation of this liner govern its expected performance. Lee and Jones-Lee (1993a, 1994b). No one knowledgeable in the properties of plastic sheeting liners claims that these materials will work perfectly forever. Anyone who does make this claim does not understand their properties.

It is generally agreed that, over time, the containment properties of both types of liners will deteriorate, eventually leading to widespread failure of the system. The US EPA (1988), as part of developing Subtitle D regulations stated in the August 1988 Federal Register,

*"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 Criteria for Municipal Solid Waste Landfills (July 1988) State:

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

The US EPA's discussion of the expected performance of MSW landfill liner systems permitted under Subtitle D is reliable. At best, these landfills only postpone for a period of time when groundwater pollution will occur. They will not prevent it.

The revised ROWD is highly deficient in failing to discuss the overall properties of the liner materials that BFI proposes to use. These liner materials as proposed cannot at the Azusa Landfill location comply with Chapter 15's mandated minimum requirements of protecting groundwaters from impaired use for as long as the wastes are a threat. Therefore, this landfill as proposed cannot conform to Chapter 15's requirements and should not be allowed to continue to operate.

BFI should be required in the revised ROWD to properly discuss the ability of the landfill liner materials that it is using at the Azusa Landfill to prevent groundwater pollution from the wastes that have been and will be placed in the landfill for as long as the wastes represent a threat.

**Section 6 Operations Plan**

Page 6-3, Section 6.3.2.2, "Load Checking," states,

*"A load checking program is implemented to identify infectious, hazardous, liquid, or other unacceptable waste arriving at the Azusa Landfill."*

This load checking if properly carried out can reduce the amounts of infectious, hazardous, liquid or otherwise unacceptable wastes. It cannot, however, prevent the introduction of hazardous or otherwise deleterious materials in the wastes which will eventually impair the groundwater uses associated with the landfill.

Page 6-6 discusses inert wastes in several sections. No mention is made, however, of testing the inert wastes for soluble components which would exceed applicable water quality objectives, i.e. the definition of inert waste. This is a significant deficiency in this revised ROWD which should cause it to be rejected.

Page 6-9, Section 6.3.7, "Landfill Gas Management Operations," should include periodic testing of the gas flares for dioxin as well as gas leaking through the cover for hazardous chemicals.

Page 6-14, Section 6.6.3, "Landfill Maintenance," states the requirements in part for Title 14 and Subtitle D. It does not present the requirements set forth in Chapter 15. At this time the state of California is operating under a Landfilling Policy. This Policy was adopted in June 1993. At that time, the State Water Resources Control Board was explicit in stating that under this Policy, the more stringent requirement of Chapter 15 or Subtitle D shall be applicable to any landfills constructed - operated after the date of adoption. As stated elsewhere in these comments, Chapter 15 mandates that post-closure maintenance shall be required for as long as the wastes represent a threat, which is effectively forever. It is understandable that BFI would not want a discussion of Chapter 15 maintenance requirements included in the revised ROWD since these are the most stringent of all of the potential regulations governing the existing and proposed expansion of the landfill.

Page 6-23, Section 6.8.2 discusses odors. Since landfill odors are now recognized as being a significant public health threat, BFI should be required to operate the Azusa Landfill so that there are no off-site odors associated with it. The public health implications of odors from landfills is discussed in the enclosed report to the Cal EPA where Dr. Shusterman of the Department of Health Services has found significant public health problems associated with malodorous conditions (Shusterman, 1992).

**Section 7 Water Quality Monitoring Program**

Page 7-3, Section 7.2.2.2, presents the types of compounds that are currently analyzed for in the water quality monitoring program. While the individual compounds to be monitored are not listed as they should have been, it appears that some of the most important chemicals that can be used to detect municipal landfill pollution of groundwaters are not on this list. This is especially important because of the difficulty in reliably monitoring the Azusa Landfill with the minimum type monitoring program that BFI proposes. The current monitoring program is therefore deficient compared to what should be done to properly manage leakage from this landfill in order to evaluate its compliance with Chapter 15 requirements.

Page 7-7, Section 7.2.2.4, "Data Evaluation and Reporting," a review of the approach that has been used by BFI in its quarterly monitoring and reporting of data up through 1992 which was the date last examined by the author, shows that BFI at least through that time was not reliably reporting on the groundwater pollution that was evident from the data that had been collected at the monitoring wells.

Page 7-5, Table 7-1, presents information on the monitoring wells. The information presented on MW-1R and MW-2R shows that this pair of monitoring wells are screened to a considerable depth. This is an inappropriate way to monitor landfill liner leakage and should not have been allowed. These wells should be immediately supplemented by a series of monitoring wells screened over limited distances designed to sample water at various locations and depths downgradient of the landfill. It is important to note that even with this inadequate monitoring that has been done by BFI at the existing landfill, there is no question that the existing landfill has been polluting groundwaters for many years with a wide variety of constituents that can impair use of this groundwater. If proper monitoring wells with limited-range screens had been used, the degree of pollution found would have been even greater than the pollution that is evident from the existing groundwater monitoring data.

Page 7-8, second bulleted item, states,

*"Background water quality in the area of the Azusa Landfill is impacted by offsite contamination from the north and northeast. There appear to be at least two separate contaminant plumes, one containing VOCs and the other containing nitrates originating upgradient of the site. Therefore, a monitoring program must be able to differentiate between the releases from the landfill and known background contamination."*

In the next bulleted item it is stated,

*"The changing groundwater gradient and the presence of background contamination preclude the use of several of the statistical approaches which require inter-well comparisons. Moreover, these same factors require the careful selection of appropriate monitoring parameters. Because of the presence of VOCs in the ground water upgradient from the site, VOCs are not appropriate monitoring parameters."*

First, it is inappropriate for BFI to suggest that VOC's are inappropriate parameters for monitoring the Azusa Landfill pollution of groundwater. As discussed in materials the author has previously submitted to the Regional Board in connection with the sand and gravel pit landfill siting review, BFI's existing landfill has been, as expected, converting part of the TCE that comes from upgradient sources into dichloroethylene species and vinyl chloride as it passes under the landfill. This is what is expected based on the aqueous environmental chemistry of TCE and vinyl chloride in such a system.

It is important to note that based on the data that was available at least through 1992, there was no upgradient vinyl chloride or dichloroethylene species found in the groundwater. Therefore, since vinyl chloride is a much more hazardous chemical than

TCE, the existing 80-acre landfill is creating even a more significant impairment of use of groundwaters downgradient of the landfill due to the release of constituents which promote the conditions for conversion of TCE to the dichloroethylene and monochloroethylene (vinyl chloride) species.

The author agrees that standard statistical techniques should not be used to evaluate the pollution of groundwaters by the existing landfill with the highly inadequate monitoring program that BFI has been conducting at this landfill. However, individuals knowledgeable in the characteristics of municipal landfill leachate and the expected behavior of these constituents in groundwaters near landfills can readily determine from the concentrations and ratios of key constituents whether the landfill leachate is polluting groundwaters. This is the approach that was used by the author when he first became involved in review of the Azusa Landfill on behalf of the Watermaster in 1989.

At the October 1989 State Board hearing on BFI's proposed expansion of the Azusa Landfill the author testified that based on the groundwater monitoring data that BFI had provided to the Regional Board, this landfill at that time was polluting groundwaters. The author knows that this situation continued through at least 1992 which was the last time that the author examined the groundwater monitoring data. There is no reason to believe that the situation is any different today than it was previously. Even if BFI was able to stop leachate generation in the existing 80-acre landfill, which would be virtually impossible to do for as long as the wastes in that landfill will be a threat, BFI still has a massive legacy of polluted groundwaters downgradient from that landfill that must be evaluated and cleaned-up to the maximum extent practicable as part of complying with Article 5 of Chapter 15. BFI should not be allowed to continue to avoid the explicit requirements set forth in that Article governing this situation.

Page 7-9, Section 7.3.2.1, "Monitoring Locations," mentions that seven wells will be used. Because of the acknowledged complexity of this system due to variable flow direction, it is essential that the monitoring program for the existing unlined landfill as well as the lined landfill be greatly increased. Seven monitoring wells in such a system is inadequate. This proposed monitoring program must be rejected as being inadequate to detect the degree of pollution that has already occurred, much less what will occur, from the lined part of the landfill. Many sets of nested wells should be constructed along the general downgradient flowpath as well as upgradient of the 80-acre landfill. Further, for the lined part of the landfill, many more vertical wells will be needed to detect leakage from this part of the landfill which would pass downgradient without going under the 80-acre unlined landfill.

Enclosed is a paper that has been accepted for publication in *Environmental Science & Technology* that discusses the issues of why vertical monitoring wells spaced more than about 10 feet apart along the downgradient edge of a landfill are essentially worthless in detecting landfill liner leakage (Lee and Jones-Lee, 1994c). In summary, the landfill liner leakage that will occur will first occur through holes, rips, tears or points of deterioration in the plastic sheeting liner. As described by Cherry (1990), such leakage will generate finger plumes that will be missed by vertical monitoring wells unless they are closely

spaced since such monitoring wells have zones of capture of about one foot around each well. Vertical monitoring wells spaced more than a few feet apart for plastic sheeting lined landfills cannot comply with the Chapter 15, Article 5 requirements. Article 5, Chapter 15, §2550.7(C)1. and 2. state,

*"a sufficient number of monitoring points installed at appropriate locations and depths to yield ground water samples from the uppermost aquifer that represent the quality of ground water passing the point of compliance and at other locations in the uppermost aquifer to provide the data needed to evaluate changes in water quality due to the release from the waste management unit;*

*a sufficient number of monitoring points and background monitoring points installed at appropriate locations and depths to yield ground water samples from portions of the zone of saturation, including other aquifers, not monitored pursuant to Subsection (b)(1)(C)1. of this section to provide the data needed to evaluate changes in water quality due to the release from the waste management unit;"*

BFI's current groundwater monitoring program for the Azusa Landfill does not comply with these requirements.

As discussed in the enclosed paper, this is the approach that is recommended today for "dry tomb" type landfills using plastic sheeting liners. Basically, this involves a double composite liner in which the lower composite liner is the base of a leak detection system for the upper composite liner. When leachate is found in the leak detection system, then the upper composite liner will have been determined to have failed, and if the landfill owner/operator cannot stop the leakage of leachate into the leak detection system, then the owner/operator must be required to exhume the wastes and properly manage them. Since this is a problem that will last in perpetuity, it is necessary to require that the landfill owner/operator develop a dedicated trust fund of sufficient magnitude to ensure that funds are available *ad infinitum* to exhume the wastes and treat them properly when the composite liner inevitably fails to prevent leachate from migrating through it.

Since the landfill has a so-called groundwater barrier liner (layer of plastic sheeting) below the containment liner, and since it is possible to examine the composition of the liquids collected in the area below the composite liner and the groundwater barrier, it is possible to use the composition of the fluid collected therein to detect composite liner failure. This is the approach that should be required for monitoring Zone II of the existing landfill. Further, if BFI is allowed to construct Zones III, IV and V they should be constructed with double composite liners where the lower composite liner is part of the leak detection system of the type described above. Further, BFI should be required to develop the dedicated trust fund to enable action to be taken including waste exhumation at any time in the future that this landfill represents a threat to the groundwater resources in the San Gabriel Basin.

It is important to note that the issues about nitrate pollution are a smokescreen created by BFI to try to confuse the issue about the existing groundwater pollution. Examination of

the existing groundwater monitoring data shows that, as expected, whenever the higher nitrate waters pass under the landfill, the nitrate is denitrified, i.e. converted to nitrogen gas, and its concentrations decrease. This is yet another indication of the fact that the existing landfill is polluting groundwaters with a wide variety of constituents which remove the dissolved oxygen from the groundwater leading to nitrate denitrification.

Page 7-12, Section 7.3.2.2.2, "Detection Monitoring Parameters," the detection monitoring parameters that should be used should be a suite of constituents, not just the few listed by BFI. Again, standard statistical analyses approaches are not reliable for this type of situation because of the inadequate monitoring program that BFI has developed for the Azusa Landfill. Examination of the absolute concentrations and the relative ratios of selected constituents can be used to reliably demonstrate that the existing landfill is polluting groundwaters. This is a technically valid approach when used appropriately. The proposed approach for detection monitoring parameters is not technically valid. BFI should be instructed to redo this section to develop a reliable approach for the detection monitoring of this landfill.

Page 7-13, second paragraph, discusses the use of sulfate as a groundwater monitoring parameter. Sulfate is a reliable parameter if it is used appropriately. Its concentration will often decrease in contact with landfill leachate due to reduction reactions.

Page 7-13, Section 7.3.2.2.3, "Constituents of Concern," mentions that the constituents are analyzed every five years. That frequency is inadequate; they should be required to analyze these quarterly until the issues regarding the degree and extent of pollution of the groundwaters by the existing landfill have been resolved and then annually thereafter.

Because of the problems that have existed in having the Regional Water Quality Control Board address the implementation of Article 5, Chapter 15 for the pollution that has been occurring in the groundwaters downgradient of the existing landfill, it is essential that a third-party independent review of this data be mandated. BFI should be required to fund third-party independent review of the data collection, including independent sampling and analysis and reporting to the Regional Board and the public of the findings of groundwater pollution by the existing landfill. This third-party independent review is not designed to replace the Regional Board's responsibilities for this activity. It is designed to supplement the Regional Board's activities and ensure that a more reliable groundwater monitoring program be developed and implemented than has occurred thus far at the Azusa Landfill.

BFI only discussed detection monitoring. They should have discussed Chapter 15, §2550.9 Evaluation Monitoring Program and §2550.10 Corrective Action Program. The evaluation monitoring program should have been started years ago based on the pollution that has occurred in the downgradient wells from the landfill. Further, BFI will have to go into a corrective action monitoring program as part of its remediation of the groundwaters that have been polluted by the existing 80-acre landfill.

**Section 8 Closure and Post-Closure Maintenance**

On page 8-1, Section 8.1.1, "General," BFI refers to post-closure requirements set forth in §2597. BFI should have mentioned the requirements set forth in Article 8, Closure and Post-Closure Maintenance, §2580 under (a) where it is stated,

*"The post-closure maintenance period shall extend as long as the wastes pose a threat to water quality."*

A properly developed revised ROWD would have included a statement of these requirements.

Pages 8-5 and 8-6 discuss regulatory requirements for the cover. It is stated on page 8-6 that,

*"The final cover for the Azusa Landfill presented in the following sections meets or exceeds the foregoing regulatory requirements."*

It is well known that meeting these minimum requirements, however, does not produce a landfill cover that will not allow leachate to be generated during periods of precipitation for as long as the wastes represent a threat.

On page 8-9, Section 8.1.5.3, "Low-Permeability Barrier Layer," it is stated that the low-permeability barrier layer for the Azusa Landfill will consist of a geomembrane, i.e. plastic sheeting. This geomembrane will be covered by a drainage layer and topsoil. It is stated,

*"The low-permeability barrier layer will virtually eliminate the potential for significant surface water infiltration in to the waste mass, and it will control landfill gas."*

Such a statement is a gross misrepresentation of what will actually occur. At the time of placement of the geomembrane, if it is done properly, such a degree of protection against leachate generation and gas control could be achieved. However, with time the properties of the geomembrane and the cover will deteriorate. It is well-known that such geomembranes in landfill covers are subject to severe stresses which will hasten their failure (see summary of Haxo and Haxo report quoted above). Since this geomembrane is buried below several feet of material and therefore is not available for inspection, the way that the geomembrane failure is detected will be based on pollution of groundwaters by landfill leachate. Since the existing landfill is already polluting groundwaters, the additional pollution that will occur will be more difficult to detect.

BFI should be required to install a leak detection system, such as the Robinson system or equivalent, in the cover for the existing landfill to detect leakage of precipitation through the cover. BFI should also be required to develop a dedicated trust fund that will ensure that funds will be available to maintain the Robinson or other equivalent system in perpetuity to prevent moisture from entering the landfill and generating leachate which will lead to further groundwater pollution. As an alternative to this approach, BFI should be required to remove all wastes from the existing landfill. The groundwater resources of

the San Gabriel Basin are far too valuable to allow this landfill to continue to pollute groundwater as it has been doing for many years.

Page 8-21, second paragraph under 8.5.1, "General," states that the post-closure maintenance period will last at least 30 years as required by Subtitle D. Why did not BFI properly quote §2580 of Chapter 15 which states that the post-closure period shall be as long as the wastes represent a threat (see Article 8, Closure and Post-Closure Maintenance, §2580)? This is more of the deceptive reporting of the regulatory requirements that is prevalent throughout this revised ROWD.

Beginning on page 8-24 through 8-25 is a listing of the items that will be undertaken in connection with maintaining vegetation on the cover. It should be explicitly stated that this maintenance will be required in perpetuity since the wastes in the landfill will be a threat in perpetuity.

Page 8-27, Section 8.5.7, under "Landfill Gas Management System," explicit mention should made of dioxin testing in the flares and hazardous components in the gases released to the area for as long as there is a threat of gas production in this landfill which should be understood to be a long period of time, effectively forever.

BFI has had a problem with controlling gaseous releases from the Azusa Landfill. The author understands that several years ago landfill gas was found under adjacent properties. Such a finding demonstrates that at that time BFI was not properly monitoring and managing gaseous releases from the waste management unit. BFI should be required to reliably monitor both subsurface and above-ground releases for as long as gaseous releases will occur from this landfill. If BFI constructs a low-permeability cover on the landfill that effectively prevents moisture from entering the landfill, then it is possible, as long as that cover is adequately maintained, that landfill gas generation in the landfill will be significantly slowed down and possibly stopped due to the lack of adequate moisture needed for gas production. However, at some time in the future, problems with landfill gas will likely occur when the cover for the landfill is not adequately maintained.

It is important to understand that the maintenance of a landfill cover is difficult to do reliably, since the key component of the cover which controls moisture entry into the landfill is buried below several feet of overlying material, i.e. the topsoil and drainage layer. Therefore, visual inspection of the cover (vegetative soil layer) will not necessarily reveal the fact that the low permeability layer within the cover is no longer able to prevent moisture from passing through it and generating leachate and landfill gas in the landfill. Since landfill gas production can take place over a long period of time, with BFI's proposed closure methods it is essential to require that funds be set aside in a dedicated trust fund to ensure that the needed funds for maintenance and remediation of the cover will be there effectively forever. If this is not done, then there can readily occur at sometime in the future both significant leachate and landfill gas production which will represent threats to public health and the environment.

Beginning on page 8-29 is an estimate of post-closure costs. The estimates are far too low compared to the real costs that will be associated with post-closure care for this landfill. This revised ROWD should be rejected and BFI be instructed to properly consider post-closure care *ad infinitum* and then be required to develop a dedicated trust fund to cover these costs.

Page 8-33 discusses various types of financial instruments that are used. Many of these are well-known to be unreliable. Enclosed is a paper discussing post-closure care financial instruments (Lee and Jones-Lee, 1993b). The dedicated trust fund is a reliable approach that has been acknowledged by the executive director of SWANA (Hickman) as the approach that should be followed for all landfills, including the existing landfill.

**Appendix**

Presented below are comments on some of the materials in Appendix to the revised ROWD.

**Additional Information on Groundwater Monitoring**

Reference is made in the revised ROWD to a 1992 report, "Waste Discharge Requirements for Compliance with Revised Article 5 Regulations on Ground-Water Monitoring and Reporting at the Azusa Land Reclamation Company Class III Disposal Facility," by Law/Crandall, Inc., David Keith Todd (Consulting Engineers, Inc.) and Geraghty & Miller, Inc. A copy of that report is appended to this revised ROWD. A review of this report shows that BFI through its consultants is attempting to justify a significantly altered landfill leachate pollution detection approach by groundwater monitoring than is prescribed in the revised Article 5 of Chapter 15. The authors of this report claim that because of the complexity of the hydrogeologic situation in the groundwaters near the landfill and upgradient sources of certain contaminants, such as a few VOC's and nitrate, that the conventional monitoring approach set forth in Chapter 15 cannot be used. While that statement is correct, the statement that the conventional monitoring approach should be abandoned is inappropriate.

As someone who has been concerned about groundwater monitoring and having published extensively on this topic, the author is highly familiar with what needs to be done to properly monitor a situation where there is complex hydrogeology, such as at the Azusa Landfill. Under these conditions, BFI cannot continue to have a couple of monitoring wells sampled quarterly for a limited number of parameters. That system works adequately for simple hydrogeologic situations for unlined landfills that leak throughout the bottom area of the landfill. For complex systems, such as the Azusa Landfill situation, far more monitoring wells, much more frequent monitoring and a much greater array of monitoring parameters must be undertaken to reliably detect in accord with Chapter 15, Article 5 requirements of detecting the release of constituents from the landfill that can impair the use of the groundwaters at the earliest possible time.

The 1992 report should not be accepted as a factual statement of the situation, but instead BFI should be required to significantly increase the number of monitoring wells, numbers of parameters, frequency of monitoring, etc. so that reliable monitoring of the landfill can be achieved and thereby conform to Article 5's mandated requirements for detection of the migration of leachate from the landfill that can impair uses of the groundwaters in the vicinity of the landfill. Contrary to the statements made in this report, VOC's should be intensively monitored. There is evidence from the monitoring data that has been generated that there may be significant release of VOC's within the landfill that adds to the upgradient sources. As discussed above, the landfill releases of oxygen-demanding materials creates an environment under and downgradient from the landfill where TCE is converted to the dichloro and monochloro ethylene species, some of which are more hazardous than TCE. Therefore, this conversion represents pollution - impaired use of the groundwater and should have mandated years ago, but at least now, Evaluation Monitoring of the releases from the landfill to determine the degree and extent of pollution that has been occurring and continues to occur today. The author is in the process of conducting a more in-depth review of this supplemental report and recent groundwater monitoring data and plans to provide the LA Regional Water Quality Control Board with comments on this report when they are completed prior to the January 1995 hearing.

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**List of Enclosures**

Summary Resume for G. Fred Lee.

Jones-Lee, A. and Lee, G. F., "Groundwater Pollution by Municipal Landfills: Leachate Composition, Detection and Water Quality Significance," October (1993).

Lee, G. F. and Jones-Lee, A., "Landfill Post-Closure Care: Can Owners Guarantee the Money Will Be There?" (1993).

Lee, G. F. and Jones-Lee, A., "Impact of Municipal and Industrial Non-Hazardous Waste Landfills on Public Health and the Environment: An Overview," May (1994).

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Lee, G. F. and Jones-Lee, A., "Geosynthetic Liner Systems for Municipal Solid Waste Landfills: An Inadequate Technology for Protection of Groundwater Quality," (1993).

Lee, G. F., "Comments on Tisinger and Giroud `The Durability of HDPE Geomembranes'," April (1994).

Lee, G. F. and Jones-Lee, A., "Closed Landfill Cover Space Reuse: Park, Golf Course or a Tomb?" (1994).

A copy of any of these enclosures is available upon request.

***Reference as:"Lee, G.F., 'Comments on Revised Report of Waste Discharge Azusa Land Reclamation Landfill Prepared by GeoSyntec Consultants, October 1994 on Behalf of BFI,' G. Fred Lee & Associates, El Macero, CA December (1994)."***