TO: Terry Koehler
FROM: Kim Bro

Please comment by 19 NOV 93.

PRELIMINARY PUBLIC HEALTH ASSESSMENT

BETTER BRITE CHROME AND ZINC SHOPS

DE PERE, WISCONSIN

CERCLIS NO. WI~~D~~T560010118

← one entry on CERCLIS as of 1990

For RCRA purposes
Zinc - WID 006132088
Chrome - WIT 560010118
↑
clked 7/93 CERCLIS

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PREFACE: THE PURPOSE OF PUBLIC HEALTH ASSESSMENTS

The federal "Superfund" law requires the U. S. Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a public health assessment of all toxic waste sites that the U. S. Environmental Protection Agency (EPA) proposes for inclusion on the list of the nation's most hazardous waste sites. This list formally is called the National Priorities List. The Wisconsin Division of Health (DOH) works with ATSDR to prepare assessments. The purposes of public health assessments are:

1. To evaluate whether contaminants at the site pose a current or future threat to public health;

2. To recommend any steps needed to protect the public from exposure to toxic substances, and

3. To recommend long-term health studies, when appropriate.

For each assessment health professionals look at the types of contamination present, including each chemical's toxicity; ability to move through soil, water or air; persistence in the environment; and ability to accumulate in the food chain. They look at ways that people could be exposed to contaminants such as eating, breathing, or touching the chemicals. Investigators check relevant health records when appropriate to see if there may be increases in health effects related to public exposure to contaminants from the site. Finally, an assessment identifies the health hazards that a site may pose and recommends action to protect public health now and in the future.

The DOH and ATSDR conduct a "preliminary" health assessment after EPA proposes to include a site on the National Priorities List. The preliminary assessment relies on whatever data are available at the time. It also identifies sampling to be addressed by the remedial investigation conducted as part of the Superfund clean-up of the site.

The DOH, in cooperation with ATSDR, completed the Public Comment Release Preliminary Health Assessment of the Better Brite Chrome and Zinc Shops in 1991. Local, state and federal agencies and the local community had an opportunity to comment on the assessment, and the WDOH arranged follow-up health activities for some immediate health concerns. The public comments are summarized in **Appendix A**, and the results of the additional health activities are reported in the text. In the meantime, the Wisconsin Department of Natural Resources (DNR) and the EPA have removed additional contaminated material and conducted additional sampling. This assessment evaluates this additional information. The assessment will be updated again when the Superfund remedial investigation of the site is complete.

SUMMARY

This site consists of a chrome plating shop and a zinc plating shop in De Pere, Wisconsin, an urban area southwest of Green Bay. The two properties are located about 2,000 feet apart in a residential area. Heavy metals (chromium, cadmium, and zinc), cyanide, and chlorinated organic solvents were used in metal plating operations at the shops from 1963 through 1989. Both buildings have been razed, and chromium-contaminated soil from beneath and around them has been removed. Contamination from the sites extends to groundwater, surface water and soils on-site and on neighboring property. Municipal wells are not yet affected. The Environmental Protection Agency (EPA) proposed the chrome and zinc shops for joint inclusion on the National Priorities List for cleanup in October 1989 and added the site to the list in August 1990. In February 1990 United States Senator Herbert Kohl of Wisconsin petitioned ATSDR to conduct a health assessment of the site. People who live near the sites are concerned about effects of contamination on their health, about whether toxic chemicals have made their yards unsafe to use, and about the value of their property.

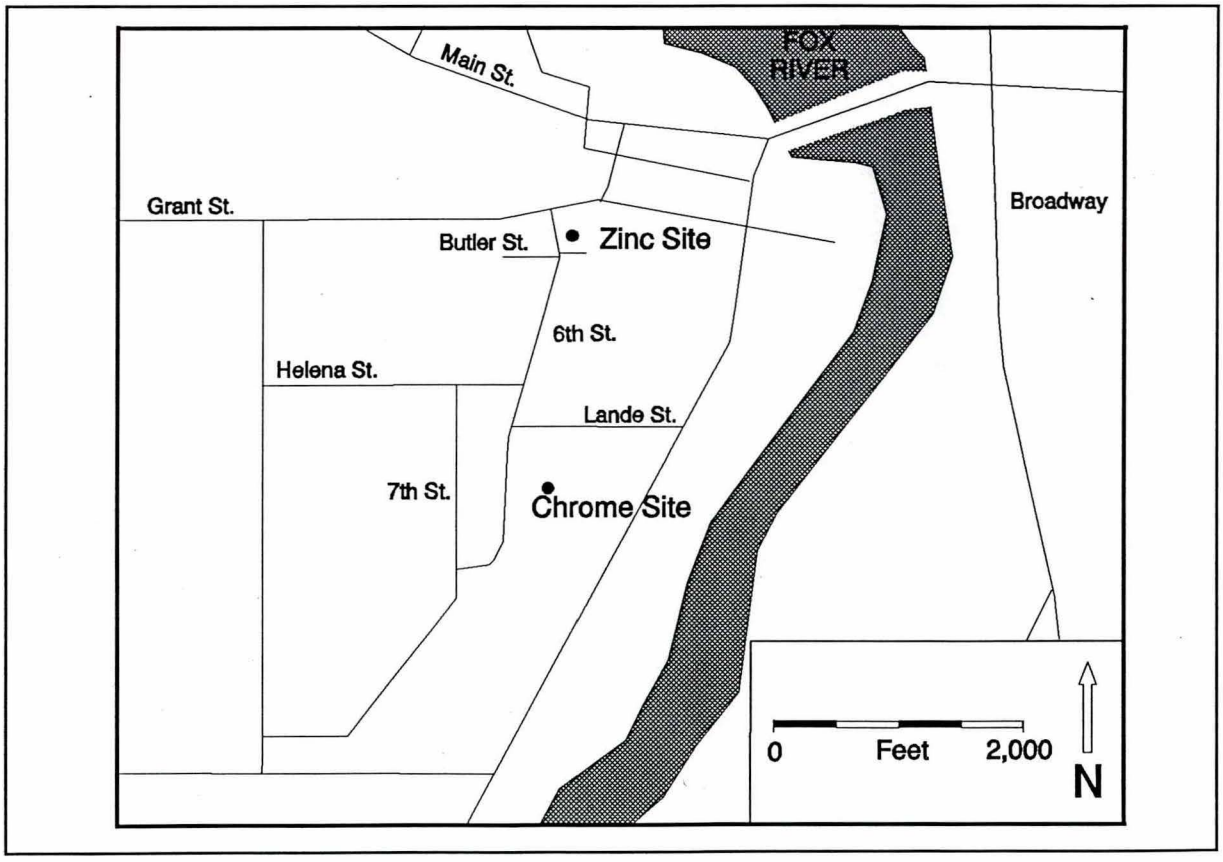
The site poses a public health hazard because there is a potential for human exposure in the future to toxic chemicals in groundwater. Chromium and VOC's in the shallow groundwater system pose a long-term threat to the quality of the sandstone aquifer used for municipal water supplies. Past exposure via dermal contact with hexavalent chromium in contaminated surface water, surface soil, and contaminated seepage water in the basement of an adjacent home may have caused allergic reactions. Chromium-sensitized people exposed to contaminated surface water might experience skin irritation from such contact. The DOH arranged testing for nearby residents who thought they may show chromium sensitivity, and none of those tested showed such sensitivity based on a standard skin-patch test. The EPA's recent removal of chromium-contaminated soil and the improvement of groundwater collection sumps is likely to prevent future exposure to high concentrations of chromium in surface soil and surface water. More extensive groundwater monitoring on and off-site is advised. The DOH will continue to evaluate the potential for site contaminants to affect public health as data from the remedial investigation become available. The DOH will also continue to provide health information to the community as the cleanup of the site progresses.

BACKGROUND

A. Site Description and History

This site consists of two former plating shops in De Pere, Wisconsin, a city south of Green Bay. The properties are about 2,000 feet apart in a primarily residential area (see Figure 1). Heavy metals (chromium, cadmium, and zinc), cyanide, and chlorinated organic solvents were used in metal plating operations at the shops (1). The EPA proposed the chrome and zinc shops for joint inclusion on the National Priorities List in October 1989 and added the site to the list in August 1990. Sites placed on the list qualify to be cleaned up under the federal "Superfund" program (2). In February 1990 United States Senator Herbert Kohl of Wisconsin petitioned ATSDR to conduct a health assessment of the site (3). In June 1990 ATSDR agreed to do so in cooperation with the DOH (4).

Figure 1: Site location of Better Brite Chrome and Zinc Shops (De Pere, Wisconsin).



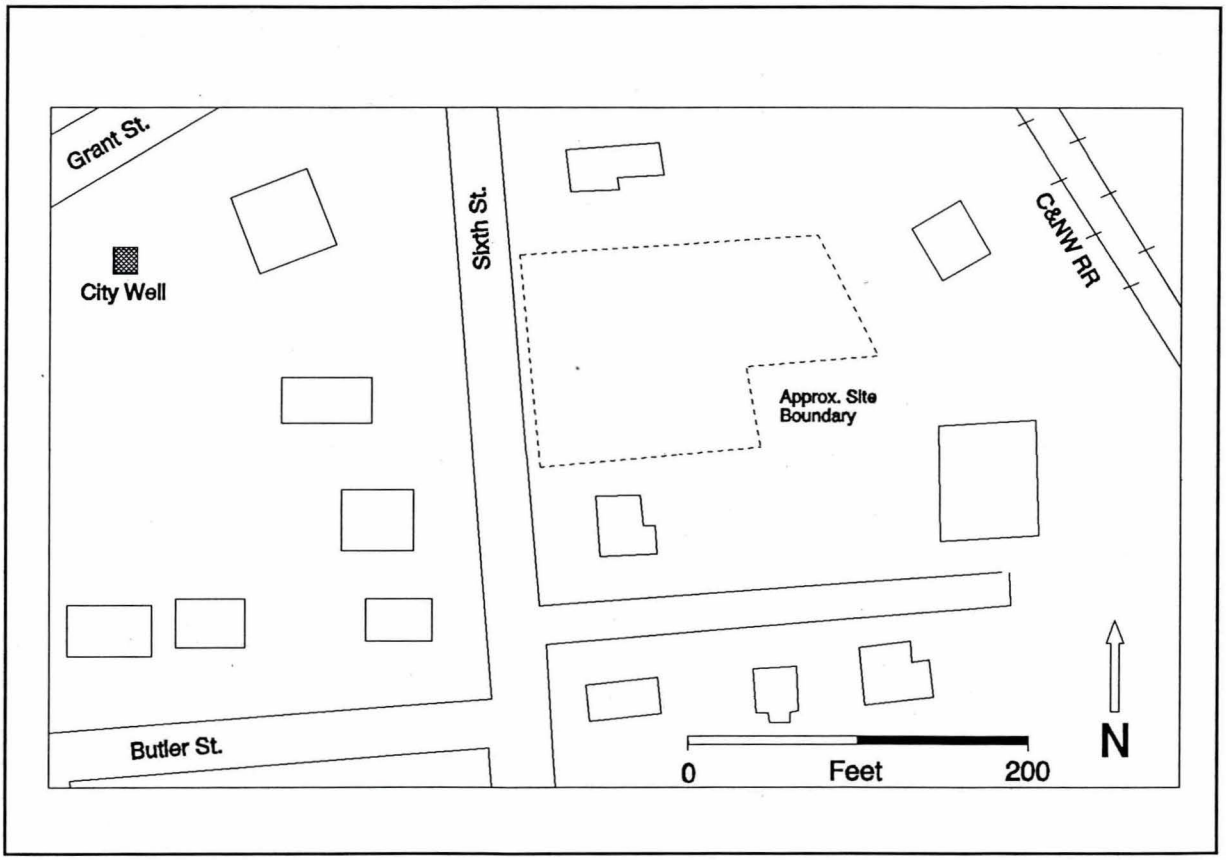
The topography of the area is relatively flat and slopes toward the Fox River one-quarter mile east of the site. The surface geology of the site consists of lacustrine silty clays

(fractured) with lenses and seams consisting of silts, silty sands, clayey sands and gravel (5, p.4). Dolomite bedrock underlies the lacustrine deposits and extends from approximately 30-40 feet below the surface to a sandstone unit at a depth of 180 feet (5, p.13).

Zinc Shop (315 South Sixth Street).

This site covers about one-half acre in a predominantly residential area (see Figure 2). Homes bound the site on the south, west, and north; a moving van line is to the east. There are gravel parking areas east and north of the area where the 120-foot by 60-foot zinc shop building formerly stood (5, pp.2-3). The area where the building once stood is now capped with clay, and the entire site is surrounded by a six-foot, chain-link fence. The property is relatively flat, with very slight surface drainage towards the northeast.

Figure 2: Better Brite Zinc Shop (315 S. Sixth St., De Pere, Wisconsin).



The zinc facility began operation in 1963 as a chrome-plating operation; by the late 1970's zinc and other metal plating had become the primary operation. The site history includes a series of violations of laws regarding chemical spills, hazardous waste, and waste water (5, p.2). Operations at the site continued until July 1989.

As part of an Interim Action metal siding was installed on the south side of the building (the plywood deteriorated) in Late 1991 (Early 92) A fence was installed.

In October 1989 an EPA Technical Assistance Team assessment confirmed DNR reports of illegal storage of hazardous materials on the zinc shop property and contamination of surface soil in an adjoining residential property (6). In March 1990 the DNR installed a sump pump in the basement of an adjoining residence to remove contaminated seepage water that enters the basement during periods of heavy rain (7). In the summer and fall of 1990 EPA's Emergency Response Technical Assistance Team carried out the following activities:

- removed hazardous materials stored in tanks, drums, and plastic containers;
- decontaminated vats, tanks, and the floor of the shop;
- covered or removed exposed insulation;
- removed soil on the east side of the building;
- ~~grouted and~~ abandoned two monitoring wells on the east side of the building; and
- installed a sump for removing contaminated groundwater.

small

gravel obtainby to a depth of aprox 20 ft.

In March 1991 the EPA installed plywood over deteriorated siding (9). In September 1992 the shop burned down. Afterward the EPA removed the remainder of the building, and contaminated soil underlying it. Perforated pipes were placed at the bottom of the pit where the soil was removed. The pipes drained to an underground sump and collection tank. The pit was filled with clean soil, which was covered with clay, topsoil, and vegetation. Groundwater requiring treatment is trucked to the pretreatment facility at the chrome shop site where it is treated and discharged to a De Pere sanitary sewer (8). By February 1993 100,000 gallons of ground water had been removed (10).

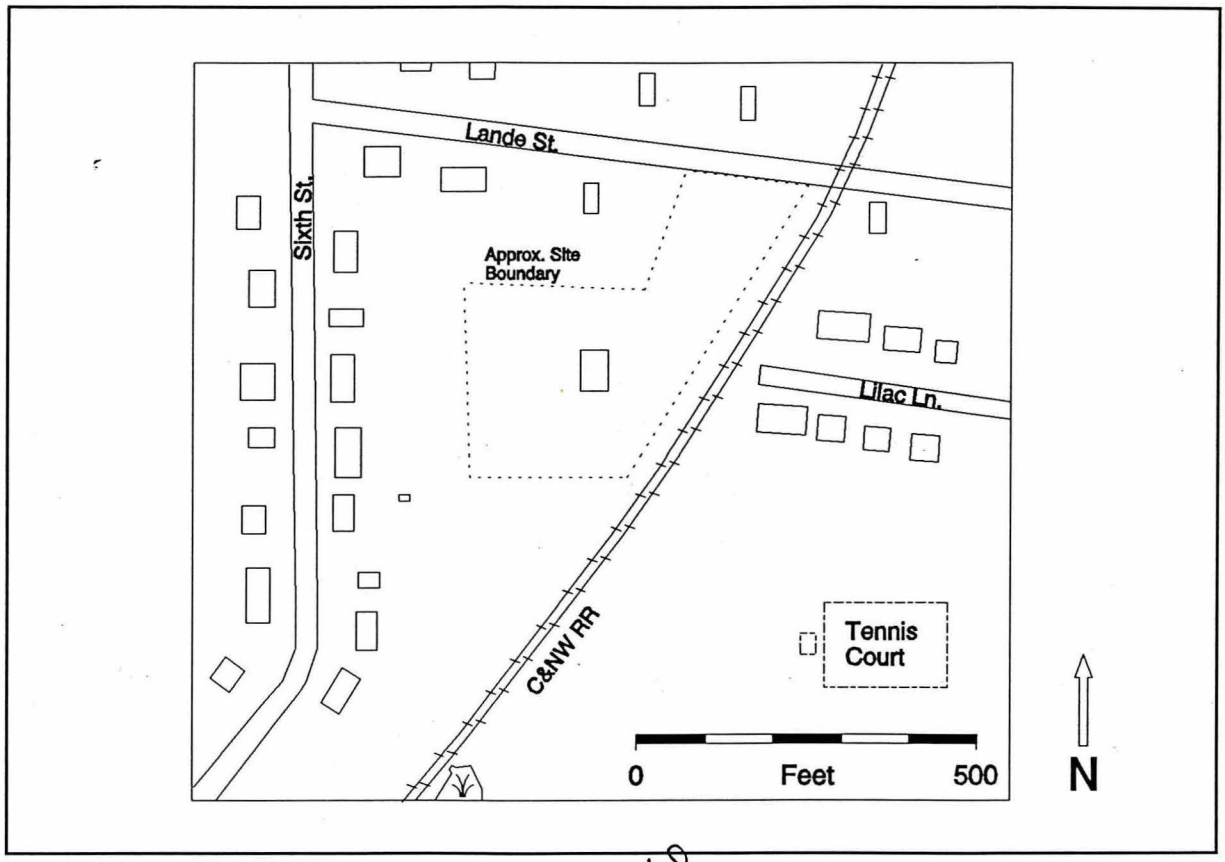
At EPA's request ATSDR provided four consultations on the public health implications of contaminants found at or near the zinc shop. In March 1988 EPA asked ATSDR to review analytical data from one sample of an on-site monitoring well and from samples of on-site soils. In response ATSDR recommended 1) an inventory and analysis of all private wells in the vicinity, 2) monthly analysis of the nearby municipal well, 3) analysis of nearby residential soil for cadmium, which could accumulate in garden vegetables, and 4) further investigation of possible off-site migration of contaminants (11). EPA sampled nearby soils in 1990 but did not inventory private wells. The City of De Pere now analyzes samples of the Grant Street Well semiannually.

In March 1990 ATSDR provided EPA a consultation regarding cyanide contamination in exposed insulation in a wall of the zinc shop and chromium contamination in the basement of a house adjacent to the site. The consultation recommended 1) collecting and analyzing soil samples around the shop and in adjoining residential yards, 2) limiting use of the basement of the house affected by contaminated seepage water, 3) posting the exterior of the zinc shop with warning signs and limiting access to exposed insulation (12). EPA conducted additional soil samples, covered the insulation, and posted warning signs around the shop. In May 1990 ATSDR provided EPA two consultations on the soil samples. One dealt with surface soil samples and the other commented on samples taken from three to four feet deep. ATSDR said that the levels of metals and cyanide in nearby residential soils did not pose a health threat and that residents should feel free to garden and play in their yards (13, 14).

Chrome Shop (519 Lande St.).

The Better Brite Chrome Shop site covers about one and one-half acres. The site consists of an excavated and filled area where the former chrome shop building once stood; a building housing groundwater treatment equipment; and a parking area. The site is bounded by private residences on the north, west and south; a raised railroad bed runs along the eastern border (see Figure 3 below). The immediate area of the site slopes to the west and south (15).

Figure 3: Better Brite Chrome Shop (519 Lande St., De Pere, Wisconsin).



The chrome shop began operations in the early 1970's. In 1978 the DNR received several complaints about illegal dumping around the facility. The first reported spill of chrome plating solution, estimated at 2,200 gallons, occurred in 1979. Also in that year, neighbors complained of dead and damaged grass, trees, and garden vegetation. Analysis confirmed the presence of chromium contamination in the soil and groundwater (16).

In the fall of 1979 the DOH evaluated the potential for chromium contamination from the chrome shop to affect the health of nearby residents. Residents expressed particular concern about exposure to chromium that may have accumulated in garden vegetables because some

vegetation near the site was stressed. In October 1979 the DOH informed WNDR, two residents, and a local health official that groundwater contaminated with chromium should not be used for human consumption. The DOH also explained that residents were unlikely to experience toxic effects from chromium accumulated in garden vegetables because the chromium would kill the plants before they accumulated levels toxic to people. The DOH advised that residents should not eat produce from these gardens until further testing showed if there may be other contaminants present in garden soil and water (17).

As a result of an initial investigation, the DNR thought contamination was confined to the upper portion of the clay soils around the building. In 1981 the company installed a trench to collect contaminated groundwater and surface water and a sump pump that discharged to the City of De Pere sanitary sewer. Contaminated soil from the garden of a neighboring property was also removed to the shop property and replaced with clean topsoil (18, p.3).

Better Brite Plating, Inc., filed for bankruptcy and discontinued chrome shop operations in October 1985. At that time, DNR discovered that vertical tanks located under the floor of the building had been leaking. It is estimated that these vessels leaked 20,000-60,000 gallons of plating solution during the shop's operation (19).

From Zinc Shop?

In 1986, EPA's Emergency Response Technical Assistance Team removed over 83 tons of contaminated soil, 9,270 gallons of chromic acid, 550 gallons of cyanide solution, 150 pounds of cyanide sludge, and 550 gallons of flammable liquids from the chrome shop (19). In March 1988, the DNR received a complaint that yellow water was overflowing from the collection trench and running across adjacent residents' back yards and gardens to a city storm sewer. Water from the trench had not been pumped since 1986 (20). DNR found elevated concentrations of chromium in the run-off and in soil at a neighboring residence. In June 1988 ATSDR responded to a request from EPA to review data on chromium concentrations in two soil samples, one at the site border and another from the back yard of a neighboring residence. ATSDR said that the levels of chromium present in the samples did not pose a threat to public health, but ATSDR also recommended more extensive sampling to better characterize the extent of contamination (21).

In October 1988, DNR was notified that the plating building at the shop was to be removed by new owners. To prevent exposure of grossly contaminated soil under the building, DNR partially fenced the site, installed a clay cap, covered it with soil, and seeded the cover (22). Off-site soil was not remediated. The EPA has installed a building on-site to house a pretreatment system designed to treat groundwater with up to 2,000,000 μg/L of chromium at a rate of at least 2,000 gallons per day. The treated water is to be discharged to the City of De Pere sanitary sewer (19).

In spring 1993 EPA's Emergency Response Program removed the concrete pad, contaminated soil from underneath and adjacent to it, and surface soil extending east to near the railroad tracks and extending west and south into residential yards. Prior to the removal, the DOH and ATSDR issued a health consultation in response to an EPA request about

to form a sump, which was then covered by clayey soil

cleaning up chromium in surface soil (23). ~~Clean fill capped with clay was~~ Perforated pipe and gravel were placed in the removal area. An extraction well, approx 30 ft deep, continues to pump contaminated groundwater to the pretreatment system (24). a limited volume of groundwater is now collected from the extraction well, a trench drain installed in 1980 and from the sump constructed in 1993. The area of the sump is fenced.

B. Site Visit

On March 14-15 and April 19, 1990 representatives from the DOH, ATSDR-Region V, and DNR conducted a site visit. The chrome shop site consisted of the chain-link fenced, clay-capped and concrete-slab covered area of the razed chrome shop building; a gravel and mud parking lot; and a large empty shed. A snow fence separated the site from homes on the western border. Due to the dormancy of the season, the health of trees and other vegetation near the site could not be readily assessed. Several residents, however, pointed out nearby trees that died since the shop began operations. – snow fence since removed

At the time of the site visit the zinc shop building was securely locked. The site was not fenced, nor were warning signs posted. Paint on the building was chipping and peeling, and cracks in wood siding revealed discolored insulation materials. Tufts of this material were scattered near the site. Deposits on the siding included powdery white material on the south wall and a yellow resin-like substance on the west side. Vegetation around the foundation was green.

The owners of the house immediately south of the zinc shop met with the site visit team and let the team inspect the basement. Half of the basement floor was covered with about one inch of seepage water. The owners had been using a portable pump to draw water from a sump in the basement to the back yard. Patches of a yellow precipitate covered an area of roughly four square feet of the concrete floor in the northwest corner of the basement.

A representative of ATSDR-Region 5 visited the shops again on February 19, 1991. Several boards had fallen from the exterior of the zinc shop. Exposed insulation was accessible to children, and only one warning sign was posted. That sign faced a private residence. No warning signs appeared on the sides of the building facing either the sidewalk or the parking lot (25). The EPA later covered all exposed insulation and dilapidated siding with plywood (9). DOH representatives Kenneth Bro and Mary Young revisited the site on May 9, 1991, November 6, 1992 and on February 16, 1993. In November, the soil removal at the zinc shop site was occurring, and in May, removal action at the chrome shop site was occurring.

1992

1993 another visit in May?

C. Demographics, Land Use, and Natural Resource Use

Both sites are located in a mixed residential/commercial area comprised chiefly of single-family homes occupied by families of mainly European descent. Around seven residential properties are adjacent to the sites (less than 15 people). Residents living adjacent to the site

who - Baby sitting? Lindsays

are mainly of middle age. Children and grandchildren of these residents often have frequented the yards adjacent to the sites. A residence adjacent to the zinc shop also functions as a family day-care facility. Commercial operations near the shops include a foundry on South Sixth St. and a moving van line adjacent to the zinc shop. A secondary school, a high school and a small college are located within one mile of the facilities. The high school is about 800 feet (less than two blocks) from the zinc shop.

(Green Bay)

The Fox River, which is used for recreation, fishing and navigation, is one-fourth to one-half mile from the shops. This lower segment of the river, extending from Lake Winnebago to Lake Michigan, is very highly industrialized. It receives discharges from numerous paper mills and municipal treatment plants and runoff from both urban and agricultural lands within the watershed (5, p.13). None of the municipalities in the vicinity of the shops uses surface water for drinking purposes. One of De Pere's six municipal wells is about 250 feet west of the zinc shop. The city's municipal water system serves a population of 16,500 (1).

from the Fox River

D. Health Outcome Data

Two groups of people might have received significant exposure to chemicals from this site: employees at the two shops and residents of property adjacent to the shops. The DOH investigated three potential sources of health data on these groups. The regional office of the Occupational Safety and Health Administration provided information on its investigations of the site. This information included investigations of workers' complaints about working conditions inside the shops (26). The DOH also conducted interviews during the spring of 1990 with residents who live adjacent to the two shops. Residents provided information on the length and frequency of their families' exposure to areas that may have been affected by contamination from the sites, and they described health problems that they have experienced. In 1992 DOH in cooperation with ATSDR offerred to arrange for residents who lived adjacent to the zinc and chrome shops to be tested for dermal sensitivity to chromium. Finally, environmental and health agencies at the state and local levels provided information on complaints they received from citizens who live near the site.

COMMUNITY HEALTH CONCERNS

A resident adjacent to the chrome shop called the DOH in September 1979 and expressed concern about symptoms that family members had shown during the three previous years -- since the same time residents noticed that back yard vegetation was dying. The symptoms mentioned were headaches, nausea, nervousness, and numbness. The resident asked whether contaminants from the chrome shop were accumulating in garden vegetables and affecting the health of the family. A representative of DOH visited the site and reviewed available data on contamination. In October 1979 the DOH informed residents adjacent to the site that exposure to chromium in plants grown in nearby soil was not a threat to human health (17). The DOH later arranged for the Wisconsin Occupational Health Lab to test tomatoes grown

concentrations

from a backyard garden near the chrome shop site. The chromium and nickel in the home-grown tomatoes was the same as that from tomatoes sold commercially (27).

Representatives from the DOH and ATSDR-Region 5 elicited community concerns by surveying residents who live near the site on March 14, 1990. Neighbors of the site also discussed their health concerns at public meetings on April 19, 1990, February 19, 1991, May 9, 1991, and February 16, 1993. About 70 people attended the 1990 meeting; about 50 people attended the 1991 meetings, and about 40 people attended the 1993 meeting. DOH staff also discussed health issues related to the site with citizens of De Pere by telephone and met with local public officials to identify additional concerns. At the residents' request, the DOH prepared a fact sheet on "Chromium Puddles in Your Backyard and Chromium on Basement Walls." The sheet described health effects associated with chromium exposure and advised people on how to respond when they observe puddles or dust that they suspect is contaminated with chromium. The DOH first distributed the fact sheet at the public meeting held in April 1990. The community also was invited to comment on the public comment release of ~~this~~ the May 1991 health assessment ~~in May 1991~~.

Many citizens who live near the chrome and zinc shops are concerned about the health effects of the contaminants at the site. Residents with homes adjacent to the chrome shop observed yellow surface water, stunted garden plants, dead trees, and dead wildlife during the shop's operation. Some of these citizens express fears that they have been exposed to toxicants via eating homegrown vegetables and via skin exposure to contaminated water. One couple questions whether varied health problems, including varied skin rashes; a cancer in a young woman; allergies and nerve conditions are associated with contamination from the site. These residents report that they are afraid to allow children to play in yards near the site. At the residents' request the City of De Pere installed a snow fence through the middle of the residents' back yards to keep children and pets away from the site. One family, suspecting that contamination had spread, also fenced their front yard. Families near the chrome shop have discontinued the use of their property for gardens that once supplied significant amounts of the families' food.

Who? I don't know of a fenced front yard.

In July 1990, a nearby resident reported that members of two families adjacent to the chrome shop had developed skin rashes. She claimed that the rashes resulted from exposure to chromium mobilized during a flood two weeks earlier. Water several feet deep flowed through the back yards adjacent to the site and seeped into the basements of homes near the site. One adult, male neighbor reported developing a rash after helping to sweep water from a flooded basement. Another adult, male resident reported developing a rash after mowing the lawn. Two children reportedly developed rashes after playing barefoot on the lawn.

Kenneth Had Past Lip Signs

A young child's weight loss, failure to grow in height, or to grow hair; another child's hyperactivity, and the unexplained sudden and dangerous behavior changes in two pets (which resulted in their being destroyed by a veterinarian) caused a family to vacate their home near the chrome shop. After moving from near the site and ending consumption of homegrown vegetables, the child who suffered low weight gain ~~has~~ was reported to have begun to gain weight.

Herbicides broke up. Mr H has recently returned to his home on 6th. I have observed a child in the backyard (Don't know if it lives there)

Residents report that the hyperactive child is performing better in school now. Restricted use of their yards and concern about the effects of the sites on property values and their health has been a source of long-term stress to some families. Residents of De Pere are also worried about eventual contamination of the municipal water supply. Despite assurances that the municipal water supply is currently unaffected, some residents are concerned that their drinking water is contaminated from the site.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

This section of the assessment describes how "chemicals of concern" are distributed in soil, water, biota, and air around the site. "Chemicals of concern" are those that occur above a level where the maximum plausible exposure to the contaminated material might affect human health. This assessment addresses only those contaminants that may be present at levels of concern. Typically, health assessors use ATSDR's Minimal Risk Levels, EPA's Reference Doses, or EPA's Cancer Slope Factors to decide whether chemicals are present at a level of concern at a site. For carcinogenic chemicals a level of concern refers to a concentration where a lifetime of exposure to the most contaminated material might result in an upper-level estimated risk of one cancer for every one million people exposed. Levels of concern are listed as "comparison values" in tables listing contaminant concentrations in surface soil and in groundwater. This assessment evaluates chemicals of concern to determine whether they pose a significant threat to public health.

A. Zinc Shop: On-site Contamination

On-site contamination from the chrome and zinc plating operations at this site involves groundwater, soil, and insulating material that was exposed on the surface of the deteriorating siding on the building.

Soil.

DNR and EPA have sampled surface soils on-site several times since 1983. Sampling occurred in May 1983, September 1985, August 1987, July 1989, March 1990, and May 1993. Most samples were collected from areas near the south and east sides of the building and were analyzed only for metals and cyanide. The results show concentrations of arsenic, barium, cadmium, chromium, lead, zinc, and cyanide elevated above background concentrations. Only lead occurred at a level of health concern (Table 1). The highest levels of barium, chromium, cyanide, and lead were found in a sample taken from near the monitoring wells on the east side of the shop in July 1988. Concentrations of these chemicals were at least ten times lower in two samples taken from the same location in 1990. Soil from the east side of the building was removed when the groundwater sump was installed during the summer of 1990 (8).

Some ~~of the~~

Table 1: **Chemicals of potential health concern in surface soils on-site at the Better Brite Zinc Shop (1983 - 1990).**

	Concentration (mg/kg)				
	Pre-Removal		Post-Removal		
Chemical	Low	High	High	Background	Comparison Value
Barium	26.9	2,970	834	106	4000.[r]
Cadmium	1.4	43	5.1	0.7	40.[e]
Chromium	40	2,910	127	20	300.[r]
Cyanide	24.6	600.9	9.3	0.8	1,000.[r]
Lead	33.8	1,540	155	24	NA

NA: Not available.
[e] Based on minimal risk level (ATSDR).
[r] Based on reference dose (EPA).

Sources: 5, p.8, Table 4.3; 28, p.4; 31; 32.

Subsurface soils were sampled in August 1987, May 1990, and May 1993. In 1987 a consultant for DNR took representative samples at two-foot intervals as monitoring wells were drilled. The samples were analyzed for chromium and zinc. At that time, most of the chromium contamination occurred at the 12 to 14-foot interval at a peak concentration of 1,200 mg/kg (5, p.8). In 1990 a soil sample taken at a depth of 3.5 feet from near the monitoring wells on the east side of the shop was analyzed for metals and cyanide. The concentrations found were comparable to background levels (29). In 1993 a sample taken from a depth of 2.5 - 3.0 feet near the southeast corner of the former building contained chromium at 200 mg/kg. Other chemicals of concern, among the 23 metals and cyanide, analyzed were at background levels (32).

Groundwater.

Three nests of two monitoring wells each were installed in 1987 on the east and south sides of the shop and at the northwest corner. Each well nest consists of one well that monitors groundwater from 3 to 20 feet below the surface and one well that monitors the lower 3 feet of the lacustrine clay down to the top of the dolomite aquifer (30 feet below the surface). Samples were collected from these wells in the summers of 1987, 1988, and 1989. Samples were analyzed for volatile organic compounds (VOC's), metals, cyanide, semi-volatile compounds, and pesticides (Table 2). Samples for metals analysis were field filtered.

Table 2: Chemicals of potential health concern in shallow groundwater at the Better Brite Zinc Shop (1987 - 1989).

Chemical	Detected Concentration (μg/L) Low	High	Comparison Value
Chromium	100	310,000	50.[r]
Cyanide	59.4	228	200.[r]
1,1-Dichloroethylene	6.5	36	0.06[c]
Tetrachloroethylene	--	2.1	0.7[c]
1,1,1-Trichloroethylene	8.6	690	200[L]

[c] Based on carcinogenic potency (EPA).
[r] Based on reference dose (EPA).
[L] Based on longer term health advisory (EPA).

Source: 5, Table 4.3.

Over the three year period, concentrations of chromium, cyanide, and VOC's generally have decreased in the shallow wells and increased in the deeper wells. Chromium concentrations are very high in the shallow wells in all three well sites. The highest concentrations of VOC's are at the wells at the northwest corner of the shop.

Surface Water.

EPA's Emergency Response Technical Assistance Team collected water samples of sump water and treated effluent ~~from inside the zinc shop~~ in October 1986 and analyzed them for metals and cyanide (Table 3). Cyanide apparently occurred in the sump water as suspended solid and is presented in Table 3 as milligrams of cyanide per kilogram of solid. This was the only surface water sampled (28). Owing to the absence of surface water when the site screening investigation was carried out in July 1988, no samples for this medium were collected at the time (5, p.13).

Exposed Insulation.

In December 1989, results of testing (for metals and cyanide) of a sample of insulation material exposed above the building foundation on the south wall indicated that this material was contaminated with cyanide at 960 mg/kg (30). In April 1990, a sample of insulating material exposed on the south side of the building contained 6,692 mg/kg chromium; other metals and cyanide were well below levels of health concern (31).

Table 3: **Chemicals in water samples (μg/L) from inside the Better Brite Zinc Shop (1986).**

Chemical	Sump	Treated Effluent
Cadmium	1,960	990
Chromium	139,000	3,130
Cyanide	142,000*	9,410
Lead	<10	470

* μg/kg in sediment.

What Sediment? Isn't This before and after treatment?

Source: 5, p.7.

Do you want additional sump sample results - Basically Done Already

Air.

In August 1982 an inspector from the U. S. Occupational Safety and Health Administration tested air inside the zinc shop for chromic acid, cyanide, and hydrogen chloride. Only cyanide was detected, and it occurred at levels well below the permissible maximum (Table 4). In July 1988 testing for release of contaminants to the air by Hnu and Extox model 40 Tri-gas meter (high-volume sample) did not detect any substance above background levels (5, p.14). More intensive sampling has not been carried out recently, and sampling of air outside the facility apparently was not carried out when the site was in operation.

Table 4: **Chemicals in air (mg/m^3) inside the Better Brite Zinc Shop (1982).**

Chemical	Detected Concentration		U.S. OSHA Permissible Exposure Limit (8-hour weighted average)
	Low	High	
Chromic Acid	ND	ND	0.1
Cyanide	0.06	0.15	5

ND: Not detected.

Source: 26.

B. Zinc Shop: Off-site Contamination

Soil.

In March 1990 EPA's Emergency Response Technical Assistance Team collected surface soil samples from the back yard of a residence immediately south of the shop and from a garden in a residential yard north of the shop. Each sample was analyzed for metals and cyanide. None of the tested chemicals occurred in concentrations significantly above background concentrations (31). The EPA team also collected subsurface soil samples (all at 3.5 feet) from the same areas in May 1990 and analyzed them for the same set of chemicals. They, too, showed no elevated concentrations of contaminants (29).

In May 1993 EPA sampled the top six inches of soil at eleven locations adjacent to and across the street from the shop. EPA also sampled background soils at two locations, each about two blocks away from the site. Each sample was analyzed for 23 metals and cyanide. While a few chemicals occur at greater than background concentrations in a few locations, none occur at levels of concern (32).

Didn't they have some deeper samples also?

Groundwater.

A City of De Pere municipal well about 250 feet west of the zinc shop extends to a depth of 765 feet below the surface and pumps water from the sandstone aquifer. The city well is cased to the interface of the sandstone and dolomite aquifers at depth of 180 feet below the surface (33). DNR collected unfiltered samples from this well in July 1988 and analyzed them for VOC's, metals, cyanide, semi-volatile compounds, and pesticides (5, p.6). VOC's were analyzed again in March 1992 by the city and in November 1992 by the EPA. The city quarterly analyzes samples from the well for chromium, zinc, cyanide, ~~benzene, ethylbenzene, toluene, and xylenes~~ (5, p.11; 34). The city well water shows no contamination (34).

D. Hevert Well

In 1993 two more monitoring wells were installed across Sixth Street, about 75 feet west of the site. One was drilled to bedrock (30 feet deep), and the other was drilled to a depth of 15 feet. Both wells were sampled and analyzed for VOC's, chromium, zinc, and cyanide. Hexavalent chromium was not detected in either well, and no VOC's were detected in the deeper well. Total chromium in the deeper well was at 160 µg/L compared to 20 µg/L in the shallow well. Several petroleum-related VOC's were in the shallow well, including benzene at 14 µg/L (35).

Was it analysed for Hex Cr? – Yes they were – You are correct

Seepage Water.

~~No~~ surface water does not regularly occur near the zinc shop. Seepage water has accumulated in the basements of houses adjacent to the property. On three occasions unfiltered seepage water

in significant amounts

I only know of the Smet Home

I think Ried may have sampled puddles around the time of the fire.

was collected from a house adjacent to the south border of the zinc shop property (Table 5). Samples collected in June and October of 1986 were analyzed for metals and cyanide, and the March 1990 sample was analyzed for hexavalent chromium.

Table 5: Chromium in seepage water from the basement of a house adjacent to the Better Brite Zinc Shop.

Form of Chromium	Concentration (μg/L)	Sample Date
Total chromium	5,800	06/27/86
Total chromium	73,000	10/29/86
Hexavalent chromium	10,000	03/15/90

Sources: 7, 28.

I thought there were more.

In March 1990 DNR also collected unfiltered water from the basement of a home adjacent to the northern border of the zinc shop property and had the sample analyzed for chromium. The sample contained total chromium at roughly 50 μg/L (7). In September 1991 DNR collected seepage water from the sumps of three other nearby buildings, one on the east side of the zinc shop site and the others across Butler Street and Sixth Street. All samples were analyzed for total chromium, cyanide, and zinc, and one was also analyzed for VOC's. No VOC's or cyanide were detected. Total chromium in the adjacent building was at 110 μg/L. Chromium and zinc in the other samples were well below levels of concern (37).

Do you have all my scamp/chip sample results? Should have copies of letters sent to residents

Precipitate on Basement Floor and Walls.

In December 1989 and February 1990, DNR collected samples of precipitate from the floor and walls in the basement of a residence adjacent to southern border of the site. The December samples were analyzed for cyanide and total chromium. The February samples were analyzed for hexavalent chromium and total chromium (Table 6). In September 1991 DNR collected samples of preciptate from basements of three houses across Sixth Street from the zinc shop. The samples were analyzed for chromium and zinc, and neither occurred at levels of concern (37).

Table 6: **Chemicals in precipitate on floor and walls of basement in residence adjacent to Better Brite Zinc Shop (1989 -1990 samples).**

	Concentration (mg/kg)	
Chemical	Low	High
Cyanide	2	31
Hexavalent chromium	390	650
Total chromium	1,300	10,200

Source: 36.

C. Chrome Shop: On-site Contamination

Soil.

Better Brite, DNR, and EPA have sampled surface soils on-site in 1979, 1987, 1988, 1990, 1992, and 1993. Prior to 1992, most samples were taken west and southwest of the chrome shop building site, where the property slopes down to residential yards. A few samples have been collected from the north, south, and east side of the building site, and one sample was taken from the southeast corner of the property. Samples collected in 1979, 1987, 1990 were analyzed only for chromium. Three samples collected in 1988 were analyzed for an array of metals and organic compounds (18). EPA's Emergency Response Technical Assistance Team collected samples in April 1990 from five areas around the southwestern portion of the site (38). In 1992 EPA collected 14 samples distributed over the entire site and analyzed them for total chromium. Three of these were also analyzed for lead (32).

Screening Spls? Any Confirmatory spls from on site?

Concentrations of chromium in soil samples from areas where spills occurred are well above background concentrations (Table 7). The highest concentrations in surface soil were along the western and southern borders of the site, prior to the recent removal action. Surface samples from the southeast corner of the property, near the railroad tracks contained elevated concentrations of chromium, cadmium, and lead.

In 1988 a contractor for DNR collected representative soil samples at two-foot depth intervals from a bore hole near the southwest corner of the site and analyzed them for chromium. Concentrations were highest at depths from 6 to 12 feet, where they averaged 1,500 mg/kg (18, p.9).

Table 7: **Chemicals of potential health concern in surface soils on site of Better Brite Chrome Shop.**

Chemical	Detected Concentration (mg/kg) Low	High	Sample Date	Comparison Value
Chromium	3.2	140	1979	300[r]
"	16.8	2,250	1988	"
"	17	870	1990	"
"	8.1	2080	1992	"
"	50.2	1570	1993	"
Cadmium	2.8	116	1988	40[e]
"	0.4	8.9	1993	"
Lead	5.8	7,900	1988	NA
"	63.4	3,890	1992	"
"	81.4	3,540	1993	"

[e] Based on minimal risk level (ATSDR).
[r] Based on reference dose (EPA).
NA Not available.
Sources: 18, 38, 39, 40, 32.

I thought BB installed 10 wells in Late 79 Early 80 (six onsite + 3 offsite = 9)

Groundwater.

Groundwater samples have been collected from the site since 1979. At that time, six observation wells were installed in the upper portion of the clay in the southwestern area of the site. One well was installed in the lower portion of the clay in the same area (39). In 1987 a contractor for DNR installed six monitoring wells on-site around the area of the former building: a nest of two wells at the southeast corner, another nest of two wells on the north side, a shallow well about 30 feet northwest of the northwest corner, and a deep well at the southwest corner. Shallow wells extend 20 feet into the clay. Deep wells are cased to the dolomite aquifer and extend about 20 feet into the aquifer. These six wells were sampled annually from 1987 through 1989 for metals and organic compounds. Water samples for metals analysis were field filtered; samples for organic analysis were not.

7 total

Vicki probably has results on these wells since 1989 (I Don't - To My Knowledge)

In 1986 hexavalent chromium typically accounted for 90 percent of the total chromium found in the shallow groundwater (19). Maximum concentrations of chromium in both the shallow wells and the deep wells have decreased considerably over the years (Table 8). VOC's occur in all of the shallow wells, and benzene (also a VOC) occurs in two of the three deep wells.

The shallow well associated with the deep well where the highest concentrations of benzene were found (at the southeast corner of the former building) has not been tested for VOC's.

~~That seems odd.~~ Is this correct

Surface Water.

In 1979 DNR collected a sample of water from a trench near the northwest corner of the building. The sample contained chromium at 1,511,000 μg/L with 1,440,000 μg/L in the hexavalent form. A sample of spring run-off water collected from a puddle near the northwest corner of the former building in 1988 contained chromium at 300 μg/L (18, pp.8-9). After the soil removal action, DNR collected a surface water sample in the summer of 1993. ~~The sample was~~ from a shallow depression southeast of the collection sump, within the currently fenced area. No chromium (less than 5 μg/L) was detected (41).

D. Chrome Shop: Off-site Contamination

Soil.

Sampling and chemical analysis of off-site soil occurred at the same time that samples were collected on the chrome shop property and followed the same methods. In most cases, off-site sampling was limited to a low spot in one adjacent, residential back yard downhill from the chrome shop. Most samples were analyzed only for chromium, although one sample in 1988 was analyzed for several metals and organic compounds. Sampling in April 1990 included surface soils in the back yards of several residences both west and south of the chrome shop property.

In November 1992 EPA collected and analyzed 24 samples of off-site soils for chromium. Two of these samples were also analyzed for lead. Prior to the removal action in May 1993, EPA collected eight additional samples and analyzed them for 23 metals and cyanide (Table 9). In May 1993 EPA removed surface soils where chromium was found above 135 mg/kg. In addition EPA excavated soils beneath the former shop building and from the western and southern perimeter of the former building. Chromium concentrations at the bottom of the excavation areas west and south of the former building all contained chromium at less than 135 mg/kg (32).

I think this is correct

They also removed soils (shallow excavation) east of the slab toward the quads (lead impacted area)

Table 8: **Chemicals of potential health concern in groundwater on the site of the Better Brite Chrome Shop.**

Chemical	Concentration (μg/L) Low	High	Sample Date	Comparison Value
Shallow Ground Water:				
Hexavalent chromium	0.06	600	1979	50.[r]
" "	60,000	280,000	1986	
Total chromium	0.1	600	1979	
" "	62,000	429,000	1986	
" "	ND	15.*	1987	
" "**	--	11	1988	
" "	<100	<100	1989	
Cadmium	0.9	1.8	1987	7.[e]
1,1-Dichloroethylene	ND	5.4*	1987	0.06[c]
"	2	27	1988	
Lead**	--	ND	1988	NA
1,1,1-Trichloroethane	5.1	44	1987	200[L]
"	19	400	1988	
Deep Groundwater (Dolomite aquifer):				
Total chromium	44	6,600	1987	
" "**	--	14.7	1988	
" "*	<100	1,000	1989	
Benzene	7.6	39	1987	

ND Not detected.
NA Not available.
* Chemical detected in only one well.
** Only one well sample was analyzed for these chemicals.
[e] Based on minimal risk level (ATSDR).
[r] Based on reference dose (EPA).
[c] Based on carcinogenic potency (EPA).
[L] Based on longer term health advisory level (EPA).

Sources: 18, 39, 42.

Table 9: **Chemicals of potential health concern in off-site surface soils near the Better Brite Chrome Shop.**

Chemical	Detected Concentration (mg/kg) Low	High	Sample Date	Comparison Value
Chromium	3.8	28.0	1977	300.[r]
"*	746	922	1988	
"	13	100	1990	
"	11.5	156	1992	
"	19.4	45.1	1993	
Cadmium*	0.99	2.8	1988	40.[e]
"	0.4	0.63	1993	
Lead*	12.6	12.9	1988	NA
"	27.9	69.3	1992	
"	15.4	60.1	1993	

* These are results of one sample and its duplicate sample.
NA Not available.
[e] Based on minimal risk level (ATSDR).
[r] Based on reference dose (EPA).

Sources: 18, 38, 39; 32.

Bore-hole soil samples taken in 1987 while drilling a monitoring well on the property west of the site showed chromium at 190 mg/kg at a depth of 0-2 feet and concentrations decreasing from 84 mg/kg at 4-6 feet to 30 mg/kg at 30-32 feet (18).

Groundwater.

see page 17

In 1979 three off-site wells were installed in the clay at the southwestern perimeter of the chrome shop property. When these wells were sampled in October 1979, only one well contained water (40). In 1987 a contractor for DNR installed one well off-site, about 60 feet west of the former chrome shop, in the upper 20 feet of the clay. That well was sampled in 1987, 1988, and 1989 and was analyzed for metals and organic compounds (Table 10). Samples for metals analysis were field filtered. As with the shallow wells on-site, this well is contaminated with VOC's. Concentrations of chromium are very high, but they have declined considerably during the past three years.

during past 3 years of sampling ?

Surface water.

Surface water off-site was sampled during a spring thaw in March 1988, when the groundwater collection trench overflowed into adjacent residents' backyards and ran into a city storm sewer. The water was analyzed only for total chromium. One sample was taken from each of three residential yards adjacent and downhill from the former chrome shop. Concentrations ranged from 5,800 μg/L to 76,000 μg/L. The highest concentration was found in the water closest to the collection trench (18, p.9).

After the 1993 soil removal action, DNR collected four surface water samples in the summer of 1993. Two samples were from near the southeast corner of the site near the drainage by the railroad tracks, and two samples were from shallow puddles in the back yards of residences adjacent to the site. Total chromium concentrations ranged from no detect (less than 5 μg/L) to 29 μg/L (41).

Table 10: Chemicals of potential health concern in shallow groundwater off-site near the Better Brite Chrome Shop.

Chemical	Concentration (μg/L)	Sample Date	Comparison Value
Chromium	21.5	1979	50.[r]
"	62,000	1987	
"	33,000	1988	
"	30,000	1989	
1,1-Dichloroethylene	7.4	1987	0.06[c]
"	1	1988	
1,1,1-Trichloroethane	170	1987	200.[L]
"	48	1988	

[e] Based on minimal risk level (ATSDR).
[r] Based on reference dose (EPA).
[c] Based on carcinogenic potency (EPA).
[L] Based on longer term health advisory level (EPA).

Sources: 18, 40.

Air.

Air testing in July 1988 using the Hnu and Extox model 40 Tri-gas meter (high-volume sample) did not detect any substance above background levels for the area (18, p.14). More intensive sampling has not been carried out recently, and sampling of air outside the facility apparently was not carried out when the shop was in operation.

To my knowledge EPA did not do air sampling at the chrome shop during the recent excavation based on results at the Zinc Shop

Garden vegetables.

In February 1980 the Wisconsin Occupational Health Lab tested a tomato grown in soil located downhill and west of the chrome shop. The concentrations of chromium and nickel were no different from those found in tomatoes sold commercially (0.015% chromium and 0.009% nickel) (27).

a raw (comment #1)

Both Store Bought and grown ?

Contamination Inside Residences.

In April 1990 the EPA's Emergency Response Technical Assistance Team collected three samples of water and one sample of sediment from the sump in the basement of a house adjacent and west of the chrome shop property. The team also collected dust from the furnace filter of another adjacent house. All samples were analyzed only for chromium. No chromium was detected in the sump water (less than 50 μg/L), and the concentrations in the sump sediment and the filter dust were very low (3.8 mg/kg and 4.1 mg/kg, respectively) (38).

E. Quality Assurance and Quality Control

In preparing this health assessment, the DOH relies on the information provided in the referenced documents and assumes that adequate quality assurance and quality control measures were followed concerning chain-of-custody, laboratory procedures, and data reporting. The validity of the analysis and conclusions drawn for this health assessment is determined by the availability and reliability of the referenced information.

D. Physical and Other Hazards

No significant physical hazards at the chrome shop site were apparent in Spring 1990. By spring 1991 physical hazards at the zinc shop had been eliminated. The main electrical transformer, which was corroded by operations in the facility, was no longer used, and EPA had covered deteriorated siding with sheets of plywood (8). By the summer of 1993, all that

remained of the former shops were the filled and ~~clay-~~capped areas ~~that are both~~ surrounded by ~~six-foot~~, chain-link fence ~~and~~ that now serve as groundwater collection sumps.

PATHWAYS ANALYSIS

A. Environmental Pathways (Fate and Transport)

The major source of contamination at the two sites appears to be chromate solution and volatile organic compounds that seeped into the ~~lacustrine clay~~ under and around the two shops. During periods of groundwater recharge, these contaminants are mobilized. ~~They may have~~ flowed either laterally or downward. When they flowed laterally, they probably discharged either to the surface water drainage in residential back yards (at the chrome shop) or to an adjacent basement (at the zinc shop). Lateral drainage at the chrome shop also collected in the seepage trench and was pumped to the sewage treatment plant. The installation of the groundwater sumps under the clean fill at both sites should ~~significantly~~ reduce the lateral flow of contaminated groundwater to the ground's surface. The removal actions should cause the lateral flow of contaminated groundwater near the fill areas to reverse. Now nearby groundwater should flow toward the collection systems rather than away from the former building sites. Contaminated ~~material~~ that already is out of the zone of influence of the sumps, however, may still flow away from the sites.

The chromate used at the shops (a hexavalent form of chromium) is very soluble. It tends to migrate with water and not to bind to soil. It also is a strong oxidizer. When the chromate comes into contact with organic matter or some other reducing agent, it oxidizes the material and then converts to a more stable -- and less toxic -- form: trivalent chromium. Trivalent chromium is typically much less soluble and adheres to soil particles. Hexavalent chromium does not accumulate in plants. Groundwater in the clay also contains VOC's. When water contaminated with VOC's seeps out from the soil, the VOC's rapidly dissipate into the air.

When the contaminated water flows downward, it enters the dolomite ~~aquifer~~, located 30 to 40 feet under the ground surface. Water flows slowly through this ~~aquifer~~, and it is unlikely that any nearby residents get their drinking water from this formation. Ultimately, water from the dolomite ~~aquifer~~ recharges the sandstone aquifer located 180 feet below the ground surface. The sandstone aquifer provides drinking water for the City of De Pere and other municipalities in the area. The potential for contaminating this aquifer is a concern. A more detailed description of the environmental fate of the contamination follows below.

Groundwater.

Hexavalent forms of chromium are very soluble and are readily transported in groundwater. At the zinc shop, the shallow groundwater table slopes slightly to the northwest toward a

ravine that drains to the Fox River (5, p.4). At the chrome shop, the shallow groundwater table slopes westward toward a drainage way in the back yards of adjacent residents (18, p.12). Regional groundwater flow is likely east to the Fox River (5, p.4). The permeabilities of silty clays are low (9×10^{-9} to 1.9×10^{-8} cm/sec), but there is a strong downward gradient (averaging -0.31 to -0.72). The clays are fractured and probably provide for secondary permeability. The clay is also interspersed with lenses and seams of silts, silty sands, clayey sands, and gravel. These could conduct contaminated groundwater away from the site more rapidly than the clay and could result in lateral flows in directions not predicted when homogeneous flow conditions are assumed. Underlying the clay is a dolomite formation of the Sinnipee Group. Dolomite extends from 30 feet to 180 feet below the ground surface and forms an aquitard over the sandstone aquifer. Private wells in the dolomite produce between 4 and 15 gallons per minute (43). approx

Under the dolomite ~~aquifer~~ is a sandstone aquifer that supplies drinking water to all the municipalities in the Lower Fox River Valley. Of the municipal wells in vicinity of the site, the City of De Pere's Grant St. well is only 250 feet from the zinc shop. Analysis of the hydrogeology in the area of this well, which is cased to the interface of the dolomite and sandstone aquifers, ~~indicates~~ suggests ? that contamination could reach the sandstone aquifer. The sandstone aquifer annually receives an estimated 2 to 4 inches of recharge from the overlying material (33). Sampling to date has not found contamination from the chrome and zinc shops in the municipal well.

Of more current concern are reports that there are many private wells in the De Pere service area that are presumed to be abandoned (5, p.13). If any private wells are in the area and are used for drinking water, they may be potential pathways for contamination from the sites. In September 1991 DNR checked 45 homes in the immediate vicinity of the two shops to see if any private wells exist nearby. None of these homes had private wells. The city chked numerous additional homes (52) for wells. Results/findings in my Nov 91 Report. Total of 91 homes checked (91-52 = 39)

Monitoring of the dolomite aquifer is inadequate to determine the current depth and extent of contamination. Additional monitoring of this aquifer, to include a wider area around the site and deeper wells would provide information on the extent to which the contamination under the site is being dispersed. Installing such a well near the site, however, could also threaten the municipal water supply. There is a chance that installing the well could create a conduit for contamination to flow more rapidly than normal through the creviced dolomite. Appropriate measures to avoid this possibility should be taken in future drilling.

Surface Water and Sediments.

Surface water is a pathway for chromium contamination originating at the chrome shop. Puddles of chromium-laden water have been detected on-site and in residential yards near the chrome shop. In a larger scope, none of the municipalities in the vicinity of the site uses surface water for drinking purposes. The Fox River, located within one-quarter mile of the site, is used for recreation, fishing, and navigation. Storm sewers near the site, into which surface water contaminated from the chrome shop discharge~~s~~, ultimately discharge to the Fox

local

is expected to

River (18, p.14). The City of De Pere sewage treatment plant also discharges to the river. It is unlikely that chromium in Fox River water or sediments could be directly attributed to the Better Brite site. The many municipal and industrial effluents discharged in the river, its high sediment load, and its high flow would tend to mask and dilute the effects of runoff from the site. Organic matter dissolved in Fox River water will reduce the hexavalent chromium in runoff from the site to the more stable trivalent form. and less toxic

Soil.

Recent sampling indicates that surface soils at the sites are not contaminated with chromium at hazardous levels. Hexavalent chromium tends to remain in solution with water rather than bind to soil particles. When hexavalent chromium is reduced to the trivalent form, it will form complexes and bind more readily to soil (18). Some of the chromium at the site is becoming bound to the soil in this manner, depending on the availability of reducing agents in the soil.

Surface soil samples at each of the shop sites did show contamination that could be carried in soil. Elevated concentrations of lead appeared in samples from the southeast corner of the chrome shop property. Recent sampling showed that the lead contamination was restricted to the southeast portion of the chrome shop property. The EPA removed this soil as part of the recent removal action.

Biota.

Since chromium uptake in plants and absorption by the body is limited, it is unlikely that vegetables grown near the site were a source of exposure to significant levels of these chemicals (44). Other metals ?

Air.

Since the facilities are no longer in operation, air is not a current pathway for contaminants from the site. Airborne contaminants that may have been released when the shop was operating were not measured and cannot be estimated. The well-vegetated nature of area soils limits wind erosion of soil, making release of contaminants to the air unlikely. When VOC's in shallow groundwater seep to the surface and come in contact with air, they will rapidly dissipate. When groundwater near the zinc shop seeps into the basement of the adjacent residence, VOC's will not dissipate as readily as they do outdoors. It is not likely, though, that the volume of seepage water was sufficient to release enough VOC's to pose a health hazard. considering the observed VOC concentrations in the groundwater

Vegetation will eventually be established over soil disturbed by recent activities. The majority of this material is clean fill.

B. Human Exposure Pathways

Ingestion.

Ingestion of contaminated surface water near the chrome shop, although quite unlikely, could pose a threat to health. Groundwater from public wells has not been shown to be contaminated. However, if private wells in the area exist and are used for drinking, water from these sources could be contaminated and pose a threat to health. If groundwater is not remediated, chromium and VOC's could ultimately flow down to the sandstone aquifer and contaminate the municipal water supply. The potential extent of contamination in the municipal water would depend on the extent to which contaminated groundwater under the site is dispersed as it migrates through the dolomite. The operation of the groundwater sump at the zinc shop and the groundwater extraction system at the chrome shop will reduce the quantity of contaminated groundwater that could migrate down to the sandstone aquifer. The recent soil removal action also reduced the amount contaminated material available to migrate into the bedrock.

Insulating material emerging from the exterior of the zinc shop that is contaminated with chromium and cyanide may have posed a health hazard if it were ingested by children. This material was covered with wood and plastic sheeting in 1990 and was removed in 1992 when the building was razed. (following the fire)

Dermal Contact.

Surface water near the chrome shop and in adjacent back yards is a source of potential dermal exposure to hexavalent chromium. Contact with water in the basement of a home adjacent to the zinc shop is also a source of dermal exposure to chromium.

Inhalation.

Since airborne release of contaminants stopped when operations at the sites ended, current inhalation of contaminated air is not likely. Recent sampling indicates that surface soil is not a pathway for human exposure, so dust-borne contaminants are not of concern. If private wells near the site are using groundwater from the dolomite aquifer, VOC's could be released from the groundwater and into houses. Inhalation of VOC's in indoor would be roughly equivalent to the dose ingested in drinking water.

One well on S. 7th (Apx 1.5 blocks West of Chrome shop) is in use. Sampled several times without detect - copies of letters sent to you. (Maes Home)

PUBLIC HEALTH IMPLICATIONS

A. Toxicological Evaluation

Recent sampling results indicate that hazards from these sites chiefly involve exposed chromium and cyanide in ~~insulating material at the zinc shop and~~ chromium-laden puddles in back yards near the chrome shop. ~~While not at life-threatening concentrations, contaminants in the insulating material could cause illness if it were ingested by children~~. Chromium in its hexavalent form in puddles and other surface water could cause skin sensitization. Most toxicological information about chromium relates to inhalation of the substance in occupational settings. Information on the doses of exposure likely to result in skin sensitization is scant. Sensitivity (dermatitis with eczema) is most common among those who received previous, occupational exposure to hexavalent chromium (45, pp.23-24). Skin tends to absorb hexavalent chromium more readily than trivalent chromium, but, at the concentrations found in surface water at the site, this difference is not likely to be significant. Overall, dermal absorption of chromium is limited (45, pp.47-48). Many of the toxicological properties of hexavalent chromium can be attributed to its being a strong oxidizing agent. Information on the toxic effects of ingesting chromium is also limited. Quantitative dose-response data on human, oral exposure to the chemical are lacking. Chromium is an essential nutrient, and average daily dietary consumption is 280 μg (45, p.91). If children regularly consumed water containing the maximum concentration found in the dolomite aquifer (an unlikely situation), their dose would be about 25 times less than the lowest dose found to be lethal in laboratory animals that were fed hexavalent chromium (45, p.54). The highest concentrations found in the dolomite aquifer could cause nausea if ingested (45, p.67).

Four VOC's appeared at levels of potential health concern in groundwater at the sites, and one of these -- benzene -- appeared in the dolomite aquifer. Frequent use of the most highly contaminated water from the aquifer (again, an unlikely situation) could affect bone marrow and increase a resident's risk of contracting leukemia (46, p.12-17). 1,1-Dichloroethylene and tetrachloroethylene cause cancer in laboratory animals and are considered probable human carcinogens. If these two VOC's contaminated a frequently used water supply, they could lead to an increased risk of contracting cancer among those who use the water (47, 48).

Elevated levels of cadmium and lead were present in the southeast corner of the chrome shop property. The area is accessible to children. The levels of cadmium in the soil are less than those likely to result in health effects in individuals who come into frequent contact with on-site soil (49, p.10). The levels of lead found ~~by the parking lot~~ at the chrome shop, if it were more widespread, could cause neurobehavioral effects in children who come into frequent contact with contaminated soil (50, p.14).

B. Health Outcome Data Evaluation

"Health outcome data" is a phrase referring to records of death and disease. When there is evidence that people near a site have been exposed to contaminants at levels that could lead to an increase in rates of death or disease, a review of health outcome data may be appropriate. A review also may be appropriate if there are reports of unusual clusters of diseases near a site. The DOH evaluated data collected from interviews with residents adjacent to the zinc and chrome shop sites and from Occupational Safety and Health Administration records. The reports were reviewed for health effects that are plausible, based on the nature and extent of exposures and on the toxicologically possible health effects of the exposures. Serious health problems reported by persons who live near the sites (noted in the Community Health Concerns section) are not consistent with specific known effects of the contaminants at the site (45). Reports of health problems among those most heavily exposed at the sites, the Better Brite workers, would provide clues about symptoms that such exposure might cause. However, a review of Occupational Safety and Health Administration inspection records for the sites did not reveal evidence of complaints related to health problems among employees at the site.

During the past year, residents reported skin rashes that they suspect represent sensitization to chromium. Skin sensitivity to chromium is more common among workers who were occupationally exposed to hexavalent chromium. None of those who reported rashes, however, reported occupational exposure to chromium compounds. Information on the dose of exposure required to cause sensitization is not available in the literature on chromium (45, pp. 23-24).

In 1992 DOH, in cooperation with ATSDR, arranged for residents who lived adjacent to the zinc and chrome shops to be tested for dermal sensitivity to chromium. An area physician who specializes in dermatology examined and tested ten individuals who volunteered to receive the test. The individuals had a number of various health-related complaints, including skin rashes, tingling sensations, and itches, and felt that these problems may be related to exposure to chemicals from the Better Brite site.

Six adults and one child received the standard North American skin patch allergy test. The standard patch kit includes 28 chemicals (including chromate) and one control. All substances were applied on the upper back. Three younger children received just the potassium dichromate patch and a control patch on their upper torso. All tests were interpreted at 48 hours after application. All of the patch tests were negative to chromate sensitivity and rule out an allergic contact sensitivity to chromate. One adult showed an allergic sensitivity to two substances unrelated to the Better Brite site.

Although uncommon health problems may have occurred among residents near the site, tests performed now cannot determine whether or how residents were exposed to contaminants in the past, or whether any health condition was caused by an exposure. The testing of human biological samples for low-level environmental exposure may not be useful because serum

also large variation in Cr Levels ?

chromium levels change only in cases of extreme exposure or deficiency (45). In the absence of multiple cases of a reportable condition among persons whose exposure to contaminants from the sites seems plausible, a population-based evaluation of health outcome data is not feasible.

C. Community Health Concerns Evaluation

Are the contaminants that seeped into the back yards of residents adjacent to the chrome shop likely to be causing skin rashes?

Tests of soil, shallow groundwater, and surface water show that chromium from the plating operation was spilled or seeped into residents' yards. Some people, typically those who receive occupational exposure to hexavalent chromium, develop a skin sensitivity to chromium. It may be possible for people who have such sensitivity to develop an allergic reaction after touching contaminated soil or water. None of the residents who volunteered for testing showed such dermal sensitivity to chromate.

Are the contaminants that seeped into the back yards likely to have affected the quality of vegetables that residents ate from their gardens?

The only contaminant found at excessive levels in back yard soils was chromium. While the hexavalent form of chromium (typical of plating operations) can be a health hazard, the trivalent form is much less toxic when eaten. The hexavalent form of chromium does not accumulate in plants. Furthermore, excessive chromium in soils would kill the plants before the chromium could accumulate in the plants to levels that may be toxic to people.

Residents reported that the subsurface soil in parts of their gardens was bright yellow. Perhaps, a greater health hazard from gardening activity was from the acute affects of dermal contact with hexavalent chromium or from inhaling soil contaminated with hexavalent chromium.

Is contamination from the site likely to be responsible for such nervous system problems as numbness in extemities, hyperactivity in children, or sudden behavior changes in pets?

It is unlikely that the concentrations of hexavalent chromium in the environment surrounding the sites would cause neurological effects.

identified since plating operations ceased

Is contamination from the sites likley to cause an increase in cancer among people who lived near the plating shops?

Inhaling hexavalent chromium is a known cause of respiratory system cancers among workers who breathed it in occupational settings for a long time. It is possible that residents who regularly breathed hexavalent chromium from the shops would have an increased cancer risk. Data on the levels of hexavalent chromium in air outside the shops are not available. It is also difficult to evaluate the effect of the plating shops on respiratory cancer rates near the shops because of the prevalence of such other causes of respiratory cancer as cigarette smoking.

Isn't the stress caused by having to live next to a facility that for years spilled hazardous chemicals into residents' yards likely to cause health effects?

For nearly twenty years neighbors of the plating shops have complained about chemical spills and worked to cleanup the contamination. The site clearly is a source of anxiety and stress for some people who lived near the shops. Such stress may affect the health of those people.

or soils?

CONCLUSIONS

The chrome and zinc shops pose a public health hazard because there is a potential for human exposure in the future to toxic chemicals in groundwater. Chromium and VOC's in the shallow groundwater system pose a long-term threat to the quality of the sandstone aquifer used for municipal water supplies. The future hazards associated with eventual contamination of municipal wells cannot be estimated at this time. It is possible that contact with chromium-laden surface water could result in dermal sensitization, but none of the nearby residents who volunteered to be tested showed such sensitivity. The recent removal of contaminated soil and the upgrading of groundwater collection systems greatly reduces the potential for surface water to become contaminated.

No pattern of excess illness among persons who live adjacent to the sites is apparent. Health complaints reported by residents near the site vary widely by symptom and no well-defined condition occurs in more than one person. Also, reported health problems among persons who may have been exposed to chemicals at the site are not consistent with reported effects of the compounds. Overall, no documentable exposure data are available, and numbers of residents who may have been exposed are too small to permit a reliable comparative health study to be designed. If numbers, data, and other circumstances eventually permit, health studies could be undertaken in the future.

RECOMMENDATIONS

Groundwater between the zinc shop and the closest municipal well should be monitored and the extent of groundwater contamination should be characterized. Municipal wells should continue to be sampled regularly for site-related contamination. The operation of the groundwater sump at the zinc shop and the groundwater extraction system at the chrome shop should reduce the quantity of contaminated groundwater that could migrate toward the municipal well. If further sampling shows that contamination has migrated beyond the effective range of these systems, additional measures to protect the municipal water supply may be needed.

A. Need for Follow-up Health Activities

The DOH and ATSDR's Health Activities Recommendation Panel reviewed the data on this site to determine the need for more research or education about health-related concerns. For example, follow-up activities could include conducting studies on cases of disease near the site or providing information about toxic chemicals. People nearby may have been exposed to contaminants in surface water and soil, but there is no evidence showing that exposure was sufficient to cause health effects. Therefore, no more studies of the site's impact on public health are needed now. During the upcoming remedial investigation, DOH will inform community members about health-related concerns. If the investigation shows that toxic chemicals are more widespread than previous sampling found, the DOH and ATSDR will reconsider the need for other activities.

B. Public Health Action

The Division of Health, in cooperation with ATSDR, will conduct the following activities to respond to the recommendations of this assessment:

1. Provide continuing public health education as new information related to public health issues becomes available;

2. Solicit health concerns of nearby residents through agency contacts with the De Pere Public Health Nurse;

3. Review and comment on public health aspects of draft work plans of sampling to be done for the remedial investigation of the site, after the lead agency overseeing the investigation provides copies of the plans to the DOH;

4. Advise and consult with the DNR and the EPA on public health concerns that may arise as new information about the site becomes available;

5. Conduct additional health evaluations of the site after the results of the remedial

investigation are provided to the DOH.

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CERTIFICATION

This public health assessment was prepared by the Wisconsin Division 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.

Technical Project Officer, SPS, RPB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.

Director, DHAC, ATSDR

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Appendix A.

RESPONSE TO COMMENTS ON PUBLIC COMMENT DRAFT

1. Comment postmarked June 7, 1991: The tomato that the DOH sampled was not canned. It was one, raw tomato.

   Response: The assessment was revised to say that a tomato was tested.

2. Comment postmarked June 7, 1991: It is inappropriate to rely on the test of one tomato as the basis of the conclusion that chromium does not accumulate in garden vegetables. One sample does not a case make.

   Response: The primary basis for the conclusion that garden vegetables are unlikely to accumulate hazardous levels of chromium was from the evaluation in ATSDR's Toxicological Profile of chromium and from consulting with a soil scientist who is a international authority on chromium uptake in vegetables. The analytical result of the test of the one tomato from near the site does not contradict these other authorities.

3. Comment postmarked June 7, 1991: In 1979 the DOH never issued any orders that residents could eat or not eat vegetables grown in gardens near the chrome shop.

   Response: In October 1979 the DOH sent a memo to the DNR in Green Bay and noted that copies of the memo were sent to two nearby residents. The memo said:

   > "With regard to human exposures, the information, while somewhat sparse, indicates that in this situation, no harm will come from eating plants grown in chromium contaminated soil."

   The memo concludes, however, that too little information is available on other possible contaminants in soil and water near the garden. Therefore:

   > "...until further tests are run on water and soil samples for other possible contaminants, (which I have recommended you search for), the vegetables should be held aside and <u>not</u> used for food."

   The assessment was revised to state this information more specifically.

4. Comment postmarked June 7, 1991: When the company replaced contaminated soil from a resident's yard, only a very small area was cleaned up, approximately 15 feet wide by 25 feet long by 8 feet deep. The replaced soil was probably contaminated by 1980.

   Response: The assessment was revised to say that soil from the garden at an adjacent property was replaced.

5. Comment postmarked June 7, 1991: I think that 20,000 to 60,000 gallons of leaked plating solution is a low estimate. Also, not all 83 tons of material removed by the EPA was contaminated soil. Much of it was concrete from where tanks were removed from below the floor.

   Response: The agencies' estimates of the quantity of contaminated material attest to the large amount of material that was spilled. The numbers cited are intended to help readers understand that the cumulative amount of material spilled was massive. There is no way to check how precise the reported estimates are.

6. Comment postmarked June 7, 1991: March 1988 was not the first complaint about yellow runoff. There had been yellow runoff for years.

   Response: The assessment notes that "in 1978" DNR received several complaints about illegal dumping at the chrome shop. The available records may not show when the first complaint was filed.

7. Comment postmarked June 7, 1991: The assessment does not mention that the leachate was permitted to be discharged directly to the city storm sewer and into the Fox River.

   Response: The "Environmental Pathways" section of the assessment notes that surface water flows into the Fox River via storm sewer discharge. Available records did not show that a permit was granted to discharge plating solution directly to a city storm sewer. The records mention that the former collection trench on the western side of the site discharged to a De Pere sanitary sewer. That sewer leads to the city's wastewater treatment plant where treated effluent flows into the Fox River.

8. Comment postmarked June 7, 1991: We did not "suspect" that skin rashes were caused by chromium from the site. We know, or we would not have lost a tree or gotten rashes when the lawn was mowed.

   Response: The assessment was revised to say that a resident "claimed" that rashes were caused by chromium from the site. Chrome plating solution can trigger allergic dermatological reactions in people who are sensitive to chromium. It also can kill plants if concentrations in soils are high.

9. Comment postmarked June 7, 1991: The young child not only did not gain weight, she also did not grow in height or grow hair. She received her first haircut at age 5½ years, after she moved away from living next to the site.

   Response: The assessment was revised to describe these concerns in greater detail.

10. Comment postmarked June 7, 1991: The fast depletion of drinking water may shorten the time for contamination to go downward.

Response: It is possible that increased pumping of the city water supply well could speed up the downward flow of contamination. The remedial investigation of the site should provide more data to evaluate such a possibility. The assessment recommends evaluating the threat to the city water supply. At this stage, one can only speculate about the extent of groundwater contamination and ways to prevent contaminating the city well.

11. Comment postmarked June 7, 1991: Please list state government standards with the concentrations in Tables 3 and 7.

(there are no standards for soil)

Response: The assessment was revised to list health comparison values for surface soil in Table 7, but no relevant comparisons are available for the liquids that were formerly stored inside the zinc shop (Table 3).

12. Comment postmarked June 7, 1991: I asked for studies of air quality. It is a shame that no one would be bothered. You can see where the air emissions caused the paint to peel on our house.

Response: It is a shame that no air quality emission data are available from when the shop was operating. Now, there is no way to estimate the extent of airborne contamination or the extent to which people may have inhaled contaminants in air. Until recently the state had little authority to require such monitoring. Recent air monitoring by EPA during excavation at the Zinc Shop did not detect Co - I do not have any results see Ried.

13. Comment postmarked June 7, 1991: Continue to study the long-term effects of low-dose exposures to these contaminants. If possible, do a cancer study of De Pere because so many seem to be getting it in our area.

Does this answer the question

Response: Even though the exposure data for this site are too limited to conduct a long-term health study (see Health Outcome Data Evaluation Section), ATSDR has established an exposure registry for people who were exposed to chromium. The agency recognizes that there are many gaps in our understanding the health effects of long-term environmental exposure to this chemical. Information learned from other sites where exposure was more closely monitored may help to explain some health effects that cannot be explained now.