Executive Summary

FINAL REPORT:
DIOXIN-LIKE POLYCHLORINATED BIPHENYL (PCB) CONGENERS STUDY
Prepared for Chemical Waste Management, Inc., Kettleman Hills Facility, California
Prepared by Wenck Associates, Inc.
November 2010

SUMMARY

At the request of United States Environmental Protection Agency (USEPA) Region IX, the Kettleman Hills Facility (KHF) has completed one of the most extensive studies ever conducted at an active and permitted hazardous waste management facility focusing on dioxin-like polychlorinated biphenyl (PCB) congeners. In accordance with a Workplan developed in close coordination with USEPA Region IX over a two-year period, KHF measured dioxin-like PCB congeners in soil, air, and vegetation within the KHF property boundary in order to evaluate the potential human health and ecological risks that may be posed by the management, storage, and disposal of PCB wastes at the facility.

The key conclusions of this study are as follows:

- The human health risk assessment results show that potential human health risks based on exposures assumed to occur essentially at the facility boundary are well below target risk levels of concern under current land use conditions (for a rancher), and are within USEPA's target risk management range even for several conservative hypothetical worst-case future land use conditions (for residents or ranchers assumed to live at the facility boundary).
- The ecological risk assessment results show that potential risks to wildlife are well below target risk levels of concern.
- The conservative, health-protective methods and assumptions that were used in the risk assessments ensured that potential risks were not underestimated.

- Potential risks associated with exposures to PCB congeners resulting from KHF activities would be even lower farther from the facility than those calculated in this study.
- The concentrations of dioxin-like PCB congeners found in soil at KHF are similar to those measured elsewhere in the country, including in rural soils located away from industrial land uses and even in remote wilderness areas.

OVERVIEW

In December 2008, the United States Environmental Protection Agency Region IX (USEPA-IX) requested that Chemical Waste Management, Inc. (CWMI) conduct extensive monitoring for the purpose of assessing the presence of polychlorinated biphenyl (PCB) congeners in soil, air, and vegetation at the perimeter of CWMI's Kettleman Hills Facility (KHF).[1] In accordance with the request from USEPA-IX, KHF contracted with Wenck Associates for the collection of extensive monitoring data and the subsequent determination of the potential human health and ecological risks that may be posed by the management, storage, and disposal of PCB wastes at KHF.

PCB-containing wastes received at KHF are disposed of in the facility's permitted B-18 hazardous waste landfill. In addition, a small percentage (less than 2%) of the wastes received at the facility are managed in the permitted PCB flushing/storage unit which is used to process and temporarily store PCB-containing transformers and capacitors.

[1] Polychlorinated biphenyls (PCBs) are a mixture of individual organic chemicals which were used for 50 years until their manufacture was banned in 1979 by the United States Congress because of their toxicity and environmental persistence. Although they are no longer produced, PCBs can still be found in old transformers, electrical equipment, fluorescent light ballasts, and other industrial products such as paints and caulking. Each individual PCB compound is called a congener, and is made up of from 1 to 10 chlorine atoms attached to biphenyl, which is a molecule composed of two benzene rings. There are 209 individual PCB congeners, among which twelve (12) are currently of greatest potential health concern because of their similarities to dioxin. These 12 PCB congeners, which have been identified by the World Health Organization (WHO) as having dioxin-like properties, are referred to by their PCB number (i.e., PCB 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, and 189). At the request of USEPA Region IX, these 12 dioxin-like PCB congeners are the focus of this study.

This report marks the completion of one of the most extensive PCB congener studies ever conducted at an active and permitted hazardous waste management facility. All aspects of this study were conducted in close coordination with staff from USEPA-IX over a period of two years. This included development of a study Workplan which was reviewed and approved by USEPA-IX, as well as additional study modifications requested by USEPA-IX throughout the course of this project. The Workplan and additional USEPA-IX inputs defined the data quality objectives and specific protocols for sampling, analysis, data validation, and the assessment of ecological and human health risks. The sampling and analysis methods used in this study were consistent with USEPA protocols and requirements.

The goal of this study was to scientifically assess the potential ecological risks both within and outside the boundaries of the KHF property, and the potential human health risks outside the boundaries of the facility property, associated with both current and historical handling and disposal of PCB wastes at KHF. The risk calculations were performed using sampling data collected from air, soil, and vegetation within the facility property boundary. The use of on-site data is a very conservative (i.e., health protective) aspect of this study that is expected to result in overestimates of risk because potential PCB congener concentrations within the facility, that may originate from KHF waste handling and disposal operations, would be expected to be highest on KHF property compared to any off-site locations.

ENVIRONMENTAL MONITORING

Air Sampling

Air sampling for PCB congeners began in January 2009 and continued for a one-year period through December 2009. Samples were collected each month. Each month-long sample consisted of four 5-day sampling periods, each separated by 24 hours, resulting in 480 hours of sample collection time within each month from each of the three air

monitoring stations. Meteorological conditions (wind speed, wind direction, temperature, and barometric pressure) were also continuously measured at KHF throughout the monitoring effort at an existing on-site meteorological monitoring station.

The air sampling strategy was designed to measure PCB congeners in both the volatile and particulate bound phase. The air sampling is expected to reflect concentrations near the perimeter of the property boundary from current handling practices of PCB waste at the site as well as from PCBs that may have historically been deposited on soil at the site and subsequently may become airborne (e.g., due to resuspension of soil by wind or through other surface disturbances).

Air samples were collected at three air monitoring station locations that were selected based on well-documented prevailing wind directions, as follows:

- One monitoring station just within the north-northwestern property boundary (designated UMS-1),
- One monitoring station just within the eastern property boundary (designated MSP), and
- One monitoring station just within the south-southeast property boundary (designated DMS-1).

At the direction of USEPA-IX, the Wenck team performed an air dispersion analysis to verify that the selected air monitoring stations were appropriately located to capture potential PCB impacts to ambient air from the facility. The results of this air dispersion modeling analysis indicate that the air monitoring stations are appropriately located to meet the study needs.

Soil Sampling

Surface soil samples were collected in the spring of 2009 during one sampling event. The soil sampling strategy was designed to measure particulate-bound PCB congeners that

were deposited on the soil over time and to try to distinguish between PCB congeners that may potentially have originated from KHF versus those present due to unrelated factors (i.e., background). Soil samples were collected from seven segments along the entire KHF property boundary, producing seven multi-increment samples. Each multi-increment sample consisted of material collected from ten individual sample points that were spatially separated along each property boundary segment. The ten individual samples were composited in the laboratory to generate one single multi-increment sample. Based on historically observed wind direction averages, and the distance of the property boundary from facility waste management activities, each multi-increment property boundary sample may reflect varying contributions from both potential site-related activities as well as background conditions. In general, however, it is expected that soil samples collected along the northern and northwestern property boundary are more likely to reflect background concentrations while soil samples collected along the southeastern boundary are potentially more likely to have been affected by site activities.

In addition to the seven property boundary multi-increment soil samples, an eighth multi-increment sample was also collected on-site from an adjacent area in the predominant downwind direction from the B-18 landfill for use in the Ecological Risk Assessment. This eighth location was selected because wildlife may access all areas in KHF and the selected area for sampling was considered most likely to reflect potential impacts to soil from the B-18 landfill.

Vegetation Sampling

The vegetation sampling was identical to the soil sampling in both strategy and locations except that vegetation was collected in two phases - green and dry. The climate around KHF is extremely arid with the majority of annual rainfall occurring in February and March. During this wet period the plants turn green and bloom. The remainder of the year the plants are primarily dry and dormant. Therefore, the vegetation sampling attempted to encompass each of these two phases to represent the condition of plant material

throughout the year and to reflect potential differences in PCB congener concentrations in vegetation during different seasons.

Monitoring Results

The collected air, soil, and vegetation samples, along with the many associated samples collected for quality assurance/quality control, were submitted to a USEPA-approved analytical laboratory for sample preparation and analysis following the USEPA-approved methodologies identified in the Workplan.

In accordance with the Workplan, all of the sampling and analytical data were subjected to a thorough data validation process before the risk assessments were performed. Both the Ecological and the Human Health Risk Assessments were based on the measured concentrations of all congeners detected at or above the estimated detection limit (EDL). If a congener was not detected at or above the EDL, a surrogate concentration of one-half of the reporting limit (RL) was used to conservatively represent that particular congener in the sample dataset. Reporting limits for soil, vegetation, and air were established for the study and identified in the Workplan. For soil and vegetation, these were 2 picograms/gram (pg/g), which is equivalent to a concentration of 2 parts per trillion. For air, the reporting limit was 0.15 picograms/cubic meter (pg/m^3), which is equivalent to a concentration of approximately 0.02 parts per trillion.

All twelve of the targeted PCB congeners were detected in at least one of the samples of air, soil, and/or vegetation at or above the laboratory EDL. Briefly, the sampling results detected at or above the reporting limit were as follows:

- In the air, only PCB congeners 105 and 118 were detected above the reporting limit at varying concentrations ranging up to 2.7 pg/m^3.
- In the soil, PCB congeners 105, 110, 156, 167, 189 were detected at varying concentrations ranging up to 100 pg/g.

- In the vegetation, PCB congeners 105, 114, 118, 156, 157, 167, and 169 were detected at varying concentrations up to 520 pg/g. The number of detected PCB congeners and the concentrations were observed to be higher in the summer (dry season) than in the spring (green season).

The concentrations of dioxin-like PCB congeners found in soil at KHF were compared with levels that have been measured elsewhere in the United States, including results from a USEPA study that measured concentrations in rural soils. This comparison showed that the levels of dioxin-like PCB congeners measured at KHF are similar to those measured elsewhere in the country, including in rural soils located away from industrial land uses and even in remote wilderness areas.

RISK ASSESSMENT RESULTS

In accordance with directions from USEPA-IX, Wenck Associates, with assistance from AECOM, performed a risk assessment to evaluate potential ecological and human health risks from the PCB congeners. Potential exposures in the risk assessment were evaluated based on the air, soil, and vegetation sampling measurements described above.

The risk assessment incorporated a number of conservative assumptions to ensure that risks would not be underestimated. This means that the risk assessment results are expected to be over-estimated and thus protective of ecological and public health. In particular, risks for off-site ecological or human scenarios are expected to be over-estimated because they were calculated using sampling data collected on site, where potential site-related concentrations are expected to be higher than at any off-site locations.

Human Health Risk Assessment

The Human Health Risk Assessment (HHRA) calculated potential risks under both current and hypothetical worst-case future land use conditions based on the measured on-

site PCB congener concentrations in the seven property boundary segment areas. Since there is no exposure to the sampled on-site locations by the public, the risk assessment results are expected to be significantly overestimated for any off-site exposure situation. In addition, although the highly conservative, hypothetical worst-case future scenarios addressed in the HHRA are unlikely to occur, they were addressed at the request of USEPA-IX to ensure that risks would not be underestimated.

The HHRA calculated exposures to the PCB congeners for several different types of individuals who could hypothetically be exposed: adult ranchers, adult and child residents, adult and child resident ranchers, adult and child subsistence ranchers, and a nursing infant. In risk assessment terminology, these groups of individuals are known as "receptors". The receptors evaluated in this study are described below.

1. Current conditions:
    - A rancher assumed to routinely work at a location adjacent to KHF. This receptor was assumed to be exposed to PCB congeners as a result of inhalation in addition to incidental ingestion of and dermal absorption from contacted soil for a total exposure duration of 25 years.

2. Hypothetical worst-case future conditions:
    - A resident rancher assumed to live adjacent to KHF who raises beef cattle at home. This receptor was assumed to be exposed to PCB congeners via inhalation, incidental ingestion of and dermal absorption from contacted soil, and regular ingestion of beef from cattle raised at home. The total exposure duration for this receptor was 40 years.
    - A resident subsistence rancher assumed to live adjacent to KHF who raises beef and dairy cattle at home and maintains a home produce garden. This receptor was assumed to be exposed to PCB congeners via inhalation, incidental ingestion of and dermal absorption from contacted soil, regular ingestion of home-raised produce, regular ingestion of beef from cattle raised at home, and regular ingestion of unprocessed dairy milk from dairy

cattle raised at home. The total exposure duration for this receptor was 40 years.

- A resident non-farmer assumed to live adjacent to KHF who maintains a home produce garden. This receptor was assumed to be exposed to PCB congeners via inhalation, incidental ingestion of and dermal absorption from contacted soil, and regular ingestion of home-raised produce for a total exposure duration of 30 years.
- A nursing infant whose mother was assumed to be an adult from each of the hypothetical future exposure scenarios.

Potential excess lifetime cancer risks were calculated for adult and child receptors for each of the current and hypothetical worst-case future receptor scenarios. Exposures were based on the measured concentrations of PCB congeners in air, soil and vegetation or based on concentrations calculated using USEPA-recommended mathematical models (e.g., concentrations in beef, dairy milk, produce, and breast milk). For each receptor, seven sets of exposures and potential risks were calculated to correspond to each of the seven property boundary segment areas. The potential toxicity of the PCBs was evaluated using recommended USEPA risk assessment methods. The excess lifetime cancer risk results were evaluated relative to a USEPA and CalEPA target risk level of 1×10^{-6} (one in one million) and also USEPA's target risk management range of 1×10^{-6} to 1×10^{-4} (one in one million to one in ten thousand). Potential exposures to the nursing infant receptor were evaluated, in accordance with current USEPA guidance, by comparison to typical background levels.

Under current conditions, for a ranch worker who is the only likely receptor that may be present adjacent to the facility, the cancer risks from the 12 PCB congeners in the seven evaluated property boundary segment areas were calculated to range from 6×10^{-9} to 1×10^{-8}. These risks are 100 or more times lower than the USEPA and CalEPA target risk level of 1×10^{-6} (one in one million) and are lower than USEPA's target risk management range.

The excess lifetime cancer risks from the 12 PCB congeners under hypothetical worst-case future conditions were equal to or greater than the USEPA and CalEPA target risk level of 1×10^{-6} (one in one million) but all three hypothetical scenarios were within USEPA's target risk management range of 1×10^{-6} to 1×10^{-4} (a range of one in one million to one in ten thousand). None of these hypothetical future scenarios are likely to represent a plausible residential situation given the presence of the current waste management facility. The total excess lifetime cancer risks were highest for the hypothetical subsistence resident rancher, ranging from 1×10^{-5} to 5×10^{-5}. The predominant exposure pathway, accounting for roughly 70% of the total risk results, was regular ingestion of unprocessed dairy milk from home-raised dairy cattle followed by regular ingestion of home-raised beef over a 40-year exposure period. The risk results for the other hypothetical future scenarios were somewhat lower, 3×10^{-6} for the resident non-farmer (due primarily to ingestion of homegrown produce) and ranging from 1×10^{-6} to 8×10^{-6} for the resident rancher (due primarily to home-raised beef ingestion). The calculated exposures of a nursing infant were all found to be well below typical background levels of exposure to the 12 PCB congeners through breast milk ingestion.

The human health risk assessment results show that potential human health risks based on exposures assumed to occur essentially at the facility boundary are well below target risk levels of concern for current off-site receptors and are within USEPA's target risk management range even for the conservatively evaluated hypothetical worst-case future receptors. The conservative methods and assumptions used in the HHRA provide confidence that there is minimal potential for risks to have been underestimated for receptors. Moreover, because potential environmental concentrations would decrease at greater distances from the facility, the potential risks from off-site exposures farther from the facility would be even lower than those calculated in this study. Consequently, it can be concluded that the presence of PCB congeners at KHF does not pose risks of concern to public health.

Ecological Risk Assessment

The Ecological Risk Assessment (ERA) was conducted in accordance with USEPA guidelines to evaluate whether the 12 PCB congeners could pose significant ecological risks. The ERA evaluated potential impacts to selected species that were chosen based on input from USEPA-IX and were considered to be at greatest potential risk based on consideration of ecological assessment endpoints (e.g., sustainability of wildlife populations), habitat use, and population status. The six species selected for evaluation were as follows:

- Western meadowlark [*Sturnella neglecta*]: representative of populations of birds that feed on invertebrates and vegetation in the study area;
- Burrowing owl [*Athene cunicularia*]: representative of populations of predatory birds that feed on the food web of the study area;
- San Joaquin pocket mouse [*Perognathus inornatus*]: representative of populations of herbivorous small mammals that feed on vegetation in the study area;
- Tulare grasshopper mouse [*Onychomys torridus tularensis*]: representative of populations of carnivorous small mammals that feed on invertebrates in the study area;
- San Joaquin kit fox [*Vulpes macrotis mutica*]: representative of populations of predatory mammals that feed on the food web of the study area, including survival and reproduction of individual San Joaquin kit foxes (an endangered species known to occur in the vicinity and likely to occur within the study area); and
- Blunt-nosed leopard lizard [*Gambelia sila*]: representative of reptiles, including survival and reproduction of individual blunt-nosed leopard lizards (an endangered species with a potential to occur in the region) should they inhabit the study area.

Potential exposures to the selected species were based on the measured on-site concentrations of PCB congeners in soil and vegetation in each of the eight exposure

areas (seven property boundary segment areas and the B-18 landfill area). PCB concentrations in food items for the selected species were calculated from the measured concentrations using USEPA-recommended mathematical models. For example, mathematical models were used to calculate concentrations in invertebrates ingested by the grasshopper mouse and western meadowlark, as well as in prey (mice) consumed by the San Joaquin kit fox and the burrowing owl. Assumptions about food items for each selected species were developed in accordance with input from USEPA-IX. The potential toxicity of the PCBs to the selected receptors was evaluated in accordance with guidance obtained from USEPA-IX and USEPA-recommended methods for evaluating ecological risks from PCB congeners.

The ecological risk assessment results were evaluated using a hazard quotient (HQ) approach in which calculated exposures to the selected species were divided by toxicity reference values (TRVs). In this approach, which is consistent with standard USEPA practice, HQs less than a target level of 1 indicate that adverse ecological effects are unlikely to occur.

All of the hazard quotients calculated for all of the selected ecological receptors were more than 10 times lower than the target level of 1.0. These ecological risk assessment results demonstrate that none of the selected representative receptors are at significant risk from PCB congeners measured around the KHF property boundary or near the B-18 landfill.

CONCLUSIONS

The Human Health and Ecological Risk Assessments showed that potential risks associated with PCB congeners at the Kettleman Hills Facility are below regulatory and other target risk levels for human health and ecological receptors under current conditions. Potential human health risks under very conservative hypothetical worst-case future scenarios are within USEPA's target regulatory risk management range. Based on this analysis, dioxin-like PCB congeners at the Kettleman Hills Facility or in immediate proximity to the facility are not anticipated to have an adverse impact on human health or the environment.