UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

JUN. 18 2010

REPLY TO THE ATTENTION OF

MEMORANDUM

SUBJECT: ACTION MEMORANDUM #2 - Request for Ceiling Increase and Exemption from 1-Year Statutory Limit for the Removal Action at Economy Plating Inc. Site, Chicago, Cook County, Illinois (Site ID #B5RT)

FROM: Ramon C. Mendoza, On-Scene Coordinator
Emergency Response Branch 2, Section 3

TO: Richard C. Karl, Director
Superfund Division

THRU: Linda M. Nachowicz, Chief FOR LN
Emergency Response Branch 2

I. PURPOSE

The purpose of this memorandum is to request and document your approval for an exemption from the 1-year statutory limit and to request a ceiling increase to expend up to an additional $88,088 to mitigate threats to public health, welfare, and the environment at the Economy Plating Inc. Site (the Site) in Chicago, Cook County. If approved, this increase will bring the total approved ceiling for the Economy Plating Site to $948,549. The expanded removal action is necessary to mitigate the immediate threat to human health and the environment posed by the elevated levels of hexavalent chromium, which is a hazardous substance as defined by CERCLA Section 101(14), inside the building, on the outside and inside walls of the building, and soils at the Site. The average concentration of hexavalent chromium on the outside walls of the Site is 1,067 milligrams per kilogram (mg/kg) which is 3,681 times higher than the United States Environmental Protection Agency (USEPA) preliminary remediation goal (0.29 mg/kg) for soils in a residential neighborhood. Residents nearest to the Site are about 4 feet from the buildings contaminated outside walls. The total lifetime cancer risk posed by the hexavalent chromium to residents is almost six times the acceptable level. The original action memorandum was approved by the Superfund Division Director Richard C. Karl on August 4, 2009.

Under the authority of Section 104(a) of CERCLA, 42 U.S.C. § 9604(a), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) § 300.415(b)(2), the expanded removal action proposed herein will address immediate threats to public health, welfare, and the environment posed by the Site through the following actions:

B. Site Background, State and Local Compliance, and Response History

Mr. Victor Koerner, the former president and operator of Economy Plating Inc., stated that plating activities had been occurring at the Site for approximately 70 years and was started as a family business. Economy Plating provided industrial hard chrome plating for various types of parts. At the present time the building is not operational and has been abandoned since 2003. It is in a dilapidated condition and is in disrepair. There has been no electricity, running water, or heat for several years.

In 1990, Economy Plating installed new fume scrubbers and applied for a Federal Air Permit through the Illinois Environmental Protection Agency (IEPA). In 1991, IEPA issued the Federal Air Permit but requested further data regarding the building's gas boiler and parking lot. Economy Plating was fined and negotiations began with IEPA that continued for seven years. In 1997, Economy Plating tested and passed new air quality standards, but in 1999 IEPA found fault with the testing and requested re-testing.

A citizen's complaint was filed due to apparent seepage on the building's north wall. IEPA inspected the property on February 10, 2000, and found deteriorating bricks with a yellow powdery residue. Victor Koerner, president of Economy Plating, told IEPA that the yellow residue appeared to be sodium hydroxide, which was used in the plating process and agreed to address the problem. Corrective actions included masonry repairs, soil sampling, and soil removal. On June 2, 2000, IEPA conducted a follow-up inspection and verified that masonry repairs were made. Soil samples taken from the area were analyzed for total chromium and lead. The TCLP results indicated a non-hazardous concentration of chromium and lead in the soil from outside the building and no further action was requested by IEPA.

In 2001, IEPA filed a lawsuit with the Pollution Control Board asking for a $10,000-per-day fine for a chrome tank that was not included in the original 1978 permit, but included on the 1991 permit. In 2002 and 2003, Economy Plating began to sell site equipment and raw materials, and eventually closed the site on December 31, 2003.

In 2004, the Illinois Attorney General won an uncontested suit against Economy Plating which resulted in a $5,000 fine and an order to cease plating operations. In 2005, Victor Koerner suffered an injury in an electrical explosion while disconnecting an unauthorized electrical connection. The unauthorized connection was made by thieves attempting to transfer electricity from an adjacent second-floor apartment into the main building. Vandals removed all the copper wire from the building.

chromium from 20,000 to 240,000 milligrams per liter (mg/l). The toxicity characteristic was also exceeded for arsenic (USEPA Hazardous Waste Number D004) and cadmium (USEPA Hazardous Waste Number D006) in liquid samples. In addition, two of the liquid samples exhibited the characteristic of corrosivity (USEPA Hazardous Waste Number D002).

USEPA Emergency Response

The presence of highly concentrated cyanide in open containers, acids, some of which were in leaking containers, and trespassing at the facility presented the unacceptable risk that hydrogen cyanide gas may be produced and released into the community. As a result, USEPA conducted an emergency response (ER) at the facility from June 13 to June 17, 2009. The goals of the ER were to collect, transport and dispose of all of the highly concentrated cyanide waste, secure all of the leaking containers in the basement, and secure the building to the extent practicable to prevent trespassing at the facility. USEPA mobilized to the site on June 13 and successfully collected all of the aforementioned cyanide which was over-packed in two 55 gallon drums. Eighteen leaking containers in the basement were repacked plus one drum of nitric acid. The facility was locked and boarded up on the first floor and signs put up to keep trespassers away. The two drums of cyanide waste were picked up and disposed of on June 17. Total ERRS contractor cost for the ER was approximately $7,484.80. The ER was conducted in coordination with the local Alderman's office, CDOE, and the Chicago Fire and Police Departments.

At the conclusion of the ER, hazardous substances including chromic acid, nitric acid, hydrochloric acid, hexavalent chromium, and low concentrations of cyanide, arsenic, and cadmium still remain at the facility. The aforementioned substances are in twelve contaminated vats and their secondary containment tanks, about 110 55-gallon drums, and 85 miscellaneous containers. In addition, basement soils and the walls and floors of the plating shop area are contaminated with yellow material suspected to be hexavalent chromium.

USEPA Time-Critical Removal Action

The Time Critical Removal Action was initiated on August 31, 2009, pursuant to an action memo dated August 4, 2009, and was completed to the extent practicable on November 19, 2009. The removal work completed during that time included removal and cleaning of metal vats and removal of solid and hazardous debris and sludge in the main plating shop and old plating shop areas. In addition, pit walls and floors were power-washed. Accessible windows and doors were boarded up and locked, and the parking lot was fenced to deter trespassers. During this period, the cleanup team made significant progress towards mitigating the threat to human health and the environment presented by the facility, including conducting the following activities: 1) recovering, decontaminating, and recycling 16.455 tons of scrap metal; 2) collecting and disposing

to demolish the building. An application for a warrant is being prepared and will be forwarded to the United States Attorney for the Northern District of Illinois once this Action Memorandum is signed.

III. THREATS TO PUBLIC HEALTH, WELFARE, OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

The conditions present at the Site present an imminent and substantial threat to the public health, or welfare, and the environment based upon the factors set forth in the NCP at 40 CFR § 300.415(b)(2). These factors include, but are not limited to, the following:

1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.

Based on the sampling results and pursuant to 40 CFR § 261.20-24, the plating shop walls (outside and inside) and underlying soils are contaminated with chromium at concentrations which are considered a hazardous waste based on the RCRA characteristic of toxicity. Specifically, hexavalent chromium, a carcinogen, has been found to be leaching out of the brick walls of the Site. The average concentration of hexavalent chromium on the outside walls of the Site is 1,067 milligrams per kilogram (mg/kg) which is 3,681 times higher than the United USEPA preliminary remediation goal (0.29 mg/kg) for soils in a residential neighborhood.

The site is located in a residential neighborhood. The closest residential building is less than four feet away from the north wall of the Site's plating shop, a wall which has been shown to be contaminated with hexavalent chromium. Residential buildings surround the Site on three sides. Pedestrian traffic by the Site is ongoing and includes pregnant women and children. The OSC observed children touching the building walls as they walked by. Although controls against trespassing inside the facility and barriers on the outside walls are in place, these are temporary and will not last for more than a few months. Because of the close proximity of the contaminated building to the residents, the total lifetime cancer risk posed by the hexavalent chromium to residents is almost six times the acceptable level. (See Attachment G, final Phase 1 Risk Assessment)

Chromium is a naturally occurring element; however, hexavalent chromium is generally produced by industrial processes such as chrome plating and finishing. The health effects of exposure to trivalent and hexavalent chromium has been researched and is well documented. Existing information about chromium, especially hexavalent chromium, is mainly related to worker exposure. Plating

contaminated with 7.8 mg/l of Chromium which is greater than the regulatory level of 5mg/l pursuant to 40 CFR 261.24, based on the RCRA characteristics of toxicity, indicating that it is a hazardous waste. The outside walls are contaminated with chromium at concentrations of 160 and 190 mg/l, indicating that they are also a hazardous waste. In addition, the average concentration of hexavalent chromium on the outside walls of the Site is 1,067 milligrams per kilogram (mg/kg) which is 3,681 times higher than the United USEPA preliminary remediation goal (0.29 mg/kg) for soils in a residential neighborhood.

Weather effects can cause the contamination in the outside building walls to migrate into the residential areas and into the storm drain system. Temporary controls prevent human contact of the walls such as plywood sheets and epoxy paint have been applied to the outside walls where chromium is leaching out of the walls.

Rain leaking into the basement can cause the contaminated soil to potentially migrate to groundwater.

4) **Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.**

Holes were found in the ceiling of the building during the site assessment with signs that rain was entering the building. In addition, water was observed seeping into the basement from the outside. Chicago DOE also reported ice in the basement during their inspection in January 2009. Visual inspection of the building indicated spillage of chrome plating sludge on the shop floors and into the soils in the basement. The inspections indicate that the saturation of these soils and sludge through rain and basement seepage is causing the contamination to migrate to the building's outside walls and potentially to groundwater. Contamination from the building's walls may migrate (through rainfall and ice) to the sidewalks, surrounding residences, and to the storm sewers.

In addition, rainfall runoff from the building roof (where the air exhaust system is located) to the storm sewers was observed to be colored green during removal activities indicating contamination may be migrating to the storm sewer system and eventually to Lake Michigan.

5) **Threat of fire or explosion.**

The Site continues to be unused, with building doors intact and locked. However, controls to prevent trespassing and potential arson cannot be maintained in perpetuity. If there is a fire there will be an immediate release of hazardous substances such as hexavalent chromium into the community and environment.

C. Other appropriate federal or state response mechanisms to respond to the release are unavailable.

On May 5, 2009, Mr. Terrence Sheahan of the CDOE Permitting & Enforcement group formally requested USEPA assistance in conducting a hazardous waste removal assessment and possible time-critical removal action at the Site. The State of Illinois and Chicago DOE do not have the funds to undertake the removal action at this Site.

VI. PROPOSED ACTIONS AND ESTIMATED COSTS

The OSC proposes to undertake the following response actions to mitigate threats posed by the presence of hazardous substances at the Site:

1. Develop and implement a Site-specific Health and Safety Plan, including an Air Monitoring Plan, and a Site Emergency Contingency Plan;

2. Develop and implement a Site Security Plan;

3. Demolish and dispose of the Site's building including hazardous substances in accordance with applicable or relevant and appropriate requirements;

4. Characterize, remove, and properly dispose of soils and building materials contaminated with hazardous substances, including asbestos abatement to the extent practical;

5. After demolition, install engineering controls to control storm water runoff and/or access at the Site;

6. Transport and dispose of all characterized or identified hazardous substances, pollutants, wastes, or contaminants that pose a substantial threat of release of release at a RCRA/CERCLA –approved disposal facility in accordance with USEPA's Off-Site Rule (40 CFR § 300.440); and

7. Take any other response actions to address any release or threatened release of a hazardous substance, pollutant or contaminant that the EPA OSC determines may pose an imminent and substantial endangerment to the public health or the environment.

The removal action will be conducted in a manner not inconsistent with the NCP. The OSC has initiated planning for provision of post-removal Site control consistent with the provisions of Section 300.415(l) of the NCP.

property disproportionate to the extent to which that property contributes to the conditions being addressed.

Applicable or Relevant and Appropriate Requirements

All applicable and relevant and appropriate requirements (ARARs) of Federal and State law will be complied with to the extent practicable. The OSC sent an email to Bruce Everetts of IEPA on July 9, 2009, requesting the State to identify ARARs. Any state ARARs identified in a timely manner will be complied with to the extent practicable.

All hazardous substances, pollutants or contaminants removed off-site pursuant to this removal action for treatment, storage and disposal shall be treated, stored, or disposed at a facility in compliance, as determined by U.S. EPA, with the U.S. EPA Off-Site Rule, 40 CFR § 300.440.

VII. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

Delayed or no action will result in increased potential of the toxic and hazardous substances to release, thereby threatening the environment and the health and welfare of nearby residents and other persons who are in proximity to the Site.

VIII. OUTSTANDING POLICY ISSUES

None

IX. ENFORCEMENT

Currently, the Site has been placed into a Land Trust. On June 23, 2009, USEPA issued a General Notice of Potential Liability to the former president/operator (Mr. Victor J. Koerner) of the Site, beneficiaries of the Land Trust, and the Land Trust itself (Attachment A Enforcement Addendum).

Given the scope and cost of the proposed removal actions at the Site, and considering both information received about Mr. Koerner's' inability to comply with Chicago DOE's recommendation to cleanup the site and his evident poor historic operation of the facility, USEPA has concluded that there is no one capable of performing the removal actions in a prompt and safe manner.

For administrative purposes, information concerning the enforcement strategy for this Site is contained in the Enforcement Confidential Addendum (Attachment A)

cc: D. Chung, U.S. EPA, 5203-G
Terrence Sheahan, Chicago DOE, **w/o Enf. Addendum**
Don Klopke, IEPA, **w/o Enf. Addendum**
M. Chezik, U.S. DOI, **w/o Enf. Addendum**

ATTACHMENT C

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL ACTION
ADMINISTRATIVE RECORD
FOR
ECONOMY PLATING INC. SITE
CHICAGO, COOK COUNTY, ILLINOIS

ORIGINAL
AUGUST 4, 2009

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	01/27/09	Badillo, P., Chicago Dept. of Environment	Mendoza, R., U.S. EPA	Site Inspection of Abandoned/Vacant Facility at the Economy Plating Inc. Site **(SDMS ID: 330900)**	19
2	02/05/09	Scott, D., Illinois EPA	Chicago Dept. of Environment	RCRA TSD Inspection Report for the Economy Plating Inc. Site **(SDMS ID: 330901)**	21
3	04/23/09	Chicago Dept. of Environment	File	Narrative Evaluation Summary of Telephone Conversation Between V. Koemer and P. Badillo **(SDMS ID: 330902)**	1
4	05/00/09	Sheahan, T.	Mendoza, R., U.S. EPA	Recent History of the Facility at 2350 N. Elston, Chicago, IL**(SDMS ID: 330903)**	1
5	05/05/09	Borries, S., U.S. EPA	Mendoza, R., U.S. EPA	Economy Plating Site Referral from Chicago Dept. of Environment **(SDMS ID: 330904)**	1
6	05/07/09	Lohse, T. North Star Trust Co.	Hesse, J., Chicago Dept. of	Notice to Disclose Beneficiaries of Land Trust 13579 **(SDMS ID: 330905)** Environment	1
7	05/12/09	Mendoza, R., U.S. EPA		Consent to Access to Property **(SDMS ID: 330906)**	1
8	06/15/09	Mendoza, R., U.S. EPA Plating Inc. Site **(SDMS ID: 330907)**	Distribution List	Pollution Report (POLREP) No. 1 for the Economy	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
5	03/30/10	Everetts, B., Illinois EPA	Mendoza, R., U.S. EPA	Letter re: Illinois EPA Identification of ARARs for the Economy Plating Inc. Site	3
6	00/00/00	Mendoza, R., U.S. EPA	Karl, R., U.S. EPA	Action Memorandum: Request for a Ceiling Increase and an Exemption from the One-Year Exemption Statutory Limit for the Removal Action at the Economy Plating Inc. Site **(PENDING)**	

ATTACHMENT E

INDEPENDENT GOVERNMENT COST ESTIMATE

ECONOMY PLATING INC. SITE
CHICAGO, COOK COUNTY, ILLINOIS

Amended May, 2010
(Increased to cover demolition)

1. The **estimated cleanup contractor** (ERRS) costs necessary to complete the removal action at the Economy Plating Site are as follows **(increased by $50,000)**:

Personnel:	1 RM @ $66 X 600 hours	$ 39,600
	1 FCA @ $37 X 500 hours	$ 18,500
	1 FCA @ $55 (OT) X 100 hours	$ 5,500
	1 Foreman @ $44 X 600 hours	$ 26,400
	1 Foreman @ $67 (OT) X 180 hours	$ 12,060
	2 Equipment Op. @ $54 X 600 hours	$ 64,800
	2 Equipment Op. @ $81 (OT) X 180 hours	$ 29,160
	3 Laborer @ $30 X 525 hours	$ 47,250
	3 Laborer @ $46 (OT) 180 hours	$ 24,840
	1 Chemist @ $47 X 180 hours	$ 8,460
	1 T&D Cord @ $67 X 180 hours	$ 12,060
	1 H&S @ $44 X 24 hours	$ 1,056
		$ 289,686

Equipment:	3 Pick-up trucks 2-wh $40/day X 60 days	$ 7,200
	1 Passenger Van @ $73/day X 60 days	$ 4,380
	1 Excavator Mini @ $95/day X 60 days	$ 5,700
	1 Excavator 42,000 @ $294/day X 30 days	$ 8,820
	1 Heavy Equip Grappler Claw @ $61/day X 30 days	$ 1,830
	1 Heavy Equip Loader/Wheel @ $220/day X 30 days	$ 6,600
	1 Heavy Equip Skid Steer @ $70/day X 60 days	$ 4,200
	1 Skid Steer Forks @ $20/day X 60 days	$ 1,200
	4 PPE-Lv1/B/SCBA/Low Pres @ $12/dayX60 days	$ 2,880
	1 Trailer Storage 10'@ $18/day X 60 days	$ 1,080
	1 Trailer Office 30ft @ $27/day X 60 days	$ 1,620
	1 Generator 50KW @ $104/day X 60 days	$ 6,240
	4 Portable Lighting @ $25/day X 60 days	$ 6,000
	1 Steam Jenny @ $38/day X 60 days	$ 2,280
	2 Washer Pressure @ $35/day X 60 days	$ 4,200
	1 Acid Pump (2") @ $90/day X 30 days	$ 2,700
	1 Trash Pump (2") @ $19/day X 60 days	$ 1,140

TOTAL START CONTRACTOR	**$ 113,080**

3. U.S. EPA (1000 direct labor hours added to be more accurate)

U.S. EPA site management activities:

Direct:	2000 labor hours (including 30 HQ hours) @ $50/hr	$ 100,000
Indirect:	200 labor hours @ $50/hour	$ 10,000
	TOTAL U.S. EPA	**$ 110,000**

ATTACHMENT G

Final Phase I Risk Assessment Economy Plating , Chicago IL.

MEMORANDUM

SUBJECT: Final Risk Assessment for Economy Plating, Chicago IL

FROM: Keith Fusinski, PhD Environmental Health Scientist US EPA

THRU: Linda Nachowicz, Section Chief, ERB2 US EPA

TO: Ramon Mendoza, On-Scene Coordinator US EPA

BACKGROUND

Economy Plating (the Site) is located at 2348 through 2352 North Elston Avenue, Chicago, Cook County, Illinois. The Site is bordered by North Elston Avenue and commercial properties to the northeast and by residential properties to the southeast, southwest, and northwest (figure 1). The North Branch of the Chicago River is located less than 1,000 feet east of the Site. The Site consists of a two-story brick building with an earthen floor basement and an asphalt-paved parking area is located southwest of the building. Economy Plating, Inc., a chrome plating facility, formerly operated at the Site. Economy Plating, Inc. ceased operations in 2003 and the building is currently vacant.

Based on results of the site assessment conducted in June 2009 by the US EPA, the Site poses an imminent and substantial threat to human health, human welfare, and the environment. The Site contains approximately 195 containers including: 55-gallon drums & 5 gallon containers. In addition, there are 12 vats. Several of the drums and containers are in poor condition (open and leaking). Yellow-staining is present on the interior and exterior walls of the Site building and yellow rain-water has been observed flowing off the roof of the Site building. Hazards identified at the Site include the following: wastes exhibiting characteristics of corrosive materials, wastes exhibiting characteristics of toxicity for arsenic and chromium, wastes containing cyanide, contaminants in uncontained areas (earthen-floor basement), disrepair of the Site building (roof, windows, and brick walls), evidence of vagrants and vandalism, and close proximity of residents to the Site.

An increase in stomach tumors was observed in humans and animals exposed to chromium(VI) in drinking water (US EPA 2008).

EXPOSURE ASSESSMENT AND ASSUMPTIONS

The Site is surrounded by concrete with a few patches of soil in the parking area behind the building. Children have been seen playing in the parking area and touching the structures of the Site.

For the dermal contact scenario, it is assumed that only an individual's hands are exposed during the winter. During the rest of the year ("warmer" months) the residents can have dermal contact with both their hands and forearms.

Even though the Site itself located within 4' of a residence, it is assumed that the residents have contact with the Site structures only 3 days a week during the year and thirty percent of the normal "soil" ingestion comes from exposure to the Site on these days from accidental touching the structure. Residents have an additional risk from exposure to the parking area of the Site. It is assumed that ten percent of the residents average soil exposure comes from the parking area, again for only 3 days per week.

The evaluation of transients in the area is difficult. However, for those who decide to take shelter within the Site during the cooler months, it is assumed that they would seek shelter for 16 hours a day while seeking food and performing other tasks for the other 8 hours. Both cancer and non-cancer inhalation risk was calculated using various times of exposure one week, one month and three months each for 16 hours a day for transients.

There maybe a problem with run off of contamination by rain events. Accumulation of contaminated water in puddles is another exposure route for residents, not to mention run off entering the storm drains and into the basement area of the apartment building. There may also be a chance of inhalation exposure in the confined four foot walkway between the Site and the apartment building. Those effects are not being evaluated at this time

CONCLUSIONS

Samples were taken from the outside walls of both the "new" and "old" shops at the Economy Plating Site average 1,067.5 ppm of chromium(VI). Soils from the parking area contain 422 ppm chromium(VI). As detailed in Appendix A, exposure to the chromium(VI) from these two sources combined equates to a Hazard Index of 1.1 for children and 2.8×10^{-1} for adults. Exposure to these sources also equates to a total lifetime cancer risk of 5.7×10^{-4}. US EPA recommends that Hazard Index values do not exceed 1 from exposure to contaminated sites and lifetime cancer not to exceed 1×10^{-4}.

Figures

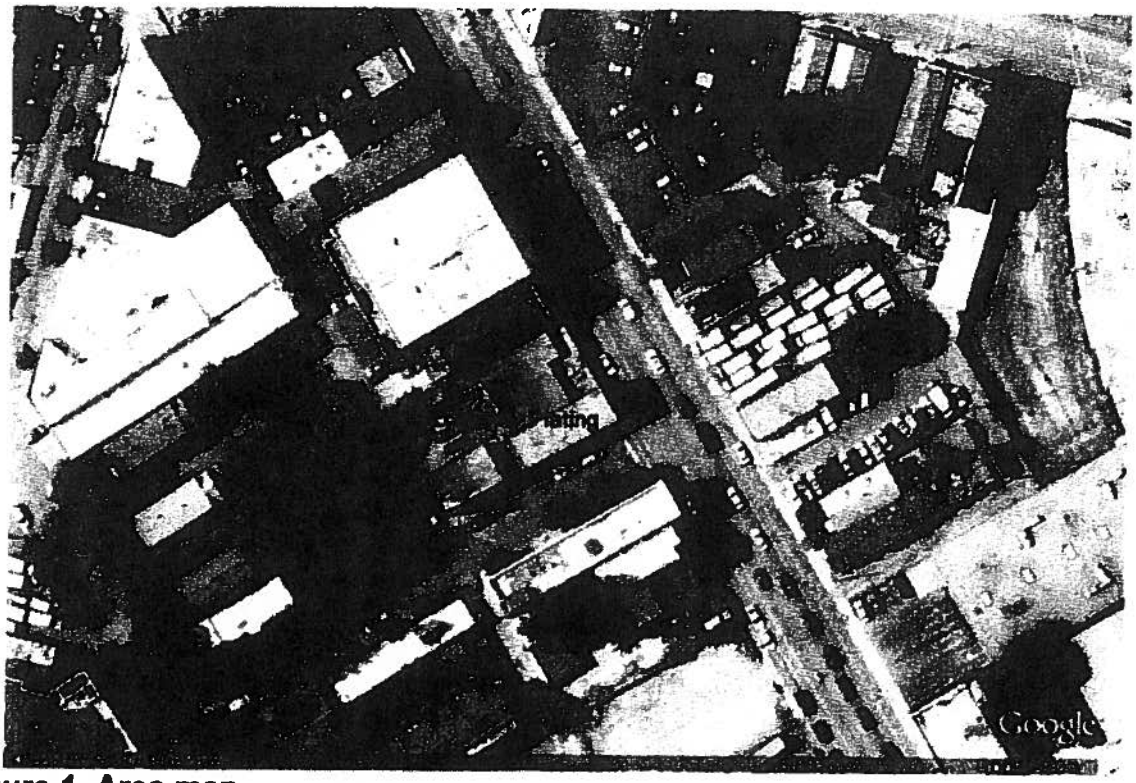
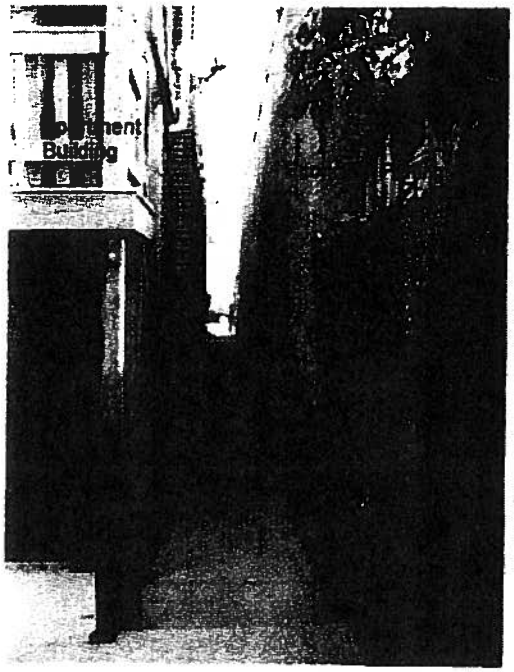


Figure 1. Area map.



Appendix A

The equations used to determine health risk for local residents near the Economy Plating Site are described below along with examples as to how these equations were used.

ABS_d = Absorbance factor (0.14 for PCBs – RAGS E)

ABS_{gi} = Fraction of contaminant absorbed via GI tract (0.02 for chromium – RAGS E)

AF_c = Soil to Skin Adherence Factor for Child (dry soil = 0.04 mg/cm^2)

AF_a = Soil to Skin Adherence Factor for Adult (dry soil = 0.011 mg/cm^2)

AT = Averaging time (cancer = 365 days/year x 70 years = 25550 days)
(non-cancer child = 365 days/year x 6 years = 2190 days)
(non-cancer adult = 365 days/year x 24 years = 8760 days)

BW_c = Body Weight for Child (15kg)

BW_a = Body Weight for Adult (70kg)

CF = Conversion factor ($1x10^{-6}$kg/1mg)

Conc = Measured Concentration (mg/kg)

DA_{event} = Absorbed Dose per Event (mg/cm^2-event)

ED_c = Exposure Duration Child (6 years)

ED_a = Exposure Duration Adult (24 years for cancer; 30 years for non-cancer)

EF = Exposure Frequency (1 hour/day)

EV = Exposure frequency (3 days a week x 52 weeks/year = 156 days)

HQ = Hazard Quotient (sum of all Hazard Indexes = should be less than 1)

Ing_c = Soil Ingestion Rate for Child (30% x 200mg/day = 60mg/day)

Ing_a = Soil Ingestion Rate for Adult (30% x 100mg/day = 30mg/day)

Rfd_o = Oral reference dose from IRIS or applicable tables (mg/kg-day)

Non-Cancer –child

Ingestion
(1,067.5 mg chromium VI/kg x 60mg/day x $1x10^{-6}$kg/mg x 156 days x 6 years x 0.021) / (15 kg x 2190 days)

This results in a daily dose of $3.8x10^{-5}$ chromium(VI) mg/kg-day for a child.

This value is then divided by Rfd_o (to determine total non-cancer risk

$3.8x10^{-5}$ chromium(VI) mg/kg-day / $3x10^{-3}$ chromium(VI) mg/kg-day = a hazard index of **$1.3x10^{-2}$ by soil ingestion**

Dermal Contact
The DA_{event} = 1,067.5mg/kg x $1x10^{-6}$kg/1mg x 0.04 mg/cm^2 x 0.14= $6.0x10^{-6}$mg/cm^2-event

Therefore;

Daily dose during the "warmer" months
= ($6.0x10^{-6}$mg/cm^2-event x 1 x 117 days/year x 6 years x 726cm^2) / (15kg x 2190 days)
= $9.3x10^{-5}$ mg/kg-day

Daily dose during the winter months
= ($6.0x10^{-6}$mg/cm^2-event x 1 x 39 days/year x 6 years x 330cm^2) / (15kg x 2190 days)
= $1.4x10^{-5}$ mg/kg-day

A time weighted average of these two values is taken to determine the Daily Average Dose of chromium (VI) throughout the year. This would result in a dose of $4.0x10^{-5}$ chromium (VI) mg/kg-day which is then divided by the absorbed reference dose (the oral reference dose/ABS_{gi}) to give a **hazard index of $6.7x10^{-1}$ by dermal contact.** When the HIs of both exposure pathways are added together, the result is a **total hazard index of $6.8x10^{-1}$ for a child.**

Non-Cancer –adult

The same equations can be used to calculate non-cancer risks for an adult exposed to 1,067.5 mg chromium(VI)/kg but with a lower ingestion rate of 100mg/day.

Ingestion

(1,067.5 mg chromium(VI) /kg x 30mg/day x $1x10^{-6}$kg/mg x 156 days x 30 years x 0.021) / (70 kg x 8760days)

This results in a daily dose of $5.1x10^{-6}$ chromium(VI) mg/kg-day for an adult.

Dermal contact

DA_{event} = 1067.5mg/kg x $1x10^{-6}$kg/1mg x 0.04 mg/cm^2 x 0.14= $6.0x10^{-6}$mg/cm^2-event

Therefore;

Daily Average Dose during the "warmer" months
= ($6.0x10^{-6}$mg/cm^2-event x 1 x 117 days/year x 6 years x 726cm^2)/ (15kg x 25550 days)
= $7.9x10^{-6}$ mg/kg-day

Daily Average Dose during the winter months
= ($6.0x10^{-6}$mg/cm^2-event x 1 x 39 days/year x 6 years x 330cm^2)/ (15kg x 25550 days)
= $1.2x10^{-6}$ mg/kg-day

This results in a time weighted average daily dose of $3.4x10^{-6}$ mg/kg-day. Multiplying this by the absorbance slope factor (Sf_o x ABS_{gi}) of $4.0x10^{1}$ (mg/kg-day)$^{-1}$ results in a lifetime **cancer risk of $1.4x10^{-4}$** for dermal exposure for children to the concentration of chromium (VI)s found in the soil.

Cancer -adult

Ingestion

(1067.5mg/kg x 30mg/day x $1x10^{-6}$kg/mg x 156 days x 30 years x 0.02) / (70 kg x 25550 days)

This results in an average daily dose of $1.8x10^{-6}$ chromium (VI) mg/kg-day for an adult. This value multiplied by the Sf_o to determine cancer risk by ingestion.

$1.8x10^{-6}$ chromium (VI) mg/kg-day x 0.79 chromium (VI) (mg/kg-day)$^{-1}$ = **$1.4x10^{-6}$** cancer risk for an adult due to ingestion.

Dermal contact

DA_{event} = 1,067.5 mg/kg x $1x10^{-6}$kg/1mg x 0.011 mg/cm^2 x 0.14= $1.6x10^{-6}$mg/cm^2-event

Therefore;

Daily Average Dose during the "warmer" months
= ($1.6x10^{-6}$mg/cm^2-event x 1 x 117 days/year x 24 years x 2300m^2)/ (70kg x 25550 days)
= $3.4x10^{-6}$ mg/kg-day

Daily Average Dose during the winter
= ($1.6x10^{-6}$mg/cm^2-event x 1 x 39 days/year x 24 years x 990cm^2)/ (70kg x 25550 days)

Appendix B

The equations used to determine health risk for transients residing within the Economy Plating Site are described below along with examples as to how these equations were used.

AT = Averaging time (cancer = 365 days/year x 70 years = 25550 days)
(non-cancer child = 365 days/year x 6 years = 2190 days)
(non-cancer adult = 365 days/year x 24 years = 8760 days)

BW_c = Body Weight for Child (15kg)

BW_a = Body Weight for Adult (70kg)

CF = Conversion factor ($1x10^{-6}$kg/1mg)

Conc = Measured Concentration (mg/kg)

ED = Exposure Duration (16 hours/24 hours)

EF = Exposure Frequency (7 days, 30 days, or 90 days)

HQ = Hazard Quotient (sum of all Hazard Indexes = should be less than 1)

Inh = Inhalation Rate ($10m^3$/day for child, $20m^3$/day for adult)

IUR = Inhalation Unit Risk for Chromium(VI) = 8.4x10-^{2} (IRIS)

Rfd_o = Oral reference dose from IRIS $1x10^{-4}$(mg/kg-day)

Sf_o = Cancer Slope factor calculated = IUR x (70/20) x 1000 = $2.94x10^2$ $(mg/kg\text{-}day)^{-1}$

Inhalation of Indoor Air

Daily Inhalation Dose = Conc x Inh x ED x EF / BW x AT

Total Risk

Cancer Risk = Daily Average Dose x SF_o

Total Cancer Risk = ΣCancer Risk

Cancer -adult

($4.3x10^{-2}$ mg chromium VI/m^3 x $20m^3$/day x (16 hours/24 hours) x 7 days)
/ (70 kg x 25550 days)

This results in an average daily dose of $2.2x10^{-6}$ chromium (VI) mg/kg-day for an adult. This value multiplied by the Sf_o to determine cancer risk by inhalation.

$2.2x10^{-6}$ chromium (VI) mg/kg-day x $2.94x10^{2}$ chromium (VI) $(mg/kg\text{-}day)^{-1}$ = **$6.6x10^{-4}$** cancer risk for an adult due to inhalation. This would result in a total lifetime cancer risk of **$2.2x10^{-3}$** for transients seeking shelter for one week within the Site. Additional risks were calculated if the transients stayed for one month or 3 months instead of 7 days as shown above.