PUBLIC COMMENT DRAFT

PRELIMINARY HEALTH ASSESSMENT

BETTER BRITE CHROME AND ZINC SHOPS
DE PERE, WISCONSIN
CERCLIS NO. WID560010118
May 1, 1991

Prepared by:
Wisconsin Division of Health (DOH)
Madison, Wisconsin

State of Wisconsin

This preliminary health assessment will be available for public comment from May 7, 1991 to June 7, 1991. Written comments should be mailed to Mary Young, Wisconsin Division of Health, P.O. Box 309, Madison Wisconsin 53701-0309 and postmarked no later than June 7, 1991. Public comments will be addressed in the final version of the assessment. If you have questions please call (608) 267-6844.

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Health Assessments

Statement of Purpose

The federal "Superfund" law requires the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) to prepare a health assessment for all toxic waste sites that the U.S. Environmental Protection Agency (EPA) proposes for placement on the Superfund list (called the National Priorities List).* The Wisconsin Division of Health works with the ATSDR to prepare health assessments. The purposes of 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 substance's toxicity; ability to move through soil, air or water; persistence in the environment; and ability to accumulate in the food chain. They look at such ways that people could come in contact with the contaminants as ingestion, skin contact, or breathing. Investigators make conclusions about the types of illness that could result from exposure to the chemicals present. Finally, they recommend actions to protect public health now and in the future.

A "preliminary health assessment" is conducted when a site is proposed for the National Priorities List. The preliminary assessment relies on whatever data are available at the time. It also identifies data needs that the remedial investigation can address. Later, after the remedial investigation of the site is completed a full "health assessment" is conducted using the more complete data. The EPA and the Wisconsin Department of Natural Resources provide much of the sampling data used for the assessment.

* Officially, this section of the "Superfund" law is 42 U.S.C. §9604 (i).

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Agency for Toxic Substances and Disease Registry (ATSDR)

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. The chrome shop has been razed and the immediate area fenced; the zinc shop is still standing and the area is unfenced. Contamination from the sites extends to ground water, 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 of the potential for exposure via 1) dermal absorption of chromium in contaminated surface water and contaminated seepage water in the basement of an adjacent home, and 2) ingestion of on-site soil contaminated with lead. Chromium-sensitized people exposed to contaminated surface water might experience skin irritation. Children who ingest lead-contaminated soil could suffer nervous system damage. Contaminated insulation at this site has been covered. More extensive soil sampling and ground-water monitoring on and off-site is advised. In addition, it is recommended that residents avoid contact with yellow-tinged puddles; that the existence of private wells in the area be evaluated (and if found, sampled).

BACKGROUND

Site Description and History

This site consists of two plating shops in De Pere, Wisconsin, a city southwest of Green Bay. The properties are located about 2,000 feet apart in a residential area (see map in Appendix A). Heavy metals (chromium, cadmium, and zinc), cyanide, and chlorinated organic solvents were used in metal plating operations at the shops (1). The Environmental Protection Agency (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).

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.

Located at 315 S. Sixth St. in De Pere, this site covers about one-half acre in a predominantly residential area (see map in Appendix B). Homes bound the site on the south, west, and north; a moving van line is located to the east. There is one structure on the property, a 120-foot by 60-foot pole building with a concrete loading dock. There are gravel parking areas east and north of the building (5, pp.2-3). The property is relatively flat, with very slight surface drainage towards the northeast.

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.

In October 1989 an EPA Technical Assistance Team assessment confirmed Wisconsin Department of Natural Resources (WDNR) 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 WDNR 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 ground water.

By March 1991 40,000 gallons of ground water had been removed. Ground water 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). In March 1991 the EPA installed plywood over deteriorated siding (9).

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 (10). 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 an 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 (11). 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 (12, 13).

Chrome Shop.

The Better Brite Chrome Shop site, located at 519 Lande St., covers about one and one-half acres. The site consists of the original facility's concrete floor; a building housing ground-water treatment equipment; and a parking area. The concrete floor and a margin of heavily contaminated soil are surrounded by chain-link fencing. The site is bounded by private residences on the north, west and south; a raised railroad bed runs along the eastern border (see map in Appendix C). The immediate area of the site slopes steeply to the west and south, in part due to excavation for a French drain (14).

The chrome shop began operations in the early 1970's. In 1978 the WDNR 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 ground water (15).

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, residents, and a local health official that ground water 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 (16).

As a result of an initial investigation, the WDNR 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 ground water and surface water and a sump pump that discharged to the City of De Pere sanitary sewer. Contaminated soil from neighboring properties was also removed to the shop property and replaced with clean topsoil (17, p.3).

Better Brite Plating, Inc., filed for bankruptcy and discontinued chrome shop operations in October 1985. At that time, WDNR 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 (18).

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 (18). In March 1988, the WDNR 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 (19). WDNR 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 (20).

In October 1988, WDNR 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, WDNR partially fenced the site, installed a clay cap, covered it with soil, and seeded the cover (21). Off-site soil was not remediated. The EPA has installed a building on-site to house a pretreatment system designed to treat ground water 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 (18).

Site Visit

On March 14-15 and April 19, 1990 representatives from the DOH, ATSDR-Region V, and WDNR 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.

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 (22). The EPA later covered all exposed insulation and dilapidated siding with plywood (9).

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 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.

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).

Relevant Health 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 (23). The DOH also conducted interviews during the spring of 1990 of 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. 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 (16). The DOH later arranged for the Wisconsin Occupational Health Lab to test canned tomatoes grown 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 (24).

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 sponsored by the EPA on April 19, 1990 and February 19, 1991. About 70 people attended the April meeting, and about 50 people attended the February 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.

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.

In July 1990, a nearby resident reported that members of two families adjacent to the chrome shop had developed skin rashes. She suspected 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.

A young child's weight loss, 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 begun to gain weight. 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

Zinc Shop: On-Site Contamination

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

Soil.

WDNR and EPA have sampled surface soils on-site several times since 1983. Sampling occurred in May 1983, September 1985, August 1987, July 1989, and March 1990. 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 ground-water sump was installed during the summer of 1990 (8).

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

	Concentrations (mg/kg)			Years
Compound	Low	High	Background	Sampled
Barium	26.9	2,970	57.8	1988, 1990
Cadmium	1.4	43	1.4	1983 - 1990
Chromium	40	2,910	19.4	1983 - 1990
Cyanide	24.6	600.9	ND	1983 - 1990
Lead	33.8	1,540	29.1	1985, 1988, 1990

Sources: 5, p.8, Table 4.3; 25, p.4; 28.

* A "level of health concern" is a concentration above a level where the maximum plausible exposure to the contaminated material might affect human health. For carcinogenic chemicals a level of health 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. This assessment addresses only those contaminants that the authors judge to be present at levels of health concern. In many cases, levels of health concern are not published standards. 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 health concern at a site.

Subsurface soils were sampled in August 1987 and May 1990. In 1987 a consultant for WDNR 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 (26).

Ground water.

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 ground water 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.

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.

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

Chemical	Detected Concentration (µg/L) Low	High	Wisconsin Groundwater Enforcement Standard
Chromium	100	310,000	50
Cyanide	59.4	228	200
1,1-Dichloroethylene	6.5	36	7
Tetrachloroethylene	--	2.1	1
1,1,1-Trichloroethane	8.6	690	200

Source: 5, Table 4.3.

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 (25). 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).

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 mg/kg	9,410
Lead	<10	470

Source: 5, p.7.

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 (27). 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 (28).

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

Source: 23.

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 (28). 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 (26).

Ground Water.

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 (29). WDNR 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). The City of De Pere analyzes samples from the well for chromium, zinc, and cyanide semiannually (5, p.11). The city well water shows no contamination (30). No other testing for contaminated ground water off-site has been conducted.

Seepage Water.

No surface water occurs near the zinc shop. Water does accumulate in the basements of houses adjacent to the property. On three occasions unfiltered seepage water 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	6/27/86
Total chromium	73,000	10/29/86
Hexavalent chromium	10,000	3/15/90

Sources: 7, 25.

In March 1990 WDNR 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).

Precipitate on Basement Floor and Walls.

In December 1989 and February 1990, WDNR 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).

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

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

Source: 31.

Chrome Shop: On-Site Contamination

Soil.

Better Brite, WDNR, and EPA have sampled surface soils on-site in 1979, 1987, 1988, and 1990. 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, and 1990 were analyzed only for chromium. Three samples collected in 1988 were analyzed for an array of metals and organic compounds (17). EPA's Emergency Response Technical Assistance Team collected the most recent samples in April 1990 from five areas around the southwestern portion of the site (32). Throughout the eleven-year period, concentrations of chromium in soil samples have not exceeded a level of health concern, although concentrations in areas where spills occurred are well above background concentrations (Table 7). One surface sample from the southeast corner of the property, near the railroad tracks contained elevated concentrations of chromium, cadmium, and lead. No further sampling has been conducted near this area of the site.

In 1988 a contractor for WDNR 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 (17, 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
Chromium	3.2	140	1979
"	16.8	2,250	1988
"	17	870	1990
Cadmium	2.8	116	1988
Lead	5.8	7,900	1988

Sources: 17, 31, 33, 34.

Ground Water.

Ground-water 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 (33). In 1987 a contractor for WDNR 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.

In 1986 hexavalent chromium typically accounted for 90 percent of the total chromium found in the shallow ground water (18). 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.

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

Chemical	Concentration (µg/L) Low	High	Sample Date	Wisconsin Groundwater Enforcement Standard
Shallow Ground Water:				
Hexavalent chromium	0.06	600	1979	--
" "	60,000	280,000	1986	--
Total chromium	0.1	600	1979	50
" "	62,000	429,000	1986	"
" "	ND*	15**	1987	"
" " ***	--	11	1988	"
" "	<100	<100	1989	"
Cadmium	0.9	1.8	1987	10
1,1-Dichloroethylene	ND	5.4**	1987	7
"	2	27	1988	"
Lead***	--	ND	1988	50
1,1,1-Trichloroethane	5.1	44	1987	200
"	19	400	1988	"
Deep Ground Water (Dolomite aquifer):				
Total chromium	44	6,600	1987	50
" " ***	--	14.7	1988	"
" " **	<100	1,000	1989	"
Benzene	7.6	39	1987	5

* ND = not detected.
** Chemical detected in only one well.
*** Only one well sample was analyzed for these chemicals.

Sources: 17, 33, 35.

Surface Water.

In 1979 WDNR 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 (17, pp.8-9).

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. At no time during this period have analyses of off-site soils revealed any chemicals at levels of health concern (Table 9).

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
Chromium	3.8	28.0	1977
"*	746	922	1988
"	13	100	1990
Cadmium*	0.99	2.8	1988
Lead*	12.9	12.6	1988

* These are results of one sample and its duplicate sample.

Sources: 17, 32, 33.

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 (17).

Ground Water.

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 (34). In 1987 a contractor for WDNR 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.

Surface water.

Surface water off-site was sampled during a spring thaw in March 1988, when the ground-water 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 (17, p.9).

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

Chemical	Concentration (µg/L)	Sample Date	Wisconsin Groundwater Enforcement Standard
Chromium	21.5	1979	50
"	62,000	1987	"
"	33,000	1988	"
"	30,000	1989	"
1,1-Dichloroethylene	7.4	1987	7
"	1	1988	"
1,1,1-Trichloroethane	170	1987	200
"	48	1988	"

Sources: 17, 34.

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 (17, 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.

Garden vegetables.

In February 1980 the Wisconsin Occupational Health Lab tested canned tomatoes 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) (24).

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) (32).

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.

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, is no longer used. EPA has covered deteriorated siding with sheets of plywood (8).

PATHWAYS ANALYSES

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 ground-water recharge, these contaminants are mobilized. They either flow 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 ground-water sump at the zinc shop and the operation of the ground-water extraction well at the chrome shop should significantly reduce the lateral flow of contaminated ground water to the ground's surface.

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. Ground water 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.

Ground Water.

Hexavalent forms of chromium are very soluble and are readily transported in ground water. At the zinc shop, the shallow ground-water table slopes slightly to the northwest toward a ravine that drains to the Fox River (5, p.4). At the chrome shop, the shallow ground-water table slopes westward toward a drainage way in the back yards of adjacent residents (17, p.12).

Regional ground-water 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 ground water 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 (36).

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 that contamination could reach the sandstone aquifer. The sandstone aquifer annually receives an estimated 2 to 4 inches of recharge from the overlying material (29). 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. 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.

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 discharges, ultimately discharge to the Fox River (17, 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.

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 (17). 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 one sample from the southeast corner of the chrome shop property. Lead also tends to bind with soil. Because no other soil samples have been collected from this area of the property and analyzed for lead, it is difficult to determine how widespread lead-contaminated soil may be in this area. Significant erosion of the soils in both of these areas will tend to be reduced by the layer of gravel that covers the soil.

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 (37).

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 ground water seep to the surface and come in contact with air, they will rapidly dissipate. When ground water 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 is sufficient to release enough VOC's to pose a health hazard.

Human Exposure Pathways

Ingestion.

Ingestion of contaminated surface water near the chrome shop, although quite unlikely, could pose a threat to health. Ground water 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 ground water 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 ground water under the site is dispersed as it migrates through the dolomite. The operation of the ground-water sump at the zinc shop and the ground-water extraction system at the chrome shop will reduce the quantity of contaminated ground water that could migrate down to the sandstone aquifer.

Insulating material emerging from the exterior of the zinc shop that is contaminated with chromium and cyanide could pose a health hazard if it is ingested by children. This material has been covered with wood and plastic sheeting; if secure, these measures should prevent exposure.

Soil sampling needs to be more comprehensive (in terms of both the area sampled and the number of chemicals tested) in yards near the sites, since children may ingest soil intentionally or unintentionally. The high levels of lead in one sample east of the chrome shop need to be followed up. It is not clear how widespread the lead may be. The area where it occurs is near residences and is readily accessible to children.

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 ground water from the dolomite aquifer, VOC's could be released from the ground water and into houses. Inhalation of VOC's in indoor would be roughly equivalent to the dose ingested in drinking water.

PUBLIC HEALTH IMPLICATIONS

Toxicological Implications

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 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 (38, 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 (38, 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 (38, 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 (38, p.54). The highest concentrations found in the dolomite aquifer could cause nausea if ingested (38, p.67).

Four VOC's appeared at levels of potential health concern in ground water 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 (39, 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 (40, 41).

Elevated levels of cadmium and lead appeared in one soil sample taken from the southeast corner of the chrome shop property. Little sampling has occurred in this area of the site, and most sampling has focused only on chromium. So it is unclear how widespread such contamination may be. 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 (42, 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 (43, p.14). The major need when only one sample shows elevated concentrations, is to define the chemical's distribution around the site more accurately. Only then can the likelihood of exposure be properly estimated.

Health Outcome Data Evaluation

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 (38). 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 (38, pp. 23-24).

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 chromium levels change only in cases of extreme exposure or deficiency (38). 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.

CONCLUSIONS

The chrome and zinc shops pose a public health hazard because there is a potential for human exposure to toxic chemicals in ground water, surface water, and on-site soil. Chromium and VOC's in the shallow ground-water 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. If nearby residents in the municipal service area are continuing to use private wells in the dolomite aquifer, there is a threat of human exposure to chromium and VOC's in drinking water and to VOC's emitted to indoor air. It is possible that contact with chromium-laden surface water could result in dermal sensitization.

There is a possibility that lead occurs at levels of health concern in soils east of the chrome shop. Soil sampling data on the extent to which this chemical is distributed around the site are inadequate to evaluate the potential health effects of the chemical.

The limited data that are available are not sufficient to indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects. However, information is not available for all environmental media to which humans may have been exposed during operation of the shops. The upcoming remedial investigation of the site should provide many more data on environmental contamination.

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

1. The zinc shop should be routinely inspected to insure that material covering insulating material at the zinc shop is secure and that other hazards (such as further deterioration of siding, broken locks) have not developed.

2. More extensive soil sampling should be conducted at and around the chrome shop site. This sampling should involve areas and depths where residents would plant vegetables and areas on the east side of the property where additional spills may have occurred. Samples should be analyzed for lead, petroleum compounds, and an array of inorganic and organic chemicals characteristic of plating operations.

3. More extensive soil sampling should be conducted at and around the zinc shop. This should involve an investigation of the extent of lead, farm chemicals that may have spilled from the former Farmer's Coop adjacent to the site, and array of inorganic and organic chemicals characterisitic of plating operations.

4. Residents should continue to be advised to avoid contact with yellow-tinged puddles or basement water.

5. Ground water between the zinc shop and the closest municipal well should be monitored and the extent of ground-water contamination should be characterized. Municipal wells should continue to be sampled regularly for site-related contamination. The operation of the ground-water sump at the zinc shop and the ground-water extraction system at the chrome shop should reduce the quantity of contaminated ground water 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.

6. The existence of private wells in the area should be evaluated. Any private wells identified should be sampled and, if contamination exceeds standards, their use should be discouraged.

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.

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APPENDICES

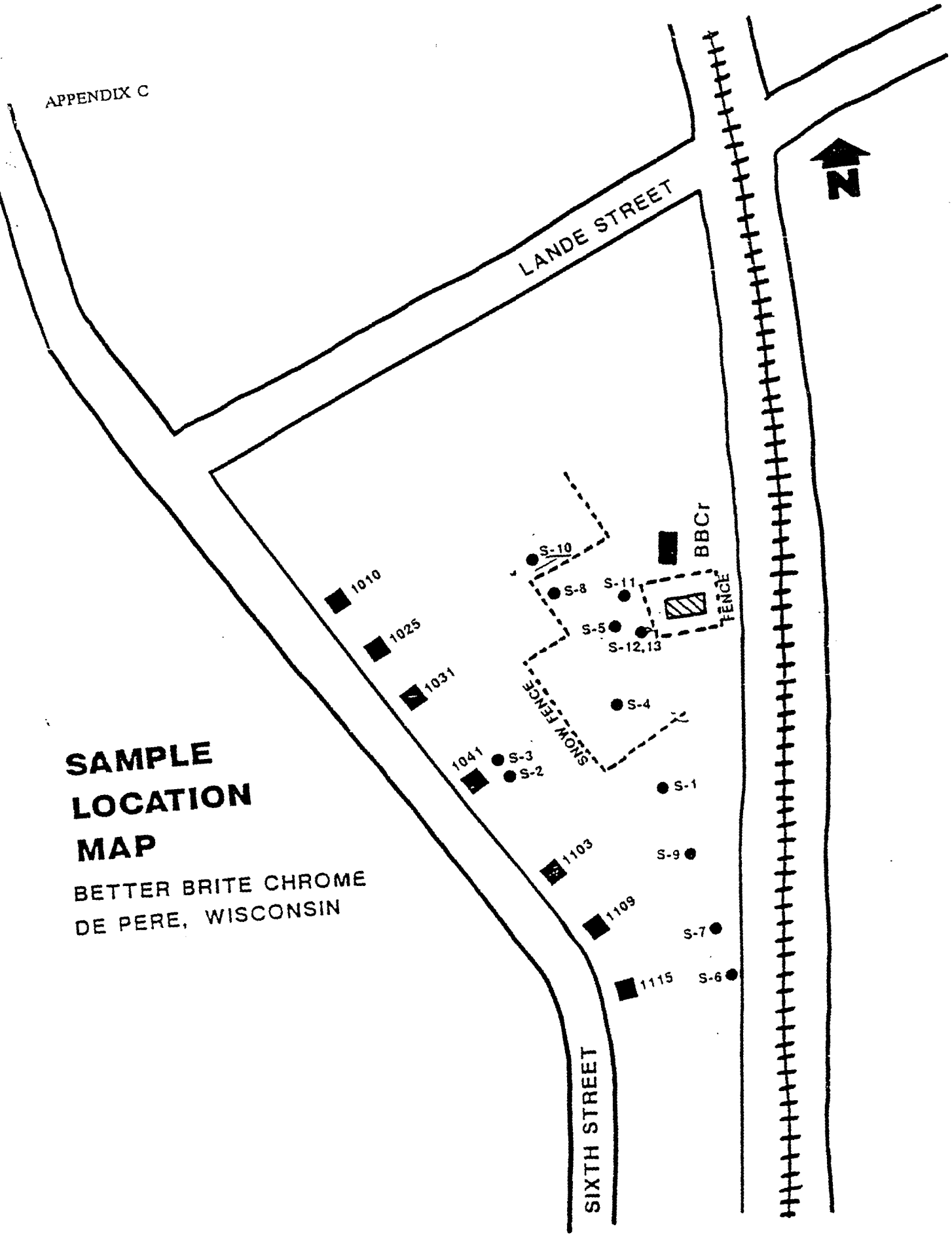
A. Sites location map.

B. Zinc shop map.

C. Chrome shop map.

KMB: 5/1/91

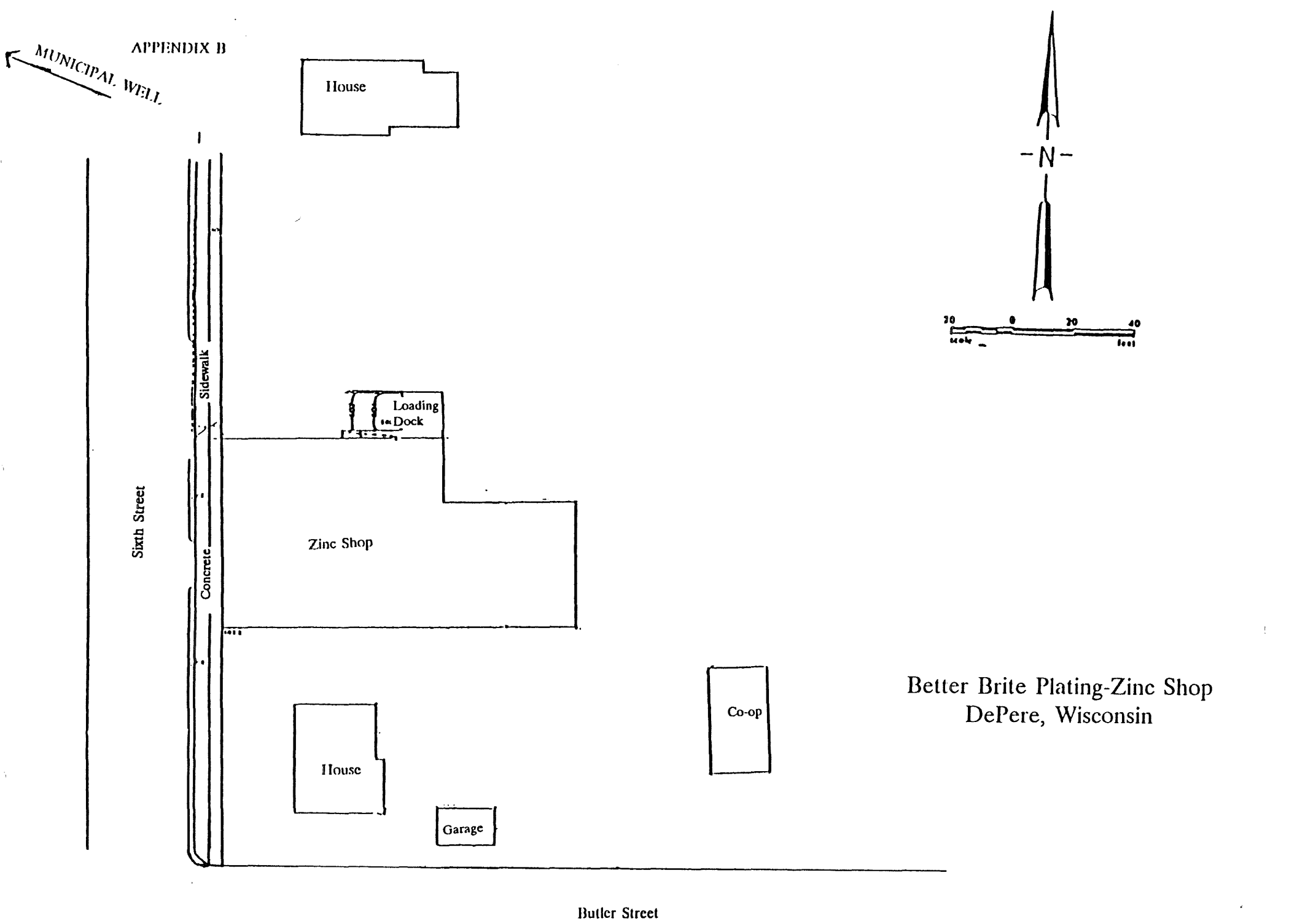
APPENDIX C



SAMPLE LOCATION MAP

BETTER BRITE CHROME
DE PERE, WISCONSIN

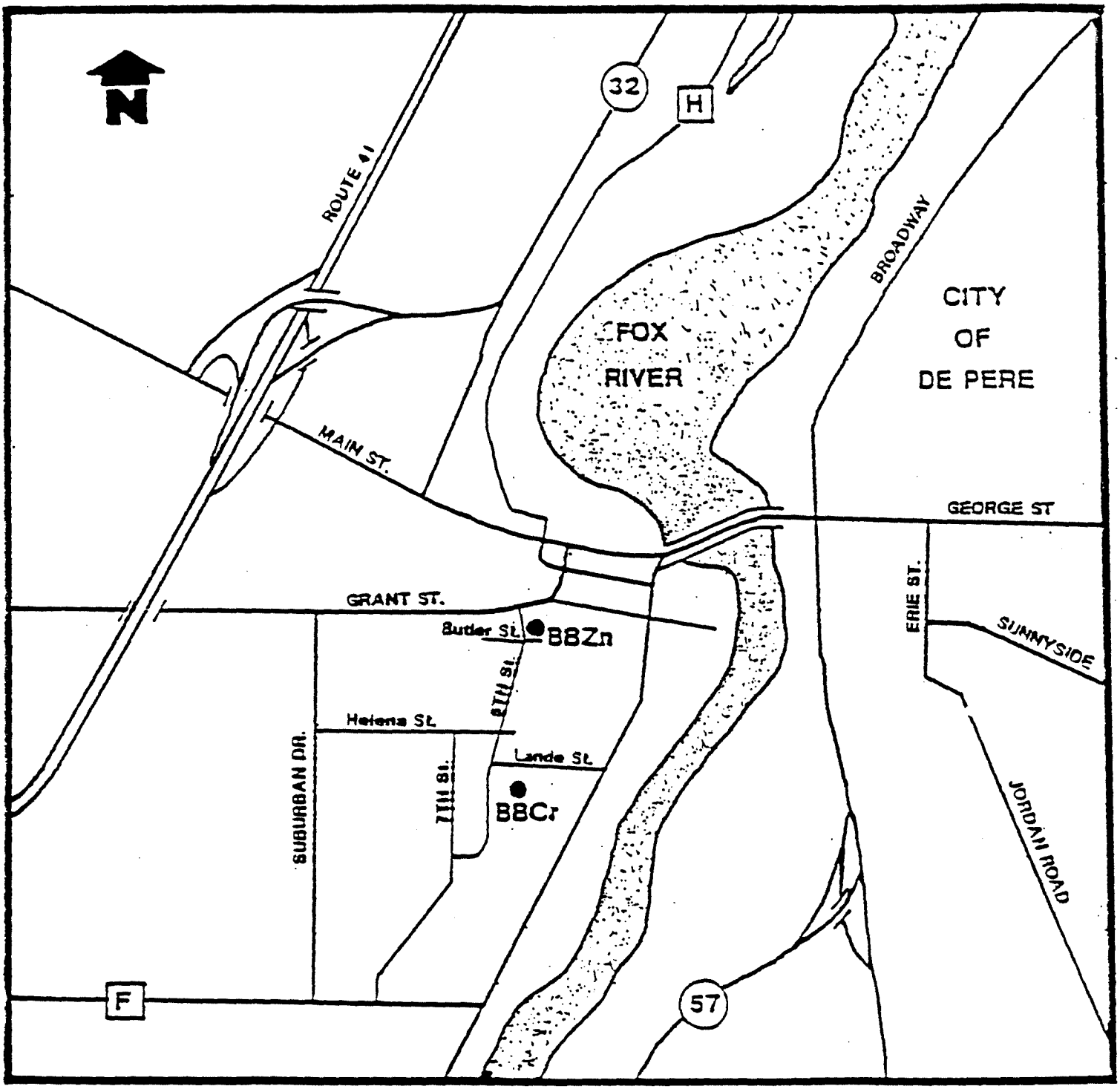
APPENDIX B



Better Brite Plating-Zinc Shop
DePere, Wisconsin

APPENDIX A

Better Brite sites location map



Source: EPA Superfund Fact Sheet, April 1990