Environmental Consultants

3900 Kilroy Airport Way
Suite 100
Long Beach, CA 90806-6816

562 426-9544
FAX 562 427-0805
http://www.scsengineers.com

SCS ENGINEERS

February 9, 2005
File No. 01203074.03

Mr. Paul Willman
Waste Management
Western Group Environmental Protection Manager
2050 N. Glassell Street
Orange, California 92865

Subject: Bradley Landfill - Impact of Vertical Expansion on LFG System

Dear Mr. Willman:

Pursuant to your request, SCS Engineers has prepared the attached document which addresses the issue of whether the proposed vertical expansion of the Bradley Landfill will impact the ability of the LFG control system to perform its environmental mitigation objectives. We understand that this document may be utilized in the preparation of the EIR for the site expansion.

We thank you for the opportunity to assist Waste Management. If you have any questions, please call.

Sincerely

Mark B. Beizer, P.E.
Vice President
SCS ENGINEERS

MBB/jml

BRADLEY LANDFILL

IMPACTS OF THE PROPOSED VERTICAL EXPANSION ON ABILITY OF THE LANDFILL GAS COLLECTION AND CONTROL SYSTEM TO ACHIEVE ITS OPERATING GOALS

Prepared for:

Mr. Paul Willman
Waste Management
Western Group Environmental Protection Manager
2050 N. Glassell Street
Orange, California 92865

Prepared by:

Mark Beizer, P.E.
Project Director
SCS ENGINEERS
3900 Kilroy Airport Way, Suite 100
Long Beach, California 90806

File No. 01203074.03

February 9, 2005

BRADLEY LANDFILL

IMPACTS OF THE PROPOSED VERTICAL EXPANSION ON ABILITY OF THE LANDFILL GAS COLLECTION AND CONTROL SYSTEM TO ACHIEVE ITS OPERATING GOALS

SCS Engineers has been asked by Waste Management, Inc. (WM) to review the proposed 43-foot vertical expansion of the Bradley Landfill to determine whether the expansion will have an impact on the ability of the landfill gas (LFG) collection and control system to achieve its environmental operating goals, which are:

- To prevent subsurface migration of landfill gas from the landfill.
- To control surface emissions.
- To minimize LFG impacts on groundwater quality.

In reaching our response to this question, we reviewed the proposed expansion plans dated April 2003, prepared for WM by GeoSyntec consultants. We also reviewed projected input tonnage information furnished by WM, recent operational and gas monitoring data provided by WM, as well as LFG generation models prepared by SCS.

BACKGROUND

The Bradley Landfill in the Sun Valley area of the City of Los Angeles has been operational since the late 1950's. The Bradley West and West Extension portions of the landfill have been operational since 1980. The landfill is equipped with a landfill gas collection and control system. The LFG system consists of a network of wells and collection piping and appurtenances (condensate management, etc.). The LFG destruction/utilization system consists of three flares, five on-site engine-generator sets, and a gas compression plant; the latter is used to pump collected LFG off-site for use at the Penrose landfill power plant. The operational objectives of the LFG system are:

- To prevent subsurface migration of landfill gas from the landfill. Perimeter migration is monitored monthly at a series of subsurface perimeter probes, pursuant to California Code of Regulations (CCR) Title 27. Monitoring results are submitted to the Local Enforcement Agency (LEA) and the California Integrated Waste Management Board (CIWMB).

- To control surface emissions. Landfill surface emissions monitoring is performed monthly pursuant to South Coast Air Quality Management District (SCAQMD) Rule 1150.1.

- To minimize LFG impacts on groundwater quality. Groundwater monitoring is performed semi-annually (currently by SCS Engineers under contract to WM). Operation of the LFG system is a required Corrective Action pursuant to orders from the Los Angeles Regional Water Quality Control Board (RWQCB).

In addition to these environmental compliance goals, the system also has a goal of utilizing collected LFG as an energy source.

Proposed Vertical Expansion

The currently permitted landfill grading plan calls for a maximum fill elevation of 1010 feet above mean sea level (MSL) with 33 million tons of waste in place. The proposed vertical expansion would allow filling to a maximum elevation of 1053 MSL with a total of 35.77 million tons in place. The projected difference in elevation is 43 feet, with additional airspace consumption of 4.7 million cubic yards and an additional 2.57 million tons of waste. The expansion will be accomplished exclusively by placing new waste over 70 acres of the existing 126-acre footprint of Bradley West, raising the 3:1 (H: V) side slopes approximately 50 feet. No change is proposed to the final cover, which at a minimum will conform to Title 27.

EFFECT OF EXPANSION ON OPERATION OF LANDFILL GAS COLLECTION AND CONTROL SYSTEM

The principal changes in the site configuration due to the expansion would be a modest increase in waste capacity (7.8%) and an increase in refuse thickness (maximum 50 feet) in some areas of the landfill. We have been asked to address the potential impact of both (1) the additional waste volume and (2) the additional depth and configuration of waste, on the ability of the landfill gas collection and control system to meet its operational objectives, including regulatory compliance. We will address these issues individually.

1A) Will the landfill gas collection and control system be able to control the subsurface migration of landfill gas generated by the approximately 35.77 million tons of refuse contemplated by the Expansion?

SCS prepared two estimates of maximum LFG production at Bradley, one for the currently permitted capacity and one for the expanded capacity. The estimates were prepared utilizing the USEPA's LandGEM model, with model coefficients calibrated to the actual and historical results of the current system operation. The model predicts "most likely" peak recovery rates of 7,985 scfm and 8,263 scfm for the two scenarios, which would be realized in the years 2002 and 2007, respectively. Given the normal "confidence levels" inherent in the models, the highest "likely" recovery rates are 9,316 scfm and 9,641 scfm in 2002 and 2007, respectively.

In reality, the gas collection and control system is designed to handle a much greater gas flow than that contemplated by the Expansion. Based on SCAQMD operating permits, the gas destruction capabilities of the various elements of the Bradley gas control system are:

- Flare No. 1 – 5,556 scfm
- Flare No. 2 – 2,083 scfm
- Flare No. 3 – 2,083 scfm
- On-site LFG power plant -- 2,500 scfm
- Compressor plant – 3,361 scfm

This totals 15,583 scfm. However, the compressor plant is currently not operating, and continued use of the gas at the Penrose power plant is in question (there are negotiations taking place among the parties which are not yet resolved). Subtracting the compressor plant component leaves a destruction capacity of 12,222 scfm, still well above the maximum projected gas yield of the site.

Further, as is typical with LFG collection systems, the hydraulic capacity of the wells, header piping and laterals will exceed the capacity of the flares and engines, because individual legs of the system are designed for locally higher flows. The constraint on gas handling is the treatment/destruction (flares, etc.) capacity.

Therefore, it is clear that the gas collection and control system is designed to manage much more than the gas recovery rate anticipated with the Expansion. In fact, based on its current design

capacity, the system is capable of controlling methane migration even if the site received as much as 20 percent additional waste.

SCS reviewed LFG operations data and compared it to the environmental monitoring results. The actual amount of gas being recovered from the site has averaged 8500 scfm, with 36.5% methane (data January – December 2004).

In 2004, perimeter migration detections in excess of the regulatory standard (5% methane) were only detected at two probes. In one case, laboratory results of isotope analysis of the gas have confirmed that it is not originating in the landfill. The LEA has been informed of this, and an exemption request will be submitted by WM to the LEA, SCAQMD, and the CIWMB. In the other case, adjustments were made to the LFG system to bring the probe into compliance. All other monthly probe readings through the year were in compliance. The probe monitoring data do not suggest any significant shortcoming in the LFG control system, or that it could not handle the additional refuse from the Expansion.

This fact is further evidence that the system design capacity is more than adequate to handle gas generated from the additional waste.

Conclusion: **The additional refuse anticipated under the Vertical Expansion will not impact the ability of the landfill gas collection and control system to prevent the subsurface migration of landfill gas.**

1B) Could the increase in refuse thickness in some areas of the landfill have an impact on the ability of the landfill gas collection and control system to prevent the subsurface migration of landfill gas?

The additional depth of refuse placement (total 43 feet) would not be expected to have an impact on subsurface migration, because (a) the new waste is placed entirely above the surrounding grade, and (b) extraction wells have been designed with the new refuse thickness in mind and will continue to be periodically extended upward as additional refuse is placed.

The surcharge effect (the weight of the new refuse serving to compress the underlying older refuse) will not have a significant impact on gas generation or migration patterns. Landfills, including Bradley, experience this surcharge effect and continuous settlement throughout their active life and beyond, and gas collection systems are designed to manage this effect.

In order to illustrate the order-of-magnitude of this compression we present the following calculation, based conservatively on what has been observed at Bradley. After new refuse is placed in any given area, short-term settlement of approximately 1 foot has been seen for the first month, principally through observation of newly placed gas collection wells or sump risers. This settlement rate is the maximum and declines over time. Further, in any given 30-day period, new lifts are placed over an average of 6 acres of the 126-acre site -- therefore, it takes 20 months for a lift to be placed over the entire area, during which the settlement rate will have declined to a fraction of a foot per month.

The average landfill depth at which additional filling will occur is from 250 to 300 feet. Assuming that the average settlement experienced over a landfill area after receiving additional fill, due solely to the surcharge effect, is 1.0 foot per month (extremely conservative), the additional compression would result in a 0.5% reduction in the void space available for gas storage each 30 days. If we assume that all of the gas in that reduced void space had to be collected, it would produce an additional short-term flow of 30 cfm. (Calculation: 38 million cubic yards X 25% void space X 0.5% volume reduction = 1.28 million cubic feet / 30 days / 1440 minutes per day = 30 cfm).

The actual settlement and compression are almost certainly less, because the 1-foot-per- month rate is a maximum. Yet even the 30 cfm does not offer a significant additional burden on the LFG collection or disposal system. It is well within the daily fluctuations seen due to barometric and other ongoing impacts and well within the design capacity of the system.

After this short-term compaction takes place, steady-state gas generation/collection resumes, and the amount of gas being generated is unchanged (except for the incremental additional flow discussed in (1) above). There would also be a longer term consolidation of the refuse due to the additional waste placement, but this would be spread out over years, and would be even less significant.

Conclusion: **The additional depth of refuse contemplated by the Vertical Expansion will not impact the ability of the gas collection and control system to prevent the migration of landfill gas.**

2) Will the additional tonnage or additional depth impact the ability of the LFG recovery system to control surface emissions?

It is understood that not all LFG generated within a landfill is captured by the LFG collection system. The percent of the gas which is not captured is conventionally estimated at between 60% and 85% of the gas generated (this range has been adopted by EPA in its methodology to predict these "fugitive" emissions). Gas that vents to atmosphere without treatment can contribute to production of photochemical smog. In order to minimize this venting, SCAQMD Rule 1150.1 requires monitoring of emissions through the surface, and sets limits – methane concentrations cannot exceed 500 ppmv at any single location nor average 50 ppmv over any specified grid (roughly 50,000 sq ft).

The increase in landfill height tends to enhance the ability of the LFG collection system to capture generated gas. Because refuse is placed and compacted in roughly horizontal layers, gas moves more easily in a horizontal/lateral direction than vertically. This results in an enhancement of the "radius of influence" of vertical extraction wells and higher vacuums can be applied at each wells without allowing air to intrude into the refuse prism.

SCS reviewed the year 2004 surface emissions monitoring results. As is typical with landfills, there were some exceedances of the 500 ppm instantaneous surface monitoring standards. In all but one case adjustments were made to nearby wells, and/or the nearby surface soils were re-worked, and the exceedance was corrected. This is the normal detection/modification cycle of instantaneous monitoring. In one case, Grid 111, the exceedance continued until additional vertical wells were installed, and then the exceedance ceased. No integrated samples through the year exceeded the 50 ppm standard. This suggests that the control system is capable of successfully limiting surface emissions.

Given that the LFG collection system has the capacity to handle the additional gas generated by the additional waste associated with the Expansion (see above), and given that the additional refuse height enhances the ability of the system to collect gas, it is concluded that the additional tonnage and depth **will not negatively impact the ability of the system to control surface emissions.**

3) Will the additional tonnage or additional depth affect the ability of the LFG recovery system to minimize LFG impacts on groundwater quality?

Gas generated in landfills is believed to potentially contribute to a degradation of groundwater quality. LFG contains volatile organic compounds (VOCs). Some of these compounds can enter the local groundwater as precipitation percolates through the refuse mass, or as it percolates through native soil outside refuse mass if LFG has migrated into that soil, or gas migrates to directly below the landfill (within the vadose zone) and comes into contact with the groundwater surface.

Hence the application of negative pressure (partial vacuum) and collection of LFG partially mitigates gas effects on groundwater. As at many landfills, the operation of the Bradley LFG collection system has been designated as a corrective action by the RWQCB in response to detections of VOCs in groundwater monitoring wells.

If the Vertical Expansion were to result in a net increase in the internal gas pressure within the landfill, or if it resulted in more lateral gas migration, this could increase the amount of vapor phase VOCs (i.e., within the LFG) impacting groundwater. However, as discussed above, the Bradley LFG collection system has the capacity to collect the additional gas generated by the additional waste, and can produce the enhanced vacuum distribution and radii of influence at extraction wells. This means there need not be any net increase in internal gas pressures. Further, migration monitoring will continue and the system will still be required to prevent migration into surrounding native soil.

Summary

- The additional 2.57 million tons of refuse will have a minor impact on gas generation rates at the landfill (a predicted 3% increase compared to peak flows from existing refuse) and will have no impact on the ability of the gas collection and control system to prevent the subsurface migration of landfill gas.

- The additional depth of waste will not have a negative impact on the ability of the LFG system to collect generated gas or to prevent subsurface migration. The additional gas generation and gas flow, if any, is within the design capacity and operational flexibility of the system.

- There should be no deterioration in the ability of the LFG control system to prevent exceedance of surface emissions standards.

- There should be no deterioration in the ability of the LFG control system to minimize gas impacts to groundwater.