Letter Health Consultation

Modeled Air Exposures from the Stericycle Medical Waste Incinerator Emissions

North Salt Lake
Davis County, Utah

February 20, 2014

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

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LETTER HEALTH CONSULTATION

MODELED AIR EXPOSURES FROM THE STERICYCLE MEDICAL WASTE INCINERATOR EMISSIONS

NORTH SALT LAKE
DAVIS COUNTY, UTAH

Prepared By:

Environmental Epidemiology Program
Bureau of Epidemiology
Utah Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

To: Dr. Robert Rolfs
Deputy Director
Utah Department of Health
288 N. 1460 W.
Salt Lake City, UT 84116

Subject: Modeled air exposures from the Stericycle medical waste incinerator emissions

Dear Dr. Rolfs,

Recently, citizens of North Salt Lake and the Utah Governor's office have expressed concerns regarding the potential for human health impacts due to pollutant emissions from the Stericycle medical waste incinerator. The Environmental Epidemiology Program (EEP) of the Utah Department of Health, in conjunction with the Division of Air Quality (DAQ), Utah Department of Environmental Quality (DEQ), conducted an analytical review of potential air emissions and stack data from the incinerator. This report uses AERMOD air dispersion modeling analyses to identify the maximum predicted air pollutant concentrations for nearby residential areas. This letter health consultation provides a summary of the EEP's evaluation of two questions: 1) Are current emissions limits for the Stericycle incinerator protective of the health of area residents?, and 2) Did Stericycle's violation of emissions limits expose area residents to unsafe levels of pollutants?

BACKGROUND

Stericycle, Inc. is a large national provider of regulated waste disposal services. Founded in 1989, the company is headquartered in Lake Forest, Illinois. In November 1999, Stericycle acquired BFI Medical Waste, Inc., and with it a medical waste incinerator located at 90 North 1100 West in North Salt Lake, Davis County, UT (DSHW, 2005. See **Map 1, Appendix A**). This facility accepts medical waste from a variety of markets throughout North America, primarily the Pacific coast and intermountain states (DSHW, 2005). The permitted capacity for the incinerator is 1,850 pounds of waste per hour (DSHW, 2006). In the 2011 calendar year, Stericycle received 7,223 tons of medical waste for incineration at the North Salt Lake facility, 84% of which originated outside of Utah (DSHW, 2012).

The types of waste the Stericycle facility is permitted to accept include (DSHW, 2006):

- Non-hazardous medical waste, including laboratory waste, glassware, and sharps
- Surgical specimens and tissues, animal tissues and carcasses, blood, and body fluids
- Infectious wastes from veterinaries, mortuaries, research, and industry
- Expired and unused pharmaceuticals and contraband
- Outdated consumer commodities, proprietary packaging, and records
- Recalled medical equipment and supplies
- Agriculture waste, and municipal solid waste contaminated with infectious waste
- Other non-hazardous waste approved by the Director that is appropriate for a medical waste incinerator

Prior to 2001, the area north of the Stericycle incinerator was zoned for industrial and manufacturing purposes and was largely undeveloped. However, the city of North Salt Lake

rezoned this area for mixed purpose use, and development began on a residential subdivision in 2003 (KUER, 2013). Currently, residential properties border the incinerator to the north and extend in that direction for approximately two miles. Properties east and south of the facility are a mix of industrial and undeveloped land, and the area west is largely undeveloped.

Incineration of medical waste produces a number of potentially hazardous pollutants, and Stericycle is required to comply with all relevant Federal and State regulations regarding air emissions as outlined in their Title V operating permit issued by DAQ. Currently, Stericycle is required to monitor the emission levels of nine pollutants: cadmium, carbon monoxide (CO), dioxins/furans, hydrogen chloride gas (HCl), lead, mercury, nitrogen oxides (NO_x), particulate matter (PM), and sulfur dioxide (SO_2) (DAQ, 2009). Testing of emissions at the stack (a 'stack test') is mandated every three years for PM, CO, and HCl, and every five years for dioxins/furans, SO_2, NO_x, lead, cadmium, and mercury. These stack tests must use conditions representative of normal operating procedures. If a test indicates emissions of a pollutant are exceeding permitted levels, annual testing for that pollutant is required until levels are in compliance for a three year period (DAQ, 2009). The Stericycle incinerator utilizes several types of air pollution control systems, including a multi-pass dry reactor to control potential emissions of dioxins/furans and mercury by injection of carbon, an electrostatic precipitator to remove particulate matter, and a wet absorber tower using sodium hydroxide to remove acid vapors (DSHW, 2005).

On May 28, 2013, DAQ issued a Notice of Violation and Order to Comply to Stericycle for multiple violations of the pollutant emissions limits specified in its operating permit (DAQ, 2013a). On August 28, 2013, DAQ issued an amended Notice of Violation to explicitly cover each day of emissions exceedance (DAQ, 2013b). The violations identified by DAQ occurred between 2011 and 2013 and include:

- Emissions exceeding the permit limits for dioxins/furans
- Emissions exceeding the permit limits for NO_x on multiple occasions
- Emissions exceeding the permit limits for HCl
- Failure to report these emission exceedances to DAQ in the requisite time frame
- Failure to maintain normal operating conditions during the December 2011 stack test
- Failure to include the test results demonstrating these emission exceedances in the requisite annual and semi-annual monitoring reports

Table 1 lists the permitted emissions limits for the Stericycle incinerator, as well as the dates and levels of emissions exceedances.

In November 2013, the EEP requested that DAQ conduct air dispersion modeling analyses to identify the maximum predicted off-property annual air concentrations of pollutants released by the incinerator. These analyses were based upon predicted maximum emission outputs, actual stack testing data, physical characteristics of the stack, emission temperature, emission velocity, and a five-year historical record of meteorology monitored near the site.

Table 1. Emissions limits, stack test dates, and test results for the Stericycle incinerator.

Pollutant	Test Frequency (years) [a]	Test Date	Result	Limit
Cadmium (mg/dscm)	5	10/18/2006	0.001	0.16
		12/28/2011	0.001	0.16
		1/25/2013	0.003	0.16
Carbon Monoxide (ppmdv)	3	11/11/2009	20	40
		11/8/2012	2	40
		1/25/2013	5	40
		4/10/2013	3	40
Dioxins/Furans (ng/dscm)	5	10/18/2006	2	125
		12/28/2011	**616.4**	**125**
		2/15/2012	2	125
		1/25/2013	6	125
Dioxins/Furans (TEQ) (ng/dscm)	5	10/18/2006	0.1	2.3
		12/28/2011	**11.7**	**2.3**
		2/15/2012	0.1	2.3
		1/25/2013	0.3	2.3
Hydrogen Chloride (ppmdv)	3	11/11/2009	6	100
		11/8/2012	0.03	100
		1/25/2013	**143.4**	**100**
		4/10/2013	5	100
Lead (mg/dscm)	5	10/18/2006	0.004	1.2
		12/28/2011	0.001	1.2
		1/25/2013	0.02	1.2
Mercury (mg/dscm)	5	10/18/2006	0.004	0.55
		12/28/2011	0.04	0.55
		1/25/2013	0.005	0.55
Nitrogen Oxides (ppmdv)	5	10/18/2006	250	250
		12/28/2011	**336**	**250**
		9/13/2012	**438**	**250**
		1/25/2013	122	250
		4/10/2013	177	250
Particulate Matter (mg/dscm)	3	11/11/2009	2	34
		11/8/2012	25	34
		1/25/2013	20	34
Sulfur Dioxide (ppmdv)	5	10/18/2006	6	55
		12/28/2011	1	55
		1/25/2013	10	55

[a] Required test frequency in the absence of an emissions violation.
dscm: dry standard cubic meter (m^3).
ppmdv: parts per million dry volume.

RESULTS AND DISCUSSION

Air Dispersion Modeling Analyses

The DAQ air dispersion modeling analyses were based on the following design and inputs:

- AERMOD modeling system version 13350
- National Weather Service surface and upper air meteorology monitored at the Salt Lake City International Airport from 2006 through 2010
- Site: Stericycle medical waste incinerator, North Salt Lake, Utah: UTM Easting 420776, Northing 4521837, elevation 4,229 feet
- Evaluated the area out to four kilometers (km) from the site location
- Unit emission rates with temperatures and flow rates based on February 2013 stack testing data

Maps 2 & 3 show the predicted isopleths of the annual concentration gradient from the air dispersion modeling analyses up to four km and two km from the Stericycle incinerator, respectively. In this situation, an isopleth is a line on a map connecting all points that have the same predicted average concentration of a pollutant. The gradient reflects the weather patterns known to occur in this area, where air flows are most often from either the north-northwest or south. Modeling indicated that the highest concentrations would occur at a point 110 meters north-northwest of the incinerator stack, designated by the innermost dark orange isopleth. This innermost isopleth encompasses a small portion of the nearby residential neighborhood. Pollutant concentrations would continue to dilute further from the facility, denoted by isopleths progressing from orange to green to purple.

The highest predicted pollutant concentrations in the vicinity of the incinerator (i.e., in the innermost dark orange isopleth) are listed in **Table 2**. Except where noted, these concentrations are based on the maximum emission limits listed in Stericycle's Title V operating permit, meaning that these concentrations assume that the incinerator is releasing the maximum allowed amount of each pollutant. Typically, stack tests at the Stericycle incinerator have shown considerably lower levels of pollutant emissions. The predicted highest concentrations were also calculated for dioxins/furans, hydrogen chloride, and nitrogen oxides based on their emissions levels when Stericycle was in violation of their permit (**Table 2**). In these cases, the analyses assume a constant release of the pollutants at their highest recorded levels.

Toxicological Evaluation

The EEP determines if a potential health risk exists by comparing environmental sampling or modeling results to comparison values (CVs) calculated by the Agency for Toxic Substances and Disease Registry (ATSDR) or the U.S. Environmental Protection Agency (EPA). A CV is a concentration of a substance in air, water, food, or soil that is unlikely to cause harmful health effects in exposed people. It should be stressed, however, that comparison values are screening tools, not thresholds of toxicity. While levels at or below a CV may reasonably be considered safe, it does not necessarily follow that concentrations above a CV would be expected to cause harmful health effects. Rather, levels above a CV indicate the need for further evaluation.

A list of relevant CVs for each pollutant is listed in **Table 2**, and includes cancer risk evaluation guides (CREG), environmental media evaluation guides (EMEG), reference concentrations (RfC), and National Ambient Air Quality Standards (NAAQS). A complete definition for each

Table 2. Predicted highest annual residential pollutant concentrations at the Stericycle incinerator and relevant comparison values (CVs).

Pollutant	Highest Predicted Concentration (µg/m^3) [a]	CREG (µg/m^3)	Non-Cancer CV (µg/m^3)	CV Source
Cadmium	0.0076	0.00056	0.01	ATSDR Chronic EMEG
Cadmium [b]	0.00014	0.00056	0.01	ATSDR Chronic EMEG
Carbon Monoxide	2.21	NA	10,000	NAAQS 8-Hour Primary Standard
Dioxins/Furans	0.0000081	NA	NA	NA
Dioxins/Furans Violation [c]	0.00004	NA	NA	NA
Dioxins/Furans TEQ	0.00000015	NA	NA	NA
Hydrogen Chloride	7.25	NA	20	EPA RfC
Hydrogen Chloride Violation [d]	10.37	NA	20	EPA RfC
Lead	0.057	NA	0.15	NAAQS 3 Month Avg. Primary Standard
Mercury	0.026	NA	0.2	ATSDR Chronic EMEG
Nitrogen Oxides	22.83	NA	99.73	NAAQS NO_2 Annual Primary Standard
Nitrogen Oxides Violation [e]	40.01	NA	99.73	NAAQS NO_2 Annual Primary Standard
Particulate Matter	1.64	NA	150	NAAQS PM_{10} 24-Hour Primary Standard
Sulfur Dioxide	0.034	NA	26	ATSDR Acute EMEG

[a] Based on the maximum emissions limit listed in the DAQ operating permit, except where noted.

[b] Based on the highest measured emissions level of 0.003 mg/m^3.

[c] Average dioxins/furans concentration assumes daily exposure at 616.4 ng/m^3.

[d] Average hydrogen chloride concentration assumes daily exposure at 143.4 ppmdv.

[e] Average nitrogen oxide concentration assumes daily exposure at 438 ppmdv.

NA: Not available.

µg: micrograms.

m^3: cubic meter.

CV is listed in **Appendix B: Acronyms and Definitions**. ATSDR has developed a hierarchy of CVs for use in screening human exposure data (ATSDR, 2005). In general, hierarchy 1 guidelines such as CREGs and chronic EMEGs are preferred, due in part to their conservative assumptions regarding exposure. If those are not available, hierarchy 2 guidelines such as intermediate EMEGs and RfCs are selected. If there are no CVs from the preceding hierarchy levels, values from additional sources may be used (such as the NAAQS levels in this report). The EEP has chosen the most conservative (i.e., lowest) comparison value available for each pollutant. CV entries of 'NA' indicate that a comparison value for that chemical/CV type combination was not available or not applicable, most commonly because that particular chemical either a) cannot be adequately assessed for it toxicity via inhalation or b) has not been classified as a human carcinogen. As of the writing of this document, no comparison values exist for inhalation exposure to dioxins/furans.

Cadmium

Cadmium is an element found the earth's crust, typically found combined with other elements like oxygen, chlorine, or sulfur. All soils and rocks contain some cadmium. It has many industrial applications and can be found in batteries, pigments, metal coatings, and plastics. Breathing high levels of cadmium can damage the lungs, and ingesting food or water with very high levels can severely irritate the stomach (ATSDR, 2012a). EPA, the U.S. Department of Health and Human Services (DHHS), and the International Agency for Research on Cancer have determined that cadmium and cadmium compounds are human carcinogens (ATSDR, 2012a). Based on air dispersion modeling, the highest residential concentration is predicted to be 0.0076 $\mu g/m^3$, which is higher than the CREG comparison value of 0.00056 $\mu g/m^3$ but lower than the non-cancer chronic EMEG of 0.01 $\mu g/m^3$. This predicted concentration is based on the assumption that the incinerator is constantly releasing the maximum permitted amount of cadmium at 0.16 mg/m^3 of exhaust gas. However, the highest concentration of cadmium actually recorded in the exhaust gas of the incinerator was 0.003 mg/m^3, which is over 50 times lower than the permitted limit. Using this value as the basis for estimation, which is more likely to accurately reflect real emission limits, results in a predicted highest residential cadmium concentration of 0.00014 $\mu g/m^3$, which is lower than both the CREG and chronic EMEG comparison values.

Based on these data, the EEP would not expect harmful health effects from residential inhalation exposures to cadmium solely released from the incinerator.

Carbon Monoxide

Carbon monoxide is a colorless, odorless, tasteless, non-irritating gas found in both indoor and outdoor air. It is formed from the incomplete combustion of carbon-based fuels; automobile exhaust is the most significant human-made source. Headache, nausea, vomiting, dizziness, blurred vision, confusion, chest pain, difficulty breathing, and heart damage have been reported in people inhaling CO. Exposure to high levels can be life threatening (ATSDR, 2012b). The highest predicted residential concentration of CO is modeled at 2.21 $\mu g/m^3$, considerably lower than the best available CV of 10,000 $\mu g/m^3$ based on the NAAQS primary standard.

The EEP would not expect harmful health effects from residential inhalation exposures to CO solely released from the incinerator.

Dioxins/furans

Dioxins and furans are a diverse class of many different yet related compounds. While they are not intentionally manufactured except in small amounts for research purposes, they can be formed during the chlorine bleaching process of pulp in paper mills, contaminants in the manufacture of some organic chemicals, or be released from municipal and industrial solid waste incinerators (ATSDR, 1995; ATSDR, 1999a). Dioxins/furans can also be found in cigarette smoke (ATSDR, 1998). The most noted health effect in people exposed to large amounts of dioxins/furans is chloracne, a skin disease consisting of acne-like lesions on the face and upper body (ATSDR, 1999a). Due to their variable toxicity, the concept of toxic equivalence (TEQ) for dioxins/furans was developed. TEQ expresses the toxicity of the various dioxins and furans in terms of the most toxic form, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). The World Health Organization and DHHS have determined that TCDD may reasonably be anticipated to cause cancer (ATSDR, 1999a). The highest predicted concentration of dioxins/furans in the vicinity of the incinerator was modeled at 0.0003 µg/m^3 TEQ, based on the maximum recorded emission during the permit violation. Based on the maximum permitted emission limits, the highest predicted concentration is modeled at 0.00006 µg/m^3 TEQ.

As of the writing of this document, there are no CVs for exposure to dioxins/furans via inhalation. Therefore, the EEP cannot determine if harmful residential inhalation exposures could occur to dioxins/furans in the vicinity of the incinerator.

Hydrogen chloride

Hydrogen chloride is a colorless to slightly yellow, corrosive, non-flammable gas with a strong, irritating odor. Upon release, hydrogen chloride gas reacts quickly with water in the air and soil, neutralizing the gas and making the water more acidic. Brief exposure to low levels can cause throat irritation, and higher levels can result in rapid breathing, lung damage, and skin and eye irritation (ATSDR, 2002a). The highest predicted residential concentration of HCl was modeled at 10.37 µg/m^3, based on the maximum recorded HCl emissions while the incinerator was in permit violation. The highest predicted residential concentration based on the emission limits allowed on Stericycle's operating permit is modeled at 7.25 µg/m^3. Both values are lower than the EPA RfC comparison value of 20 µg/m^3.

The EEP would not expect harmful health effects from residential inhalation exposures to HCl solely released from the incinerator.

Lead

Lead is a naturally occurring bluish-gray metal found in small quantities in the earth's crust. It is used in many different products, including batteries, ammunition, metal solder, and devices to shield x-rays. In the past, it was used in paints and as an additive in gasoline. Lead can be found in all parts of our environment, in part due to human activities such as mining, manufacturing, and burning fossil fuels. Lead can affect nearly every organ and system in the body, but the main target is the nervous system where long term exposure can cause decreased function and weakness in fingers, wrists, or ankles. Young children are among the most sensitive groups, and exposure can affect mental and physical growth (ATSDR, 2007). The best available CV for lead exposure via inhalation is based on the NAAQS three-month average primary standard of 0.15 µg/m^3. The highest predicted residential concentration of lead based on the emission limits

allowed on Stericycle's operating permit is modeled at 0.057 µg/m^3, substantially lower than the CV.

The EEP would not expect harmful health effects from residential inhalation exposures to lead solely released from the incinerator.

Mercury

Mercury is a naturally occurring metallic element that has several forms. Elemental mercury is a shiny, silver-white, odorless liquid that becomes a colorless, odorless gas when sufficiently heated. Mercury also may combine with other elements, such as chlorine, oxygen, and sulfur, to form inorganic mercury salts, or with carbon to form organic mercury compounds. Exposure to high levels of mercury can damage the brain, kidneys, and the developing fetus. Short term exposures high mercury concentrations can cause lung damage, nausea, vomiting, diarrhea, skin rashes, and increased blood pressure and heart rate (ATSDR, 1999b). The highest predicted residential concentration of mercury based upon the emission limits allowed on the Stericycle operating permit is modeled at 0.026 µg/m^3, which is significantly lower than the chronic EMEG comparison value of 0.20 µg/m^3.

Based on these data, the EEP would not expect harmful health effects via residential inhalation exposures to mercury solely released from the incinerator.

Nitrogen oxides

Nitrogen oxides are a mixture of gases composed of nitrogen and oxygen, the two most toxicologically significant of which are nitric oxide (NO) and nitrogen dioxide (NO_2). Both are non-flammable and colorless to brown at room temperature. Reactions between nitrogen and oxygen containing compounds during combustion are a major source of NO_X, and it can be a significant source of air pollution in areas with high motor vehicle traffic. NO_X is broken down quickly in the environment to form nitric acid, ozone, and other compounds, primarily by reacting with other atmospheric gasses in the presence sunlight and water. Exposure to NO_X can cause eye, nose, throat, and lung irritation, shortness of breath, tiredness, and nausea (ATSDR, 2002). The highest predicted residential concentration of NO_X near the incinerator was 40.01 µg/m^3, calculated from the maximum recorded emissions while Stericycle was in permit violation. The highest residential concentration based on permitted emission limits is modeled at 22.83 µg/m^3. Both predicted values are lower than the best available CV of 99.73 µg/m^3, which is based on the NAAQS NO_2 annual primary standard.

Based on these data, the EEP would not expect harmful health effects from residential inhalation exposures to nitrogen oxides solely released from the incinerator.

Particulate matter

Particulate matter is a complex mixture of extremely small particles and liquid droplets. PM can consist of a number of components, including acids, organic chemicals, metals, and soil or dust particles. The size of the particles is linked to their potential for causing health problems. Particles that are 10 micrometers in diameter or smaller (PM_{10}) can pass through the nose and throat and enter the deepest parts of the lungs. Short term exposure can aggravate preexisting lung conditions, such as asthma and bronchitis, and cause non-fatal heart attacks and irregular

heartbeat. Longer term exposures have been associated with reduced lung function and chronic bronchitis (EPA, 2013a). The highest predicted residential concentration of PM near the Stericycle incinerator is modeled at 1.64 µg/m^3, based upon the maximum permitted emissions limits. This concentration is much lower than the best available CV of 150 µg/m^3, based on the NAAQS PM_{10} annual primary standard.

The EEP would not expect harmful health effects from residential inhalation exposures to particulate matter solely released from the incinerator.

Sulfur dioxide

Sulfur dioxide is a colorless gas with a pungent odor that dissolves easily in water. SO_2 found in the air is mainly due to human activities such as the burning of coal and oil in power plants and copper smelting. It is also used in the manufacture of sulfuric acid and in the winemaking process. Long term exposure to SO_2 can cause changes in lung function (ATSDR, 1999c). The highest predicted concentration of SO_2 near the incinerator is modeled at 0.034 µg/m^3 based on the maximum permitted emissions limits. This concentration is significantly lower than the most conservative available CV of 26 µg/m^3.

The EEP would not expect harmful health effects from residential inhalation exposures to sulfur dioxide solely released from the incinerator.

UNCERTAINTIES AND LIMITATIONS

Risk evaluations often have some errors in the estimation of environmental exposures and related health risks due to uncertainties associated with assumptions regarding exposure and toxicity. Typically, these assumptions are conservative in order to bias the misestimation in a health protective direction. This section highlights the major assumptions and limitations specific to this evaluation that result in uncertainty.

- Due to a lack of adequate data, ATSDR and EPA have been unable to derive CREG, EMEG, or RfC comparison values for inhalation exposure to dioxins/furans. This prevents the EEP from making an assessment of the health risks associated with breathing dioxins/furans released from the Stericycle incinerator.
- This evaluation assessed only the health risks associated with emissions from the Stericycle incinerator. There are alternate local sources for many of the discussed pollutants, including refineries, factories, and high traffic freeways, that may alter the overall health risks associated with a particular pollutant.
- While the results presented in this evaluation are based on historic meteorological and stack testing data and conservatively estimate residential air concentrations of pollutants using maximum permitted emissions, it is possible that the results over- or underestimate the true average annual air concentrations of pollutants.

CONCLUSIONS

Based on air dispersion modeling analyses, exposure via inhalation to emissions from the Stericycle medical waste incinerator is not expected to harm people's health. Furthermore, air modeling predicted that the highest recorded emission levels of pollutants during the periods of violation are not expected to have harmed people's health. With the exception of cadmium

emission limits, the current air quality regulations are protective of the health of area residents based on air dispersion modeling. It should be noted that stack tests at the Stericycle incinerator have shown levels of pollutant emissions considerably lower than the permitted limits (**Table 1**).

The highest predicted concentration of cadmium based on the current maximum permitted emission limit was lower than the most conservative non-cancer CV, but higher than the CREG. It must be stressed that this predicted concentration was not based on actual emissions data and overestimates the actual cadmium emissions from the incinerator. The highest recorded level of cadmium emitted from the incinerator dating back to 2006 was 0.003 mg/m^3 (3 $\mu g/m^3$) during the January 25, 2013 stack test, a value 50 times lower than the emission limit. Based on these data, the highest predicted concentration of cadmium resulting from a recorded emissions level is 0.00014 $\mu g/m^3$. This is lower than both comparison values and would not be expected to harm people's health (**Tables 1 & 2**).

Given that the current cadmium emissions limit for the Stericycle incinerator is 0.16 mg/m^3, the potential exists for the facility to release cadmium at a level that exceeds the cancer-based CV yet remain in compliance with their operating permit. This potential problem has been addressed by DAQ through new air quality regulations effective October 2014 that will lower the cadmium emissions limit for the Stericycle incinerator to 0.0092 mg/m^3 (EPA, 2013b). If the facility releases cadmium at this new maximum level, the highest predicted residential concentration near the incinerator would be 0.00044 $\mu g/m^3$. This is lower than both the CREG and the non-cancer chronic EMEG, and would not be expected to harm people's health.

During portions of the time period between December 2011 and April 2013, DAQ found that the Stericycle incinerator exceeded their maximum permitted emission limits for NO_X, HCl, and dioxins/furans. Modeled residential exposures to incinerator emissions predicted that concentrations of HCl and NO_X were below the health-based CVs for these contaminants (**Table 2**); therefore, the EEP finds that these contaminants would not have been expected to harm people's health during these periods of violation.

As there are no comparison values currently available for inhalation of dioxins/furans, the EEP has no basis to make an assessment of the potential health impact for this exposure pathway. Therefore, the EEP cannot determine if harmful residential inhalation exposures to dioxins/furans could occur in the vicinity of the incinerator.

In summary,

- With the exceptions of cadmium and dioxins/furans as discussed above, the EEP concludes that the current emissions limits for the Stericycle medical waste incinerator are protective of the health of area residents. Even if pollutants were emitted at their maximum permitted levels, the resulting predicted residential air concentrations remain below the applicable CVs.
- The EEP cannot determine the potential for adverse health effects due to air exposures to dioxins/furans due to the lack of conclusive toxicological data needed to generate a health-based CV.

- Actual cadmium emissions from the incinerator are not expected to harm people's health as the predicted pollutant concentrations are lower than both the CREG and chronic EMEG CVs.
- Stericycle's violation of the emission limits for HCl and NO_X are not expected to have harmed resident's health since predicted pollutant concentrations are lower than the EPA RfC and NAAQS CVs, respectively.

RECOMMENDATIONS

- Although stack testing at the Stericycle facility indicates that cadmium emissions are not expected to harm people's health, the current emissions limit for cadmium at this facility is not protective of residents' health as cadmium could be released at a level that is in permit compliance and yet results in concentrations that exceed the CREG. However, the new emissions limit scheduled for October 2014 (EPA, 2013b) is protective of residents' health. Therefore, the EEP supports the transition to the new air quality standards.

- As dioxins/furans are probable carcinogens, and it is known that oral exposure to low levels of dioxins/furans from contaminated soil and food grown in contaminated soils represents the major route of environmental exposure for the general population (ATSDR, 1998), the EEP finds that soil sampling of the residential and non-residential areas surrounding the Stericycle incinerator is warranted.

- Although modeled residential exposures to predicted and actual heavy metal emissions were below health-based CVs, the persistence of these contaminants in soils, coupled with community concerns, warrants further investigative soil sampling. The EEP recommends that residential soil be sampled for the eight heavy metals regulated by the federal Resource Conservation and Recovery Act (RCRA) (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). The results of these soil samplings will be released in a separate assessment document.

Sincerely,

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CERTIFICATION

This Letter of Health Consultation, **Modeled Air Exposures from the Stericycle Medical Waste Incinerator Emissions, North Salt Lake, Davis County, Utah,** was prepared by the Utah Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun. Editorial review was completed by the Cooperative Agreement partner.

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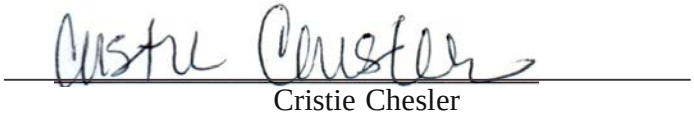

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ATSDR's Partnership to Promote Localized Efforts to Reduce Environmental Exposures

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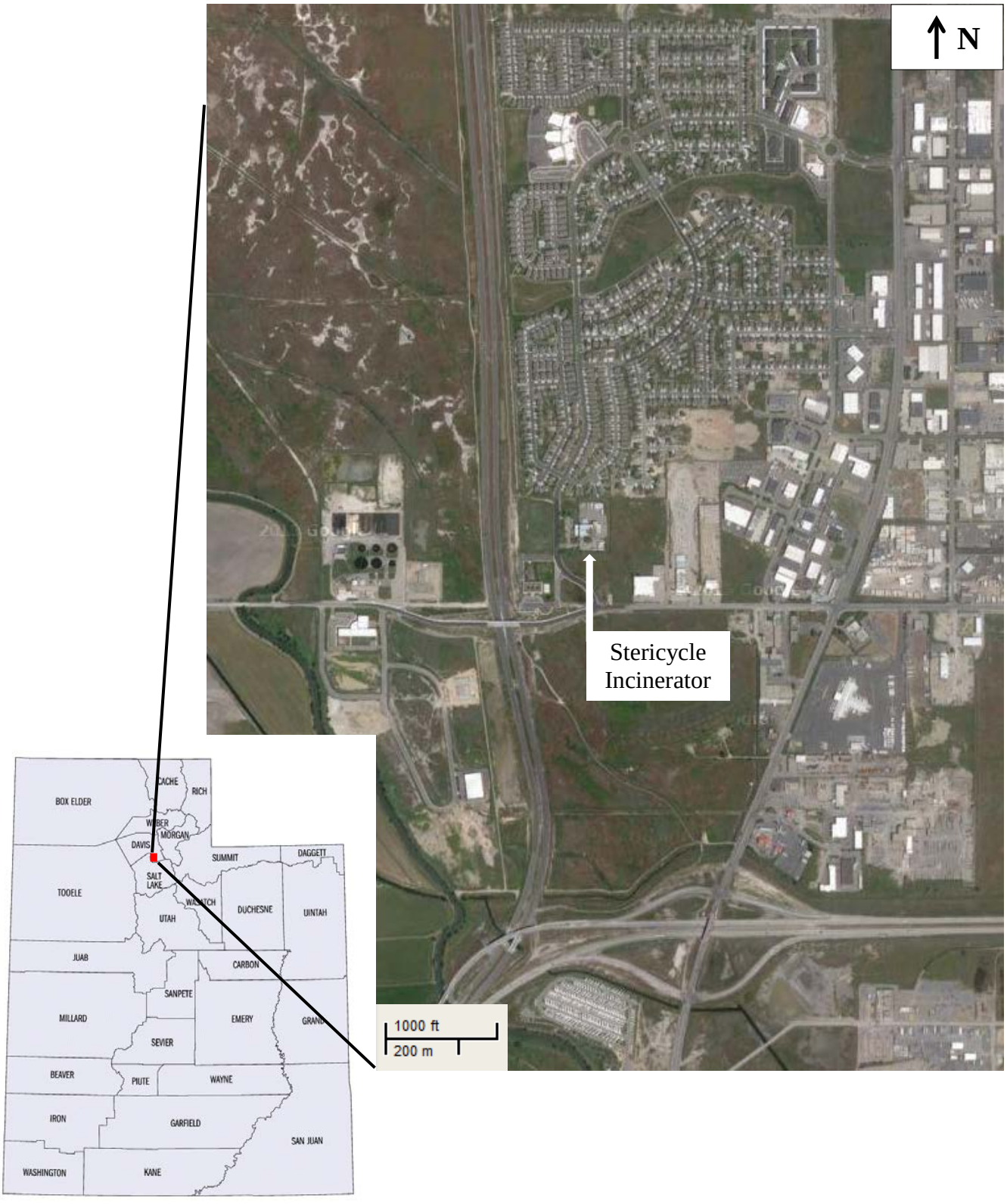
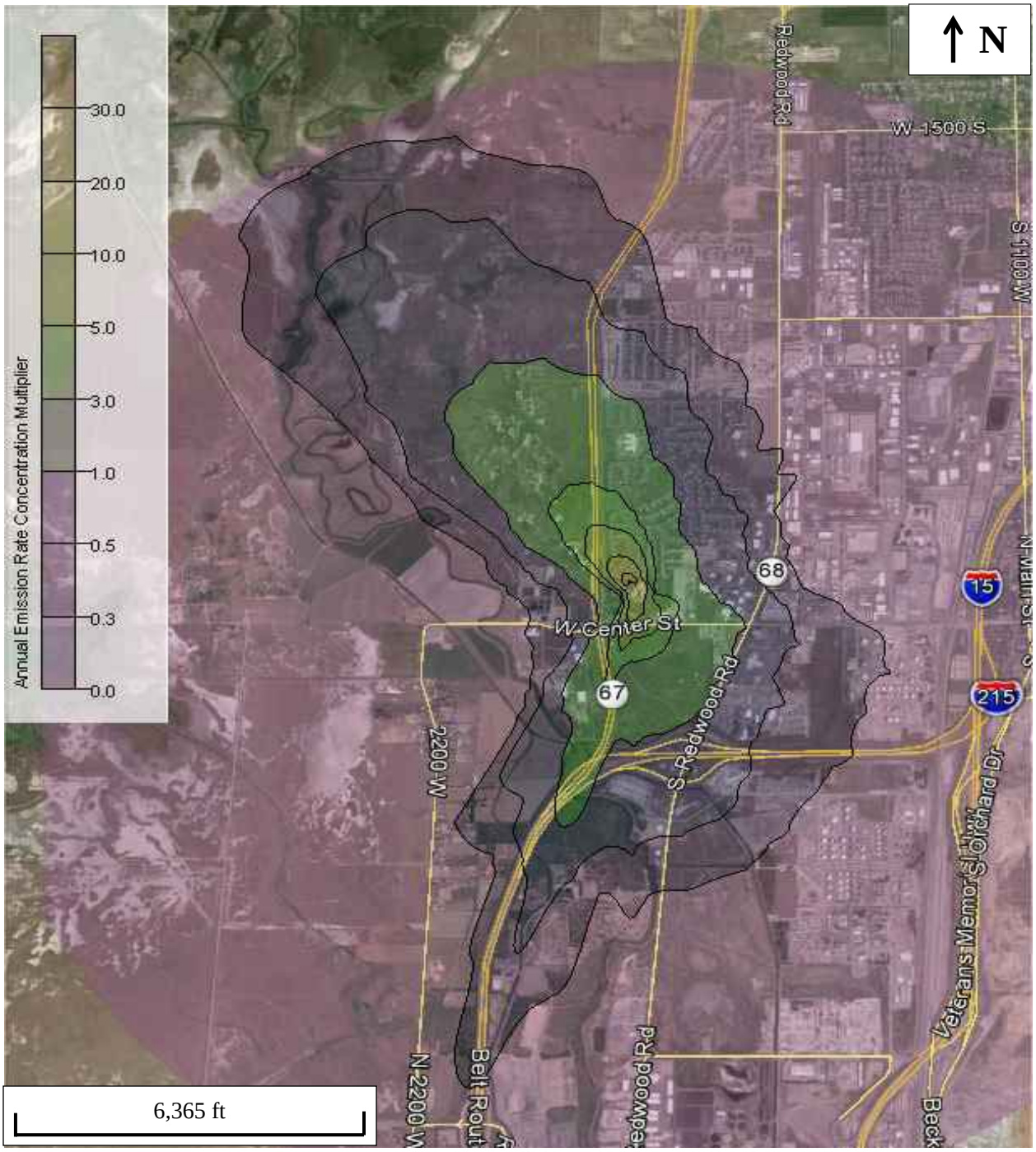
Appendix A

Maps

Map 1: Location of the Stericycle hospital/medical/infectious waste incinerator.



Map 2: Pollutant concentration gradient out to four kilometers from the Stericycle incinerator. Map courtesy of DAQ.



The innermost, dark orange isopleth denotes the highest predicted pollutant concentration. Isopleths progressing outward from orange to green to purple indicate decreasing predicted concentrations.

Map 3: Pollutant concentration gradient out to one kilometer from the Stericycle incinerator. Map courtesy of DAQ.

The innermost, dark orange isopleth denotes the highest predicted pollutant concentration. Isopleths progressing outward from orange to green to purple indicate decreasing predicted concentrations.

Appendix B

Acronyms and Definitions

ATSDR Agency for Toxic Substances and Disease Registry.

CO Carbon monoxide.

CREG Cancer risk evaluation guide. An estimate of the concentration of a contaminant that would be expected to cause no more than one excess case of cancer in a million persons exposed every day, 24 hours a day, for their lifetimes.

CV Comparison value. A concentration calculated by ATSDR or EPA of a substance in air, water, food, or soil that is unlikely to cause harmful health effects in exposed people.

DHHS United States Department of Health and Human Services

dscm Dry standard cubic meter of gas.

DSHW Division of Solid and Hazardous Waste, within the Utah Department of Environmental Quality.

DAQ Division of Air Quality, within the Utah Department of Environmental Quality.

DEQ Utah Department of Environmental Quality.

EEP Environmental Epidemiology Program, within the Utah Department of Health.

EMEG Environmental media evaluation guide. Concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, intermediate, or chronic) without experiencing adverse non-cancer health effects. Acute is 14 days or less, intermediate is 15 days to one year, and chronic is over one year.

EPA United States Environmental Protection Agency.

HCl Hydrogen chloride gas.

Isopleth A line on a map connecting all points that have the same value of some measureable quantity. In this report, the lines connect all points having the same predicted concentration of pollutant.

km Kilometers.

m^3 Cubic meter.

mg Milligrams. One thousandth of a gram.

NAAQS National Ambient Air Quality Standards.

NAAQS Primary Standard	An ambient air quality standard that provides public health protection, including the health of at-risk populations (e.g., asthmatics, children, and the elderly).
ng	Nanograms. One billionth of a gram.
NO_X	Nitrogen oxides. A mixture of gases composed of nitrogen and oxygen, the most toxicologically significant of which are nitric oxide (NO) and nitrogen dioxide (NO_2).
PM	Particulate matter.
PM_{10}	Particulate matter with a diameter of 10 micrometers or less.
ppmdv	Parts per million by dry volume.
RCRA	Resource Conservation and Recovery Act. Originally enacted in 1976, it is the principle federal law governing the disposal of solid and hazardous waste.
RfC	Reference concentration. An EPA estimate of the continuous inhalation exposure that is likely to be without an appreciable risk of adverse effects during a lifetime.
SO_2	Sulfur dioxide.
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin. The most toxic type of dioxin/furan.
TEQ	Toxic equivalency for dioxins/furans. Expresses the toxicity of the various dioxins and furans in terms of the most toxic type, TCDD.
µg	Micrograms. One millionth of a gram.