Comments on

Draft Supplemental Environmental Impact Statement (DSEIS) proposed Campo Regional Landfill Project on the Campo Indian Reservation in San Diego County, California

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Submitted by
G. Fred Lee, PhD, BCEE, F.ASCE and Anne Jones-Lee PhD
G, Fred Lee & Associates
El Macero, California
gfredlee@aol.com www.gfredlee.com

Submitted to
Dale Risling, Acting Regional Director, Pacific Regional Office, Bureau of Indian Affairs, 2800 Cottage Way, Sacramento, California 95825.
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According to the Supplemental information provided by the Bureau of Indian Affairs (BIA), "*The proposed Class III (non-hazardous) solid waste landfill would occupy approximately 400 acres of the 1,150 acre lease area. An additional approximately 200 acres would be developed to support the landfill. Supporting developments include the site entrance facilities, screening berms, utilities, surface recharge basins, and leachate storage lagoons. The remaining 550 acres of the lease area that surround the proposed sold waste landfill facility would serve as an undeveloped buffer area.*"

"*The Proposed Project would be required to comply with 40 CFR Part 258 (Criteria for Municipal Solid Waste Landfills). The Project proposes to utilize alternative landfill design and cover, and therefore, requires a site-specific flexibility determination to ensure the alternative designs and cover are equivalent to 40 CFR Part 258.*"

Overall Findings on the Adequacy of the DSEIS

This review of the Draft Supplemental Environmental Impact Statement (DSEIS) on the currently proposed Campo Landfill focus on inadequate discussion of the expected performance of the landfill liner system and cover, and postclosure and groundwater monitoring issues. Though out the DSEIS the characteristics of each of these proposed landfill containment and monitoring systems are presented without discussion of the potential problems with the long term performance of the containment components and the monitoring system to detect groundwater pollution by the landfill before offsite groundwater pollution occurs for as long as the wastes in the proposed "dry tomb" type landfill will be a threat to generate leachate when the wastes are in contact with water. As documented herein there is substantial professional literature that discusses the potential problems with the proposed approach for developing the Campo Landfill. The reviewer of the DSEIS should be made aware of this literature. Without this information the review agencies will be misled to believing that the proposed Campo Landfill will not be a threat to public health and the environment.

* These comments were prepared at the request of Donna Tisdale, President, Backcountry Against Dumps

In this review of the DSEIS we have provided references to the post 1992 literature that discuss issues that should have been reviewed in the DSEIS. This DSEIS does not provide the information base that those who review this DSEIS need to adequately understand the potential public health and environmental impacts as well as other impacts of the proposed landfill. As a result it does not conform to NEPA requirements for an adequate discussion of these issues. This DSEIS needs to be redone to reliably inform the public and review agencies about the potential impacts of the proposed landfill.

The most significant deficiencies with this DSEIS include:

- Failure to inform the review agencies and the public about the substantial professional literature on issues on the expected long term performance of the proposed Campo Landfill waste containment landfill liner and cover systems, - the wastes in the proposed landfill will be a threat to public health and the environment for hundreds of years or more yet the landfill liner and cover have limited periods of time that they can be effective and will eventually fail to prevent adjacent property pollution.
- Failure to reliably evaluate and discuss the potential for landfill leachate polluted groundwater to migrate to the east leading to pollution of offsite groundwaters, - the approach used by CAMPO consultants to predict that no offsite pollution of groundwater will occur in not technically valid,
- Failure to reliably discuss the potential impact of seismic activity (earthquakes) on the landfill waste containment, monitoring and leachate management systems, - the analysis of the impact of seismic activity fails to discuss the variety of ways that strong earthquakes can disrupt the integrity of the proposed landfill containment and monitoring systems,
- Failure to inform the review agencies and the public about the length of time that the wastes in the proposed landfill will be a threat to generate leachate and landfill gas that can cause offsite adjacent properties pollution of groundwaters and air, - the wastes in the proposed landfill will be a threat to cause offsite pollution for hundreds of years far longer than Campo proposed to provide postclosure monitoring and maintenance of the landfill,
- Failure to discuss the costs of landfill postclosure monitoring, maintenance and groundwater remediation for as long as the wastes in the landfill will be a threat to public health and the environment due to leachate and landfill gas generation and migration – the true cost of the landfill monitoring and maintenance will far exceed the income that can be generated during the time that garbage is to be disposed of in this landfill.

Qualifications to Provide Comments

Information on Drs. G. F. Lee and Anne Jones-Lee's qualifications to provide these comments is summarized below. G. F. Lee earned a bachelor's degree in environmental health sciences from San Jose State College in San Jose, California, in 1955. His undergraduate education included work on public health aspects of landfilling of municipal solid wastes. He obtained a Master of Science in Public Health degree from the University of North Carolina, Chapel Hill, NC in 1957, and a PhD degree in Environmental Engineering from Harvard University in 1960. Both his masters and PhD degree work included studies on water quality, public health, and waste management.

For 30 years he held teaching and research positions in graduate-level environmental engineering/environmental science programs at several major US universities. During that time he conducted more than $5 million in research and published more than 500 papers and reports on various aspects of water quality and the impact of chemical contaminants on public health and environmental quality. His work included investigating numerous municipal solid waste landfills and conducting research for the US EPA and others on landfill liner properties. In 1989 he retired from university teaching and research and expanded his part-time, private consulting activities into a full-time business. He was joined in that work by his wife, Dr. Anne Jones-Lee, who at that time held a professorship in environmental engineering/science. They have been active in investigating more than 85 municipal solid waste landfills located in various parts of the US and other countries. They have published more than 650 additional papers and reports, approximately 120 of which are devoted to landfill pollution issues.

In 1992 Drs. Lee and Jones-Lee developed a "Flawed Technology" review in which they summarized the significant potential problems with the US EPA Subtitle D landfilling with respect to protecting public health and the environment for as long as the wastes in the landfill will be a threat. The proposed Campo Landfill must comply with the US EPA Subtitle D landfilling regulations. Throughout the 1990s Drs. Lee and Jones-Lee developed several papers and reports that provided further information on the potential problems with Subtitle D landfilling. The discussion presented herein represents an integration of the current understanding of the problems with Subtitle D landfilling of municipal solid waste as applied to the proposed Campo Landfill. Additional information on Drs. G. F. Lee and Anne Jones-Lee's experience and expertise in evaluating landfills' public health and environmental impacts is appended to these comments and is available from www.gfredlee.com, at,
http://www.gfredlee.com/landfill.htm.

Dr. Lee visited the area near the proposed Campo Landfill on July 26, 2006 in the company of Donna Tisdale.

Comments on the Executive Summary

Purpose of DSEIS

*Under **ES.1 Intended Uses and Authorizing Actions** states,*

*"The BIA is the Lead Agency under the National Environmental Policy Act (NEPA) and has prepared this Draft SEIS to identify and evaluate the potential environmental impacts associated with implementing the current Proposed Project. **The purpose of this document is to inform the public and the permitting agencies about the potential adverse and beneficial environmental impacts of the current Proposed Project,*** [emphasis added] *and to recommend feasible mitigation measures."*

A key issue in this review will be the adequacy of the this DSEIS to discuss the near term and especially the long term potential public health, groundwater and surface water impacts and the environmental impacts of the proposed landfill for as long as the wastes in the proposed landfill will be a threat. Also of concern is whether this DSEIS adequately covers the additional technical information that has been developed on the impact of landfills that are applicable to this updated Campo Landfill Project since the previous EIS was approved in the early 1990s for the originally proposed Campo Landfill project. Of particular concern to this review of this draft SEIS is the large amount of new technical information by various individuals and organizations on the inability of landfill liner components of the type that are proposed for this revised landfill liner system design to prevent groundwater pollution by landfill leachate for as long as the wastes in this type of landfill will be a threat to adversely impact public health, groundwater resources and the environment. Also of concern is whether this draft SEIS discusses the new information on the projected long term postclosure costs of this type of landfill. These issues and others are documented in the discussion presented herein. Without these discussions this draft *SEIS* will not comply with NEPA and BIA requirements of DSEIS "*to identify and evaluate the potential environmental impacts associated with implementing the current Proposed Project. The purpose of this document is to* ***inform the public and the permitting agencies about the potential adverse*** *and beneficial environmental impacts of the current Proposed Project, and to recommend feasible mitigation measures."*

Purpose of the Campo Landfill
ES.2 Project Purpose and Need states that the purpose of this landfill project is *"the Band would derive revenues from the landfill as well as establish a local employer to provide jobs for which tribal members are qualified,"*

As an economic venture, the DSEIS for the proposed Campo Landfill will in accord with full disclosure of the long term economic impacts of the proposed project, need to discuss the true long term cost of postclosure monitoring, maintenance and the eventual costs of remediation of onsite and offsite pollution of groundwaters when the proposed landfill liner system fails to prevent leachate from entering the groundwater aquifer system that underlies the proposed landfill. As discussed in the comments presented below the true long term costs of MSW landfills can be far greater than the profit gained during the active life of the landfill.

Landfill Location
ES.3.2.2 Project Site states,
"The Project Site consists of an 1,150-acre Lease Area (comprised the 493 acre landfill footprint and a 657-acre buffer area) and a 300 acre water well field northwest and partially outside of the Lease Area (Figure ES-1). The Project Site is bounded by Reservation land to the north and private lands to the east and south, and partially to the west."

As discussed below the amount of so-called buffer land is not the critical issue but the distance between where wastes will be deposited and adjacent private lands to the east of the landfill area. Figure ES-1 Proposed Site Map in the DSEIS shows that the proposed waste deposition area is very near the adjacent private property lines to the east, northeast, south (including Mexico) and southwest. As discussed below the proposed landfill will provide grossly inadequate buffer land between where wastes are to be deposited and adjacent private properly lines. This will lead to waste derived materials/chemicals to trespass onto adjacent properties and thereby adversely impact the health, groundwater and surface water resources and the interests of those who own or otherwise use the properties adjacent to the proposed landfill.

Landfill Liner Characteristics

Table ES.3-1. Liner System Comparison (Layers from base of waste to subgrade) *states that the proposed landfill liner system will consist of the following components.*

Proposed Project
Waste layer
2 Foot Soil Operations Layer
Geotextile
Drainage layer (granular 1 ft)
Geotextile
Not Applicable
HDPE 60 mil geomembrane
GCL ≈ .25 in 5 x 1 0^{-9} cm/sec
HDPE 60 mil geomembrane
HDPE Drainage Net Geocomposite
HDPE 60 mil geomembrane
Subgrade

The characteristics of landfill liner materials of the type and configuration for the proposed Campo Landfill is of a long standing interest to the authors of these comments. As discussed in the biographical information provided in these comments, this interest stems from an over five decade interest in groundwater quality protection from all sources of pollution including landfills as well as pioneering in university studies conducted for the US EPA on landfill liner systems to prevent groundwater pollution. Also this interest arises from having reviewed the existing and potential impacts of over 85 municipal solid wastes landfills on public health, groundwater and surface water resources and the interests of those within the sphere of influence of the landfill. This experience is provided in,

> Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Updated September (2009).
> http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

Sections of this "Flawed Technology" review are quoted as appropriate in the main body of these comments. A copy of the complete "Flawed Technology" review with references to the technical literature and reports is available on the Lee and Jones-Lee website at,
http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

Table ES.3-1 and the following discussion of the proposed landfill liner focuses on the use of geosynthetic clay liner (GCL) system where a discussion is presented on the components of this system and their purpose. However this discussion is fundamentally deficient in providing the public and the review agencies with the information they should have to understand the significant potential deficiencies in this GCL liner system to prevent leachate that will be generated in this landfill from penetrating through the liner system and polluting the underlying groundwaters by landfill leachate for as long as the wastes in the proposed landfill will be a threat to generate leachate when contacted by water that will penetrate through the landfill cap. This section of the DSEIS states,

"*The previous project analyzed in the FEIS included a liner system with more layers in a different sequence than those required by federal and tribal standards for solid waste landfills. The Proposed Project has additional layers as well as new design features. The key differences between the previous project and the current Proposed Project are the leak detection layer and an additional HDPE layer under the primary liner, a revised low permeability geosynthetic clay liner (GCL) layer, and the use of textured materials for all geomembrane layers, which reduces the potential for slippage between layers. The previous project included a drainage and leak detection layer over the primary liner. The Proposed Project includes a secondary leak detection layer under the primary liner. The Proposed Project also includes a thinner GCL layer with permeability comparable to the 24-inch engineered soil liner. The overall depth of the liner system for the current Proposed Project is less, but the number of layers, including three HDPE geomembrane layers, is greater."*

Leachate Management

In discussing the proposed landfill liner characteristics information is provided on leachate management as,

"Leahate is liquid that collects within the waste mass or is introduced via precipitation. It would be collected by the LCRS and pumped into one of two leachate storage ponds. These ponds would be constructed during the phased landfill development to ensure adequate collection and storage capacity based on the anticipated (and, after several years of operation, the actual) leachate accumulation rates and ultimate volume of each landfill area draining to the leachate collection pond or ponds".

"Total leachate storage for the Proposed Project is planned to ultimately involve two storage ponds. Each pond would be approximately 250 feet on a side and 12 feet deep, providing approximately a total of 5.4 million gallons of combined storage. The size of the second pond would be adjusted based on actual experience with the initial pond to provide adequate total capacity."

The bottom of the leachate ponds would be covered by a bottom liner comprised, top to bottom, of: 60 mil HDPE geomembrane; geosynthetic drainage layer similar to that described above for the secondary landfill liner; 60 mil HDPE geomembrane; GCL; and 60 mil HDPE geomembrane. The perimeter of the leachate storage ponds would be fenced for personnel safety and to keep wildlife out."

Potential Problems with GCL Liners

The discussion of the proposed landfill liner system is presented as though the component of the landfill liner system and leachate storage ponds will function perfectly as described for as long as the wastes in this landfill will be a threat to generate leachate. However as is well known in the landfill literature (see below discussion in the Lee and Jones-Jones "Flawed Technology" review there are a number of well documented reasons for this liner system and its components to fail to function as described in the DSIES. Lee and Jones-Lee discuss these issues in the section "Potential Problems with Geosynthetic Clay Liners" where they state,

"*Some landfill developers propose to use a single composite liner for the landfill with a 60 mil HDPE plastic sheeting layer and geosynthetic clay layer (GLC). While some states allow the substitution of a geosynthetic clay layer for the two feet of clay specified in US EPA Subtitle D regulations, such practice can allow more rapid failure of the composite liner than if the two feet of compacted clay had been used. The US EPA (2001a) has reviewed the properties of geosynthetic clay liners, where a number of the potential advantages and potential problems with substituting a geosynthetic clay liner for two feet of compacted clay have been discussed. A key problem with geosynthetic clay liners is that they are so thin that they have limited structural integrity and will allow rapid penetration of leachate through the liner by diffusion. While landfill applicants and their consultants, and unfortunately some regulatory agencies, will claim that the permeability of a geosynthetic clay liner of* 10^{-9} *cm/sec under one foot of head will control the passage of leachate passing through the liner, in fact, because of diffusion, leachate can pass through more rapidly. In addition cation exchange-related shrinkage of the bentonite in the geosynthetic clay layer can lead to higher permeability and possible failure through cracking*."

"*The US EPA Region 9 has conducted a review of the potential problems with the GLC liners in a landfill liner and cover. Vaille (2008) has pointed out in comments on the proposed used of GLC liner in the proposed Cortina Landfill to be located in Colusa County, California that while GLC manufactures claim a permeability of* 3×10^{-9} *cm/sec, validating testing of GLC delivered to a landfill site has measured permeability of* 10^{-8} *cm/sec. Vaille also stated,*

'In the HELP model liner/cover analysis, the geomembrane liner is assumed to have 5 flaws of 1 cm^2 *per acre and no assumption was made about flaws in the GCL liner. It is highly possible for a tractor or other equipment to damage both the geomembrane and underlying GCL, therefore rendering a preferential flow path for moisture. Like any thin liner, GCLs are vulnerable to puncture and to tearing e.g., as described for a case involving accidental puncture of a GM/GCL composite liner by a piece of maintenance equipment.1 Therefore, we suggest including the assumption of a GCL seam split or other damage near a geomembrane puncture, and using a more conservative 10 flaws of 1* cm^2 *per acre sensitivity analysis for the HELP and MULTIMED models.'*

1. Daniel, D.E., and Gilbert, R. B., "Practical Methods for Managing Uncertainties for Geosynthetic Clay Liners, " Uncertainty in the Geologic Environment: From Theory to Practice, American Society of Civil Engineers, New York, 1996.

Vaille, (2008) stated with respect to the equivalency of GLC to a compacted liner compacted clay liner (CCL),

'The objective of this demonstration is to show that the GCL has equivalent or superior hydraulic conductivity and chemical attenuation properties when compared with the soil layer components of the liner and cover." Assessment of full technical equivalency is much more complicated. A comparative assessment of GCLs to CCLs should be made, and included in the submission, on the basis of hydraulic, physical/mechanical, and construction criteria. Caution should be exercised in substituting a GCL alone for the CCL as the low-permeability soil component of a Subtitle D single-composite liner on the base of a landfill. While the hydraulic efficiency of a GM/GCL composite liner is as good, or better, than a GM/CCL composite liner, the GM/GCL composite liner is more susceptible to diffusive transport 3 and puncture than the GM/CCL composite liner." GM is a geomembrane liner, FML.'

3 Rowe, R.K. and Booker, J.R. (1998). "Modeling impacts due to multiple landfill cells and clogging of leachate collection systems", Canadian Geotechnical Journal, 3 5(1): 1-14.

Dwyer, Stephen 2003. "Water Balance Measurements and Computer Simulations of Landfill Covers", Dissertation, University of New Mexico.

4. Benson, C.H. et al. 2004. "Forensic analysis of excessive leakage from lagoons lined with a composite GCL". Geosynthetics International, 11, No. 3;

Vaille stated,

'Vulnerability to chemical alterations — Bentonite is subject to increases in hydraulic conductivity caused by chemical alterations, particularly at sites containing calcium-rich soils. This vulnerability increases in hydrologic settings where there is the potential for transient wetting and drying conditions to occur. This can occur where the GCL goes though wetting and drying cycles due to intermittent direct contact with groundwater, or where the GCL would become saturated through contact with the unsaturated zone above the groundwater table. When subject to such transient conditions in near surface applications, i.e. cover systems, GCL permeability has been shown to increase, sometimes by orders of magnitude. The performance degradation is due to ion exchange problems, desiccation cracking, and bentonite leaching from the product'

4. Jo, Ho Young. 2005. "Long-Term Hydraulic Conductivity of a Geosynthetic Clay Liner Permeated with Inorganic Salt Solutions", Journal of Geotechnical And Geoenvironmental Engineering. April.

'Low Shear Strength and Low Slope Stability — Bentonite, the key ingredient in GCLs is well known for its very low strength when hydrated. In particular, problems arise when GCLs are placed on slopes in applications where they may become saturated (hydrated). Should a GCL become saturated, its internal friction angle [a key factor in shear strength] is reduced and may significantly reduce its slope stability, particularly under seismic conditions. Because bentonite is so well known for its low shear strength, caution is appropriate when employing materials such as GCLs that contain bentonite on slopes.'

Vaille (2008) has stated that a discussion of the liner in relation to the physical and chemical characteristics of the leachate should be included in evaluation of a landfill liner. He also stated a proposal for a landfill 'must include a fully-developed groundwater monitoring plan in order to demonstrate that the alternative liner design will ensure that *the concentration values listed in Table 1 40 CFR 258.40 will not be exceeded in the uppermost aquifer at the relevant point of compliance.'*

The US EPA Region 9 (Vaille) comments on the proposed Cortina Landfill development summarized above have applicability to many other landfill development situations including to some extent the proposed use of GCL liner system in the proposed Campo Landfill."

The NRC (2007) report states, in a discussion of 3.3.5 Geosynthetic Clay Liner Barrier Monitoring
'Because geosynthetic clay liners (GCLs) are manufactured and thus undergo manufacturing quality assurance, their end of construction reliability tends to be significantly higher than that of compacted clay layers and is probably similar to that of geomembranes. GCLs are often used beneath relatively shallow depths (e.g., less than 1 m) of soil in cover systems. Because of serious performance concerns about GCLs buried under shallow depths of soil covers, GCLs have been exhumed and tested after several years of service to evaluate their integrity in the early medium term (e.g., Mansour, 2001; Henken-Mellies et al., 2002). However, this type of examination has been conducted only for research purposes and not as a routine part of barrier system monitoring. Recently, exposure of the GCLs in several composite liner systems employing the GCL as the low-permeability soil layer beneath the geomembrane has shown that GCL seams can separate as a result of environmental effects (Thiel and Richardson, 2005). The GCL seams in these cases were generally exposed because of other performance concerns (e.g., during repair of mechanical defects to the overlying geomembrane). The accidental discovery of GCL seam separation indicates the value of direct monitoring of barrier components. Most barrier system components are hidden from view after construction, and thus component defects will not be identified until performance problems appear elsewhere in the system.'

In the Lee and Jones-Lee "Flawed Technology" review section "Cation Exchange-Related Failure" states,
"Some types of clays used in landfill liners, with an expandable lattice structure, exhibit strong shrink/swell properties dependent on the type of cation on the clay's ion exchange sites. With sodium at the exchange site, the clay is in a swollen state. However, in contact with water with high calcium/magnesium compared to sodium concentrations, the calcium and magnesium will replace the sodium on the clay, and the clay will shrink, leading to higher permeability and possible failure through cracking. Auboiroux et al. (1999) have investigated the impact of calcium exchange for sodium in bentonite geosynthetic clay liners for landfills. They stated,
'Results suggest that while GCL 's may be considered as useful materials for reinforcing compacted clay layers at the base of landfills, they should not be considered as "equivalent" to compacted clay layers, at least in terms of pollutant breakthrough times." Guyonnet et al. (2005) reported that,"... calcium carbonate in the bentonite, formed during activation of the calcium bentonite, may redissolve during contact with a dilute permeant, releasing calcium ions that exchange with sodium in the clay. This exchange leads to obliteration of a so-called "gel" phase ~beneficial in terms of low permeability and to the development of a more permeable "hydrated-solid" phase." James et al. (1997), in a study of the use of a GCL as a liner to enhance the cover over a reservoir, reported that, "The evidence demonstrates that calcium

from calcite, contained in the GCL bentonite, exchanged with sodium and, in so doing, contributed to shrinkage and cracking.'

Jones-Lee and Lee (1993) presented a summary of the concentrations of various ions present in leachates from 83 US landfills. The data show that some MSW leachates have higher concentrations of calcium than sodium. In fact, the overall average calcium concentration for all of the landfill leachates investigated was higher than the sodium concentration. This means that, for some compacted clay liners, the low advective permeability (rate of penetration) at the time of installation of the liner will increase as the sodium on the clay is replaced by calcium and the clay shrinks from its original characteristics at the time of construction. This shrinking can lead to ion exchange cracking of the compacted clay liner."

As evidenced by the literature cited above there is considerable literature that discusses potential problems with using GCL in landfill as part of the liner system. This literature should have been discussed in this DSEIS to inform the public and the agency reviewers about the potential problems with the proposed Campo Landfill liner system that can occur over the period of time that the wastes in this proposed landfill can be a threat. Without this discussion the reviewers will not have been informed that there is considerable concern about the long term reliability of the proposed landfill liner system.

References for this section

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US EPA, "Geosynthetic Clay Liners Used in Municipal Solid Waste Landfills," EPA 530-F-97- 002, US Environmental Protection Agency, Washington, D.C., December (2001a).

Vaille, R "Comments on the Proposed Development of the Cortina Tribe Landfill," Letter to Cortina Integrated Waste Management Inc. by US EPA Region 9 San Francisco, CA, June 17, (2008).
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Use of Leachate for Dust Control

The DSEIS states,

"Leachate in the storage ponds would be extracted and applied over lined active portions of the landfill, including interior operations roads, for dust control. Leachate would not be applied over any unlined areas outside the landfill footprint. Leachate for dust control would be applied using water trucks. Monthly representative samples of the liquid in the leachate storage ponds would be collected and tested to verify that it is non-hazardous. One water truck would be employed to distribute leachate around the site."

Lee and Jones-Lee in their "Flawed Technology" review discussed the use of leachate for dust control issues as,

"*Landfill Dust Control Problems. Dust emissions from landfills can be a severe problem that can impact adjacent properties. There are several aspects of the dust control issue that need to be evaluated. First, the landfill owner should be required to control all dust emissions from the landfill so that no dust from the landfill is deposited on adjacent properties. Some landfill operators use landfill leachate for dust control. While in the past this was a common practice, in many states it is no longer allowed, since it can lead to polluted stormwater runoff. Leachate should not be used for dust control, since leachate contains a variety of hazardous and deleterious chemicals that can be present in stormwater runoff from the areas to which the leachate is applied."*

This statement is another example of the significant deficiency in the DSIES in providing the public and the review agencies with the information they need to understand the potential impact of the proposed Campo Landfill. A proper discussion of this issue in a NEPA compliant EIS would have included a discussion that the use of leachate for dust
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control is not allowed in many areas because of the pollution of surface waters in stormwater runoff from the area where the leachate is applied.

Also the statement that only so-called non hazardous containing leachate would be applied for dust control. Lee and Jones-Lee in their "Flawed Technology" review state,

"Hazardous versus Nonhazardous Waste Classification

The typical approach that is used by regulatory agencies and landfill proponents is to say that no "hazardous wastes" will be deposited in a Subtitle D landfill. However, that statement is based on the fact that an arbitrary and often not protective approach is used to define "hazardous" waste. An understanding of the basis of this classification shows that the US EPA's approach allows substantial amounts of hazardous chemicals to be added to so-called "nonhazardous" waste (Subtitle D) landfills. Further, the US EPA's classification system provides for no recognition of so-called "nonhazardous" waste containing constituents which are highly detrimental to the use of the groundwaters that are polluted by leachate from such wastes, rendering the waters unusable for domestic and many other purposes. As discussed by Jones- Lee and Lee (1993), the presence in a water supply well of municipal solid waste and other waste leachate, with no "hazardous" chemicals above the US EPA criteria that are used to make the distinction between hazardous and nonhazardous, can still cause the water supply well to have to be abandoned because of the aesthetic problems of taste and odor, color, iron, manganese, hydrogen sulfide, corrosion, scaling, etc."

"*The most significant problem with the US EPA's classification of hazardous versus nonhazardous waste is the use of the leaching test – originally, the EP-Tox test, and now the toxicity characteristic leaching procedure (TCLP). The test is patterned after dredged sediment elutriation. While the dredged sediment elutriation conditions make sense for dredged sediment open-water disposal, similar conditions have no validity for the leaching of constituents in a solid waste landfill. The liquid-to-solid ratios used, redox conditions, pH and exposure surface area of the solid particles are all highly arbitrary. The EP-Tox test, now TCLP, is a political test designed to limit the size of the hazardous waste stream that must be managed as hazardous waste. The tests have little or nothing to do with properly evaluating chemicals that could affect groundwater quality.*

The interpretation of what constitutes excessive leaching in the EP-Tox test and TCLP is another example of an arbitrary approach on the part of the US EPA in defining hazardous waste. The allowed attenuation factor (5-to-1 dilution is assumed) will, for some hydrogeological groundwater systems, be overprotective, and for others, under-protective. Yet the characteristics of the hydrogeology of the site are not taken into account in interpreting the results of the test to determine whether a waste can be placed in a nonhazardous waste landfill.

"There is considerable unreliable information on the potential for municipal solid waste leachate to pollute groundwaters, rendering them unusable for domestic and many other purposes. Jones- Lee and Lee (1993) have presented a review of the potential for MSW leachate to pollute groundwaters. As they discuss, MSW leachate typically contains high concentrations of conventional and so-called "non-conventional" pollutants. The conventional pollutants include heavy metals, a variety of organics, and various salts, some of which are hazardous to the health of those who consume water that has been polluted by municipal landfill leachate."

"*Lee and Jones-Lee (2009d) have provided a discussion of the unreliability of the TCLP based procedure leaching of a solid waste, soil, and sediments including cement "stabilized" wastes in evaluating the potential hazard of chemicals in the wastes."*

Non-conventional contaminants are largely organic chemicals that have not been defined, and whose potential hazards to public health and groundwater quality are not known. Typically the organic Priority Pollutants – those organics that are identified and quantified – represent a very small fraction of the total organic matter present in leachate as measured by chemical oxygen demand and total organic carbon. It is estimated that from 90 to 95 percent of the organic materials in municipal landfill leachate are of unknown composition. Those chemicals have not been identified, and obviously their potential impacts on public health and groundwater quality are unknown."

"The regulation of landfill stormwater runoff water quality impacts occurs under the US EPA National Stormwater Runoff permit system. Nationally and in states, stormwater runoff from a landfill is regulated as an "industrial" source. Critical review of the existing landfill stormwater runoff monitoring requirements shows that they are seriously deficient in providing the monitoring needed to insure with a reasonable degree of certainty that the landfill stormwater runoff will not pollute the waters receiving the runoff from the landfill. MSW and its leachate contain thousands of chemicals that are not monitored/regulated, which are a threat to public health and the environment. Some of the unmonitored constituents can be adverse to public health at very low concentrations. Dr. Christian Daughton (2005), Chief of the Environmental Chemistry Branch, National Exposure Research Laboratory, Office of Research and Development, US EPA, Las Vegas, Nevada, has discussed the inadequacy of water quality monitoring programs in identifying pollutants in wastewaters/stormwater runoff for the range of chemicals that could be impacting public health and the environment. In his presentation he stated,
"Further Truisms Regarding Environmental Monitoring

> *• What one finds usually depends on what one aims to search for.*
> *• Only those compounds targeted for monitoring have the potential for being identified and quantified.*
> *• Those compounds not targeted will elude detection.*
> *•The spectrum of pollutants identified in a sample represent but a portion of those present and are of unknown overall risk significance.:*

"Lee and Jones-Lee (2005b) have recently published a review on unrecognized pollutants." In the Lee and Jones-Lee Stormwater Runoff Water Quality Newsletter Volume 13 Number 1, January 12, 2010 - Topics: include "Impacts of unmonitored, unregulated, and unrecognized chemicals in the aquatic systems," This newsletter is available at,
www.gfredlee.com/Newsletter/swnewsV13N1.pdf

The March 17, 2010 Ground Water Protection Newsletter contained the following information on pharmaceuticals in MSW leachate.
"*Maine Study May Help Bid For State Limits On Landfilling Pharmaceuticals*

A new study detecting common prescription drugs in the leachate from municipal waste landfills in Maine could aid efforts by supporters of state legislation to create industry-funded drug takeback programs, with proponents in Maine already citing the results to bolster their claims that existing approaches to drug disposal put the environment at risk.

Maine's study appears to be the first to show significant levels of pharmaceuticals in landfill leachate -- the liquid that seeps to the bottom of landfills and is commonly sent to municipal wastewater treatment plants. Traditional wastewater treatment methods do not remove all chemicals in pharmaceuticals and personal care products, and supporters of drug takeback programs say having drug manufacturers collect excess pharmaceuticals and incinerate them as hazardous waste would help reduce threats to surface and groundwater contamination. Re-printed in part from the Water Policy Report, Association of State and Interstate Water Pollution Control Administrators, February 2010

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A NEPA EIS compliant discussion of this issue would have pointed out that leachate that is classified as "non-hazardous" can contain a wide variety of hazardous chemicals and other chemicals that are a threat to be adverse to public health and the environment. Without this discussion the DSIES misleads the reader to believing that it is safe to use landfill leachate for dust control.

Final Cover Design
The DSEIS discussion of the proposed Campo Landfill cover as,

Table ES.3-2. Final Cover Design Comparison

Proposed Project
60-inch (vegetative soil cover)
Geocomposite drainage layer
60-mil linear low density polyethylene (LLDPE) geomembrane liner sheet
12-inch foundation layer of soil
Waste Layer

"The final cover proposed for the CRL is designed to exceed applicable regulatory standards. The final cover design for the Proposed Project differs from the design originally addressed in the FEIS and is based on mitigation recommendations in that document. Table ES.3-2 identifies the layers of material for the proposed final cover design compared to the previous project and federal and CEPA regulations.
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The uppermost layer of the proposed final cover on top of the landfill consists of 60 inches (5 feet) of soil. Compared to the landfill design considered in the FEIS, the vegetative layer was increased in thickness to five feet (from two feet), based on mitigation proposed in the FEIS, and the foundation layer decreased in thickness by one foot (from two feet). This soil layer would be placed over a geocomposite drainage layer, which in turn would be placed over a textured linear low density polyethylene (LLDPE) 60-mil geomembrane. Low density polyethylene is more flexible and elastic than HDPE and is therefore better suited to the top portions of a landfill where post-closure settlement proceeds unevenly causing some portions to settle more than others. LLDPE readily accommodates these differential settlement rates. All of these layers would be on top of one foot of soil cover placed over the final waste layer.

Again the DSEIS is deficient in providing the reviewers with the information that is needed to understand the protective nature of the proposed landfill cover to keep the Campo Landfilled waste dry for as long as the wastes in the landfill will be a threat. While someone not familiar with the landfill literature could be lead to believe that the changed landfill cover design will prevent moisture (rainfall) from entering the landfill that sometime in the future that will generate leachate that could penetrate through the failed landfill liner system and pollute groundwater, the facts are that this landfill is well documented to eventually fail to keep the wastes dry for as long as the wastes in the landfill will be a threat to generate leachate. This DSEIS should have informed the public and agency reviewers that the BIA statement in the DSEIS, *"The Proposed Project would be required to comply with 40 CFR Part 258 (Criteria for Municipal Solid Waste Landfills)* means that this landfill will be a "dry tomb" type landfill where there is an attempt to isolate the deposited wastes from water that can generate leachate and to collect any leachate that is generated to be collected by the landfill liner system and thereby prevent groundwater pollution for as long as the wastes in the landfill will be a threat.

Lee and Jones-Lee in their "Flawed Technology" review have discussed the issues associated with dry tomb type landfills as,

"Overview of Landfilling Regulations

"*In 1991 the US EPA (1991) promulgated regulations for landfilling of municipal solid wastes (MSW). These regulations cover Resource Conservation Recovery Act (RCRA) Subtitle D requirements mandated by the US Congress. These regulations establish the "dry tomb" landfilling approach, where the MSW to be landfilled is entombed in a plastic sheeting and compacted soil/clay liner and cover."*

"There was growing recognition that the dry tomb landfilling approach with compacted soil and plastic sheeting liner and cover was not a reliable approach for preventing groundwater pollution for as long as the wastes in a minimum Subtitle D landfill would be a threat. This led to the US EPA's delaying the promulgation of the Subtitle D regulations beyond the due date that Congress had established. An environmental group filed suit against the US EPA to force the Agency to promulgate the Subtitle D regulations, with the result that the current Subtitle D regulations were adopted in 1991, even though it was well understood that landfills that conformed to these regulations would not be protective of public health and the environment for as long as the wastes in the landfill would be a threat."

"The dry tomb landfilling approach, however, leads to a situation where the wastes that are isolated from the environment in a compacted soil and plastic sheeting lined "tomb" will remain a threat to cause groundwater pollution and to generate landfill gas."

"The US EPA, as part of adopting the RCRA Subtitle D regulations, stated in the draft regulations (US EPA, 1988a),
"First, even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in MSWLF (municipal solid waste landfill) containment technologies suggest that releases may be delayed by many decades at some landfills."

The US EPA (1988b) Criteria for Municipal Solid Waste Landfills stated,
"Once the unit is closed, the bottom layer of the landfill will deteriorate over time and, consequently, will not prevent leachate transport out of the unit."

With this background of the ultimate long-term failure of the landfill containment system, it is appropriate to inquire as to why the US EPA adopted a fundamentally flawed approach for landfilling of wastes. This situation arose out of the fact that environmental groups had filed suit against the US EPA for failure to develop municipal and industrial "nonhazardous" solid waste landfilling regulations. This led the Agency to promulgate the Subtitle D regulations (US EPA, 1991), based on a single composite liner and equivalent landfill cover, even though it was understood in the early 1990s that at best this approach could only postpone when groundwater pollution occurs by landfill leachate."

"A review of the properties of municipal solid wastes and how they degrade/decompose in a landfill shows that the rate of decomposition is dependent on the amount of moisture that enters the landfill. Water is needed by bacteria that are present in the landfilled wastes in order to decompose those parts of the waste that are subject to bacterial decomposition. These issues have been discussed by Christensen and Kjeldsen (1989). This decomposition leads to landfill gas production. Another mechanism for decomposition of municipal solid waste components is the leaching (dissolving) of waste components to produce leachate. In a true dry tomb landfill, the wastes are kept dry and, therefore, do not decompose or leach. Under this condition, the wastes will, forever, be a threat to generate landfill gas and leachate. This situation necessitates that the landfill bottom liner collect all leachate that is generated for as long as the wastes are a threat (forever). Further, the landfill cover must be designed, operated and maintained to greatly restrict the amount of moisture that enters the landfilled wastes through the cover, forever.

As noted by John Skinner, Executive Director of the Solid Waste Association of North America (SWANA) and former US EPA official in the Office of Solid Waste and Emergency Response, on pg.16 of the July/August 2001 MSW Management Journal,
"The problem with the dry-tomb approach to landfill design is that it leaves the waste in an active state for a very long period of time. If in the future there is a breach in the cap or a break in the liner and liquids enter the landfill, degradation would start and leachate and gas would be generated. Therefore, dry-tomb landfills need to be monitored and maintained for very long periods of time (some say perpetually), and someone needs to be responsible for stepping in and taking corrective action when a problem is detected."

“***Leachate Generation Potential Will Continue for Thousands of Years.*** *The municipal solid wastes (MSW) in a classical sanitary landfill where there is no attempt to prevent moisture from entering the wastes have been found to generate leachate for thousands of years. Freeze and Cherry (1979) of the University of British Columbia and the University of Waterloo, Ontario, Canada, in their book, Groundwater, discuss that landfills developed in the Roman Empire about 2,000 years ago are still producing leachate. Belevi and Baccini (1989), two Swiss scientists who have examined the expected contaminating lifespan of Swiss MSW landfills, have estimated that Swiss landfills will leach lead from the waste at concentrations above drinking water standards for over 2,000 years.”*

Obrien (2009) executive director of the Solid Waste Association of North America has recently discussed the “*Long Term Potential Problems of Subtitle D Landfills*,” This is an important admission in that even now the public agency landfill owners recognize that there are highly significant long term problems with the dry tomb landfilling approach in protecting groundwaters from pollution by landfill leachate.

As many locations in this DSEIS it is stated that the current proposed design of the landfill liner and cover exceeds the current regulatory requirements for developing landfills. For example, “*The final cover proposed for the CRL is designed to exceed applicable regulatory standards.”* Those who understand the adequacy of the current landfill liner and cover requirements know that as originally developed the design requirements were well known to be inadequate arising out of a litigation settlement. In the past 15 years there have been numerous reviews that confirm that meeting and even exceeding the regulatory requirements does not mean that the landfill such as the proposed Campo Landfill will be protective of public health, ground and surface waters and the environment. This DSEIS is deficient in attempting to mislead the public and review agencies into believing the proposed landfill will be protective. The DSEIS should have informed the public and agencies about the long term problems issue in order that they may understand that meeting or even exceeding current landfilling regulations in landfill liner and cover design is not expected to be protective of public health, groundwater and surface water resources for as long as the wastes in the landfill will be a threat.

With this background on the long term problems with landfill liner and cover design as a result of inadequate regulatory requirements, it is important to review the characteristics of the proposed Campo Landfill cover design. As set forth in Table ES.3-2. Final Cover Design Comparison the proposed design is a five foot thick soil layer underlain by a plastic based drainage layer and a plastic sheeting layer. Lee and Jones-Lee in their “Flawed Technology” review discussed landfill cover issues for this type of cover as,

“Unreliable Evaluation of the Long-Term Integrity of Landfill Covers. *Subtitle D landfills are allowed to be closed with a landfill cover consisting of a soil layer above the wastes shaped to serve as the base for a low-permeability plastic sheeting layer, which is overlain by a one- to two-foot-thick drainage layer. Above the drainage layer is a few inches to a foot or so of topsoil that serves as a base for a vegetative layer. The vegetative layer is designed to promote the growth of vegetation that will reduce the erosion of the landfill cover. In principle, this landfill cover is supposed to allow part of the moisture that falls on the vegetative layer* *of the landfill to penetrate through the root zone of the vegetation in this layer to the porous (drainage) layer. When the moisture reaches the low-permeability plastic sheeting layer, it is supposed to move laterally to the outside of the landfill by flow upon the plastic sheeting layer in the cover.*

Landfill permit applicants and their consultants as well as some regulatory agency staff will claim that the eventual failure of the landfill bottom liner system is of limited significance in leading to groundwater pollution, since the landfill cover can keep the wastes dry, and thereby prevent leachate generation. Landfill permit applicants and their consultants, as well as some governmental agency staff who support a single composite liner system, will, at permitting hearings, show a picture of landfill leachate generation once the landfill is closed with a low-permeability cover. This image shows that the leachate generation rate in the closed landfill is greatly curtailed within a year after the cover is put in place. While they would like to have others believe that this situation will continue to exist in perpetuity, it will not because of the eventual deterioration of the plastic sheeting layer in the landfill cover. This issue is discussed further below."

"Another deception with respect to landfill covers is that they can be effectively monitored to detect when moisture leakage through the cover occurs. The typical monitoring approach that is advocated by landfill owners and operators and allowed by regulatory agencies involves a visual inspection of the surface of the vegetative soil layer of the landfill cover. However, as discussed by Lee and Jones-Lee (1995a, 1998a, 2004a), since the low-permeability layer (plastic sheeting) is buried below topsoil and a drainage layer, it is not possible to detect when the plastic sheeting layer deteriorates sufficiently to allow moisture that enters the topsoil and drainage layer to pass into the landfilled wastes. Distressed vegetation on the cover is not reliable for detection of plastic sheeting layer failure. If cracks or depressions are observed in the topsoil layer, these are filled with soil. Such an approach will not detect cracks in the plastic sheeting layer. As a result, the moisture that enters the drainage layer, which comes in contact with the plastic sheeting layer and which, when the plastic sheeting is new and constructed properly, runs off of the landfill, will instead penetrate into the wastes. This could occur at any time during the postclosure care period, and the increased leachate generation would be detected. However, it could also readily occur in year 31 after closure or thereafter, when there could be no one monitoring leachate generation, collection and removal.

Unless the landfill owner agrees to install, operate, and maintain in perpetuity, a leak-detectable cover for the landfill, the landfill cover system will fail to prevent entrance of moisture into the landfill and generation of leachate, even if it meets minimum Subtitle D requirements that are typically accepted by regulatory agencies. The leachate will, in turn, pass through the deteriorated bottom liner system into the underlying groundwaters.

Further, even if failure of the landfill cover were detected, the typical postclosure funding that is allowed does not provide adequate funds to determine the location in the low-permeability layer of the landfill cover that has failed and to repair it. In developing the amount of required postclosure funding, it is assumed by the regulatory agencies that the low-permeability plastic sheeting layer in a dry tomb landfill cover will maintain its *integrity throughout the 30-year postclosure care period, even though it is understood that the plastic sheeting layer in a landfill cover is subject to significant stresses due to differential settling of the wastes that can lead to its failure to prevent moisture from entering the wastes."*

"In the late 1980s/early 1990s, the US EPA conducted a series of seminars on RCRA/CERCLA landfill design issues. One of these was devoted to "Design and Construction of RCRA/CERCLA Final Covers" (US EPA, 1990). Included in the seminar notes was a section developed by Dr. David Daniel, then of the University of Texas, Austin (Daniel, 1990), which presented "Critical Factors in Soils Design for Covers." Dr. Daniel, in the appendix to his presentation, presented a paper by Montgomery and Parsons (1989), which summarized the results of a three-year study conducted in cooperation with the state of Wisconsin on the performance of various types of landfill soil covers. The Montgomery and Parsons study was conducted on three different 40ft x 40ft test plots near Omega Hills, Wisconsin, which is near Milwaukee. Daniel (1990) summarized the results, where, after three years,

- *"Upper 8 to 10 in. of clay was weathered and blocky*
- *Cracks up to 1/2 inch wide extended 35 to 40 inches into the clay*
- *Roots penetrated 8 to 10 inches into clay in a continuous mat, and some roots extended into crack planes as deep as 30 in. into the clay."*

Daniel also discussed the problems with soil/clay covers in withstanding stress-strain relationships associated with differential settling of the wastes under the cover, where he pointed out that differential settling can readily lead to cracks in the soil cover.

The NRC (2007) report states,
'Finally, a capability to predict the occurrence and impact of local heterogeneities in soil on the flow through cover systems does not yet exist. Most predictions are based on models that assume the properties of each soil layer in a cover system are homogeneous. However, the existence of local heterogeneities resulting from compaction, settlement induced cracking, and desiccation can result in significant differences between predicted and actual performance.'

'An alternative to conventional Subtitle D landfill cover design is the development of a ET cover. This cover approach is based on potential evapotranspiration (PET) that exceeds the actual supply of water (precipitation). Dryer (2003) and Dryer et al. (2000) have presented information on this approach. While the average monthly evapotranspiration exceeds the monthly average precipitation would lead to the conclusion that no moisture would enter the wastes through the cover, periods of above average precipitation could lead to some moisture would penetrate through the cover into the wastes. This in turn could lead leachate generation that can lead to groundwater pollution. The evaluation of an ET cover should not be based on monthly average net moisture flux through the cover but on worst case situations for wet periods.'

It is inappropriate to assume that the design permeability of the soil cover for a landfill will be applicable to controlling the amount of moisture that enters the wastes through the cover for as long as the wastes in the landfill will be a threat. What will actually occur at *proposed landfills with alternative landfill covers is that within a few years after construction of the cover the permeability of the cover will increase due to desiccation and differential settling cracks. Over time, vegetation roots will also increase the permeability of the cover. Therefore, the so-called equivalency of the soil cover to the plastic sheeting based cover will no longer hold."*

The Montgomery and Parsons (1989) Wisconsin study mentioned above involved five foot thick covers. The US EPA did not approve this type of landfill cover.

As with other sections of the DSEIS concerned with proposed Campo Landfill cover design the DSEIS is deficient in adequately and reliably presenting information on the expected performance of the proposed landfill cover for as long as the wastes in the landfill will be a threat. There is no doubt that in time the "top soil" will develop cracks that can serve as pathways for rapid transport of precipitation through this layer. The maintenance of the top soil layer will need to be maintained forever, i,e., for as long as the wastes in the landfill will generate leachate upon contact with water. Also there is no doubt that the plastic sheeting layer integrity will deteriorate and no longer transport water off the landfill but allow water to enter the wastes to generate leachate. Further since the plastic sheeting layer is buried under 5 feet of top soil it cannot be inspected to detect its deterioration. These issues should have been discussed in this DSEIS in order to inform the public and the agencies about the long term problems with this proposed landfill cover design. Without this discussion this SEIS does not comply with NEPA EIS requirements.

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Landfill Active Life and Closure

ES.3.3.3 Landfill Operations states, "Operations would proceed in 19 phases over the 30 year life of the landfill." indicating that the proposed active life during which wastes are to be accepted in the landfill is expected to be 30 years. This means that those who own and use property within the potential sphere of influence of this proposed landfill will experience the active life releases from the landfill for a projected 30 years. Based on experience at other landfills, the sphere of influence of active life releases can be a mile or more from the landfill. With only a few hundred feet of buffer land between where wastes will be deposited and adjacent property lines and existing as well as future uses of adjacent properties residences and other facilities the active life releases from this landfill will have to be dissipated on adjacent properties as a result of trespass of waste derived releases on to their properties. This situation leads to justified NIMBY (not in my backyard) opposition to this proposed landfill where the landfill developer does not provide adequate buffer lands where no wastes are deposited to dissipate landfill releases on landfill owner property. As discussed by Lee and Jones-Lee in their "Flawed Technology" review,

Hazards of Living/Working near Landfills

"*There are questions about the potential hazards of using a closed landfill as a playfield for children, constructing a school or playground adjacent to a closed (inactive) landfill, or purchasing residential property near an active and/or closed landfill. The public is justifiably concerned about the hazards of living next to, locating a school next to, or locating a playfield on a former landfill. Landfills, even those that contain so-called "nonhazardous" wastes, contain a variety of hazardous chemicals that, if not properly managed, can pollute groundwaters, soil and the atmosphere and therefore be a threat to those using properties near the landfill.*

An issue of concern is whether those who live near landfills show evidence of adverse health effects. Lee and Jones-Lee (2007c) have recently discussed this issue. It is known from a number of studies conducted by the Centers for Disease Control (Anderson, pers. comm., 1999) that some populations living near landfills have shown a greater incidence of some diseases. Elliott et al. (2001) have reported that children of people living near landfills in England tend to have a higher rate of birth defects than the general population. Environmental Health Perspectives has published a paper (Kouznetsova, et al., 2007) which relates residential proximity to hazardous waste sites to hospitalization associated with diabetes. A review of the various studies that have been conducted, however, reveals that the epidemiological approach for discerning health effects associated with populations living *near landfills is not sufficiently sensitive to reliably determine whether releases from the landfill are at least in part responsible for the health effects. A complicating factor is that those living near landfills frequently are economically disadvantaged and of a different ethnic mix than the general population. Further, data that have been developed on this issue have often been devoted to former (closed) landfill situations, where there is far greater limiting of landfill emissions than will occur, at least initially, with today's Subtitle C and D landfills.*

In the Lee and Jones-Lee (2007b) discussion of the hazards of living/working near landfills and hazardous chemical sites, they state,
"*It is well-established that airborne releases from hazardous chemical sites (including active and inactive landfills) can have a significant adverse impact on the population within the sphere of influence of the site."*

The Agency for Toxic Substances and Disease Registry (ATSDR, 2006) has developed a discussion on gaseous emissions from landfills, in which they state,
"Many of the typical landfill gases, notably the alkyl benzenes and the sulfur compounds (both organosulfides and acid gases), may present an odor problem that can cause adverse health effects such as mucous membrane irritation, respiratory irritation, nausea, and stress. If an individual has a pre-existing health condition (e.g., allergies, respiratory illness), these additional health impacts can be significant."

Lee and Jones-Lee (2007b) further state,
"With respect to the populations at risk from airborne releases of hazardous chemicals from a hazardous chemical site/landfill, as a first estimate, it would be all individuals who experience odors from the site. While many of the chemicals that are responsible for illness are non-odorous, typically, airborne releases from hazardous chemical sites/landfills have odorous components which are readily detectable by smell. It is for this reason that hazardous chemical site and municipal, industrial and hazardous waste landfills should be practicing sufficient odor control so that there is no detectable odor at the site boundary – i.e., no trespass of odorous emissions onto adjacent properties. The odor control should not be done through masking agents, but with treatment technologies that destroy the odor and, it is to be hoped, the hazardous chemicals associated with the odor as well.

It should not be assumed that the typical testing for airborne releases of hazardous chemicals associated with the evaluation of the impact of a landfill or other hazardous chemical site on adjacent properties is adequate to detect airborne hazardous chemicals released from the site. For some hazardous chemicals the analytical method detection limits are not adequate to detect the hazardous chemicals at concentrations of concern, either individually or in combination with other chemicals. The evaluation of whether odorous chemicals are being released from a site should be based on a properly documented assessment by individuals with above-average olfactory sensitivity."

Graiver et al. (2009) has reported that H6N2 sub-type of the avian influenza virus can remain infectious in MSW landfill leachate for up to 600 days. They conclude that the disposal of bird flu infected birds carcasses in MSW does not represent a threat to other birds."

Additional Impacts of Landfills on Nearby Properties Owners/Users

As discussed below typically MSW landfills have significant adverse impacts on nearby property owners/users. These issues are discussed in Lee and Jones-Lee Flawed Technology review and are summarized below.

Justified NIMBY

"Hirshfeld et al. (1992), of Duke University, in a paper, "Assessing the True Cost of Landfills," have summarized the potential impacts of landfills that should be addressed as part of landfill development. They point out that the environmental and social costs of landfills are usually ignored, which in turn inhibits the development of other waste management options, such as waste reduction, recycling and resource recovery. They divide the impacts of landfills into "physical" impacts and "social" impacts. The physical impacts are related to ground and surface water pollution by leachate migration, atmospheric releases of landfill gas, and fires. Landfill gas is known to cause explosions resulting in loss of life and property, and damage to vegetation. Hirshfeld et al. also point out that the non-methane organic compounds in landfill gas contain toxic chemicals that are a threat to cause cancer. Further, other components in landfill gas, such as hydrogen sulfide and organosulfur compounds can cause unpleasant odors associated with landfills.

The social impacts of landfills include increased traffic, visible air pollution, noise, aesthetic degradation and limited land utility. The social-impacts cost of landfills, according to Hirshfeld et al., is "(1) the cumulative decrease of surrounding property values; (2) the cost associated with land utility effects, also known as an 'opportunity cost'; and (3) a 'hastening cost'."

The state of Washington Department of Ecology in its Beyond Waste Project is conducting a comprehensive review of solid waste management practices in the state. As part of this effort a series of documents has been developed which discuss solid waste management issues. One of these publications, "Disposal – Yesterday, Today and Tomorrow" (Smith, 2004) states,
'The extent to which today's landfills adequately protect human health and the environment is a subject of debate, however. Requirements that govern siting, operation, closure, and post-closure are stringent and extensive. While the newest landfills are state-of-the-art facilities, they are far from benign in their impacts. Landfills may still affect the air, land, and water but to a significantly lesser degree than before today's standards went into effect.'

Typically, landfill proponents will characterize local opposition to a landfill as an ill-founded "Not In My Back Yard" (NIMBY) response of the public in the region. The authors have yet to find an individual located near a proposed landfill who does not become a "NIMBY." However, it is the authors' experience that, with few exceptions, all of those within a few miles of a proposed landfill are justified in their NIMBY response.

The authors have been involved in investigating over 80 landfills located in various parts of the US and in several other countries. They have also served as consultants to public groups and agencies on the potential impacts of proposed and existing landfills. Several years ago they published two papers, "Addressing Justifiable NIMBY: A Prescription for Siting MSW Landfills," (Lee and Jones-Lee, 1994d) and "Landfill NIMBY and Systems Engineering: A Paradigm for Urban Planning" (Lee et al., 1994), which discuss when NIMBY is justified.

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

Lee and Jones-Lee (2007d) have presented a discussion of the issues that need to be considered in evaluating the potential impacts of a landfill on those within the sphere of influence of the landfill. This review provides guidance on how those concerned about the siting of a landfill in their area should proceed to evaluate its potential impacts on their health, groundwater resources and interests.

Table 2, from the Lee et al. (1994) paper, lists the potential adverse impacts of landfills. As discussed above, the current typical municipal solid waste stream contains a wide variety of known and yet-to-be-identified hazardous and otherwise deleterious chemicals that are a threat to public health and the quality of groundwater that is used for domestic and agricultural purposes."

***"Inadequate Buffer Lands.** Landfill developers state that appropriate buffer zones have been planned for a proposed landfill, where a few hundred feet are allowed between where the wastes will be deposited and adjacent properties. While landfill developers claim that appropriate buffer zones have been planned, in fact even the most elementary understanding of the distances over which modern landfills can be adverse to adjacent property owners/users' health, welfare and interests shows that often several miles of buffer land is needed to dissipate the releases from a landfill on the landfill owner's property so that they are not adverse to adjacent property users/owners."*

***"Other Impacts of Landfill Releases and Activities.** Landfills can have a variety of additional impacts, such as fugitive trash, vermin, birds, noise, lights, etc., which are deleterious to the interests of those in the sphere of influence of the landfill. One of the major deficiencies of Subtitle D landfilling regulations is that the US EPA failed to address the justified NIMBY issues by failing to require that landfill owners provide adequate buffer lands between where the wastes will be deposited and adjacent properties. The typical approach that landfill owners/operators claim they will use as part of gaining a permit for siting a landfill, of limiting the size of the working face where each day's garbage is deposited, and then at the end of the day covering the daily deposited garbage with a thin layer of soil or other material, can, if fully implemented, reduce the magnitude of many of the adverse impacts associated with releases from the landfill during its active life, but does not eliminate them so that they are not adverse to adjacent property owners/users in those situations where there are inadequate buffer lands between the waste deposition area and adjacent properties. With at least a mile of land between where wastes are deposited and adjacent properties, it is possible to reduce the magnitude of justified NIMBY. To completely eliminate justified NIMBY would require, at many landfill locations, several miles of buffer lands owned by the landfill owner between where wastes can be deposited and adjacent properties.*

Table 2

<u>Adverse Impacts of "Dry Tomb" Landfills on Adjacent/Nearby Property Owners/Users</u>

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

From Lee et al. (1994)

<u>Vermin-Disease Vectors.</u> Vermin include animals such as rats and other rodents, and insects such as flies. In addition to being a nuisance, vermin can be vectors (carriers) of disease organisms and hazardous chemicals. Birds (gulls, crows, etc.) can be a significant problem at landfills, where large numbers will congregate and circle the landfill area, defecating on nearby residents and their properties, as well as schools, etc.

<u>Noise Pollution.</u> Hirshfeld et al. (1992) discuss landfill noise as part of their discussion of "Social Impacts" of landfills:

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

Noise pollution of the areas near a proposed landfill is a justified issue of concern because of the often limited buffer land between where wastes will be deposited and adjacent properties. This means that adjacent property owners can potentially experience noise pollution on their properties by the proposed landfill.

<u>Light Pollution.</u> Another issue of concern to the public is that some landfills operate at night, where nearby property owners would experience pollution by lights at the landfill. Some landfill operators plan to operate heavy equipment at night, under lights, for compaction of the wastes that had been received that day. This can lead to significant disruption of the interests of the nearby property owners/users, which should be controlled/prohibited.

<u>Stormwater Flooding Problems.</u> Frequently, landfill applicants will state that a landfill facility will be designed, constructed and maintained with a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 24 hr 25-year storm, and a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Some members of the public are concerned about a proposed landfill causing increased flooding of their property through diversion of stormwater. While, the landfill developer plans to collect all

stormwater that occurs on the landfill property in detention basins, this collection only applies to storms that result in a magnitude of less than the 25-yr, 24-hr discharge. Storms of greater magnitude than this will result in runoff from the landfill property onto adjacent properties.

Some landfills are constructed with a berm around the landfill property to divert waters around the property that now run onto this property. This berm could lead to increased flooding problems downstream of the proposed landfill. This would be of justifiable concern to the public, unless the landfill owner is required to manage the waters that now run onto the landfill property, which would be diverted around it by a berm, in such a way as to restore the current flow regime and amount downstream of the proposed landfill. Without requiring this approach, some downstream property owners could be adversely affected by the proposed stormwater management approach.

Decreased Values of Nearby Property. *One of the major concerns of property owners with the establishment of a landfill in their area is the decrease in their property values. Establishing a landfill with inadequate buffer lands between the waste deposition area and adjacent properties leads to decreased property values. This is a consequence of landfill owners/operators' failing to adequately control landfill releases to the air (odors, explosive gases, hazardous volatile chemicals, etc.) and groundwater (pollution), and landfill-associated activities such as truck traffic, noise, lights etc. While some landfill owners will claim that establishing a proposed landfill will not affect nearby property values, this is not in accord with the results of the studies conducted by Hirshfeld et al. (1992). They reported, based on studies at various locations, that decreased property values have been found as far as three miles from the landfill.*

Individuals who own land immediately adjacent to a proposed landfill, as well as most others who own property within several miles of a landfill, can be expected to have their property values significantly decreased by the development of the landfill. This is of particular economic significance to some property owners, since their property could be developed with substantial residential and commercial activities if it were not for the presence of the landfill."

There are many well known impacts of landfills that are developed without adequate buffer lands between the areas where wastes are deposited and adjacent properties such as the proposed Campo Landfill whose owners health, environmental resources and welfare will be adversely impacted by releases and the existence of the landfill. This DSEIS does not inform the public or review agencies about these issues for the proposed Campo Landfill and as a result does not comply with NEPA and BIA requirements for an adequate DSEIS.

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Landfill Closure Issues
The DSEIS section **ES.3.3.4 Landfill Closure** states,
"*Detailed design for monitoring systems to detect penetration of the final cover;*

However, no information is presented in the DSEIS on how the monitoring system will be developed and implemented to "*detect penetration of the final cover.*" As discussed above the key to keeping water from penetration of the cover and entering the wastes to thereby generate leachate is the integrity of the plastic sheeting layer in the cover which will deteriorate over the time that the wastes in the landfill will be a threat and which cannot be inspected.

"Detailed design for removal and decommissioning of facilities and controls, site security, final grading and face construction, including slope stability analysis, drainage controls, erosion controls, leachate control, ground water monitoring, gas monitoring, and details of the proposed final cover characteristics."

This statement about "decommissioning" of "*controls, site security, final grading and face construction, including slope stability analysis, drainage controls, erosion controls, leachate control, ground water monitoring, gas monitoring, and details of the proposed final cover characteristics*." misleads the reviewers of the DSEIS into believing that after a period of time there will be no need to operate and maintain the monitoring and controls that have been developed for this landfill. As discussed above concerning the problems with the "dry tomb" landfilling approach information is now well established in the professional literature that these features and activities will have to be operated and maintained for as long as the wastes in the landfill represent a threat to generate leachate when contacted by water. This period of time will extend beyond hundreds of years. This situation has important implications for landfill that are developed by private companies and others that are developing the landfill as a economic venture such as the proposed Campo Landfill. While in the early 1990s it was mistakenly thought that it would be possible to develop a landfill and generate a substantial revenue from its operation during the landfills active life followed by a few of no more than 30 years of postclosure monitoring and maintenance, in the past 15 years there has been a general understanding that only 30 years of postclosure monitoring and maintenance is a very small part of the time that funds will have to be spent on postclosure activities.

In addition to the literature discussed above on the long term problems of "dry tomb" landfills by Skinner, SWANA, NRC, and others Lee and Jones-Lee in their "Flawed Technology" review state,

"*Typically those developing a landfill propose to only be responsible for providing the financial assurance for: closure; postclosure and corrective action for the 30-year minimum period. Hickman (1992, 1995, 1997) and Hickman and Lanier (1998), in a series of articles ("Financial Assurance-Will the Check Bounce?", "Ticking Time Bombs?", "No Guarantee," "A Broken Promise Reversing 35 Years of Progress"), has discussed the inadequate approaches for postclosure funding under Subtitle D regulations. Lee and Jones-Lee (1992, 1993b, 2004d) and Lee (2003c) have published a number of reviews on the need for longer-term postclosure care, as well as the use of more reliable financial instruments to provide funding during the postclosure care period than is typically provided today.*

Lee and Jones-Lee (2004d) have discussed the unreliable information that some private landfill owners and their consultants are foisting on regulatory agencies where they claim that it is possible to predict, based on landfill monitoring, the duration of postclosure care. This is an attempt to try to limit the long-term liability of landfill owners for postclosure care. As *discussed by Lee and Jones-Lee (2004d), such claims ignore the processes that will take place in a "dry tomb" type landfill. Figure 8 provides a diagram of the expected situation with respect to landfill gas formation and leachate generation in a closed dry tomb landfill. A similar relationship has been developed by the California Integrated Waste Management Board (CIWMB, 2004). Once the landfill is closed with a low-permeability cover, the rate of landfill gas generation and leachate production will drop off and eventually stop if the landfill cover is effective in limiting moisture from entering the landfill. This is because both leachate generation and landfill gas production are dependent on moisture in the wastes.*

Christensen and Kjeldsen, (1989) have discussed the role of moisture in influencing landfill gas production. These relationships are shown in Figure 9. However, in time, as the low-permeability plastic sheeting layer in the cover deteriorates and moisture enters the landfill, landfill gas and leachate generation will start to occur again. There is no reliable way, under current "dry tomb" Subtitle D landfill cover design and monitoring, to predict when the postclosure dormant period will end and landfill gas and leachate production will begin to occur again.

The CIWMB, in accord with California Title 27 landfilling regulations of requiring postclosure monitoring and maintenance for as long as the wastes in the landfill will be a threat, is in the process of developing an approach to secure assured funding for postclosure monitoring and maintenance of closed landfills. Landfill owners, especially private owners, have voiced opposition to this approach. Lee and Jones-Lee (2007b) have provided the CIWMB with comments in support of its current efforts."

Since as quoted above the purpose of developing this proposed landfill is to develop income for the Campo Band, a NEPA compliant DSEIS must discuss the long term financial issues in developing the landfill so the public and review agencies that will review this proposed landfill and the Campo Band members can understand that the profits that can be developed during the landfill active life can have to be spent many times over in providing postclosure monitoring and maintenance as well as for groundwater remediation when the proposed landfill liner system fail to prevent leachate from penetrating through the liner into the underlying groundwater. It is important to note that developing a MSW landfill that *"comply with 40 CFR Part 258 (Criteria for Municipal Solid Waste Landfills)."* as indicated by the BIA in this DSEIS mandates that the long term postclosure monitoring and maintenance of the landfill be carried out. Failure to provide this level of postclosure funding will lead to offsite pollution of the groundwater by this landfill. All of these issues should have been discussed in this DSEIS; without this discussion the DSEIS does not comply with NEPA requirements for informing the public and reviewing agencies about the potential impact of the proposed Campo landfill.

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The DSEIS states,
“*There are no changes to landfill post-closure maintenance from the previous project evaluated in the FEIS. After completion of closure, CEPA would require the operator of the landfill to conduct a minimum of 30 years of post-closure maintenance or until the applicant demonstrates that the facility does not pose a threat to the public health, safety, and the environment as*

required under CTR §505.34(m). Post-closure maintenance would include monitoring water quality and landfill gas concentrations, final cover and vegetation inspection, routine maintenance, corrective action when necessary, and explosive gas control."

A key issue in this statement is the reliability of CEPA in enforcing the regulations. Of particular concern is how CEPA would determine that the wastes in the landfill would no longer be a *"threat to the public health, safety, and the environment as required under CTR §505.34(m).* **This information needs to be spelled out in detail to determine whether the proposed approach is reliable compared to extracting samples of wastes from the closed landfill and exposing it to water to determine if it still has the potential to generate leachate when contacted by water.**

The DSEIS also states in, *ES.4Environmental Impacts and Mitigation Measures,*

"The focus of the analyses in this SEIS is on the extent to which changes in the Proposed Project compare to that assessed in the FEIS, or changes in environmental conditions, analytical methods, or other information since 1992, would result in impacts different from those identified in the FEIS. Where impacts and mitigation measures would be essentially the same as those identified in the FEIS, the impacts are briefly summarized and the mitigation measures are retained. Where the impacts are expected to be different, or where more analysis has occurred since 1992 that supports different conclusions, those effects are discussed in detail in this document."

Since the development of the FEIS for the proposed landfill as documented herein there has been a considerable amount of new information on the closure of landfills that should have been discussed in this DSEIS. This DSEIS is simply a statement of the proposed development approach of the design of the landfill liner system, cover, closure and postclosure care. No discussion of the potential reliability of the proposed design, and expected performance based on information readily available in the post 1992 literature is presented. Without this information the public and reviewing agencies are not reliably informed on the potential public health, groundwater and surface water resources and other impacts on the adjacent and nearby property owners and users to the proposed landfill.

Failure of HDPE Liners

ES.4.1 Land Resources ES.4.1.1 Project Impacts states,

"*The Proposed Project would not rely on a two foot clay liner layer as considered in the FEIS and would instead utilize a GCL, consisting of pure bentonite sandwiched between two layers of geotextile. A GCL achieves a level of performance comparable to the prescriptive two foot clay layer and would be augmented by additional geomembrane layers both above and below the GCL. The leachate storage ponds would also be lined with double layers of geomembrane (60 mil HDPE), thereby resolving concerns about the porosity of the soil for water retention structures*."

The DSEIS fails to discuss the numerous documented problems with GCL liners; these have been discussed above. Without this discussion the reviewers of the DSEIS are mislead into believing that GLC liners will work perfectly for as long as the wastes in the landfill

will be a threat. This is a highly inappropriate conclusion where in fact some authorities recommend against using GLC liners as replacements for compacted clay liners.

The DSEIS mentions that HDPE plastic sheeting layers will be used in the landfill liner system and in the liners for the leachate storage ponds. However, it fails to discuss the numerous long term problems with geomembrane (60 mil HDPE) plastic sheeting liners. As discussed in Lee and Jones-Lee in their "Flawed Technology" review these plastic sheeting liners are well documented to undergo decomposition and will eventually fail to function as an effective barrier to leachate penetrating through the liner. Lee and Jones-Lee state,
"Expected Performance of Subtitle D Landfill Liner System. Lee and Jones-Lee (2004a) have discussed the characteristics and expected performance of the typical Subtitle D landfill liner containment system and monitoring system. As discussed, it is possible to construct a single composite landfill liner system that will not leak leachate at the time of construction at a sufficient rate to pollute large amounts of groundwaters. However, ultimately the plastic sheeting layer of such a landfill liner will deteriorate to the point where it will be ineffective in collecting leachate to enable its removal from the landfill in the leachate collection/removal system. This deterioration will eventually allow transport of leachate through the liner on its way toward the groundwater resources hydraulically connected to the landfill through a vadose (unsaturated) zone, which could be used for domestic water supply purposes. Further, compacted soil (clay layers) used in landfill liners are well-known to experience increased permeability with time over that which was designed and originally constructed.

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

Liner Failure Inevitable. Hsuan and Koerner (1995) have reported on the initial phase of long term (10-year) studies underway at that time devoted to examining the rates of deterioration of flexible membrane liners. The focus of the Hsuan and Koerner work was on the breakdown of the polymers in the plastic sheeting liners. They predicted that such breakdown will occur due to free radical polymer chain scission in 40 to 120 years. These estimates were indicated by Koerner to consider only some of the mechanisms that could cause breakdown. It is possible that breakdown could begin much earlier. Even if the breakdown of the plastic sheeting polymers took 100 years or so, ultimately the plastic sheeting in the flexible membrane liners will break down, leading to an inability to prevent large amounts of leachate from passing through the liner, causing groundwater pollution in the landfill area.

One of the approaches used by Koerner and his associates in an attempt to predict long-term stability of HDPE plastic sheeting liners is the application of the Arrhenius equation. This equation is used in physical chemistry to relate the effect of temperature on the rates of reactions. In some of Koerner's publications he has made predictions in which he has estimated, using the Arrhenius equation and short-term elevated temperature liner deterioration studies *that the HDPE liners should be serviceable for hundreds to a thousand or so years, but eventually will break down. The US EPA (Bonaparte et al., 2002) has released a report that claims that a single composite landfill liner can be expected to have a service life of "1,000 years." A critical review of the technical base for this estimate shows that it is based on an Arrhenius equation extrapolation of a few studies on liner stability that were conducted for short periods of time at elevated temperatures compared to landfill temperatures. This approach for extrapolation is highly speculative and likely to be unreliable. That report continues to support the US EPA (1988a,b) conclusion about the eventual failure of the landfill liner system and its leading to groundwater pollution. While the length of time that the landfill liner will delay groundwater pollution is unknown, there is no doubt that a single composite landfill liner system will eventually fail, and groundwater pollution will occur, when the landfill is sited at locations where there is high-quality groundwater underlying the landfill.*

In the US EPA (Bonaparte et al., 2002) report, Koerner made a significant error in claiming that the municipal solid wastes in a Subtitle D "dry tomb" landfill will only be a threat for about 200 years. There is no technical validity for that estimate. It is obvious that in a "dry tomb" landfill, a number of the normal components of MSW will be a threat forever – not just 200 years. The metals, salts, and many organic compounds that are typically present in MSW and that produce hazardous and deleterious leachate will be a threat forever. In that report the US EPA is attempting to support the continued use of single composite lined landfills for MSW management by claiming the wastes will be a threat for only 200 years, and the liner will work perfectly for 1,000 years. Such claims are fundamentally flawed.

Needham et al. (2003) reported on a study commissioned by the Environment Agency of the UK on the long-term service life of HDPE geomembrane liners. They concluded that, " the service life of HDPE liners depends upon the rate of generation of holes in the liner and the acceptability of leachate or gas leakage at a particular site. A thorough review of physical damage, material degradation processes and the development of holes by stress cracking has been undertaken. A conceptual model of hole generation in six stages throughout the service life of an HDPE liner is presented. Electrical leak location surveys are seen to be effective means of identifying holes caused by physical damage during liner installation and waste disposal, and permitting their repair. Degradation of the HDPE liner is controlled by the liner exposure conditions, the activation energy of the antioxidant depletion process and the oxidative resistance of the material. Where the liner is subjected to long-term stresses, stress cracking will lead to the development of holes, and the rate of cracking will increase once oxidation of the liner commences."

Rowe et al. (2003) have reported on the failure of an HDPE lined leachate lagoon. They stated, "A geomembrane – compacted clay composite liner system used to contain municipal solid waste (MSW) landfill leachate for 14 years is evaluated. Field observations of the geomembrane revealed many defects, including holes, patches, and cracks.

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"Contaminant modelling of the entire lagoon liner suggests that the geomembrane liner most likely stopped being effective as a contaminant barrier to ionic species sometime between 0 and 4 years after the installation."

It is evident that under some situations there can be rapid failure of HDPE liners that are used in waste management including landfill leachate lagoons and liners.

Minimum Subtitle D landfills include a composite liner composed of a flexible membrane liner (FML) (plastic sheet) and a compacted soil layer or geosynthetic clay liner below it. While in concept a composite liner can provide greater postponement of leakage than the sum of the two liner components, the true composite character is difficult to achieve in practical applications (Lee and Jones, 1992), since it requires that the plastic sheeting liner be in intimate contact with the compacted soil layer. There are significant problems in achieving this degree of contact in the construction of a composite liner.

NRC Committee Report. In 2007 a National Resources Council Committee (NRC 2007) issued a report, "Assessment of the Performance of Engineered Waste Containment Barriers," that presents a discussion of expected performance of landfill liner containment systems. Considerable information is presented on many of the issues discussed in this Flawed Technology report on the near term and especially the long term performance of plastic sheeting and compacted clay landfill liners and covers. The NRC (2007) report provides additional references beyond those presented herein and discussion of the long term issues of the plastic sheeting (HDPE) and compacted clay liners and landfill covers to contain landfilled wastes for as long as the wastes are a threat to release pollutants to the groundwaters and the atmosphere.

The NRC Committee report states that landfill containment systems (liners and cover) has performed satisfactorily where the report states,
"Based on as much as 20 years of observations, the committee concluded that most engineered waste-containment barrier systems that have been designed, constructed, operated, and maintained in accordance with current statutory regulations and requirements have thus far provided environmental protection at or above specified levels."

Obrien (2009) in SWANA ARF Disposal Group Report on the Long Term Potential Problems of Subtitle D Landfills, is attempting to use this statement to support that today's Subtitle D landfills are performing satisfactorily. However, Lee and Jones-Lee (2009a,b) have discussed a significant problem with the NRC (2007) report in the discussion of the NRC Committee assessment of the performance of the existing Subtitle D landfills. The basic problem with the NRC Committee conclusion on the performance of existing Subtitle D landfills is that the Committee failed to understand/discuss that the approach used of relying on the presence of leachate in the leachate collection system and the failure to find leachate polluted groundwater at the point of compliance for groundwater monitoring are not reliable indicators for the integrity of the landfill liner system. As discussed below failure to find leachate polluted groundwater at the point of compliance for groundwater monitoring reflects the unreliability of groundwater monitoring wells spaced hundreds of feet apart where each well only samples water about one foot around the well in detecting initial groundwater pollution by failed landfill liners."

The NRC (2007) report states,

"Over the medium and long terms, geomembrane performance may be reduced by punctures caused by increased overburden pressure, material degradation, and high temperatures. The estimated service lives of geomembranes decrease from 1,000 years at 10°C to only about 15 years at 60°C."

As discussed herein and in the NRC (2007) report there is considerable uncertainty about the performance of plastic sheeting liners in preventing leachate from leaving the landfill and polluting groundwaters."

"*Permeation through the Liner. The plastic sheeting HDPE liner will allow dilute solutions of organic solvents such as those that can be purchased in hardware stores for household use to pass through an intact (no holes) liner. Many of these solvents are carcinogens and can be readily transported through groundwater systems. The phenomenon in which organics pass through intact plastic sheeting layers is known as permeation and has been recognized in the landfill liner literature since the late 1980s (Haxo and Lahey, 1988). This is a chemical transport process in which low molecular weight organics dissolve into the plastic liner and exit on the downgradient side. Sakti et al. (1991) and Park et al. (1996), at the University of Wisconsin, Madison, have reviewed the available information on permeation of landfill liners by solvents and have conducted extensive research on it. They found that an HDPE liner would have to be over three inches thick to prevent permeation of certain organics through it for a period of 25 years. Buss et al. (1995) reviewed the information on the mechanisms of leakage through synthetic landfill liner materials. They discussed the importance of permeation of organics through plastic sheeting liners as a landfill liner leakage mechanism that does not require deterioration of the liner properties for leakage to occur. The US EPA and other regulatory agencies continue to ignore this mechanism of landfill liner leakage. There is need to address this issue as part of recommending a single composite liner system for municipal solid waste landfills.*

Diffusion Can Be Important. Daniel and Shackelford (1989) have reviewed the inherent leakage rates of plastic sheeting layers and clay liners. They point out that even though plastic sheeting layers can have low permeabilities to water on the order of 10^{-12} cm/sec, compared to clay liners which have a permeability of about 10^{-7} cm/sec at the time of construction, the thin layer of plastic that is used, coupled with its inherent chemical diffusion coefficients, cause plastic sheeting liners of the type used in Subtitle D landfills to have diffusion-controlled breakthrough times for waste components of about two to three years. The clay liner, however, in the landfill cells would be expected to have diffusion-controlled breakthrough times of about 10 years."

It is clear from the landfill liner literature almost all of which has been developed since 1992 that plastic sheeting HDPE liners will ultimately fail to prevent leachate from passing through them over the period of time that the wastes in the proposed Campo Landfill will be a threat. Contrary to the above quoted statement in the DSEIS, *"thereby resolving concerns about the porosity of the soil for water retention structures."* a full disclosure discussion of the expected performance of the plastic sheeting liners and the leachate storage lagoons that are proposed for the Campo Landfill would show that the concern about the *porosity of the soil for water retention structures* is even greater today than it was in 1992. In order to conform to NEPA and BIA requirements for discussing the potential

problems with the proposed Campo Landfill these issues should have been discussed in this DSEIS.

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Surface Water Quality Impacts
ES.4.2 Water Resources ES.4.2.1 Project Impacts states,
“*For surface water, project impacts would be considered significant if: the facility stormwater control system cannot convey, as defined by the prescriptive design standards (V CTR §530.38(a)); alterations of surface water runoff patterns adversely impact downstream flows; degradation of surface water quality results from project construction or operation, including adverse release of sediment or chemicals;..”*

While meeting minimum the 24-hour, 100-year flood requirements meets current minimum Subtitle D flood flow design requirements, flood flows above this amount do occur that at the proposed Campo Landfill setting will be more adverse to the nearby downstream owner/users of properties than would occur if the landfill were not constructed as proposed a the proposed location. This issue should have been discussed in this DSEIS.

The DSEIS also states,
“ with respect to protection of groundwater quality; the groundwater monitoring program would not adequately detect potential contamination plumes; groundwater quality would be degraded due to project activities. Water quality would be considered degraded if testing indicated project-related contaminant levels in excess of standards listed in Appendix II of 40 CFR § 258.”

“*With regard to groundwater quality, there is a potential for both leakage from beneath the landfill and contaminated surface runoff to adversely affect water quality if adequate precautions are not implemented. The proposed liner system exceeds federal prescriptive design standards. A secondary liner and leak detection system is also proposed for the landfill that would permit the operator to detect leakage in the primary liner and take corrective action before leakage would affect groundwater. In addition, a Groundwater Detection Monitoring Program would be implemented to sample groundwater beneath the landfill in case the composite liner system in combination with the leak detection system in the secondary liner failed to detect a leak. The combination of the proposed monitoring program, CEPA* *regulations, and the above measures would ensure reduce groundwater quality impacts would be less than significant."*

"ES.4.2.2 Cumulative Impacts *In addition, implementation of the proposed groundwater monitoring plan, in combination with recommended mitigation measures presented in this DSEIS, would result in less than significant groundwater quality impacts. Therefore, based on the low likelihood of groundwater contamination impacts associated with cumulative project development, in combination with less than significant impacts as a result of the Proposed Project, cumulative impacts would be less than significant."*

The adequacy of the proposed groundwater monitoring system proposed for the Campo Landfill is one of the most significant issues that should have been discussed in this DSEIS. Attached to these comments is a letter from the US EPA Region 9 dated January 4, 1993 from Deanna Wieman Director of the US EPA Office of External Affairs to R, Jaeger BIA Area Director which states,
"*Based on new information in the Final EIS and the response BIA provided to EPA's comments on the Draft EIS, it indeed appears that the project may not be able to comply with the groundwater monitoring provisions of 40 CFR Part 258. Our detailed comments regarding the feasibility of groundwater monitoring at the proposed landfill site and compliance with Part 258 are enclosed. Additional comments regarding other FEIS issues are also enclosed."*

Attached to the US EPA letter is a detailed discussion of issues pertinent to the monitoring of groundwater underlying the landfill to "*comply with 40 CFR Part 258 (Criteria for Municipal Solid Waste Landfills)."* as set forth in the initial DSEIS BIA statement of applicable regulations for the development of this landfill.

The background to the US EPA January 4, 1993 letter states,
"56 Fed. Reg. 51049 (October 9, 1991).
The relevant groundwater monitoring requirements referred to in the above paragraph provide as follows:
258.51 Groundwater Monitoring Systems
(a) A groundwater monitoring system must be installed that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer...that:

...(2) Represent the quality of the groundwater passing the relevant point of compliance specified by the Director of an approved State under § 258.40(d) or at the waste management unit boundary in unapproved' States.

In this case, the proposed landfill must have a groundwater monitoring system that is capable of sampling and representing the quality of groundwater passing under the landfill boundary.

Additionally, 40 CFR Part 258.51(d)(1)(i) states "(t)he number, spacing and depths of the monitoring system shall be determined based upon site-specific technical information that must include a thorough characterization of aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in the groundwater flow...."

On December 12, 2005 Duane James, Manager US EPA Region 9 Environmental Review Office in a letter to Clay Gregory, Regional Director BIA provides "EPA Comments on the Proposed Campo Solid Waste Landfill Facility on the Campo Indian Reservation, San Diego, California" This letter is attached to these comments. The letter contains requirements that the US EPA that will consider in reviewing the DSEIS which states,

'***Municipal Solid Waste Landfill Requirements***

EPA will review the SETS to ensure the design, siting, and operation of the proposed landfill satisfies the Federal regulatory requirements for Municipal Solid Waste Landfills (MSWLFs), 40 CFR 258.

'*Pursuant to 40 CFR 258.51(a)(2), a groundwater monitoring system must be installed which ensures detection of contamination to the uppermost aquifer. The Campo-Cottonwood Aquifer, which lies underneath the Campo Reservation, is designated as a Sole Source Aquifer under the Safe Drinking Water Act. This designation signifies the area's dependence on this aquifer as the major source of drinking water, and its protection is critical. Past studies have documented that the aquifer beneath the site is contained within fractured bedrock and that drinking water wells are located downgradient of the site.*

The fractured bedrock nature of the aquifer presents a challenge to effective groundwater monitoring. To meet federal criteria for aquifer protection and groundwater monitoring, the project proponent must demonstrate how a monitoring well network installed in fractured bedrock will meet these requirements. EPA will closely review the facility design (liner and leachate collection system) and the groundwater monitoring system design to ensure federal criteria for aquifer protection and groundwater monitoring are met. The SETS should document this monitoring requirement,'

Attached to the US EPA Region 9 1994 letter are two maps of the highly fractured geology that underlies the site of the proposed Campo Landfill. It is this geology that has stimulated the US EPA to indicate that the proposed groundwater monitoring program for the proposed Campo Landfill "*., it indeed appears that the project may not be able to comply with the groundwater monitoring provisions of 40 CFR Part 258"quoted above.*

Dr. Victor M. Ponce, in "IMPACT OF THE PROPOSED CAMPO LANDFILL ON THE HYDROLOGY OF THE TIERRA DEL SOL WATERSHED A REFERENCE STUDY" May 2006 report provides a detailed discussion of the hydrogeology of the area under and near the proposed landfill. A copy of this report is being submitted by Dr. Ponce in comments on the DSEIS. This report states in the Executive Summary,

'Analysis of precipitation and well data suggests the presence of an effective hydraulic connection between surface water and groundwater in the region. Existing fracture maps and other geologic evidence reveal the extent to which the underlying aquifer is fractured. The presence of numerous springs and photogeologic lineaments indicates that water flows readily from the fractured-rock aquifer to the creeks, streams, and wells of the Tierra del Sol watershed.'

'In fractured-rock aquifers, a leachate plume will move preferentially along the fractures. Advection is likely to be the predominant physical mechanism, with travel times from capture zone to nearby wells measured in days, rather than in years as would be the case in more traditional diffusion-dominated settings. Given the complexity of the fractured-rock system, the probability that leachate plumes will be missed by the system of monitoring wells is high. Thus, placing a major landfill on top of a fractured-rock aquifer such as Tierra del Sol's significantly compromises the health and welfare of the local population on both sides of the U.S.-Mexico

border. Moreover, Tierra del Sol is part of the federally designated Campo-Cottonwood Sole Source Aquifer, i.e., it has been determined that, should this aquifer become contaminated, there are no reasonably available alternative sources of drinking water.'

Lee and Jones-Lee in their "Flawed Technology" review state with respect attempting to monitoring the failure of landfill liners that are located above a fractured bedrock,
"*Monitoring of Some Fractured Rock Aquifers Nearly Impossible. The ability to define the shape and movement of a contaminant finger-plume from a lined landfill depends on the hydrogeological characteristics of the aquifer-strata. In homogeneous, isotropic "sand" systems, the vertical and horizontal spread of point source discharges/leaks from a given point can be estimated with some degree of reliability. However, the hydrogeology of many locations in which landfills are sited is sufficiently complex so that predictions of the spread of a leachate plume are fairly unreliable. The presence of fractured bedrock, fissures, cavernous calcareous strata, and non-isotropic lenticular aquifers (such as former river beds) make the reliable prediction of flow paths from point-source leaks from lined landfills more difficult or even impossible and make the monitoring of groundwater for incipient leachate pollution highly unreliable and virtually impossible,*

"Haitjema (1991) stated
"An extreme example of Equation (1) (aquifer heterogeneity) is flow through fractured rock. The design of monitoring well systems in such an environment is a nightmare and usually not more than a blind gamble."

* * *

"Monitoring wells in the regional aquifer are unreliable detectors of local leaks in a landfill."

"Even the fact that a monitoring well intercepts a fissure/crack does not mean that the leachate in that fissure system is reliably sampled during groundwater monitoring. The amount of water extracted during sampling is typically quite small; the result is that the zone of capture around the monitoring well, even in a fracture, is often limited. Thus, leachate-contaminated groundwater can be present in a fracture without its being detected by the monitoring programs typically used. Therefore, in addition to misconceptions about the nature of the spread of leachate from lined landfills, an incomplete or unreliable assessment of the geological features of the subsurface system and complex hydrogeology can further reduce the probability that the groundwater monitoring well array will intercept any initial plume of leachate-contaminated groundwater at the point of compliance for the MSW landfill monitoring program. This situation raises significant questions about whether single composite lined landfills should be allowed to be located above fractured rock aquifer systems, because of the inability to reliably monitor groundwater pollution in such systems."

Overall it is clear that the BIA DSEIS for the proposed Campo Landfill falls far short of reliably of the DSEIS in providing the information that the public and review agencies need to understand the issues associated with the impact of the fractured bedrock underlying the proposed landfill in the potential for the eventual failure of the proposed landfill liner system will lead to offsite groundwater and surface water pollution by landfill leachate.

Table ES-4 presents a summary of the Compo Landfill impacts and the proposed mitigation. This table presents the regulations governing the monitoring of groundwater quality as,

Campo Regional Landfill Supplemental EIS

 Campo Tribal Regulations require the following Water Quality Protection Measures:
o Construction of an engineered double liner system to isolate the landfill from the subsurface environment [V CTR § 530.33].
Operational controls which include sorting to prevent introduction of toxic materials into the waste materials disposed to the landfill [V CTR § 530.03(b)].
o Construction and operational controls to minimize generation of leachate in the landfill [V CTR § 530.50].
o Stormwater drainage controls to prevent stormwater runoff from entering the landfill [V CTR §§ 505.23(c), 530.17(f), and 530.36].
o Daily cover of waste to retard infiltration of stormwater [V CTR § 530.16(f)(1)].
o Final cover and revegetation of portions of the landfill as they reach final grade [V CTR § 530.16(f)(3) and 530.72(a)].

- In order to minimize the possibility of groundwater quality degradation due to landfill operations, the operator must design, develop, and maintain a groundwater monitoring program that is consistent with federal and tribal regulations. A water quality monitoring plan is applicable for the active life, closure, and post-closure maintenance periods of the proposed disposal facility and is required by CEPA regulations to include the following:

o **Detection Monitoring Plan (V CTR 530.36)**. A routine groundwater sampling and analysis program for groundwater samples from both weathered and unweathered tonalite wells. Statistically significant results will trigger the Evaluation Monitoring Program.
o **Evaluation Monitoring Plan (V CTR530.48)**. Statistically significant results in the Detection Monitoring Program shall trigger evaluation monitoring, to establish proposed changes to the existing water quality monitoring system, assess the nature and extent of the release from the disposal facility, require submittal to CEPA an assessment of the release, and update the engineering feasibility study.
o **Corrective Action Program (V CTR 530.49)**. If a release has occurred, the operator shall be required to initiate a Corrective Action Program that shall comply with CEPA regulations, and that shall be designed to achieve water quality protection standards, as specified in the permit conditions.
Any corrective actions in the weathered or unweathered tonalite shall be both location and release specific.

- The landfill operator shall establish a program for sampling of off-site domestic wells within the project area. This sampling program shall allow for voluntary participation by owners of the domestic wells for establishment of background water quality and conduct of ongoing sampling. Background data shall be used to assess water quality impacts, should a release from the facility occur.
- The landfill operator shall establish a detailed construction quality assurance/quality control (QA/QC) program for all landfill liner and cap components. The purpose of this QA/QC program shall be to assure that maximum control is maintained over construction quality throughout all phases of landfill construction.

The blanket statements made in this "Summary" table about how the proposed landfill liner system will prevent groundwater pollution by landfill leachate ignores the substantial literature some of which is presented in these comments that this liner system will

eventually fail to prevent leachate that will be generated in the landfill over the period that the wastes in the landfill will be a threat to generate leachate upon contact by water to pollute the underlying and offsite groundwaters and surface waters of the area. The statement of the regulation requirements without discussing the potential reliability of the proposed approach for developing this landfill does not meet NEPA requirements for a credible DSEIS.

Comments on the Main Body of the SEIS Pertinent to the Proposed Landfill Ability to Prevent Groundwater Pollution

The comments provided in this section will supplement the comments made on the same issues discussed above in the Executive Summary comments and will not be repeated herein.

Protection of Area Water Resources
Section 4.2 Water Resources presents additional information on the proposed landfill liner design and its ability to protect the groundwater resources of the area.
"*4.2.5.2 Supplemental EIS*
New circumstances or information relevant to water quality since completion of the FEIS are addressed below.

Unreliable Use of the HELP Model
4.2.5.2.1 Hydrologic Evaluation of Landfill Performance
Federal landfill design criteria specified in Subtitle D (40 CFR Part 258), require a single composite liner, consisting of: (1) an upper component with a minimum 30 mil flexible membrane liner or for 60 mil for flexible membrane liners components consisting of HDPE, and (2) a lower component with at least a 2 foot layer of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} *cm/sec. Alternative liners are permitted under Federal regulations with EPA approval of a Site Specific Flexibility Request (SSFR) that demonstrates the liner is at least as protective as the prescriptive liner defined in 40 CFR Part 258."*

This statement is misleading in that the Subtitle D landfill liner system required is only a single composite liner. The DSEIS should have indicated that it has been recognized since the late 1990s that that design will only at best postpone the landfill pollution of groundwater. As discussed above it will not prevent it. There are over half a dozen states that will not allow the minimum landfill liner design to be used in their state.

Meeting Minimum Required Design is Not Protective
This section of the DSEIS states,
"*The proposed landfill has been designed with an encapsulated GCL and a double liner system, rather than a single liner. This double liner system is shown schematically in Figure 2.1-6 and consists of two components: the primary liner which forms the base of the landfill beneath the waste; and (2) a secondary liner beneath the primary liner. The latter would serve the dual purpose of an additional barrier to the transport of fluids accumulated in the waste layers, should the primary liner system develop a leak, as well as a leak detection system that would alert the landfill operator to the presence of a leak in the primary liner and facilitate remedial action before leakage could reach the soil beneath the landfill. The combination of primary and*

secondary liners is designed to exceed federal and Tribal regulatory requirements for Class III landfills. The primary and secondary liner systems are described in more detail in Section 2.3.3.1."

As discussed above meeting and exceeding the minimum federal landfill design regulations does not provide for protection of groundwater quality for as long as the wastes in the "dry tomb" landfill will be a threat to generate leachate.

The discussion provided above provides detailed discussion of the many problems with the GCL liners to provide an effective barrier to leachate leaving the landfill and entering the underlying groundwater system. These issues should have been discussed in the DSEIS.

"*A SSFR, included in Appendix D, has been prepared by the applicant to demonstrate (to CEPA and the USEPA) that the alternative liner is equally or more protective of groundwater, in accordance with 40 CFR Part 258.40(a)(1). As part of the SSFR, an updated HELP model was used to evaluate the performance of the landfill and for a leak from a single hole. The latter scenario is the most conservative. As a further conservative assumption, the single hole was located at the downgradient edge of the landfill so that it was closest to the groundwater monitoring wells. The leaks were assumed to leak continuously for 50 years and the modeled concentration approached steady-state in that time.*

The model results demonstrate that the proposed landfill liner with GCL has less potential for leakage than the prescriptive standard. The proposed liner is calculated to have an estimated leakage rate approximately one-fourth the amount of the prescriptive liner. No exceedances of the EPA maximum contaminant levels (MCLs) or secondary standards, California MCLs or California Detection Limits for Purposes of Reporting (DLRs) for drinking water were predicted by the model."

These paragraphs are additional examples of the misleading information presented in the DSEIS with respect to the reliability of the HELP model to predict the rate of leakage of leachate through the landfill liner system over the very long period of time that the wastes in the proposed landfill can generate leachate.

Lee and Jones-Lee in their "Flawed Technology" review stated,
A critical review of the HELP model calculations shows that a key component of the calculations of the expected amount of percolation of water through the cover into the wastes is the assumed permeability of the low-permeability layer of the cover. Typically, landfill consultants assume that the construction of the cover will achieve the design permeability. Further, and most importantly, they assume that the design permeability of the cover will be maintained over the period of postclosure care (30 years) and throughout the period that the wastes in the landfill will be a threat. However, no information is provided on the permeability of the cover over the period of time that the wastes in the landfill will be a threat – i.e., effectively, forever."

"Potential impacts on local groundwater quality would be minimized by the proposed engineered double liner and LCRS, combined with proper landfill operating procedures and the final landfill cover."

"*4.2.5.2.2 Groundwater Quality Impacts*
As described in Section 3.2.2, Local Hydrogeologic Conditions, detailed evaluations demonstrate that the groundwater flow system, even though it is in part a fractured rock system, can be described and modeled as equivalent to porous media, using Modflow as a modeling tool. In order to address the nature of groundwater flow and the effectiveness of the monitoring well network at the Project Site, Golder Associates Inc. presented (Appendix C-4) used the FracMan system of codes (Dershowitz et al. 1994) for groundwater flow analysis, in combination with Modflow (Harbaugh et al. 2000).

Potential contamination pathways from the northern portion of the Project Site were evaluated by simulating contaminant releases from nine different points on the base of the landfill bottom liner (Figure 4.2-4). The points were spread evenly over the base of the landfill bottom liner so that a release from any portion of the landfill module could be evaluated. Particle tracking shows that the particles (representing a potential contaminant plume) all move west-northwest with velocities on the order of about 1 foot per day to 5 feet per day, which is consistent with the velocities measured in the tracer tests results (see Section 3.2.2,

Local Hydrogeologic Conditions). The pathways remain relatively shallow, due to upward gradients in groundwater flows in the western portion of the landfill. These gradients are consistent with upward flows measured from the lower zone wells (Appendix C-4). For expected values of transverse dispersion (which is the tendency for a contaminant to spread laterally as it moves in groundwater), plume widths would be on the order of 100 to 400 feet wide upon encountering

The monitoring well network. The spreading of the contaminant particles depends on the distance traveled and transverse dispersion coefficient. The variation with travel distance implies that particles that are released in the western part of the landfill, especially those with small dispersion values, would be more difficult to capture in widely spaced monitoring wells because the travel distances are shorter and the plumes spread less than releases from further up in the landfill (Appendix C-4).

The results of the site investigation, including well testing and modeling of the monitoring well network, indicate that the groundwater system at the Project Site is composed of a hydraulically interconnected network of weathered fractures. Flow is predominantly lateral and/or downward in the upper zone (generally moving less than a depth of 100 feet) and upgradient from portions of the deeper system, indicating recharge from below. This scenario indicates that upper zone wells located along the downgradient margin of the Project Site would be likely to detect a release under most contaminant release conditions.

The hydrodynamic information yielded by ambient flow testing, in the vicinity of the landfill (Appendix C-4), has important implications for the expected behavior of the monitoring well network in the event of a contaminant release. The hydraulic gradients in the lower zone boreholes indicate that the downward movement of potential contaminants from the landfill should be limited to about 100 feet. Below this depth, if contaminants were to reach that depth, they would move laterally or upwards. Numerical modeling simulations indicate that this flow *pattern would not be affected by development of the landfill and subsequent influences to the recharge of groundwater in the area."*

It is inappropriate to try give the impression that modeling the rate of leakage using *for a leak from a single hole* as is done in this DSEIS is representative of the conditions that will exist over the time that the wastes in this proposed landfill will be a threat to generate leachate that can cause offsite groundwater pollution. In fact over time the number of holes in GCL liner system will increase from the initial single hole to eventual deteriorate to the point where it is no longer an effective barrier to preventing leachate from passing through the liner. This is an issue that should have been discussed in the DSEIS to reliable inform the public and review agencies about the ability to function as an effective barrier for as long as the wastes in this proposed landfill will be a threat.

"*Other measures required by tribal regulations to prevent leachate from impacting groundwater resources have been included in the design of the Proposed Action, as well. These measures include: Operational controls, which include inspection and sorting to prevent introduction of toxic materials into the waste materials disposed to the landfill [V CTR § 530.03(b)]."*

It is highly inappropriate to claim the proposed waste sorting that is proposed for the Campo Landfill or that mater for any landfill owner/operator to claim that it will *"prevent toxic materials into the waste materials disposed to the landfill [V CTR § 530.03(b)]."* While the Subtitle D landfill regulation require that hazardous wastes are not deposited in a MSW landfill, as discussed above the definition of hazardous wastes does not preclude the deposition of hazardous chemicals that are a threat to human health and the environment. The DSEIS should have discussed that that even if all defined "hazardous wastes" could be excluded from the landfill the normal municipal waste solid wastes stream contains a wide variety of toxic chemicals and other chemicals that can be a significant threat to the use of a leachate polluted groundwater as a domestic water supply.

"*Consistent with the conclusions in the FEIS, the current analysis concurs that, should a breach in the liner system occur and should leachate reach the groundwater, the leachate concentration would be attenuated by dispersion, dilution, chemical adsorption, and other factors, while migrating downgradient by longitudinal and lateral hydrodynamic dispersion. Once the leachate front extends beyond the Project Site perimeter, additional dilution through recharge from infiltration is possible. However, these attenuating factors would not reduce impacts to less than significant levels."*

While dilution dispersion and other attention mechanisms can in certain types of aquifers for landfills located with adequate buffer lands between where the wastes are deposited and the adjacent property lines, the situation at the proposed Campo Landfill with only a few hundred feet between where wastes will be deposited and adjacent properties in a fractured bedrock aquifer system, it is impropriate to claim that attenuation in this aquifer system and the location of the landfill to adjacent properties as it is done in this DSEIS will eliminate offsite groundwater pollution. The DSEIS should have discussed the reliability of modeling of attenuation of pollutants in this system so that the public and review agencies

understand that the modeling of attenuation is highly dependent the assumptions used in the modeling.

"*4.2.5.2.3 Groundwater Detection Monitoring Program Purpose and Goals*
The success of any given groundwater monitoring system depends on the detection of contaminants by the monitoring well network. For this detection to occur, the monitoring well systems should meet several criteria.

First, the network should concentrate on the downgradient side of the landfill, where groundwater flow is likely to occur. Second, the wells should be screened at the depths where contaminant flow is likely to occurs so that contamination does not pass above or below the monitored well intervals. Third, the monitoring wells should be spaced at intervals comparable to the width of possible contaminant plumes, in order that those plumes do not pass undetected between the wells. Finally, the sampling intervals should be sufficiently frequent that a contaminant plume would not pass far from the site before detection.

More specific to the Proposed Action, important parameters in developing the groundwater monitoring plan include: The connectivity of the fracture system, which determines whether a release would be detected in the monitoring wells; and the geometry and flow characteristics of the fracture system, which determines whether pathways exist that could bypass the monitoring well system. The following is a summary of the Groundwater Monitoring Plan that has been proposed as part of the Proposed Action (Appendix C-3). This plan supplements the Groundwater Monitoring Plan discussed in Section Monitoring Points A conceptual cross-sectional view of the monitoring plan is illustrated on Figure 4.2-5; proposed monitoring well locations are shown in Figure 4.2-6; and a complete copy of the plan is included as Appendix C-3. The proposed monitoring network consists of existing groundwater monitoring wells, proposed groundwater monitoring wells, surface sampling locations, and leachate sampling locations. A combination of upgradient (background) wells, downgradient (compliance) wells, and supplemental monitoring points would be used to evaluate whether or not any leachate is escaping from the landfill into the groundwater. The location, depth, and spacing of monitoring wells are based on conclusions from the groundwater characterization and modeling program prepared by Golder Associates Inc. (Appendix C-4). The Golder Associates Inc. study concluded that groundwater impacts from a potential release are likely to remain at relatively shallow depths (i.e., less than 100 feet). Therefore, the detection monitoring plan focuses on the upper 100-foot, weathered hydrogeologic unit. However, the monitoring network also will include monitoring points in the deeper zone, focusing primarily on fractures. Point of compliance monitoring wells along the perimeter will be sited by considering two factors: 1) need to establish appropriate well spacing to detect model-predicted contaminant plumes, and 2) need to monitor preferential high-hydraulic conductivity zones, such as fracture zones, discovered by prior studies or fracture zones found through observation of cut surfaces during construction.

Point of compliance monitoring wells will be sited along the existing perimeter well network, approximately 250 to 350 feet from the landfill boundary, where the model analysis of pathways and transverse spreading estimated that plume widths would be on the order of 100 to 400 feet wide. The smaller spreading would occur for contaminant sources in the western part of the landfill that have short distances to the monitoring well network, resulting in less dispersion *upon reaching the wells. Based on the particle tracking results from both 1994 and 2004, as well as the multi-tiered approach to groundwater protection (i.e., double liner, leak detection layer, and vadose zone monitoring), Golder Associates Inc. (Appendix C-4) recommended a monitoring well spacing of approximately 200 feet (measured normal to groundwater flow) to provide sufficient detection capability. Establishing the point of compliance 250 to 350 feet from the landfill boundary allows for direct application of modeling conclusions and falls within the 450-foot limit set forth for an alternate relevant point of compliance, per CTR §530.45(a)(1).*

Point of compliance wells will also be placed along the northern boundary of the landfill, due to a slight northern component of flow along the northwestern perimeter of the landfill. However, based on the results of particle track modeling, the northern perimeter is predominantly parallel to the groundwater flow; therefore, spacing of the monitoring wells along this perimeter will be wider (approximately 500 feet) than spacing along the west edge of the landfill (Figure 4.2-6). Downgradient wells will also be placed to monitor appreciable fracture zones. New wells screened in the upper and lower zones will be installed in downgradient locations for each appreciable fracture zone identified during excavation phases of construction. This will provide compliance monitoring in potentially high hydraulic conductivity zones of the aquifer.

For redundancy, and to provide a robust network, existing lower zone wells will also be included in the monitoring network. New lower zone wells will be installed along any appreciable fracture zone that is observed during excavation of a landfill phase, thus providing compliance monitoring in potentially high conductivity zones of the aquifer."

As discussed above the fractured bedrock underlying geology make the reliability "*a monitoring well spacing of approximately 200 feet (measured normal to groundwater flow) to provide sufficient detection capability. Establishing the point of compliance 250 to 350 feet from the landfill boundary allows for direct application of modeling conclusions and falls within the 450-foot limit set forth for an alternate relevant point of compliance, per CTR §530.45(a)(1)."* highly speculative and almost certainly unreliable of detected the leachate polluted groundwater at the point of groundwater compliance for groundwater monitoring. Dr. G. Fred Lee is a member of the California Water Environmental Modeling Forum steering committee. One of the areas of concerned by the Forum is the unreliable groundwater monitoring that is conducted by those who have a purpose in developing results in support of their client. To accept as reliable a landfill consultants groundwater modeling efforts without an independent expert peer review for a complex hydrological system such as under the proposed Campo Landfill is highly questionable. This should have been discussed in this DSEIS to fully inform the public and review agencies about this issue.

This DSEIS is significantly deficient in failing to discuss one of the most important issues of concern to the property owners/users to the east, north east, south (including Mexico) and southwest of the proposed Campo Landfill, namely the potential for this landfill to pollute groundwaters adjacent to and along fracture zones transecting the proposed landfill. All of the discussion on groundwater pollution provided above is devoted to the potential pollution to

the north and west of the landfill. However as quoted above Dr. Ponce in his report on the potential for the fractured rock aquifer system under the proposed landfill has stated that,
"In fractured-rock aquifers, a leachate plume will move preferentially along the fractures. Advection is likely to be the predominant physical mechanism, with travel times from capture zone to nearby wells measured in days, rather than in years as would be the case in more traditional diffusion-dominated settings. Given the complexity of the fractured-rock system, the probability that leachate plumes will be missed by the system of monitoring wells is high. Thus, placing a major landfill on top of a fractured-rock aquifer such as Tierra del Sol's significantly compromises the health and welfare of the local population on both sides of the U.S.-Mexico border. Moreover, Tierra del Sol is part of the federally designated Campo-Cottonwood Sole Source Aquifer, i.e., it has been determined that, should this aquifer become contaminated, there are no reasonably available alternative sources of drinking water."

"With estimated fractured-rock solute velocities comparable to the hydraulic conductivity of medium-sized gravel, estimated at 1 cm/s (864 m/day), advection-dominated travel times from capture zone to nearby wells in the Tierra del Sol watershed, a distance of about 600 m (2,000 ft), could be less than 1 day."

"The potential for such a fast hydraulic connection is supported by accounts from local property owners, who describe the effects on their wells from extensive drilling, borehole washing, packer testing and other activities conducted on the landfill site in the early 1990s. Within a short time after the tests, water pumped from local wells was contaminated with sand and well-drilling debris. According to eyewitness accounts, the sand appeared (or disappeared) with concurrent activity (or non activity) on the landfill wells, suggesting the existence of an effective hydraulic connection between the landfill site and private domestic local wells."

The Ponce 2006 report was sent to David Moran of the US Department of Interior, Assistant Sec of Indian Affairs in Washington DC on June 8, 2006 by Donna Tisdale in a letter titled "Campo Landfill SEIS / Site Specific Impact Study." and therefore should have been discussed in this DSEIS.

The maps of fracture traces at the site of the proposed landfill that are attached to the US EPA January 4, 1993 letter appended to these comments that were developed by a consultant to the Campo Landfill clearly show several fracture traces that cross the proposed landfill site some of which are connected to the offsite properties to the adjacent the proposed landfill. These fracture traces could readily serve as pathways for leachate that will eventually pass through the landfill liner system to rapidly be transported in groundwater to the east of the proposed landfill and pollute adjacent properties groundwaters and water supply wells.

Also Jim Bennett, the San Diego County geologist has indicated (personal communication March 2010) that the DSEIS ignores the potential for groundwater pollution of offsite groundwater wells to the east of the proposed Campo Landfill. This is the area where there is only a few hundred feet of buffer land between the area where wastes are proposed to be deposited and adjacent properties. A credible DSEIS that confirms to NEPA requirements for full disclosure of potential impacts of the proposed landfill must discuss these issues.

"*Background wells are upgradient, and are, therefore, unlikely to detect a release. However, these wells would provide background data on potential natural geochemical background variability over time and would contribute in defining spatial variability within the aquifer.*"

Lee and Jones-Lee in their "Flawed Technology" review state,
"*Prosser and Janechek (1995) have discussed that gaseous emissions from landfills are a threat to cause groundwater pollution that will not likely be detected by the groundwater monitoring wells, since gas migration can be in a direction different than down groundwater gradient.*

Richgels (2000) has provided additional information on landfill gas pollution of groundwaters based on his experience in investigating the situation near the Kiefer Landfill in Sacramento, California. The focus of his discussion is estimating reasonably foreseeable releases from municipal solid waste landfills. The California State Water Resources Control Board (SWRCB/CIWMB, 2006) landfilling regulations (Title 27) require that landfill owners make estimates of the potential for a particular landfill to release landfill gas and/or leachate to the environment. This information, in turn, is used to establish the magnitude of funding needed to remediate these releases should they occur at some time in the future.

Richgels (2000) has pointed out that landfill gas emissions, including the associated VOCs, from today's lined landfills are a much greater threat to cause widespread groundwater pollution than the expected initial near-term leakage of leachate through the HDPE compacted clay liner system. He recommends that landfill gas collection systems be developed that are designed and operated to more effectively control landfill gas emissions than is often done today. His recommendations include placing the leachate collection and removal system under vacuum to remove any landfill gas that collects in this system. This approach would tend to reduce the penetration of landfill gas through holes, rips, tears, etc., in the HDPE liner that can lead to groundwater pollution."
As discussed upgradient pollution of groundwater by landfill gas is a common situation. This should have been discussed in this DSEIS.

With respect to the duration of landfill gas formation, Lee and Jones-Lee in their "Flawed Technology" review state.
"*Another issue that is not adequately addressed in the permitting of dry tomb Subtitle D landfills is that much of the waste placed in today's landfills is in plastic bags. Since these plastic bags are only crushed and not shredded, the crushed bags will "hide" the fermentable components of the waste that can lead to landfill gas formation. The net result is that, rather than landfill gas production following the classic generation rates and durations that were developed based on unbagged wastes or situations where much of the wastes in the landfill were able to interact with the moisture that enters the landfill during the first decade or so of landfill operation, the period of landfill gas production will be extended until the plastic bags decompose. This can readily be many decades, to a hundred or more years.*"

This issue should have been discussed in this DSEIS to inform the public and reviewing agencies that the period of landfill gas production can extend for very long periods of time well beyond the 30 years required minimum postclosure monitoring period.

References for this section

Prosser, R. and Janechek, A., "Landfill Gas and Groundwater Contamination," Proceedings: Landfill Closures. Environmental Protection and Land Recovery, American Society of Civil Engineers, Geotechnical Special Publication No. 53, New York, NY (1995).

Richgels, C. M., "Reasonably Foreseeable Water Quality Risks from Lined Landfills - Leachate and Landfill Gas Releases," Proceedings of SWANA 5th Annual Landfill Symposium, Solid Waste Association of North America, pp 2 13-224 (2000). Proceedings available for purchase from: http://swanastore.stores.yahoo.net/gensym-2 1 .html

SWRCB/CIWMB, "COMBINED SWRCB/CIWMB REGULATIONS DIVISION 2, TITLE 27," California State Water Resources Control Board/California Integrated Waste Management Board, Sacramento, CA (2006).
http://www.waterboards.ca.gov/cwphome/land/docs/t2797m.pdf

Unreliable Information on Expected Performance of Liner System

Golder Associates in Appendix D-1 to the DSEIS presents several requests for alternative designs for the landfill containment system. This request was prepared by BLT Enterprises inc. This appendix states,
"The design of the proposed CRL is subject to EPA solid waste regulations, found at 40 C.F.R. Part 258, and the Campo Band's solid waste regulations, found in Title V of the Campo Tribal Regulations ("CTR"). BLT seeks authorization to modify design criteria specified in federal and tribal regulations for the CRL bottom liner and final cover. The analysis included with the SSFRs show that the proposed alternative designs provide greater safeguards for the environment than would be achieved using the bottom liner and final cover designs prescribed in the regulations. Both sets of regulations permit modifications to prescribed design criteria when the applicant demonstrates that the alternative designs proposed would meet or exceed regulatory requirements."

The Section devoted to 1.0 BOTTOM LINER SSFR claims in the "1.4 CONCLUSIONS AND RECOMMENDATIONS,"
"*The performance of the proposed CRL Alternative Bottom Liner exceeds the performance of the Prescribed Bottom Liner. The double-liner with an encapsulated GCL provide three layers of geomembrane and a low-permeability GCL that provide multiple barriers to the release of leachate to groundwater."* **The US EPA will need to determine if the proposed bottom liner is a satisfactory alternative design. However the presentation of the characteristics of this bottom liner fails to discuss the substantial professional literature that discusses potential problems with this proposed bottom liner in preventing groundwater pollution by landfill leachate for as long as the wastes in this landfill will be a threat. This information is presented in part in the discussion presented herein of these issues. Without this information the public and review agencies will be misled into believing that the DSEIS presents a creditable discussion of these issues.**

Similar deficiencies exist in the discussion provided in the other section of the DSEIS covering other alternative designs for components of the proposed Campo Landfill containment systems as well in the HELP modeling results. As discussed herein the modeling that was done with the HELP will mislead the public and the reviewers to believing that the conditions assumed in the modeling will be applicable to the very long period of time that the wastes in the proposed Campo Landfill will be a threat to pollute the environment.

The discussion of the alternative landfill cover in 2.0 FINAL COVER SSFR also fails to reliably inform the public and review agencies about the issues discussed above about the long term deterioration of the landfill cover properties assumed in the DSEIS over the period that the wastes in this landfill will be a threat. A key issue is the inability to inspect the plastic sheeting layer in the cover when it deteriorates due to free radical attack discussed in Lee and Jones-Lee "Flawed Technology review."

An additional SSFR is required because the proposed landfill site is within a seismic impact zone as defined by tribal and federal regulations. Those regulations permit construction of a landfill within a seismic impact zone if regulatory criteria are met. The slope stability analyses included within the seismic SSFR demonstrate that the CRL meets these criteria and may safely be located in the proposed site on the Campo Reservation.

Section 3.0 SEISMIC IMPACT ZONE SSFR in Appendix D-1 presents the Golder developed information on the impact of seismic activity on the proposed Campo Landfill containment and monitoring systems. While the DSEIS lists some earth quakes in the area it fails to list the 1892 earth quake that was 7.8 or 7.3. McCain Valley is probably about 8 miles or so northeast of the Campo Landfill site. D. Tisdale has developed the following discussion on nearby seismic activity to the proposed Campo Landfill.
"*In February 1892 a 7.8 (or 7.3 depending on which report you read) earthquake occurred with reported ground fissures in McCain Valley and Jewell Valley and rockslides in Mountain Springs, Carrizo and Jewel Valley areas. Here is Link to USGS page:*
http://earthquake.usgs.gov/earthquakes/states/events/1892_02_24.php . A more detailed report of ground cracking open in McCain Valley, earth appearing sifted several feet deep in Jewel Valley, and rock slides in Mountain Springs and Jewel Valley, is included at page 103 of Memories of the Early Settlements by Ella McCain (1955). Ella reported that:
" My husband and I were living in McCain Valley at the time, he was plowing to plant grain. In the field where he was plowing, the ground cracked open and the crack remained there for several years. At Jewel Valley, then Church Dome, the ground opened and closed again near where my nephew, Johnny Williams was playing. He ran to the house, told his father and uncle, they dug down to see and the earth looked like it had been sifted for several feet down. Rocks rolled from hillsides. I was visiting in Potrero at the time and I have never felt another quake as severe as that one, in Potereo. It kept shaking four or five days, it was said that there were one hundred sixty two shocks in the next two days..."

The map below from the California Geological survey shows locations of where the 1892 earthquake was reportedly felt, including McCain Valley. This earthquake has reportedly been

associated with a 20 foot displacement on the Laguna Salada fault in western Imperial County near where the Imperial Valley Substation is located, near the proposed SES Stirling Solar Two project site at Plaster City, and near the Sunrise Powerlink route. Go to this link to use the interaction feature for the map shown below:
http://redirect.conservation.ca.gov/cgs/rghm/quakes/historical/events/18920224_0720/18920224_0720.html

Section 3.8 "References" in the DSEIS fails to include one of the most important references on the potential impact of seismic activity on landfill containment systems namely,

> Anderson, R., "Earthquake Related Damage and Landfill Performance" ASCE Geotechnical Special Publication No. 54, "Earthquake Design and Performance of Solid Waste Landfills," American Society of Civil Engineers, New York, NY, pp 1-16 (1995).

Anderson (1995) published a summary review of the California Integrated Waste Management Board (CIWMB)'s evaluation of the impact of seismic activity on the integrity of MSW landfill containment systems based on the California Integrated Waste Management Board staff's site inspections of about a dozen landfills following an earthquake. Anderson reported that the containment system of many of the landfills inspected showed damage that was attributed to the earthquake. He reported,
"*Damage to landfills observed by the IWMB staff is categorized into four groups: 1. cracking of daily, intermediate, or final covers; 2. damage to liners; 3. damage to environmental collection and control systems; and 4. damage to infrastructure such as water tanks and on-site structures.*"
His review included a discussion of each of those categories. In addition to visual damage to the liners, there can be subsurface damage to the leachate collection system, liners, and other components that may not become apparent for many years. Such hidden damage is of particular concern at minimum design, single-composite-lined, Subtitle D landfills. As discussed herein, liner failure in a minimum design Subtitle D landfill will most likely first be detected in offsite production wells. This is expected because the typical groundwater monitoring wells arrays allowed by regulatory agencies consist of vertical monitoring wells spaced hundreds of feet apart at the point of compliance for groundwater monitoring. Such a system has a low probability of meeting the Subtitle D requirement to detect leachate-polluted groundwater when it first reaches the point of compliance. **Again the DSEIS discussion of the potential impact of seismic on landfills falls far short of reliably informing the public and the review agencies about the findings of a comprehensive review of the issues that they should be aware of in reviewing the DSEIS.**
~~~~~~~~~

Overall the BIA in developing this DSEIS has presented the minimum regulatory requirements for developing a MSW landfill and then discussed how the proposed Campo Landfill will exceed these requirements with the implications that the proposed Campo Landfill will not cause adverse impacts to offsite groundwater quality, surface water quality or public health and the environment. While this approach would have possibly been considered adequate by some review agencies in 1992, as documented in these comments
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there is a very large high quality literature that discusses the potential problems with the proposed Campo Landfill in protecting public health, groundwater and surface water quality, environmental quality and the interests of those within the sphere of influence of this proposed landfill. All of these issues should have been discussed in this DSEIS in order to comply with NEPA and BIA requirements for a credible SEIS.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

JAN 0 4 1993

Ronald M. Jaeger
Area Director
Bureau of Indian Affairs
2800 Cottage Way, Room W2550
Sacramento, CA 95825

Dear Mr. Jaeger:

The U.S. Environmental Protection Agency (EPA) has reviewed the **Campo Solid Waste Management Project Final Environmental Impact Statement (FEIS)**, Campo Indian Reservation, San Diego County, California. Our comments on this FEIS are provided pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's Regulations for Implementing NEPA, and EPA's authorities under §309 of the Clean Air Act.

In our comment letter, dated June 8, 1992, regarding the Campo Draft Environmental Impact Statement (DEIS), we rated the DEIS as EO-2 -- Environmental Objections-Insufficient Information. Our objection to the proposed project was based in large part on our belief that compliance with the groundwater monitoring and corrective action provisions of the Federal solid waste disposal facility criteria (40 CFR Part 258) could prove difficult or infeasible in the geologic setting of the proposed landfill. In our comment letter, we requested additional information, including that regarding siting criteria and hydrogeology.

Based on new information in the Final EIS and the response BIA provided to EPA's comments on the Draft EIS, it indeed appears that the project may not be able to comply with the groundwater monitoring provisions of 40 CFR Part 258. Our detailed comments regarding the feasibility of groundwater monitoring at the proposed landfill site and compliance with Part 258 are enclosed. Additional comments regarding other FEIS issues are also enclosed.

If you have any questions, please contact me at (415) 744-1015, or your staff may contact Jeanne Dunn Geselbracht, Office of Federal Activities, at (415) 744-1576.

Sincerely,

Deanna M. Wieman

Deanna M. Wieman, Director
Office of External Affairs

Enclosure

cc: Mike Connolly, Campo EPA
Ralph Goff, Campo Band
Donna Tisdale, Backcountry Against Dumps
Dick Sanderson, EPA Office of Federal Activities
Tim Atkeson, EPA Office of International Activities
Anne Alonso, U.S. Embassy, Mexico - Laredo, Texas
Bernie Vlach, Calif. Integrated Waste Management Board

I. General Comments

The Campo EPA recently transmitted a tentative 'Authority to Construct' permit to EPA Region 9 for the purpose of a technical assistance review. However, we have not yet reviewed or commented on the tentative Authority to Construct. Therefore, EPA Region 9's comments on the Final EIS are based only on our review of the information included in the Final EIS.

Based on our review of the FEIS, the proposed project may not be able to comply with provisions of the Federal solid waste disposal facility criteria (40 CFR Part 258). The following section addresses the requirements of Part 258 and the feasibility of monitoring groundwater at the proposed site.

II. Groundwater Monitoring Requirements and Feasibility

RCRA Solid Waste Requirements

Subtitle D of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6941 - 6949a, was amended by the Hazardous and Solid Waste Amendments of 1984 ("HSWA") to require EPA to revise the regulations for disposal of solid waste. The new provisions required EPA to establish national criteria for those municipal solid waste landfills ("MSWLF") that may receive household hazardous waste or hazardous waste from small quantity generators exempt from the hazardous waste requirements of RCRA Subtitle C.

On October 9, 1991, EPA published the revised MSWLF criteria as 40 CFR Part 258. These rules will become effective on October 9, 1993. The proposed Campo landfill will be required to comply with Part 258 after October 9, 1993. Therefore, EPA's responsibility in commenting on the EIS includes reviewing the proposed landfill in light of the requirements of 40 CFR Part 258.

Groundwater Monitoring Requirements

When 40 CFR Part 258 was proposed in 1988, EPA sought comment as to whether siting MSWLFs in certain types of hydrogeologic formations should be prohibited. The preamble to the proposed rule stated "[s]ome geologic settings that could preclude effective groundwater monitoring are fractured bedrock where complex fractures and joint systems impede flow direction prediction...." The analysis continued, "it is the responsibility of the owner or operator to prove that the landfill can be monitored." 53 Federal Register 33366 (8/30/88).

EPA received several comments on this issue. EPA responded to these comments in the appendix to the final rule as follows:

> Several commenters suggested that MSWLFs should be banned from locating in unmonitorable areas and that these areas should be included as a location restriction. The Agency agrees with these comments, but believes that this issue is adequately addressed by the groundwater monitoring requirements under subpart E of today's rule...If an owner and operator is unable to comply with these requirements due to unmonitorability of a particular location, he/she cannot site or operate an MSWLF at that location. EPA believes that this approach effectively meets the objective of the commenters.

56 Fed. Reg. 51049 (October 9, 1991).

The relevant groundwater monitoring requirements referred to in the above paragraph provide as follows:

> 258.51 Groundwater Monitoring Systems
>
> (a) A groundwater monitoring system must be installed that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer...that:
>
> ...(2) Represent the quality of the groundwater passing the relevant point of compliance specified by the Director of an approved State under § 258.40(d) or at the waste management unit boundary in unapproved States.

In this case, the proposed landfill must have a groundwater monitoring system that is capable of sampling and representing the quality of groundwater passing under the landfill boundary.

Additionally, 40 CFR Part 258.51(d)(1)(i) states "[t]he number, spacing and depths of the monitoring system shall be determined based upon site-specific technical information that must include a thorough characterization of aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in the groundwater flow...."

Groundwater Monitoring Feasibility

The groundwater monitoring regulations of Part 258 require the facility to detect groundwater contamination in the uppermost aquifer and represent the quality of groundwater at the relevant point of compliance. The regulations further require that site-specific technical information on groundwater flow direction be obtained. The FEIS describes the proposed groundwater monitoring systems for both the weathered and unweathered bedrock. However, the FEIS does not demonstrate that groundwater monitoring results would adequately represent the groundwater quality at a point of compliance; nor does the FEIS provide site-specific information on the groundwater flow directions in the fractured, unweathered bedrock.

The proposed facility is underlain by weathered, decomposed bedrock and unweathered bedrock. Fractures extend through both bedrock systems. Because the two bedrock systems are both saturated with groundwater and groundwater flow between them is likely interconnected, they constitute a single, uppermost aquifer for the purposes of regulation. The fractures in the unweathered bedrock may provide conduits for groundwater flow as described in the FEIS: "...water production may vary with depth, suggesting that the fractures behave as groundwater conduits in the unweathered crystalline rock...." The FEIS states that groundwater flows at a rate of 0.3 to 1.0 feet/day in the upper, weathered bedrock and much more rapidly, from 9 to 111 feet/day, in the fractures of the unweathered bedrock.

The FEIS describes a proposed five-tiered detection network for the landfill. The FEIS documents that the detection of a release may occur in the following systems: (1) a leachate collection system above the primary liner; (2) a leachate detection system within the liner; (3) an unsaturated zone monitoring system; (4) a weathered bedrock groundwater monitoring system; and (5) an unweathered bedrock groundwater monitoring system.

A groundwater monitoring system, by regulatory definition, must be installed in the uppermost aquifer. Tiers 1, 2, and 3 are not installed in the uppermost aquifer underlying the proposed facility; therefore, only the monitoring systems of Tiers 4 and 5 are discussed further below.

According to the FEIS, the Tier 4 groundwater monitoring system is designed to "detect any changes in groundwater quality" in the weathered bedrock. The FEIS states that permanent monitoring wells will be placed at the perimeter of the site in the weathered bedrock.

The FEIS states that the Tier 5 groundwater monitoring is designed to "detect changes in groundwater quality" in the unweathered bedrock. The FEIS states that "monitoring wells will be completed in the six major fracture zones identified during field investigations." (Although not stated in the FEIS, these monitoring wells are presumed to be the Tier 5 system.) A map showing the location of the Tier 5 monitoring wells was not provided in the FEIS. However, the proposed locations for permanent Tier 5 wells are shown along the facility boundary in the December 2, 1992 Campo EPA construction permit currently under review by Region 9.

A hypothetical release of a dense nonaqueous phase liquid (DNAPL) contaminant is used in the following illustration to highlight EPA's concerns about the ability to obtain samples that represent groundwater quality at the Campo facility. A DNAPL may be released from discarded sources such as household spot removers and automotive solvents. Health-based levels for maximum concentrations of DNAPLs in groundwater are on the order of five parts/billion. Therefore, the release of just 16 ounces of a spot remover containing a DNAPL such as perchloroethelene could potentially contaminate 25 million gallons of groundwater to levels unsafe for human consumption.

The Campo operations will include a random check of a minimum of two incoming loads of waste per day (out of a maximum of 70) to determine if hazardous wastes such as DNAPLs are present. The FEIS does state, however, that "[l]imited quantities of household hazardous waste are deposited in virtually every landfill as part of the overall waste stream." Because disposal of these materials is expected at solid waste landfills, monitoring for certain DNAPL constituents is a requirement of the Part 258 groundwater monitoring regulations.

If a release of DNAPL were to occur, a slug (mass) of the DNAPL would migrate vertically downward through the unsaturated zone and through the pore space of the weathered bedrock within the saturated zone. The slug of DNAPL would dissolve slowly into the groundwater as it penetrates the saturated zone. The dissolved phase of contaminants would be carried along with the groundwater as it flows in the pores of the weathered bedrock toward the facility boundary.

In hydrogeological settings where groundwater flows through relatively homogenous, porous rock, such as in the weathered bedrock at the Campo site, a plume of dissolved-phase contaminants disperses across a broad volume of an aquifer. Therefore, the Tier 4 monitoring wells could potentially detect a release of the contaminants dissolved in groundwater. However, because DNAPLs dissolve very slowly, the concentrated slug of a release can continue to migrate vertically downward through the weathered bedrock. As the slug migrates downward, it poses a continuing source of contamination as it dissolves into the adjacent groundwater.

Upon reaching the base of the weathered zone, the slug could encounter numerous fractures in the unweathered bedrock. Upon encountering a fracture, the DNAPL would "drain" into or along the conduit that the fracture has created. The slug of the DNAPL would continue to dissolve into the groundwater contained within the fracture as it moves further downward.

Unless a Tier 5 monitoring well along the facility boundary (i.e. the point of compliance) can intersect the path within the fracture along which the slug of the DNAPL is travelling, the quality of the groundwater in the unweathered bedrock would not be represented as required by Part 258. A vertically oriented monitoring well along the waste management unit boundary would have to be drilled to a depth of over 4000 feet to intercept a slug of contaminants along a fracture dipping at 60°, assuming that the fracture is continuous and extends to a plane projected below the point of compliance. (Note: the location of the trace of the single fracture used in this example was obtained from information in the FEIS. The dip of the trace of fractures with this orientation was obtained from a supplementary hydrogeologic report.)

The footprint of the facility overlies the traces of approximately 50 such fractures, some greater than 0.5 mile in length. Because fractures are intercepted by other fractures at depth, groundwater contaminants would likely follow an unpredictable path from fracture to fracture beneath the site.

In our DEIS comments, EPA stated that the site-specific groundwater flowpaths needed to be identified in order to conduct adequate groundwater monitoring. However, site-specific flowpaths for groundwater in the unweathered bedrock were not included in the FEIS or the "Response to Comments." This information is necessary because, unless the three-dimensional flowpaths of the groundwater through the network of fractures is precisely known, Tier 5 monitoring wells at the waste management unit boundary would not likely detect or adequately represent a release of contamination in the fractured bedrock.

III. Other Comments

Enforcement Authority

The response to comments (A18) states that U.S. EPA would have the authority to enforce compliance with the federal regulations under RCRA Section 3008 and obtain information regarding compliance under RCRA Section 3007.

As stated in our comments on the Draft EIS, EPA does not currently have the authority to enforce the 40 CFR Part 258 regulations on state or tribal lands (and cannot currently use the RCRA Section 3007 and 3008 authorities in implementing the MSWLF program). EPA would only have the authority to enforce compliance with the Part 258 regulations at the proposed facility if we first determined that the Campo EPA regulatory program was not adequate to ensure compliance with those regulations. EPA must make a determination that a program is inadequate in order to obtain enforcement authority in any state or Tribal land.

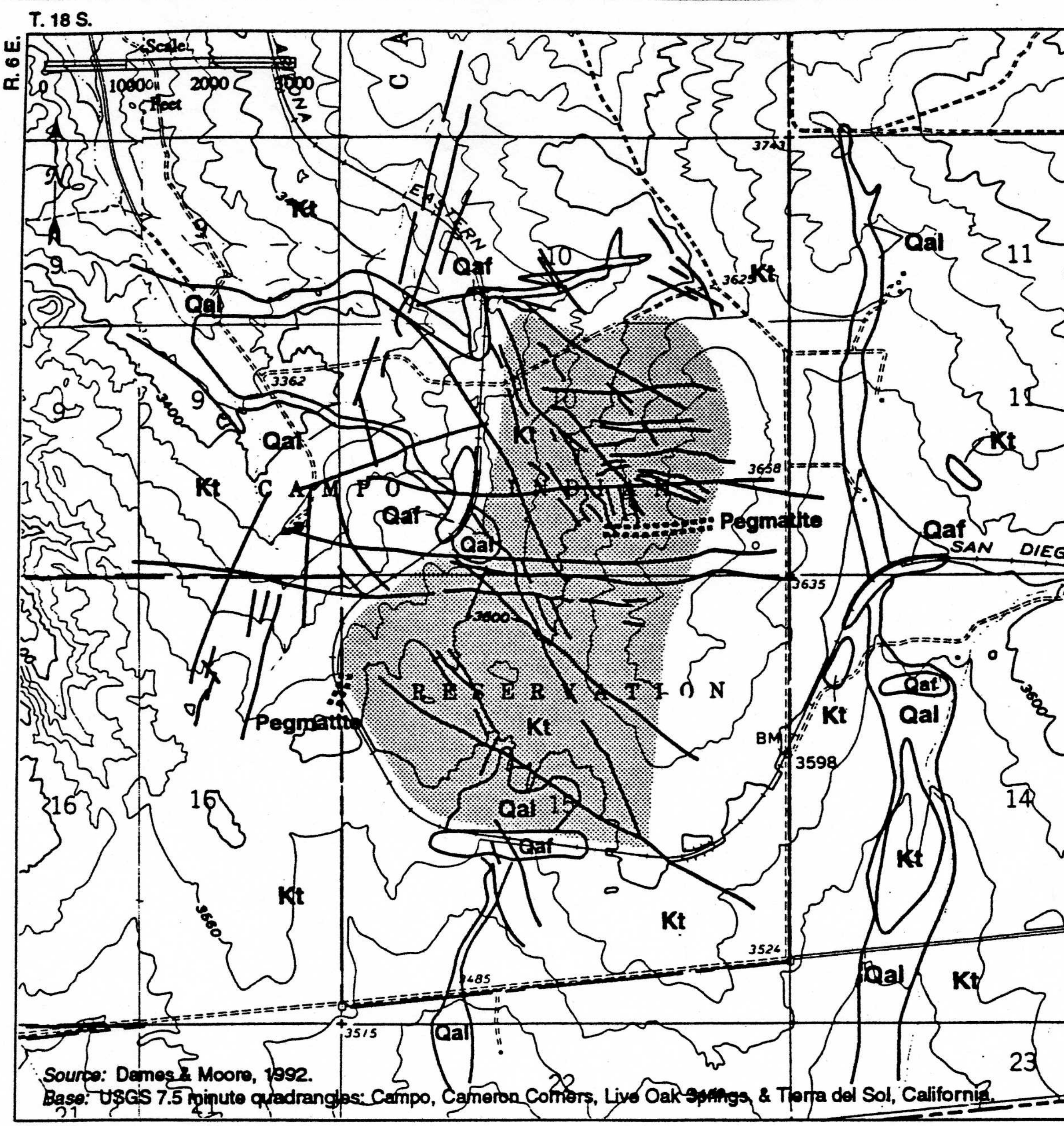
The reference to section 4.3.5.5. in the A18 response to comments is confusing. There does not appear to be a section 4.3.5.5 in the FEIS, and section 4.2.5.5 does not appear to address EPA's enforcement role.

The response to comments (A19) states that the project would be required to provide the same financial assurances that any project constructed off-reservation in California would be required to provide. The response then addresses only Campo EPA requirements, not Federal EPA requirements. In addition, some areas of the FEIS refer only to Campo or California regulations. This may be misleading because EPA has not yet determined that either California's or Campo EPA's MSWLF requirements assure compliance with the Federal regulations (i.e., 40 CFR Part 258).

The Record of Decision should clarify that owners and operators of MSWLFs are always responsible for complying directly with the 40 CFR Part 258 landfill regulations, regardless of whether a state or tribal landfill permitting program has been approved by EPA. The 40 CFR Part 258 landfill criteria are always enforceable via citizen suits which may be filed against MSWLF owners and operators for non-compliance with the 40 CFR Part 258 regulations.

MSWLF Program Approval

Section 4.2.5.5 states that the U.S. EPA should review the Campo EPA regulations for consistency with 40 CFR Part 258 regulations, specifically Subpart E, concerning groundwater monitoring. Campo EPA has indicated that they intend to seek program approval under the Federal MSWLF regulations. EPA will review Campo EPA's regulations as part of the MSWLF program application and approval process. However, Campo EPA is not required to apply for program approval. EPA has not yet received a program application from Campo EPA.



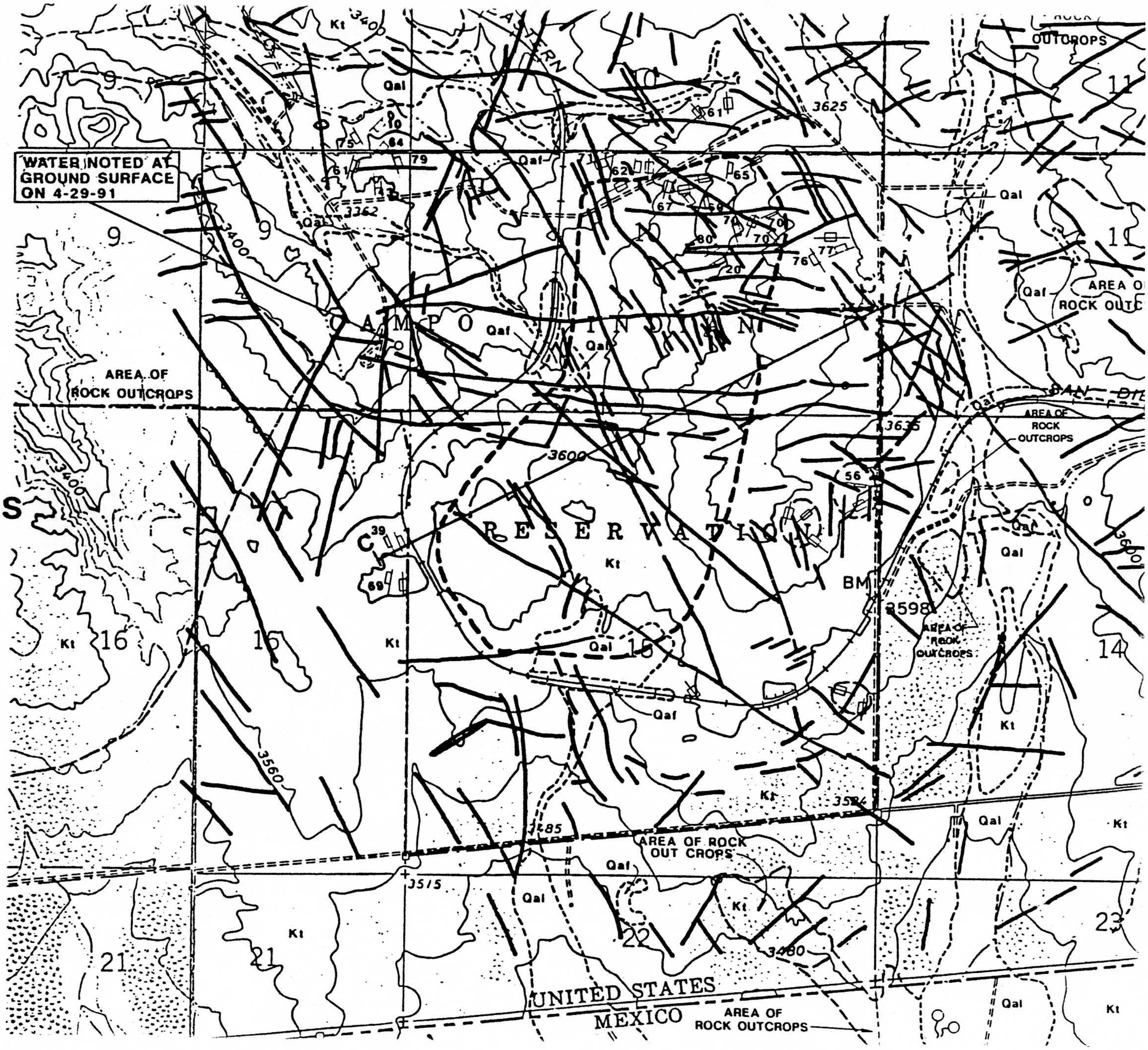
LEGEND

Qaf	Earthen Fill: Fill sections of railroad and water retention dikes; consists primarily of silty sand derived from highly weathered, near surface tonalite or local alluvium.		Photogeologic lineament
Qal	Quaternary Alluvium: Occurs along primary drainageways; consists primarily of silty sand and relatively clean, well-sorted sand.		Approximate geological contact
Kt	Cretaceous Tonalite: occurs at the surface as highly weathered regolith or as protruding exposures of intact, less weathered rock; consists primarily of light gray to yellowish brown, extremely to moderately weathered, fine to coarse-grained granite.		Approximate extent of landfill
			Spring
		— — —	Reservation Boundary

Figure 3.1-10 FEIS

PROPOSED SITE GEOLOGY

18 S



PRELIMINARY MAP PROVIDED
TO ED + DONNA TISDALE BY
DAMES + MOORE WHEN THEY
WERE WORKING ON CAMPO LANDFILL

NOTE HOW MANY MORE FRACTURES
ARE SHOWN THAN IN THE FEIS MAP

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

December 12, 2005

Clay Gregory, Regional Director
Pacific Regional Office
Bureau of Indian Affairs
2800 Cottage Way
Sacramento, CA 95825

Subject: EPA Comments on the Proposed Campo Solid Waste Landfill Facility on the Campo Indian Reservation, San Diego County, California

Dear Mr. Gregory:

The Environmental Protection Agency (EPA) has reviewed the Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) for the proposed Campo Solid Waste Landfill facility on the Campo Indian Reservation, San Diego County, California. Our comments are provided pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508) and Section 309 of the Clean Air Act.

The Bureau of Indian Affairs (BIA), in cooperation with the Campo Band of Kumeyaay Indians, is proposing to approve a lease and sublease to allow a 1,150-acre portion of the Campo Indian Reservation to be used for the construction and operation of a solid waste landfill facility. The BIA is preparing a SEIS to supplement the Final Environmental Impact Statement (FEIS) for the project, which was released on November 24, 1992.

In response to the NOI, we have identified several issues for your attention in the preparation of the SEIS, including municipal solid waste landfill requirements, water resources, air resources, environmental justice, hazardous waste management, cumulative impacts and habitat and wildlife. Detailed comments are attached. EPA specifically requests a thorough evaluation in the SEIS of potential groundwater impacts and groundwater monitorability. It is important that the SEIS fully explore groundwater impacts and monitoring issues, even if the site location alternatives have not changed.

The NOI states that the SEIS will incorporate the proposed project description from the FEIS by reference, and will discuss aspects of the project that have changed since the FEIS was released, any changes in environmental impacts associated with those changes, and changes to alternatives. EPA recommends the SEIS provide a summary of critical issues, assumptions and decisions complete enough to stand alone without depending upon continued referencing of the FEIS and other documents. The SEIS should include a concise summary of the history of the project, events leading to the decision to prepare the SEIS, and a summary of the various elements of the solid waste landfill facility.

We appreciate the opportunity for early participation in the evaluation of environmental impacts associated with the proposed Campo Solid Waste Landfill facility. EPA has agreed to be a cooperating agency for the SEIS and awaits your invitation letter. In the near future, BIA should contact Karen Vitulano, the lead reviewer for this project, to coordinate development of a Memorandum of Understanding which will outline EPA's role as cooperating agency. Karen can be reached at (415) 947-4178.

Sincerely,

/s/

Duane James, Manager
Environmental Review Office
Communities and Ecosystems Division

cc: Harry Cuero, Chairman, Campo Band of Kumeyaay Indians
Melissa Estes, Environmental Director, Campo Band of Kumeyaay Indians

Municipal Solid Waste Landfill Requirements

EPA will review the SEIS to ensure the design, siting, and operation of the proposed landfill satisfies the Federal regulatory requirements for Municipal Solid Waste Landfills (MSWLFs), 40 CFR 258.

The Campo Reservation is geologically within a seismic impact zone. Under 40 CFR 258.14, a new MSWLF can not be located in a seismic impact zone without a determination by EPA that the design meets certain seismic impact standards. EPA anticipates receiving a request to review the design, and will make its determination in response to such a request. EPA will closely review the facility design (liner, leachate collection system, monitoring systems, and surface water control systems) and seismic stability analysis to ensure the landfill is adequately designed to meet earthquake requirements. The SEIS should document this design requirement.

Pursuant to 40 CFR 258.51(a)(2), a groundwater monitoring system must be installed which ensures detection of contamination to the uppermost aquifer. The Campo-Cottonwood Aquifer, which lies underneath the Campo Reservation, is designated as a Sole Source Aquifer under the Safe Drinking Water Act. This designation signifies the area's dependence on this aquifer as the major source of drinking water, and its protection is critical. Past studies have documented that the aquifer beneath the site is contained within fractured bedrock and that drinking water wells are located downgradient of the site.

The fractured bedrock nature of the aquifer presents a challenge to effective groundwater monitoring. To meet federal criteria for aquifer protection and groundwater monitoring, the project proponent must demonstrate how a monitoring well network installed in fractured bedrock will meet these requirements. EPA will closely review the facility design (liner and leachate collection system) and the groundwater monitoring system design to ensure federal criteria for aquifer protection and groundwater monitoring are met. The SEIS should document this monitoring requirement.

Water Resources

Since the Campo Band of Kumeyaay Indians (Campo Band) has not received delegation from EPA to establish water quality standards pursuant to Section 518 of the Clean Water Act, EPA assumes responsibility for identifying appropriate standards. EPA policy is to refer to applicable State standards, using the "tributary rule" to identify standards for waters for which specific standards have not been designated. We recommend that the SEIS identify the State of California water quality standards and the antidegradation policies applicable to the project area. There should also be a discussion of the means of implementing and enforcing water quality standards on tribal lands.

The SEIS should estimate the quantity of water the project will require, describe the source of this water and potential effects on other water users and natural resources in the project's area of influence. Assuming groundwater is used, the SEIS should clearly depict reasonably foreseeable direct, indirect and cumulative impacts to this resource. Any potential for subsidence and impacts to springs or other open water bodies and biologic resources should be analyzed.

The SEIS should address the potential effects of project discharges, such as leachate, on surface water quality. The specific discharges should be identified and potential effects of discharges on designated beneficial uses of affected waters should be analyzed. The SEIS should note that a National Pollutant Discharge Elimination System (NPDES) permit would be required for discharges to waters of the United States. The SEIS should address how the proposal would be designed and operated to ensure that the facility meets Water Quality Standards (WQS) that provide for the protection and maintenance of beneficial uses downstream from the facility. Effluent limitations guidelines have been promulgated for specified discharges from solid waste landfills (40 CFR Part 445). Since this project is on tribal land, the U.S. EPA would be the NPDES permit-issuing entity.

If the facility is a zero discharge facility, the SEIS should disclose the amount of process water that would be disposed of on-site and explain methods of on-site containment. If evaporation ponds will be used for disposal, identify chemical characteristics of the pond water and how seepage into groundwater will be prevented. Identify the storm design containment capacity of ponds, explain how overflow in larger storm events will be managed, and discuss potential environmental impacts (drainage channels affected, water quality, biological resources) in the event of overflow.

The SEIS should note that, under the Federal Clean Water Act, any construction project disturbing a land area of one or more acres requires a construction storm water discharge permit. See http://cfpub.epa.gov/npdes/stormwater/cgp.cfm for more information on the construction general permit. The SEIS should document the project's consistency with applicable storm water permitting requirements including a storm water pollution prevention plan (SWPPP). The SEIS should discuss specific mitigation measures that may be necessary or beneficial in reducing adverse impacts to water quality and aquatic resources.

If stormwater discharges occur during the operational phase of the project, a stormwater multi-sector general permit is required, which calls for a SWPPP and monitoring program. See http://cfpub.epa.gov/npdes/stormwater/msgp.cfm for more information on the multi-sector permit. The SEIS should detail this requirement.

The SEIS should describe the original (natural) drainage patterns in the project locale, as well as the drainage patterns of the area during project operations. Also, the SEIS should identify whether any components of the proposed project are within a 50 or 100-year floodplain.

The BIA and the Campo Band should consult with the U.S. Army Corps of Engineers to determine if any component of the proposed project requires a permit of authorization under Section 404 of the Federal Clean Water Act. Section 404 regulates the discharge of dredged or fill materials into waters of the United States, including wetlands and other "special aquatic sites." EPA strongly recommends avoidance of waters when siting project features. However, if a CWA Section 404 permit is needed, EPA will review the project for compliance with Federal

Guidelines for Specification of Disposal Sites for Dredged or Fill Materials (40 CFR 230), promulgated pursuant to Section 404(b)(1) of the Clean Water Act. Pursuant to 40 CFR 230, any permitted discharge into waters of the U.S. must be the least environmentally damaging practicable alternative available to achieve the project purpose. If dredged or fill material would be discharged into waters of the U.S., the SEIS should discuss alternatives to avoid such discharges. If a discharge is permitted, the SEIS should discuss how potential impacts would be minimized and adequately mitigated.

Air Resources

The SEIS should describe the air quality impacts of the proposed project and summarize all existing air quality regulations and their implementing agencies for the Campo Band, including required monitoring and enforcement.

The SEIS should include a summary of the changes that have occurred since the 1992 Final EIS. EPA issued a Prevention of Significant Deterioration (PSD)/ New Source Review (NSR) permit for construction of the proposed landfill in 1995 (NSR 4-4-10, SD 92-02), and then extended the permit twice, in 1998 and 2003. The most recent permit extension expired on July 13, 2004. When the PSD/NSR permit was issued in 1995, the New Source Performance Standard (NSPS), Subpart WWW, had not been promulgated and there were no federally enforceable limitations on the proposed project's potential to emit volatile organic compounds (VOCs).

Since that time two significant events have occurred. First, in March 1996, EPA promulgated the NSPS for MSW landfills, Subpart WWW, (61 Fed. Reg. 9919), and thus the proposed project is now subject to a federally enforceable limit on its potential to emit VOCs. Second, on June 26, 2003, EPA redesignated the San Diego County area to attainment for the 1-hour ozone National Ambient Air Quality Standard (NAAQS), which raised the major source threshold for ozone in that area from 50 tons per year to 250 tons per year (68 FR 37976, June 26, 2003). Although San Diego County was designated as an ozone non-attainment area for the 8-hour ozone standard in June 2004, EPA excluded Campo Areas 1 and 2 from the San Diego County non-attainment area for the 8-hour ozone NAAQS (69 FR 23887, April 30, 2004). The major source threshold for VOCs is now 250 tons per year.

Subpart WWW requires the facility to install and operate a capture and control system that will achieve 98% control efficiency. According to the original project proponent's 1992 PSD application, and addendum letter from the current project proponent dated August 13, 2004, the potential to emit VOC from the proposed project is significantly less than the current major source threshold in the area. Therefore the project is not subject to pre-construction air permitting under either the PSD or NSR programs.

If the project proponent chooses a compliance option for Subpart WWW other than that outlined in its 1992 application and specified in 40 CFR 60.752(b)(2)(iii)(B), it must submit a revised PSD applicability analysis to Region 9 for review. The project proponent may want to consider a compliance option that generates electricity for the Tribe. This compliance option is specified in 40 CFR 60.752(b)(2)(iii)(C).

Finally, the SEIS should describe the Part 71 permit required for the project, pursuant to 40 CFR 60.752(b). An application for a Part 71 permit must be submitted to EPA within one year of commencing operation of the proposed landfill (40 CFR 71.5(a)(1)(i)).

Environmental Justice

In February 1994, the President issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations". The SEIS should describe measures taken by BIA to: (1) fully analyze the environmental effects of the proposed actions on minority and low income populations, both within the tribe and in affected areas not on tribal land; and (2) present opportunities for affected communities to participate in the NEPA process, including information and participation materials in all languages spoken by those in affected areas. The Council on Environmental Quality's (CEQ) environmental justice guidance to Federal agencies should be addressed in the SEIS. Please refer to the CEQ's *Environmental Justice Guidance Under the National Environmental Policy Act*, December 1997.

Environmental justice considerations may play an important role in this proposal, both from the standpoint of anticipated benefits of the project and adverse impacts. In the context of "affected environment," the SEIS should document existing human health and environmental risks to which people in the project areas are exposed. The document should also explore potential mitigation measures for any adverse environmental justice effects.

Hazardous Waste Management

The SEIS should discuss and characterize waste generated from landfill operations, including how household hazardous waste that enters the solid waste stream will be managed, where disposal will occur, and regulatory requirements associated with storage and disposal. Include waste management from associated activities such as vehicle maintenance, etc.

Cumulative Impacts

For the cumulative impacts assessment, we recommend focusing on resources of concern or resources that are "at risk" and/or are significantly impacted by the proposed project, before mitigation. Identify all on-going, planned, and reasonably foreseeable projects in the study area that may contribute to cumulative impacts. Where studies exist on the environmental impacts of these other projects, use these studies as a source for quantifying cumulative impacts. When cumulative impacts occur, mitigation should be proposed. Clearly state the lead agency's mitigation responsibilities and the mitigation responsibilities of other entities.

Vegetation and Wildlife

BIA and the Tribe should work closely with the U.S. Fish and Wildlife Service (USFWS) and the State of California to determine potential impacts of the project on plant and wildlife species. If the project affects threatened or endangered species, or their critical habitat, BIA and the Campo Band are required to consult with USFWS under Section 7 of the Endangered Species Act (ESA). The SEIS should identify all petitioned and listed threatened and endangered species and critical habitat that might occur within the project area including which species or critical habitat might be directly or indirectly affected by each alternative, and discuss how and when BIA and the Campo Band intend to meet their obligation under Section 7. If available, include a biological assessment and any results of consultation with USFWS. If applicable, the SEIS should discuss avoidance, minimization, and mitigation of losses or modifications of habitat and plant/animal species composition, and include a detailed mitigation plan.

Dr. G. Fred Lee, PE(TX), BCEE, F.ASCE

AAEE Board Certified Environmental Engineer

Expertise and Experience in Hazardous Chemical Site and Municipal/Industrial Landfill Impact Assessment/Management

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

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 ground water systems. An area of specialization during his PhD work was aquatic chemistry, which focused on the transport, fate and transformations of chemical constituents in aquatic (surface and ground water) and terrestrial systems as well as in waste management facilities.

For a 30-year period, he held university graduate-level teaching and research positions in departments of civil and environmental engineering at several major United States universities, including the University of Wisconsin-Madison, University of Texas at Dallas, and Colorado State University. During this period he taught graduate-level environmental engineering courses in water and wastewater analysis, water and wastewater treatment plant design, surface and ground water quality evaluation and management, and solid and hazardous waste management. He has published over 1,100 professional papers and reports on his research results and professional experience. His research included, beginning in the 1970s, the first work done on the impacts of organics on clay liners for landfills and waste piles/lagoons.

His work on the impacts of hazardous chemical site and municipal/industrial solid waste landfills began in the 1960s when, while directing the Water Chemistry Program in the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison, he became involved in the review of the impacts of municipal solid waste landfills on groundwater quality.

In the 1970s, while he was Director of the Center for Environmental Studies at the University of Texas at Dallas, he was involved in the review of a number of municipal solid and industrial (hazardous) waste landfill situations, focusing on the impacts of releases from the landfill on public health and the environment.

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

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

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

Dr. Lee's expertise includes surface and ground water quality evaluation and management. This expertise is based on academic course work, research conducted by Dr. Lee and others and consulting activities. He has served as an advisor to numerous governmental agencies in the US and other countries on water quality issues. Further, he has served on several editorial boards for professional journals, including *Ground Water*, *Environmental Science and Technology*, *Environmental Toxicology and Chemistry*, etc. Throughout his over-49-year professional career, he has been a member of several professional organization committees, including chairing the American Water Works Association national Quality Control in Reservoirs Committee and the US Public Health Service PCBs in Drinking Water Committee.

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

In 1989, he retired after 30 years of graduate-level university teaching and research and expanded the part-time consulting that he had been doing with governmental agencies, industry and community and environmental groups into a full-time activity. A principal area of his work since then has been assisting water utilities, municipalities, industry, community and environmental groups, agricultural interests and others in evaluating the potential public health and environmental impacts of proposed or existing hazardous, as well as municipal solid waste landfills. He has been involved in the review of approximately 85 different landfills and waste piles (tailings) in various parts of the United States and in other countries, including 12 hazardous waste landfills, eight Superfund site landfills and five construction and demolition waste landfills. He has also served as an advisor to a hazardous waste landfill developer and to IBM corporate headquarters and other companies on managing hazardous wastes.

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 150 professional papers and reports on landfilling issues provide guidance not only on the problems of today's minimum US EPA Subtitle D landfills, but also on how landfilling of non-recyclable wastes can and should take place to protect public health, groundwater resources, the environment, and the interests of those within the sphere of influence of a landfill/waste management unit. They make many of their publications available as downloadable files from their web site, www.gfredlee.com.

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

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

In 2004 Dr Lee was selected as one of two independent peer reviewers by the Pottstown (PA) Landfill Closure Committee to review the adequacy of the proposed closure of the Pottstown Landfill to protect public health, groundwater resources and the environment for as long as the wastes in the closed landfill will be a threat.

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

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

Throughout Dr. Lee's 30-year university graduate-level teaching and research career and his subsequent 20-year private consulting career, he has been active in developing professional papers and reports that are designed to help regulatory agencies and the public gain technical information on environmental quality management issues. Drs. Lee and Jones-Lee have provided a number of reviews on issues pertinent to the appropriate landfilling of solid wastes. Their most comprehensive review of municipal solid waste landfilling issues is what they call the "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," which was originally developed in 1992, and redeveloped and updated in the fall of 2004. Between the two versions they have published numerous invited and contributed papers that provide information on various aspects of municipal solid waste landfilling, with emphasis on protecting public health and the environment from waste components for as long as they will be a threat. The "Flawed Technology" review has been periodically updated, including the most recent update in December 2008, which can be found on their website at
http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

This review provides a comprehensive, integrated discussion of the problems that can occur with minimum-design Subtitle D landfills and landfills developed in accord with state regulations that conform to minimum Subtitle D requirements. The "Flawed Technology" review contains a listing of the various reviews that Drs. Lee and Jones-Lee have developed, as well as peer-reviewed literature. Over 40 peer-reviewed papers are cited in "Flawed Technology" supporting issues discussed in this review.

Drs. Lee and Jones-Lee have developed guidance on the evaluation of the potential impacts of landfills. This guidance is available as,

Lee, G. F., and Jones-Lee, A., "Guidance on the Evaluation of the Potential Impacts of a Proposed Landfill," Report of G. Fred Lee & Associates, El Macero, CA January (2007).
http://www.gfredlee.com/Landfills/EvaluationImpactLF.pdf

SUMMARY BIOGRAPHICAL INFORMATION

NAME: G. Fred Lee

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

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

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

E-MAIL: gfredlee@aol.com

WEBPAGE: http://www.gfredlee.com

EDUCATION

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

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

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

ACADEMIC AND PROFESSIONAL EXPERIENCE

Current Position:

Consultant, President, G. Fred Lee and Associates

Previous Positions:

- Distinguished Professor, Civil and Environmental Engineering, New Jersey Institute of Technology, Newark, NJ, 1984-89
- Senior Consulting Engineer, EBASCO-Envirosphere, Lyndhurst, NJ (part-time), 1988-89
- Coordinator, Estuarine and Marine Water Quality Management Program, NJ Marine Sciences Consortium Sea Grant Program, 1986
- Director, Site Assessment and Remedial Action Division, Industry, Cooperative Center for Research in Hazardous and Toxic Substances, New Jersey Institute of Technology et al., Newark, NJ, 1984-1987
- Professor, Department of Civil and Environmental Engineering, Texas Tech University, 1982-1984
- Professor, Environmental Engineering, Colorado State University, 1978-1982
- Professor, Environmental Engineering & Sciences; Director, Center of Environmental Studies, University of Texas at Dallas, 1973-1978
- Professor of Water Chemistry, Department of Civil & Environmental Engineering, University of Wisconsin-Madison, 1961-1973

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

American Academy of Environmental Engineers Board Certified Environmental Engineer, Certificate No. 0701

PUBLICATIONS AND AREAS OF ACTIVITY

Published over 1,100 professional papers, chapters in books, professional reports, and similar materials. The topics covered include:

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

LECTURES

Presented over 760 lectures at professional society meetings, universities, and to professional and public groups.

GRANTS AND AWARDS

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

GRADUATE WORK CONDUCTED UNDER SUPERVISION OF G. FRED LEE

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

ADVISORY ACTIVITIES

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

Municipal Solid Waste Landfills and Groundwater Quality Protection Issues Publications

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

Publications are available in the following topics at http://www.gfredlee.com/plandfil2.htm

- **Overall Problems with "Dry Tomb" Landfills**
- **Liner Failure Issues**
- **Groundwater Pollution by Leachate**
- **Groundwater Monitoring**
- **Post-Closure Care**
- **Permitting of Landfills**
- **Fermentation/Leaching "Wet Cell" Landfills**
- **Landfill Mining**
- **Landfills and the 3R's**
- **NIMBY Issues**
- **Review of Specific Landfills**
- **Hazardous Waste Landfills**
- **Groundwater Protection Issues**

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

Arizona *(State Landfilling Regulations)*	Verde Valley - Copper Tailings Pile Closure Mobile – Southpoint Landfill
California *(State Landfilling Regulations)*	Colusa County - CERRS Landfill San Gabriel Valley - Azusa Landfill (Superfund Site) City of Industry - Puente Hills Landfill North San Diego County, 3 landfills San Diego County - Gregory Canyon Landfill El Dorado County Landfill Yolo County Landfill Half Moon Bay - Apanolio Landfill Pittsburg - Keller Canyon Landfill Chuckwalla Valley - Eagle Mountain Landfill Mountain View – Mountain View Landfill Barstow - Hidden Valley (Hazardous Waste) Mohave Desert - Broadwell Landfill (Hazardous Waste) Cadiz - Bolo Station-Rail Cycle Landfill University of California-Davis Landfills (4) (3 Superfund Site) San Marcos - San Marcos Landfill Placer County - Western Regional Sanitary Landfill Placer County – Turkey Carcass Disposal Pits Imperial County - Mesquite Landfill Los Angeles County - Calabasas Landfill and Palos Verdes Landfill Contra Costa County – Concord Naval Weapons Station Tidal LF (Superfund) Nevada County - Lava Cap Mine Area Landfill (Superfund Site) Sylmar - Sunshine Canyon Landfill Roseville - Roseville Landfill San Diego County – Campo Landfill Cortina Landfill – Colusa County
Colorado (*State Landfilling Regulations)*	Last Chance/Brush – (Hazardous Waste Landfill) Denver - Lowry (Hazardous Waste Landfill) Telluride/Idarado Mine Tailings
Delaware	Various MSW landfills – Evaluate past disposal of industrial wastes
Florida	Alachua County Landfill
Georgia	Meriwether County – Turkey Run Landfill Hancock County – Culverton Plantation Landfill
Illinois (*State Landfilling Regulations*)	Crystal Lake - McHenry County Landfill Wayne County Landfill Kankakee County – Kankakee Landfill Peoria County – Peoria Waste Disposal (Hazardous Waste) Chemical Waste Unit at Clinton Landfill
Indiana (*State Landfilling Regulations*)	Posey County Landfill New Haven-Adams Center Landfill (Hazardous Waste)
Louisiana	New Orleans vicinity - Gentilly Landfill and Chef Mentuer Landfill

Michigan (*State Landfilling Regulations*)	Menominee Township - Landfill Ypsilanti- Waste Disposal Inc. (Hazardous Waste - PCB's)
Minnesota	Reserve Mining Co., Silver Bay - taconite tailings Wright County - Superior FCR Landfill
Missouri	Jefferson County - Bob's Home Service (Hazardous Waste)
New Jersey	Fort Dix Landfill (Superfund Site) Cherry Hill – GEMS (Superfund Site) Lyndhurst - Meadowlands Landfill Scotch Plains Leaf Dump
New York	Staten Island - Fresh Kills Landfill, Niagara Falls Landfill – (Hazardous Waste), New York City – Ferry Point Landfill
North Dakota	Turtle River Township - Grand Forks Balefill Facility Landfill
Ohio	Clermont County - BFI/CECOS Landfill (Hazardous Waste) Huber Heights - Taylorville Road Hardfill Landfill (C&DD) Morrow County – Washington and Harmony Townships C&DD Landfills
Pennsylvania	Pottstown – Pottstown Landfill
Rhode Island	Richmond – Landfill (C&D)
South Carolina	Spartanburg - Palmetto Landfill
Texas	Dallas/Sachse – Landfill Fort Worth - Acme Brick Landfill (Hazardous Waste) City of Dallas - Jim Miller Road Landfill Pasadena – Mobil Mining and Minerals industrial waste pile
Vermont	Coventry, Vermont - Coventry Landfill
Washington	Tacoma - 304th and Meridian Landfill
Wisconsin	Madison and Wausau Landfills
INTERNATIONAL LANDFILLS	
Alberta, Canada	Waste Management proposed Thorhild Landfill
Belize	Mile 27 Landfill
Ontario, Canada (*Prov. Landfilling Regulations*)	Greater Toronto Area - Landfill Siting Issues Kirkland Lake - Adams Mine Site Landfill Pembroke - Cott Solid Waste Disposal Areas
Manitoba, Canada	Winnipeg Area - Rosser Landfill
New Brunswick, Canada	St. John's - Crane Mountain Landfill

Nova Scotia, Canada	Sydney Tar Ponds and Coke Ovens Site
England	Mercyside Waste Disposal Bootle Landfill
Hong Kong	Three New MSW Landfills
Ireland	County Cork - Bottlehill Landfill County Clare - Central Waste Management Facility, Ballyduff
Korea	Yukong Gas Co. - Hazardous Waste Landfill
Mexico (*Haz. Waste Landfilling Reg.*)	San Luis Pontosi Landfill- (Hazardous Waste)
New Zealand	North Waikato Regional Landfill
Puerto Rico	Salinas - Campo Sur Landfill

Surface and Groundwater Quality Evaluation and Management
and
Municipal Solid & Industrial Hazardous Waste Landfills

http://www.gfredlee.com

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

Landfills and Groundwater Quality Protection
Water Quality Evaluation and Management for Wastewater Discharges
  Stormwater Runoff, Ambient Waters and Pesticide Water Quality Management Issues, TMDL Development, Water Quality Criteria/Standards Development and Implementation
Impact of Hazardous Chemicals -- Superfund
  LEHR Superfund Site Reports to DSCSOC
  Lava Cap Mine Superfund Site reports to SYRCL
  Smith Canal
Contaminated Sediment -- Aquafund, BPTCP, Sediment Quality Criteria
Domestic Water Supply Water Quality
Excessive Fertilization/Eutrophication, Nutrient Criteria
Reuse of Reclaimed Wastewaters
Watershed Based Water Quality Management Programs:
  Sacramento River Watershed Program
  Delta -- CALFED Program
  Upper Newport Bay Watershed Program
  San Joaquin River Watershed DO and OP Pesticide TMDL Programs

Stormwater Runoff Water Quality Newsletter

G. Fred Lee Advisory Services

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

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

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

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

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

Louisiana Environmental and Action Network, Baton Rouge, LA
OUTRAGE and POWER, Kankakee, IL
John Cobey et al., Morrow County, OH
Heart of Illinois Sierra Club and Peoria Families Against Toxic Waste, Peoria, IL
Sierra Club of Canada, Cape Breton Group, Nova Scotia
Tulane Environmental Law Center, New Orleans, LA
Backcountry Against Dumps, Boulevard, CA
The Roth Law Firm, Marshall, TX
Citizens group Meriwether, County, GA
North Sacramento Land Company, Sacramento, California
Macuga, Liddle & Durbin Detroit, Michigan
Lozeau & Drury, Alameda, CA
DeWitt County, IL
Concerned Citizens of Thorhild County Alberta, Canada
Fox River Consortium
Minnesota Agricultural Water Resources Coalition