INTEROFFICE MEMORANDUM

TO: Robert E. Wright

FROM: Michael P. Tracey

DATE: May 29, 1998

RE: **Hartford Landfill - Air Quality Emissions**

Enclosed for your use is the final report for the above-referenced matter as prepared by Brian Leaderer, Ph.D., M.P.H. from Yale University.

I would be available to discuss any questions you may have on the report at your convenience.

MT:sem
Enclosure
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cc: Dennis Martin
Dave Brown

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May 19, 1998

Michael P. Tracey, P.E.
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Dear Mr. Tracey:

A Hartford citizen's group, ONE/CHANCE Inc., has raised concerns over the potential community air quality impact of emissions associated with the operation of the North Meadows Landfill. This concern has lead to a number of studies which have sought to estimate, through air contaminant measurements and modeling, the nature and extent of potential emissions and the resultant impact on air quality in the North Hartford neighborhood. At the request of the Connecticut Resource Recovery Authority (CRRA), operators of the North Meadows Landfill (NML), I have reviewed the findings of the two principal studies on the landfill, the Agency for Toxic Substances and Disease Registry (ATSDR) report and the report prepared by the TRC Environmental Corporation (TRC), and comments received on these reports.

A) ATSDR REPORT

This report was undertaken by the ATSDR of the U.S. Department of Health and Human Services in response to a petition from a Hartford community based organization. The objective of the study was to investigate potential adverse human health impacts on residents resulting from exposure to hazardous substances emitted from disposing of ash residue at the NML. The report utilized information from three sources: 1) ambient air sampling results obtained from the

Connecticut Department of Environmental Protection (CTDEP) for Hartford, Milford and Bridgeport; 2) air emission data for the landfill, measured four inches above the landfill surface by Environmental Risk Limited (ERL); and, 3) mathematical modeling, conducted by ERL, of gas emissions from the landfill to estimate concentrations at the perimeter of the landfill and at six community locations. Work conducted by ERL was done under contract to CRRA. The list of compounds selected for evaluation was developed after consultation between the CTDEP, Connecticut Department of Public Health (CTDPH) and the CRRA. The contaminants were selected based upon their potential for association with the landfill. A very conservative set of assumptions (worst case) were used in the modeling effort. CTDEP reviewed the modeling effort.

The major finding of ATSDR study was that "air emissions generated by the Hartford Landfill do not pose any short-term or long-term health effects to residents who live nearby. Consequently, this site represents No Apparent Public Health Hazard". Air monitoring results indicated that ambient concentrations for several compounds measured in Hartford, Bridgeport and Milford exceeded some health comparison values. The report notes that the health comparison values used do not indicate the occurrence of adverse effects. Levels of these compounds measured in Hartford were similar to those in Bridgeport and Milford and probably represent background levels for Connecticut. Sampling of 53 volatile and semi-volatile compounds emitted from 4 inches above the landfill surface indicated that six exceeded health comparison values. These values had no public health relevance, however, since they do not represent community or individual exposures and are an unrealistic exposure route. The modeling effort indicated that for worst case conditions only benzene and hydrogen sulfide may exceed health comparison values. The estimated benzene values were found to be similar to those found in American cities and pose no apparent risk for children or adults. The modeling predicted a maximum 30 minute hydrogen sulfide concentration of 19 ug/m^3 and concluded that the concentration may be sufficient to produce a rotten egg smell but posed no health risk. This concentration would be reached only once in five years. The ATSDR report while finding no apparent health risk did suggest that additional data should be gathered on community levels of hydrogen sulfide and mercury.

The ATSDR investigation was carefully conceived and carried out. It made full use of available data and provided a thorough and thoughtful analysis of that data. All conclusions presented in the report are fully justified by the data presented. The community air sampling data indicates that Hartford's air quality is similar to that of other Connecticut cities and that the NML does not contribute measurably to current community levels. The modeling effort, correctly considered only worst case (conservative) conditions (i.e., worst case wind speed and direction) and found hydrogen sulfide to be, on occasion, a potential odor problem. The modeling, however, used an estimated hydrogen sulfide emission rate, since no measured values were available. A check of

the landfill hotline, established by CRRA and operating since October 20, 1994, revealed that there have been only two complaint calls, with one related to odors. An investigation of that complaint indicated the odor originated from a source other than the NML. Accurate landfill emission rates for hydrogen sulfide for input into the model would be desirable. It is not clear why ATSDR called for additional sampling for mercury, but presumably this information might prove useful in determining if the landfill has any impact on ambient mercury levels.

In follow up to the ATSDR report the CTDPH issued a March, 1998 report in which it reviewed ambient air sampling data for hydrogen sulfide collected by the CTDEP at its Windsor Avenue sampling station. The sampling station is located approximately one-half mile northwest of the Hartford Landfill. Several days of data were collected over a five minute averaging time for several days in June 1997. Average daily concentrations ranged from 2.76 $\mu g/m^3$ to 7.07 $\mu g/m^3$ with five minute concentrations ranging from 0 to 12.54 $\mu g/m^3$. The report concludes that peak concentrations may cause a noticeable rotten egg odor and some additional symptoms in sensitive individuals, but are unlikely to cause asthma or impact symptom severity in asthmatics. The report identified a number of potential sources of the measured hydrogen sulfide, including the landfill. It also noted that no additional sampling was needed. This study combined with the few odor complaints recorded over the past several years would indicate that hydrogen sulfide emissions from the landfill are not a problem.

The most important finding in the ATSDR report was that there is no apparent health hazard to the residents in the nearby community. This conclusion is fully supported by the data presented in the report. It is highly unlikely that air contaminant emissions from the landfill present any increased risk to the community. It is noteworthy that the report did not attempt to assess any adverse health risk level associated with NML emissions or estimate any potential benefits associated with reductions in emissions. The available data would not support such an effort. The landfill is only one of many sources in Hartford emitting a complex mix of air contaminants, which impact the community air quality. Any estimate of risk or benefit from mitigation of emissions would have to consider this complex mix in the background of other sources and would require a reasonably accurate assessment of exposures.

The ATSDR report did not address the issue of geographic location of the community which originally raised the concern of potential exposures to landfill emissions. The community, Hartford North End, is located west/north west of the landfill. The prevailing wind direction for this part of the State is from the north, west and south. This would suggest that the community expressing concern would most likely be upwind of the landfill a majority of the time, resulting in only limited exposure to landfill air emissions.

B) TRC REPORT

As a follow up to the ATSDR report, TRC Environmental Corporation was funded by CRRA to conduct a more detailed evaluation of emissions from the NML. The primary objectives of the TRC study were to: a) verify results of the ERL modeling used in the ATSDR study; b) determine community exposures to particulates, metals, and organic compounds emitted from the landfill; and, c) demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) and CTDEP regulations for hazardous air pollutants. The TRC study protocol was developed by a committee composed of individuals from CRRA, Mitchell Health Consultants (MHC), ERL and TRC. The City of Hartford was also involved.

The protocol utilized both air quality measurements at the landfill and mathematical modeling to estimate the impact of contaminant emissions from the landfill on community air quality. Particulate mass (TSP, PM_{10} and $PM_{2.5}$), metals (chromium, nickel, mercury, etc.), dioxins and furans were measured upwind and downwind of the landfill. These measurements were conducted at the landfill perimeter. Flare stack emission measurements (flare inlet/outlet) for several compounds, including hydrogen sulfide, were made to determine compliance with maximum allowable stack emission limits for several hazardous air pollutants. Air dispersion modeling utilized the measured flare inlet/outlet emission measurements, ambient monitoring data, EPA emission rates, facility operating data, and five year meteorological data to estimate the impact of the landfill on community air pollutant concentrations. Conservative (worst case) assumptions were used as model inputs in order to estimate the highest potential community pollutant exposures associated with landfill emissions. The TRC modeling predicted concentrations at the same six community sites modeled in the ERL study and used in the ATSDR report. The TRC model was also used to estimate concentrations at an additional 286 community sites. The contaminants evaluated in the TRC study and health guidelines to which the results were compared were determined by the study advisory committee.

Flare gas testing results indicated that emissions of all metals, inorganic and organic compounds (except for hexavalent chromium) were below the maximum allowable stack concentrations (MASC). Emissions of radioactive gases and particulates from the flare stack were found to be low. TRC flare gas test results agreed well with those performed earlier by ERL except for hexavalent chromium, where TRC's levels were an order of magnitude higher than ERL's. Air contaminant measurements from the upwind/downwind landfill study indicated that the landfill, its' perimeter, contributed 38.9 $\mu g/m^3$ of TSP, 12.0 $\mu g/m^3$ of PM_{10} and 6.0 $\mu g/m^3$ of $PM_{2.5}$. The landfill contribution at its' perimeter to levels of chromium, nickel and mercury were found to be 0.00627 $\mu g/m^3$, 0.00403 $\mu g/m^3$ and <0.00028 $\mu g/m^3$ respectively. There were no detectable emissions of dioxins or furans from the landfill. Only the highest modeled concentrations of

particulates, from among the array of community sites, were used for comparison to 24-hour and annual NAAQS standards for PM_{10} and $PM_{2.5}$. The second highest modeled 24-hour concentration of $PM_{10,}$ attributable to the landfill, was 8.66 $\mu g/m^3$ with a highest predicted annual average of 0.85 $\mu g/m^3$ (the NAAQS levels used for comparison were 150 $\mu g/m^3$ and 50 $\mu g/m^3$). The second highest modeled 24-hour concentration of $PM_{2.5,}$ attributable to the landfill, was 4.75 $\mu g/m^3$ with a highest predicted annual average of 0.47 $\mu g/m^3$ (the NAAQS levels used for comparison were 50 $\mu g/m^3$ and 12 $\mu g/m^3$). The TRC report listed the maximum concentration estimates for 24 hour and annual averages of several metals, but there are no NAAQS standards available for comparison. Concentrations were predicted for a number of metals, and gaseous contaminants for averaging times of 0.5 hours, 8 hours for comparison with Hazard Limiting Values (HLVs). In all cases the modeled values were well below the HLVs. TRC's modeled concentrations were generally lower than those estimated by the ERL modeling.

The most important conclusion of the TRC report is that "the NML has an insignificant impact on the local ambient air quality, and that the landfill air emissions modeled at the property line and in the community are in compliance with regulatory and health standards." This conclusion is fully supported by the data presented in the TRC report. The TRC study was carefully done and the conclusions drawn are well supported by the data.

While I am in full agreement with the conclusions of the TRC report, I have a number of comments:

1. The ATSDR report identified the need for assessing potential landfill emissions of mercury and hydrogen sulfide. The TRC report addressed this recommendation in its study, but did not discuss it. The flare gas emission measurements and landfill ambient air sampling data suggest that neither mercury nor hydrogen sulfide should be a problem.

2. Hexavalent chromium was higher (2.33 $\mu g/acm$) than total chromium (0.85 $\mu g/acm$) in the flare emission measurements and exceeded the MASC level of 1.03 $\mu g/acm$. (The MASC level for total chromium is 10.3 $\mu g/acm$). Since hexavalent chromium should never be greater than total chromium and typically is half or less than the total chromium level, there was, apparently, a problem with the measurement of chromium. Total chromium was well below the MASC. The measured flare gas hexavalent chromium level in the ERL study was 0.22 $\mu g/acm$. Given the apparent sampling and/or analysis problem with the TRC data, it might be more appropriate to use the ERL data for determining MASC compliance as an input to the model. The TRC measured concentrations of hexavalent chromium at the stack level, however, even if accurate do not represent human exposure levels since they are measured on the landfill, where community exposures do not occur. The impact of these emission levels on community exposures is likely to be negligible, since the community of concern is typically upwind of the source and over 3,000 ft away. The TRC air modeling results suggest that the contribution of the landfill to community

hexavalent levels is insignificant, even when the higher emission rate is used .

3. The upwind/downwind air sampling study may have overestimated the contribution of the landfill to the air quality at the perimeter of the landfill. The wind rose provided for the day of sampling indicates that the wind was south/southwest approximately 35% of the time. This suggests that emissions from cars on I-91, which borders the full length of the west end of the landfill, may have provided a significant interference.

4. The NAAQS levels for $PM_{2.5}$ used for comparison with the modeled $PM_{2.5}$ were not appropriate. The $PM_{2.5}$ standard that is in effect is 65 $\mu g/m^3$ for the 24 hour value (based on the 3-year average 98th percentile of 24-hr $PM_{2.5}$ concentrations at each population-oriented monitor within an area) and 15 $\mu g/m^3$ as a annual value (based on 3-year annual average of annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors). The TRC values were too conservative. The TRC report estimated percent contribution of the landfill to the ambient $PM_{2.5}$ is too high.

5. TRC modeling results for the six receptor sites used by ERL tended to be lower than those predicted by the ERL model. It would appear that these differences are due to three factors: a) TRC used a measured flare flow rate of 914 cfm rather than the estimated ERL flow rate of 1,500 cfm; b) TRC used a more realistic efficiency rate of 75% for the collection of landfill gases by the gas recovery system, rather than the 50% rate used in the ERL model; and, c) TRC used the flare emission rates it measured, which were lower than those measured by ERL. The differences in modeled concentrations between the TRC and ERL efforts are reasonable.

C) RESPONSE TO CONCERNS

Since the ATSDR and TRC reports became available a number of concerns have been voiced related to the findings of the studies and their interpretation. The following is a brief response to those concerns.

1. The risk from exposure to emissions from the NML is about 1 in 100,000

This comment did not identify which human health outcome (cancer, decreased respiratory function, respiratory symptoms, chronic respiratory disease, etc.) was assigned this risk level or how it was calculated. Neither the ATSDR nor the TRC studies attempted to estimate the increased risk of potential exposures to emissions of air pollutants from the landfill. The ATSDR report stated only that there was "No Apparent Public Health Hazard". Any attempt to assign a risk without supporting information is misleading. As I noted earlier, the data presented in both studies do not support an effort to assess any risks associated with the landfill. The landfill is only one of many sources in Hartford emitting a complex mix of air contaminants, which impact the

community air quality. Any estimate of risk associated with landfill emissions would have to consider a complex mix of contaminants in a background of emission from a variety of other sources (automobiles, power generation, home heating, etc.) and employ a reasonably accurate assessment of population exposures. The proposed estimate of a 1 in 100,000 risk is apparently based upon some unknown combination of the TRC modeling estimates of the landfill contribution of hexavalent chromium, particulates and the combination of other toxins (metals, volatile organics, dioxins, etc.) to the community air. The following points regarding the use of these contaminants for any risk estimate should be noted:

a) The model estimated the community annual air concentration of hexavalent chromium, under worst case conditions at the site of the highest concentration, to be 2.92 X 10^{-5} $\mu g/m^3$ - well below the 8 X 10^{-5} $\mu g/m^3$ guideline. This represents at most 5% of the levels measured in Hartford community air. As noted earlier in this letter, I believe the hexavalent chromium estimate for the landfill contribution is high.

b) Measured and modeled concentrations from the TRC and ERL reports indicate that landfill emissions of metals, volatiles, dioxins, etc. do not contribute significantly to levels measured in the Hartford area. There is no justification for including these compounds in a risk assessment.

c) The issue of particulate concentrations is discussed below.

2. Particulate concentrations associated with the landfill are high

There are several issues related to the interpretation of the modeled particulate concentrations, standards used for comparison, and the use of the modeled results in risk assessments.

a) The relevant community air quality standards (NAAQS) are the following:

	Highest 24 Hour	Annual Average
PM_{10}	150 ug/m^3 (99^{th} percentile)	50 ug/m^3
$PM_{2.5}$	65 ug/m^3 (98^{th} percentile) (3-year avg.)	15 ug/m^3 (3-year avg.)

The $PM_{2.5}$ standard was just set by EPA and is not as conservative as that use in the TRC report (24 hour max of 50 $\mu g/m^3$ and annual average of 12 $\mu g/m^3$). There is little or no ambient air monitoring data to identify areas in non-compliance for the $PM_{2.5}$ standard, since there is no established national air quality monitoring network. The EPA final rule making recognized this deficiency and established a timetable to gather the necessary ambient data. In the next two years a monitoring network will be established. Once the network is established three years of data will

be required before compliance can be assessed and contribution by various sources estimated. It is worth noting that the EPA review process of the $PM_{2.5}$ standard has started. The Federally mandated time table requires recommendations for revisions in five years time - coinciding with the time that monitoring data becomes avaialble. Any effort to determine the potential contribution of the landfill to ambient $PM_{2.5}$ concentrations in Hartford should be based upon the data gathered over the next five years by the EPA network. If Hartford is found to be in non-compliance, the required implementation plan will identify sources and specify control measures to be taken. At that point the need for particulate mitigation at the landfill can be assessed.

b) The modeled maximum contribution of the landfill to community particulate levels is low and it is unlikely that it could be identified through a community based ambient air quality monitoring program. There is no information to support the contention that $PM_{2.5}$ concentrations in Hartford are any higher than any other U.S. city of a comparable size. No support data in either the ATSDR or TRC study was presented to support a risk assessment determination on particulate levels associated with the landfill.

3) Increased amounts of sulfuric acid may be produced

Sulfuric acid emissions in the TRC study were estimated from measured flare gas sulfur dioxide emissions by using the sulfuric acid to sulfur dioxide ratio for No.2 fuel oil. No estimate was provided in the TRC report for the sulfuric acid emission rate. It is unlikely that sulfuric acid is created in the flare gas exhaust. If there were sulfuric acid emitted it would be quickly neutralized by the ammonia in the flue gas to ammonium sulfate.

4) The landfill makes a significant contribution to background ammonia levels

The TRC report measured ammonia emissions from the flare exhaust, but no modeling or ambient measurement information was presented to determine the landfill contribution to background community levels. There are many sources of ammonia, including humans, and it is unlikely that the landfill is a significant contributor or that its contribution has any health implications.

D) CONCLUSIONS AND RECOMMENDATIONS

The ATSDR and TRC studies were well designed to address their clearly stated objectives. The air quality monitoring protocols and models used were appropriate and executed in a suitable manner. The major conclusion of both studies, that air contaminant emissions from the North Meadows Landfill represents no apparent public health hazard to the community, is well supported by the results. The major identified concern was related to the potential for particulate

emissions from the landfill. This concern is not supported by the data collected in either study. Although the data presented in the reports indicate there is not a problem with particulate emissions, there are actions that CRRA could take to alleviate the concerns expressed. The following actions should be taken by CRRA :

1. CRRA's aggressive program to pave roads at the landfill should be maintained, and if possible expanded. Considerably less road dust, a major particulate source at all landfills, will be emitted if trucks hauling ash at the landfill travel over paved roads as opposed to unpaved roads.

2. Water spraying of ash while dumping occurs should be conducted during periods of meteorological conditions (wind from the east or south east at speeds greater than 10 miles per hour) which are more likely to result in particles becoming airborne and impacting the North Hartford community air quality. Although the ash arrives wet, additional water spraying would ensure little or no emissions during the most critical times.

3. Ground cover (grass, shrubs, trees, etc.) should be established as soon as practical once any area of the landfill has been filled. This would serve to minimize wind blown particle emissions from completed areas of the landfill.

4. A modest ambient air monitoring program should be designed to monitor particle emissions at the parameter of the landfill relative to community levels. Consideration should be given to establishing one monitoring location using a protocol similar to that used by the CTDEP (i.e., sampling every other 6th day).

I hope you find my comments and suggestions helpful.

Sincerely,

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