Health Consultation

GARY DEVELOPMENT LANDFILL

GARY, LAKE COUNTY, INDIANA

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
AOC	Area of Concern
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CREG	Cancer Risk Evaluation Guide
CSO	Combined Sewer Overflows
DHHS	Department of Health and Human Services
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FWS	Fish and Wildlife Service
GDL	Gary Development Landfill
IDEM	Indiana Department of Environmental Management
IRAC	International Agency for Research on Cancer
ISBH	Indiana State Board of Health
ISDH	Indiana State Department of Health
NIPSCO	Northern Indiana Public Service Company
NPL	National Priorities List
NRS	Northeastern Recreation Research Symposium
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
RCRA	Resource Conservation and Recovery Act
SVOC	Semi-volatile Organic Compounds
USDA	U.S. Department of Agriculture
UST	Underground Storage Tanks
VOC	Volatile Organic Compounds

Summary

INTRODUCTION

Gary Development Landfill (GDL), located in Gary, Lake County, Indiana, was approved by the state in 1975 for operation primarily as a private sanitary landfill. Although not permitted to do so, records indicate that the landfill began accepting hazardous substances and wastes containing volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), asbestos, metals, and pesticides shortly thereafter. Large quantities of hazardous wastes were landfilled on this 62 acre property by the time the landfill was closed in 1989. In 1995, 14 vents were installed by the Northern Indiana Public Service Company (NIPSCO) to collect methane gas for reuse; however, neither a collection system nor flares were ever installed. The landfill is still owned by a private company. Although some buildings remain on the landfill, no activities are currently taking place anywhere on the landfill.

GDL is bordered by five other properties that are considered sources of hazardous substances. Further, there are hundreds of other point and nonpoint pollution sources within two miles. The Gary Airport is adjacent to GDL and the Grand Calumet River is on the southern border.

The Agency for Toxic Substances and Disease Registry (ATSDR) evaluated the possible health impact of exposure to contaminants originating from GDL because it was recently proposed (March 2011) for the Environmental Protection Agency's (EPA's) National Priorities List (NPL). ATSDR staff conducted a site scoping visit on July 22, 2011, with the U.S. EPA, the Indiana Department of Environmental Management (IDEM), and the City of Gary. ATSDR reviewed information on the wastes received by GDL, the limited onsite sampling data, summary information from surrounding contaminated areas, and sediment and fish data for the Grand Calumet River. This consultation summarizes the findings of ATSDR's evaluation.

Although this report does not evaluate the health implications of future use options, future uses of GDL could offer opportunities for economic development and/or further preservation of the Calumet region's natural areas. Although complete remediation of GDL may not be possible – especially given the numerous other contamination sources surrounding GDL – contaminant control and exposure prevention are possible. The City of Gary and others have expressed interest in using portions of GDL. ATSDR could provide another review of GDL if uses or other conditions change.

CONCLUSION 1

ATSDR concludes that people using the Grand Calumet River for recreational purposes may be exposed to contaminants in fish, sediments, and water. Regularly eating fish over many years from areas where there is a fish and swimming advisory could harm people's health. The elevated levels of semi-volatile organic compounds (SVOCs), including polychlorinated biphenyls (PCBs), in the fish represents a public health hazard to people consuming those fish.

ATSDR also concludes that infrequently eating small amounts contaminated sediments from dirty hands or ingesting sediments or water while swimming is not expected to result in illness over the short term. "Worst-case" (i.e., over a year or more) exposures to PCBs and other SVOCs in sediments are unlikely and therefore would not harm people's health.

BASIS FOR CONCLUSION

Leachate continues to discharge from the Gary Development Landfill (GDL). With no collection system in place, those discharges run off into the Grand Calumet River. Additionally, past inspections (while in operation) revealed that contaminated waters (e.g., runoff, leachate) were being discharged into the river.

The Grand Calumet River and Indiana Harbor and Canal are contaminated with SVOCs (including PCBs), heavy metals such as mercury, cadmium, chromium and lead, and pesticides. Those waterways are also impacted by conventional pollutants (e.g., phosphorus, nitrogen, iron, magnesium, volatile solids, oil and grease). In some areas, the contamination in sediment is as great as 20 feet deep. The Indiana State Department of Health (ISDH) currently has a full fish consumption advisory for the Grand Calumet River which warns against the consumption of any fish. Although limited, signage along the river reads "Warning Unsafe Waters" "You should not swim in or eat fish caught from these waters". Fishing has been restricted, at least in part, in the Grand Calumet River since 2002.

People could be exposed to contaminants in the Grand Calumet River (from GDL and many other nearby pollution sources) if they violate the advisory and eat the contaminated fish or contact the contaminated sediments.

A 2002 and 2003 angler assessment of recreational fishing in the industrialized Calumet region showed that 70% of the 97 participants reported that they fish at least occasionally for consumption and 45% said that they usually eat the fish they catch (including in the advisory areas). The assessment showed notable differences in fish consumption patterns among the three groups (i.e., Whites, Blacks, and Latinos). *The angler assessment concluded that the existing advisories and detailed fish consumption risk information was failing to reach Calumet's angling community.*

The PCB contaminant levels in fish tested (i.e., carp, catfish, goldfish,

	pumpkinseed, white sucker, and sunfish) ranged from moderate (less than 2 milligrams per kilogram (mg/kg) to high (27 mg/kg) depending on the location and type of fish. A large number of the fish sampled from the Grand Calumet River had elevated PCB levels. People, including children who ate fish from these areas over many years are at greater risk for developmental (i.e., enamel defects on permanent teeth) and endocrine (i.e., thyroid and diabetes) effects as well as an increased risk of developing cancer from this PCB exposure.
NEXT STEPS	ISDH and local governments and organizations should provide continuous community notification and education on the hazards of eating fish from the Grand Calumet River. This should include posting more signage along the river. Additional angler outreach should also be implemented like those suggested in the 2002 and 2003 angler assessment. Outreach should using new information channels, providing information aimed at minimizing risk through fish selection and preparation techniques, and providing information in accessible formats. The angler assessment suggested that new channels could include those outside the fishing-oriented network like church groups and kinship networks. Another idea was to create a "Master Angler" certificate where experienced anglers offer classes including information on fish consumption, avoiding highest risk areas, and better species, size, and preparation choices.
CONCLUSION 2	ATSDR concludes that active methane vents on GDL pose a fire or explosion hazard for trespassers and other visitors to GDL and thus can harm people's health.
BASIS FOR CONCLUSION	Although the landfill is mostly inaccessible to vehicles and difficult to walk around due to overgrowth, there were no signs warning of the hazards present on the landfill. At times, a spark from an engine, cigarette, or another ignition source near the methane vents might cause a fire or explosion.
NEXT STEPS	ATSDR recommends posting signs indicating the hazards present on the landfill and implementing institutional controls on digging unless special standards and procedures (e.g., a hazardous waste/explosion safety plan) are followed by utility workers, sampling contractors, and others.
CONCLUSION 3	ATSDR concludes that contaminants in soils, wetland sediments, and leachate on GDL are sufficiently high to impact people's health, but people are not coming into contact with them.
BASIS FOR CONCLUSION	The main road into the landfill is blocked off by large concrete barriers making driving cars or trucks onto the landfill difficult. Although people can access the landfill from several perimeter roads on foot, during the growing season the landfill is mostly overgrown. It is difficult to walk around or reach

	some of the known sources of surface contamination (e.g., leachate outfall). In July 2011, there were no signs of trespassing or four wheel drive or other recreation vehicle (e.g., motorcycle) entry. Further, GDL is in a primarily industrial area with the nearest residential area across the river and more than a mile upstream.
NEXT STEPS	ATSDR recommends EPA further restrict access to the surface contamination by posting signs indicating the hazards present on the landfill, and implementing institutional controls on digging unless special standards and procedures (e.g., a hazardous waste/explosion safety plan) are followed by utility workers, sampling contractors, and others. More sampling is needed to delineate the areas with surface contamination. If use of GDL changes, ATSDR recommends additional environmental samples be collected to help determine the nature and extent of contamination and that a re-evaluation of the possible health impact of exposure to contaminants be conducted.
FOR MORE INFORMATION	If you have additional concerns about your health, please call ATSDR at 1-800-CDC-INFO and ask for information on the Gary Development Landfill site.

Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) evaluated the possible health impact of exposure to contaminants originating from Gary Development Landfill (GDL), Gary, Lake County, Indiana because it was recently proposed (March 2011) for the Environmental Protection Agency's (EPA's) National Priorities List (NPL). ATSDR staff conducted a site scoping visit in July 2011, reviewed information on the wastes received by GDL, the limited onsite sampling data, summary information from surrounding contaminated areas, and sediment and fish data for the Grand Calumet River. This consultation summarizes the findings of ATSDR's evaluation.

This report does not evaluate the health implications of future use options. Future uses of GDL could provide opportunities for economic development and/or further preservation of the Calumet region's natural areas. The City of Gary and others have expressed interest in using portions of GDL. If uses or conditions change, an additional review of GDL should be requested.

Site Description

The Gary Development Landfill (GDL), located at 479 Cline Avenue in Gary, Indiana, is the site of a 62 acre landfill that operated from approximately 1975 to 1989. This privately owned, former landfill is in a primarily industrial area and has a wetland on the southeastern portion of the property. The Grand Calumet River forms the southern border of the landfill (Figure 1) [EPA 2011a].

In July 2011, ATSDR staff conducted a site scoping visit at the Gary Development Landfill. Other participants included the U.S. EPA Remedial Project Manager, David Linnear; the Indiana Department of Environmental Management, Remedial Services Branch Senior Technical Advisor, Mike Sickels; and the City of Gary Environmental Coordinator, Dorreen Carey.

The main road into the landfill was blocked by large concrete barriers making driving cars or trucks onto the landfill difficult. Several open-air buildings remain on the landfill; however, no activities are taking place on the property. Because the landfill is not fenced, people can access the landfill on foot from several perimeter roads. However, in July 2011, there were no signs of trespassing such as debris, fire pits, or signs of recent four wheel drive or other recreation vehicle (e.g., motorcycle) entry.

Walking the western and southern perimeters of the landfill, we observed the drainage outfall to the Grand Calumet River, and inspected one of the methane vents. Although we did not see any deer, there were signs that large numbers of deer inhabit the landfill (i.e., deer beds, deer tracks). Hunting is not permitted on the landfill or in the surrounding areas. The landfill was completely overgrown with phragmites and various other weeds (Figure 2). The nearest residential area is across the river and more than a mile upstream.

GDL is bordered by five other properties and within a 2 mile area are 12 sites (EPA, state lead, local lead, etc.) that are considered sources of hazardous substances [EPA 2011b] (Figure 3). Numerous nature preserves and/or natural areas are also in the area (Figure 4). The Gary Airport is adjacent to GDL.

Background

GDL was approved by the state for construction as a sanitary landfill in 1973. Previously, the property was a mined-out, water-filled sand pit. GDL received their operating permit in 1975 [IDEM 1992].

Several times in 1975, the Indiana State Board of Health (ISBH) visited the landfill and ordered the GDL to stop accepting unauthorized hazardous waste, to install monitoring wells, and to improve the cover of the landfill [ISBH 1976]. Additionally, in 1976, ISBH visited the landfill to inform the operators that they were discharging water (i.e., leachate) to the Grand Calumet River in violation of their permit. A water/leachate sample revealed that it contained "significant amounts" of heavy metals and oils. A violation letter was sent to GDL about the leachate discharge, lack of adequate cover on the landfill, and the need for monitoring wells [ISBH 1976].

According to records reviewed by the Indiana Department of Environmental Management (IDEM)[1], GDL began accepting (listed) hazardous waste for disposal in 1980. IDEM inspections and notices of violation continued for several years. Groundwater samples taken in 1984 and 1985 showed numerous analyte concentrations above the primary and secondary drinking water standards [ISBH 1986]. Throughout its history of operation, GDL neither achieved interim status under the Resource Conservation and Recovery Act (RCRA) [2] nor obtained a RCRA permit [USEPA 2011b].

According to hazardous waste manifests of waste sent to GDL for disposal, the landfill accepted volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), asbestos, metals, and pesticides [USEPA 2011b]. GDL ceased operations and stopped accepting waste on August 31, 1989.

In 1992 during a periodic inspection, IDEM staff identified several abandoned drums. As a result, the U.S. EPA conducted a Time Critical Removal Action at GDL removing numerous containers (e.g., oils, paint, insecticides, antifreeze, and electrical capacitors) [USEPA 2011b].

In 1995, the Northern Indiana Public Service Company (NIPSCO) installed 14 methane gas collection system vents with the goal of collecting the methane gas. NIPSCO did not complete the project, and the vents remain [IDEM 2000].

In 1997, GDL entered into a Consent Decree and paid $86,000 in fines and put $40,000 in a trust established to fund closure and post closure care activities, groundwater quality assessment, and remediation of contamination and/or the prevention of release of hazardous substances from the site [USEPA 2011b]. No closure or post closure care activities have taken place.

[1] The Indiana State Board of Health was the predecessor to the Indiana Department of Environmental Management.

[2] The Resource Conservation and Recovery Act (RCRA) gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. http://www.epa.gov/regulations/laws/rcra.html

On March 10, 2011, GDL was proposed to the U.S. EPA's National Priorities List (NPL), the list of the most serious uncontrolled or abandoned hazardous waste sites identified for long-term cleanup. According to the Hazard Ranking record, hazardous substances have been found in the 2.83 acre wetland which includes habitats known to be used by numerous state endangered species [EPA 2011b]. GDL ranked for the NPL primarily on the environmental threat posed by migration of contaminated surface water into nearby waterways [EPA 2011b].

Discussion

Wastes Disposed

Over the course of its operation, GDL received a large variety and volume of wastes in solid and liquid form that contained organic and inorganic compounds. During the 1975 to 1977 timeframe, GDL received permission from the state to accept special wastes in specified volumes [USEPA 1983]. Other wastes sent to GDL were listed on hazardous waste manifests from the generators [IDEM 2010]. For example, tank bottom sludges were sent to GDL containing SVOCs such as acenapththene. Paint sludges, possibly containing VOCs such as benzene, were also shipped to GDL as well as fly ash and foundry sand likely containing heavy metals such as arsenic, lead, and cadmium. Table 1 provides a summary of both the special and listed wastes sent to GDL, the estimated quantity shipped, and the possible hazardous substances associated with those wastes.

Environmental Samples and Other Hazards

From the time GDL began operations, the state inspectors identified problems with the type of wastes being accepted. They also recognized GDL's improper disposal resulting from the lack of adequate cover and an operational leachate collection system [ISBH 1976]. Although few samples were collected historically, ISBH reported that water and leachate samples showed "heavy metals and oils" [ISBH 1976 - no data were available]. Since the late 1970s and early 1980s, limited sampling has taken place including sampling for the proposed listing of GDL to U.S. EPA's NPL. Below is a summary of the available data.

Onsite

Soil/Sediment

Samples were collected in May 2009 by IDEM to determine whether GDL should be placed on the NPL. A total of 20 soil/sediment samples were collected at 0-12 inches (") and 12-24" depths on and off-site. Many of the on-site samples were taken in the wetland portion of the landfill nearest to the Grand Calumet River. (Figures 5 & 6, ("QQ" samples are upstream off-site)). Table 2 lists the background concentrations. On-site metals chromium, iron, lead, and zinc were detected above background levels (0-12") (Table 3) Chromium levels are shown in Figure 7. The SVOCs acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzofuran, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene have been detected in soils and sediments (12-24") at levels above the regional concentrations. Table 4 lists the maximum SVOC onsite concentrations and the background comparisons (Sample # E2QS2 can also be seen on Figure 8). Figure 9 is a picture of the landfill and the sampled sediment/soils. Pesticides, including delta-BHC (delta-hexachlorocyclohexane) and polychlorinated biphenyls (PCBs) were also detected (12-24"). On and off-site concentrations are shown in Figures 10 & 11 ("QQ"samples are upstream off-site).

Although the metals and SVOC soil/sediment concentrations are moderate to very high, they will not likely harm people's health because there is no indication that people have been exposed to them onsite (i.e., accidently ingesting).

Groundwater

According to the ISBH reports, observations made in 1976 showed the groundwater table was two feet below ground surface. Samples taken from six monitoring wells in 1976 (Figure 12) found the following chemicals above federal drinking water standards: chromium (in wells 1, 2, 5, 6), lead (in wells 1, 5, 6), cadmium (in wells 1, 2, 3), arsenic (in well 5) and fluoride (in wells 2, 4, 5). Barium, selenium, silver, mercury, iron, and copper were reported to have been detected at levels the drinking water standards. No actual data were available [USEPA 1983].

In 2011, an IDEM geologist reported that it is likely that surface recharge (i.e., precipitation and runoff) due to the lack of an impermeable cap on the landfill and groundwater flow through the landfilled wastes transports the contaminants from the landfill to the adjacent wetlands and to the Grand Calumet River [IDEM 2011]. Because of this hydraulic connection and the size of the landfill, completely stopping leachate from reaching the Grand Calumet River is difficult.

Groundwater ingestion is not a likely route of exposure at this site because people are not using groundwater in the area as drinking water. Contact with the Grand Calumet River and the other local sources are possible dermal and incidental ingestion routes of exposure to contaminated water (see information on Grand Calumet River below).

Landfill Cover

According to reports by ISBH, flyash was used for daily cover although the permit required the cover be restricted to clay. No samples were taken of the flyash; however, it is possible that it contained several heavy metals such as arsenic, cadmium, and lead. During the July 2011 site visit, the landfill was overgrown with brush. If the brush dies back, the ash could become exposed and made more mobile especially on windy days. Additionally, runoff carrying the ash into the wetland areas of the landfill or the Grand Calumet River could further contribute to contamination in sediments and fish.

Methane Vents

There are 14 methane vents throughout the landfill. According to IDEM staff, the venting gasses have set off their portable explosimeters at times. Methane is explosive even at low concentrations in air (5 to 15% methane) [ATSDR 2001]. Although the landfill is mostly inaccessible to vehicles and is difficult to walk around due overgrowth, there were no signs warning trespassers and others of the explosive hazards of the landfill gases. A spark from an engine, cigarette, or another ignition source near the methane vents might cause a fire or explosion.

Offsite

Little data was available for GDL. Many other point and nonpoint pollution sources are within two miles of GDL. Therefore, ATSDR reviewed data and information from nearby pollution sources collected by other agencies and groups to put the GDL contamination into context with the surrounding area and how people could be exposed to other sources of contamination.

Grand Calumet River

The Grand Calumet River, originating in the east end of Gary, Indiana, flows 13 miles through the heavily industrialized cities of Gary, East Chicago and Hammond. Runoff from GDL flows into the Grand Calumet River. The Grand Calumet River and Indiana Harbor and Canal are contaminated with SVOCs, pesticides, and heavy metals such as mercury, cadmium, chromium and lead. Those waterways are also impacted by conventional run-off pollutants (e.g., phosphorus, nitrogen, iron, magnesium, volatile solids, oil and grease). In some areas, the contamination in sediments was found at depths down to 20 feet [EPA 2011c].

Sediment: Surficial sediment samples taken in the Grand Calumet River and Indian Harbor Canal between 1987 and 1999 by the U.S. Army Corps of Engineers, IDEM, and others showed that many of the SVOC concentrations were the same order of magnitude of those found at GDL while the pesticide concentrations were much higher in the river sediments (Table 4) [FWS 2003b].

Fish: Whole fish and fillets (skin on/scales off) samples taken in the river and harbor in the 1980s and 1990s found mercury, pesticides (chlordane, dieldrin, DDD, DDE, DDT), and PCBs. The fillet samples found mercury as high as 27 µg/kg, chlordane, 133 µg/kg, dieldrin, 210µg/kg, DDD, 290µg/kg, DDE, 1,300µg/kg, DDT, 1,500µg/kg, and PCBs, 27,000 µg/kg [FWS 2003b].

The Food and Drug Administration (FDA) set residue tolerance limits of 2,000 µg/kg (2 mg/kg) for PCBs in edible portions of fish [FDA 2011]. The tolerance level is used to decide whether to issue local advisories to consumers recommending limits on consumption of all or certain species of locally harvested fish or to close waters for commercial harvesting of all or certain species of fish [FDA 2011].

The Indiana State Department of Health (ISDH) currently has a full fish consumption advisory for the Grand Calumet River which warns against the consumption of any fish [ISDH 2010]. Although limited, signage along the river reads "Warning Unsafe Waters. You should not swim in or eat fish caught from these waters". Fishing has been restricted, at least in part, in the Grand Calumet River since 1986 [FWS 2003a].

Angler appraisal: Between May and November 2002 and March and July 2003, the U.S. Department of Agriculture (USDA) Forest Service and the Center for Cultural Understanding and Change conducted research on recreational fishing in the industrialized Calumet region of northwest Indiana and southeast Chicago to gage the extent of fishing for consumption and to learn about perceptions of the risks of eating contaminated fish. Below are some of the findings of that research [Westphal et al., 2008].

<u>Angler Fish Consumption</u>

- Of the 97 study participants who provided definitive information about their fish consumption habits, 70% reported ever eating fish from Calumet waters.
- There was a strong tendency – among both fish eaters and noneaters – to give away unwanted caught fish (either surplus fish or species they did not want) to others.
- There were notable differences in fish consumption patterns among the three groups. About 93% of Blacks, 78% of Latinos, and 57% of Whites reported at least *occasionally* fishing for consumption in Calumet; 68% of Blacks, 50% of Latinos, but

only 20% of Whites said that they *usually* fished for consumption.[Participants could choose more than one answer so the percentages do not add up to 100%]

- Anglers talked about sharing fish with friends and family as one of the social aspects of fishing, as part of being a good neighbor, and/or as part of being a good provider. For example, 14 participants had held summer fish fries with family and friends.

<u>Assessing Pollution</u>

- When assessing pollution, anglers relied mainly on their senses, personal experiences, judgment, and/or information from friends, family, and other anglers rather than on written fishing guides, local officials, or the media.
- When considering consumption risks, they focused on four primary factors: the general environment, water quality, fish characteristics, and observable human health.
- Anglers felt that more fish species meant that it was safer to eat fish caught at that location because water quality was good.
- Carp and catfish were mentioned most frequently as species to avoid, but the response to catfish and carp varied across ethnic groups. About half of the black anglers who discussed carp said they did eat carp when they caught them.
- People who chose to eat Calumet fish generally identified bacteria or contamination with other infectious agents as a possible negative consequence of fish consumption but were generally not aware of the threat of bioaccumulated chemicals.

<u>Communication</u>

- Existing advisories and detailed fish consumption risk information are failing to reach Calumet's angling community.
- Black and Latino anglers in this study were much more likely than Whites to be consuming local fish, to be consuming fish species named in advisories (such as catfish and carp), and to be consuming fish from specific water bodies named in advisories.

The paper offered several suggestions for disseminating risk information to diverse urban populations such as outreach through new channels, providing information aimed at minimizing risk through selection and preparation techniques, and providing information in accessible formats. For example, new channels could include those outside the fishing-oriented network like church groups and kinship networks. Another idea was to create a "Master Angler" certificate where experienced anglers offer classes including information on fish consumption, avoiding highest risk areas, and better species, size, and preparation choices [Westphal et al., 2008].

Nearby waste sites

GDL is bordered by five other properties that are considered sources of hazardous substances (Figure 3). Many other contaminated areas are near GDL and may also impact the Grand Calumet River. EPA has summarized the contamination in the Area of Concern (AOC) (Figure 13-GDL is approximated here) as follows. [Excepted from USEPA 2011c]

<u>Nonpoint Sources</u>:

- CERCLA Sites – There are 52 sites in the AOC listed in the federal Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Five of these sites are Superfund sites on the National Priorities List (NPL).
- Hazardous Waste Sites under Resource Conservation and Recovery Act (RCRA) – There are 423 hazardous waste sites in the AOC regulated under RCRA, such as landfills or surface impoundments, where hazardous waste is disposed. Twenty-two of these sites are treatment, storage and disposal facilities.
- Underground Storage Tanks (USTs) – There are more than 460 USTs in the AOC. More than 150 leaking tank reports have been filed for the Lake County section of the AOC since mid-1987.
- Industrial Waste Site Runoff – Storm water runoff and leachate from 11 of 38 waste disposal and storage sites in the AOC, located within 0.2 miles of the river, are degrading AOC water quality. Contaminants include oil, heavy metals, arsenic, PCBs, polycyclic aromatic hydrocarbons (PAHs) and lead.
- Atmospheric Deposition – Atmospheric deposition of toxic substances from fossil fuel burning, waste incineration and evaporation enter the AOC through direct contact with water, surface water runoff and leaching of accumulated materials deposited on land. Toxins from this source include dioxins, PCBs, insecticides and heavy metals.
- Urban Runoff – Rain water passing over paved urban areas washes grease, oil and toxic organics such as PCBs and PAHs into AOC surface waters.
- Contaminated Groundwater – Groundwater contaminated with organic compounds, heavy metals and petroleum products contaminates AOC surface waters. U.S. EPA estimates that at least 16.8 million gallons of oil float on top of groundwater beneath the AOC.

<u>Point sources</u>:

- Industrial and Municipal Wastewater Discharges – Three steel manufacturers contribute 90% of industrial point source discharges to the AOC. One chemical manufacturer discharges into the AOC. Permitted discharges include arsenic, cadmium, cyanide, copper, chromium, lead and mercury. Three municipal wastewater treatment works (Gary, Hammond and East Chicago Sanitary Districts) discharge treated domestic and industrial wastewater into the AOC.
- Combined Sewer Overflows (CSOs) – Fifteen CSOs contribute untreated municipal waste, including conventional and toxic pollutants, to the AOC. Annually, CSO outfalls discharge an estimated 11 billion gallons (41.6 billion liters) of raw wastewater into the harbor and river. Approximately 57% of the annual CSO volume is discharged within eight miles of Lake Michigan, resulting in near shore fecal coliform contamination.

Public Health Implications

The most plausible exposures would be the ingestion of sediments (while swimming) or fish from the advisory areas of the Grand Calumet River due to the ease of access to and high levels of contamination. The PCB contaminant levels in fish tested (i.e., carp, catfish, goldfish, pumpkinseed, white sucker, and sunfish) could be moderately (less than 2 mg/kg to significantly high (at least 27 mg/kg, 27,000 μg/kg) depending on the location, type of fish, and portion consumed. Surficial sediment PCB levels (total) were as high as 4,000 mg/kg (4,170,731 µg/kg) and individual SVOC levels were more than 25,000 mg/kg (25,000,000 µg/kg) [FWS 2003b]. Although there is a full fish consumption advisory for the Grand Calumet River, one study indicated that people are not following the advisory [Westphal et al., 2008].

Non-cancer health effects

Studies of non-cancer health effects of exposure to PCBs and PCB-like compounds have shown variable conclusions. Evaluation of the health effects of PCB mixtures is complicated by their congeneric composition since ultimately the toxicity of the mixture is due to the toxicity of the individual congeners, their interactions, and the interactions with other structurally related chemicals such as chlorinated dibenzofurans and dioxins. Additionally, commercial PCBs have been reported to have lot-to-lot differences in the congener distribution which could contribute to some variations in toxicity observed among studies.

Recent studies have shown an association between PCB exposure and developmental (i.e., enamel defects on teeth) and endocrine (i.e., thyroid and diabetes) effects. The following are findings from some recent studies.

A study of 432 Slovenian children 8–9 years of age evaluated for long-term exposure to PCBs showed a relationship between PCB exposure and developmental enamel defects of permanent teeth in children [Jan et al. 2007].

Another study examined 118 pregnant women age 25–34 years of age for the association between transplacental exposure to dioxins/PCBs and thyroid and growth hormones in newborns. The findings showed that utero exposure to (non-ortho) PCBs may alter the free T_4 (FT_4) feedback to the hypothalamus and differences in compositions and levels of exposure to PCBs might result in different health effects [Wang et al. 2005].

Studies of diabetes have shown some associations with PCB exposure. Serum from 196 men (median age 60 years) and 184 women (median age 64 years) was measured for PCB 153 concentrations in Swedish fishermen and their wives. Elevated PCB-153 serum concentrations were significantly associated with diabetes mellitus type 2 prevalence even after adjustment for confounding variables [Rylander et al. 2005]. Similarly, others have reported associations between incidences of type 2 diabetes mellitus and exposure to PCBs [Vasiliu et al. 2006; Chen et al. 2008; Codru et al. 2007; and Wang et al. 2005].

Cancer health effects

Information on cancer health effects of PCBs is available primarily from animal studies. In rat studies, rats that ate commercial PCB mixtures (i.e., very high PCB levels) throughout their lives developed liver cancer [ATSDR 2000]. The findings of human studies, however, are not as obvious. Many of the human studies involve worker populations. Worker studies of people who worked with PCBs showed evidence that PCB exposure may be associated with certain types of cancer in humans, such as cancer of the liver and biliary tract [ATSDR 2000].

Based on the evidence for cancer in animals, the Department of Health and Human Services (DHHS) has stated that PCBs may reasonably be anticipated to be carcinogens. Both EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans (inadequate human data, sufficient animal studies) [ATSDR 2000].

The Cancer Risk Evaluation Guide (CREG) for PCBs is 0.4 mg/kg (400 µg/kg). CREG values are used by ATSDR to screen sampling data to determine whether additional evaluation is needed. CREGs are estimated contaminant concentrations that would be expected to cause no more than one theoretical excess cancer case in a million (10^{-6}) in persons similarly exposed during their lifetime (70 years). The highest fish tissue sample from the Grand Calumet River/Indiana Harbor Canal showed a PCB (total) concentration of 27 mg/kg (27,000 µg/kg) [FWS 2003b] which is more than 67 times higher than the screening level.

Summary

Figure 14 shows the range of concentrations detected in fish above 2 mg/kg (2000 µg/kg) by year and type of fish. A large number of the fish sampled from the Grand Calumet River had elevated PCB levels. The results of an angler study conducted from 2002-2003 indicates that people are not following the fish consumption advisory in the Grand Calumet River. People, including children who eat fish from these areas over many years are at greater risk for developmental (i.e., enamel defects on permanent teeth) and endocrine (i.e., thyroid and diabetes) effects as well as an increased risk of developing cancer from this PCB exposure.

Community Concerns

In late July 2011, the EPA community involvement coordinator met with the City of Gary and others to determine if there were community health concerns. EPA reported that there were none specific to the Gary Development Landfill. A 60-day comment period began when the site was proposed to the NPL on March 10, 2011 and closed on May 9, 2011. No comments were received.

Future Uses of GDL

Although the complete remediation of GDL may not be possible – especially given the numerous other contamination sources surrounding GDL – contaminant control and exposure prevention are possible. The City of Gary and others have expressed interest in using portions of GDL. GDL is in an industrial part of Gary and easily accessible via major roadways. It is also adjacent to the Gary Airport. After many of the steel mills closed, Gary has been trying to reinvent itself, but the local economy has struggled due to the manufacturing decline resulting in high unemployment and poverty [NRS 2009]. Expanding the airport is one investment opportunity the city is considering to generate income and jobs.

Additionally, many residents, agencies, and organizations recognize Calumet's ecological importance and value its remaining natural areas. The Calumet Initiative, for example, is a coalition of educational, government, nonprofit, cultural, business, and philanthropic organizations that has been working for almost 10 years on projects and partnerships to revitalize the region's economy and environment. More information on the initiative is available from http://www.cooperativeconservation.org/viewproject.asp?pid=761

The Grand Calumet River restoration is also part of the Marquette Plan which provides a large-scale vision for connecting, attracting investment to, and providing public access to the beaches

and natural areas. More information is available from
http://www.csu.edu/cerc/documents/RestorationSitesNWIndianaMap.pdf

Although the City of Gary and others may be interested in using portions of GDL, liability issues (e.g., cleanup or management of buried wastes and leachate) have limited any actions. Some of the suggested uses have included the following:

- Additional parking for the Gary Airport
- A rental car facility for the airport
- A commuter railroad station
- A city composting facility
- A wildlife preserve

This report does not evaluate the health implications of future use options; ATSDR could provide a review if GDL uses or other conditions change.

Conclusions

1. A 2002 and 2003 angler assessment concluded that the existing advisories and detailed fish consumption risk information was failing to reach Calumet's angling community. Therefore, ATSDR concludes that people using the Grand Calumet River for recreational purposes may be exposed to contaminants in fish, sediments, and water. Regularly eating fish from areas where there is an advisory over many years could harm people's health. The elevated levels of semi-volatile organic compounds (SVOCs), including polychlorinated biphenyls (PCBs), in the fish represent a public health hazard.

2. ATSDR concludes that infrequently eating small amounts contaminated sediments from dirty hands or ingesting sediments or water while swimming is not expected to result in illness over the short term. "Worst-case" (i.e., over a year or more) exposures to PCBs and other SVOCs in sediments are unlikely and therefore would not harm people's health.

3. Although Gary Development Landfill is mostly inaccessible to vehicles and it is difficult to walk around due overgrowth, there were no signs warning of the hazards present on the landfill. ATSDR concludes that active methane vents on the landfill pose a fire or explosion hazard for trespassers and other visitors to GDL and thus harm people's health.

4. ATSDR concludes that contaminants in soils, (wetland) sediments, and leachate on GDL are sufficiently high to harm people's health but currently there are no exposures.

Recommendations

1. The Indiana State Department of Health (ISDH) and local governments and organizations should provide continuous community notification and education on the hazards of eating fish from the Grand Calumet River. This should include posting more signage along the river. Additional angler outreach should also be implemented like those suggested in the 2002 and 2003 angler assessment. Outreach should using new information channels,

providing information aimed at minimizing risk through fish selection and preparation techniques, and providing information in accessible formats. The angler assessment suggested that new channels could include those outside the fishing-oriented network like church groups and kinship networks. Another idea was to create a "Master Angler" certificate where experienced anglers offer classes including information on fish consumption, avoiding highest risk areas, and better species, size, and preparation choices.

2. ATSDR recommends that EPA further restrict access to the surface contamination on GDL by posting signs indicating the hazards present on the landfill (particularly the fire and explosion hazard) and implementing institutional controls on digging unless special standards and procedures (e.g., a hazardous waste/explosion safety plan) are followed by utility workers, sampling contractors, and others. More sampling is needed to delineate the areas with surface contamination.

3. If use of the GDL site changes, ATSDR recommends additional environmental samples be collected to help determine the nature and extent of on-site contamination and that a re-evaluation of public health impact of exposure be conducted.

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Figures

Figure 1. Site Location Gary Development Landfill, Gary, Indiana

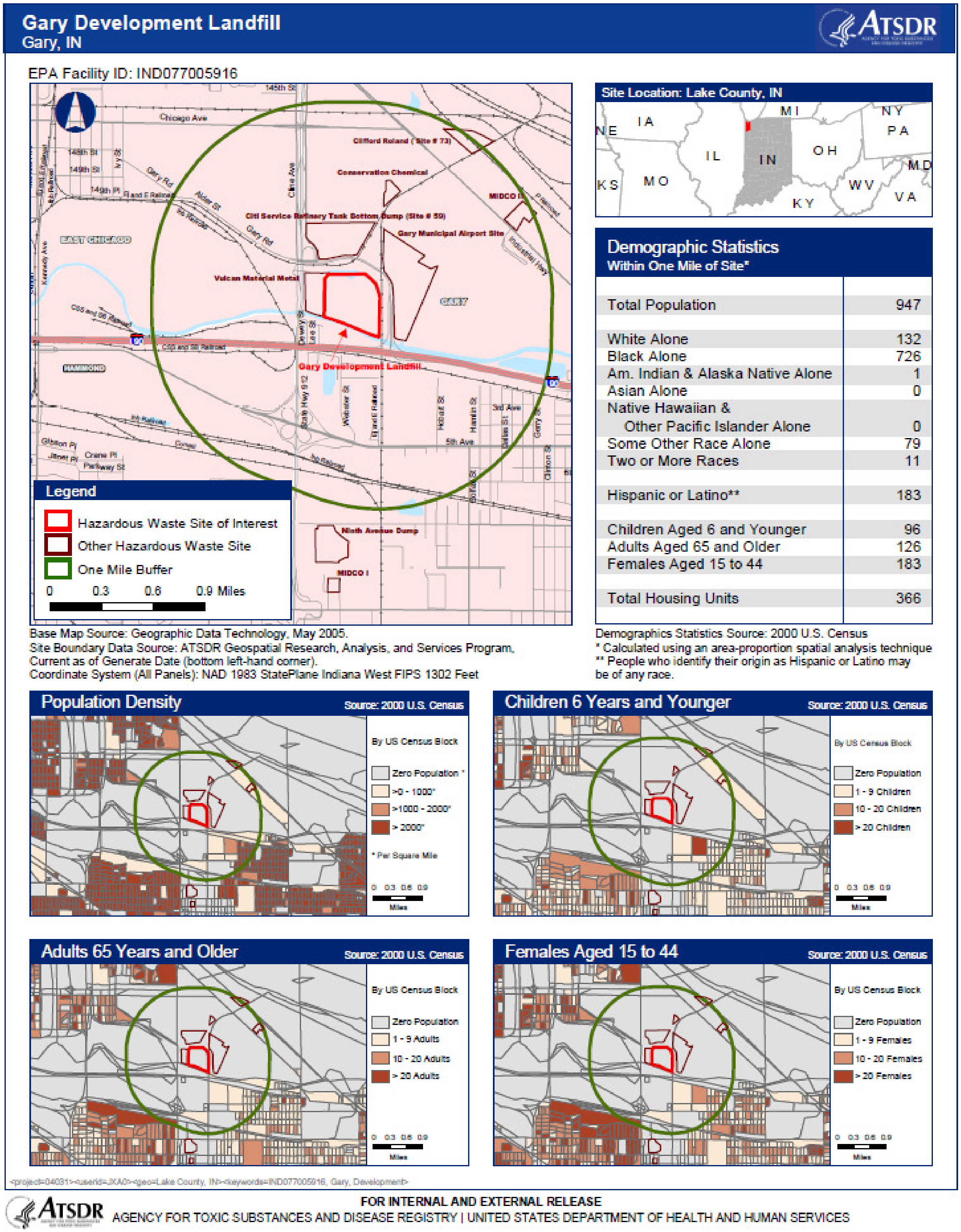
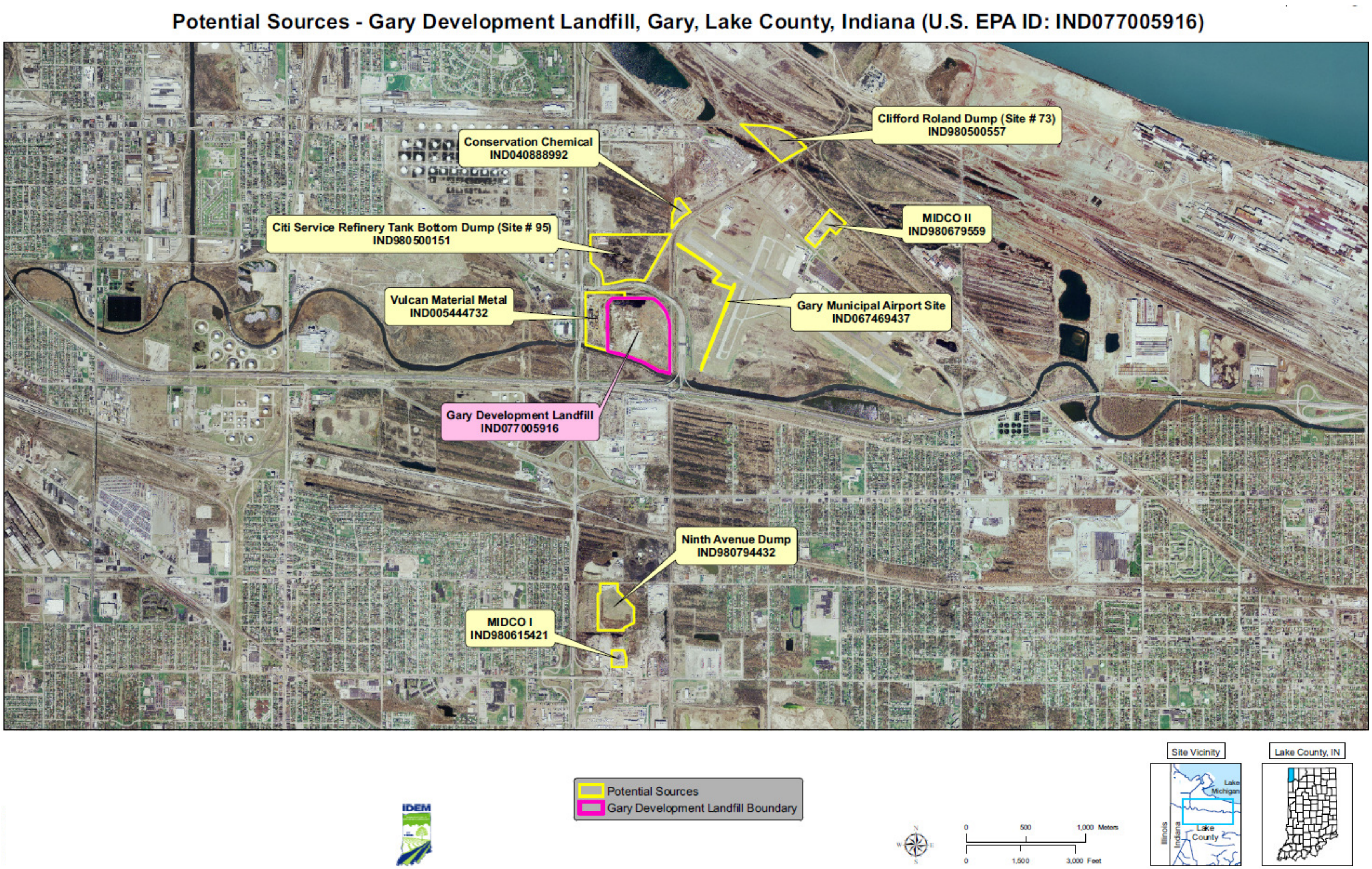


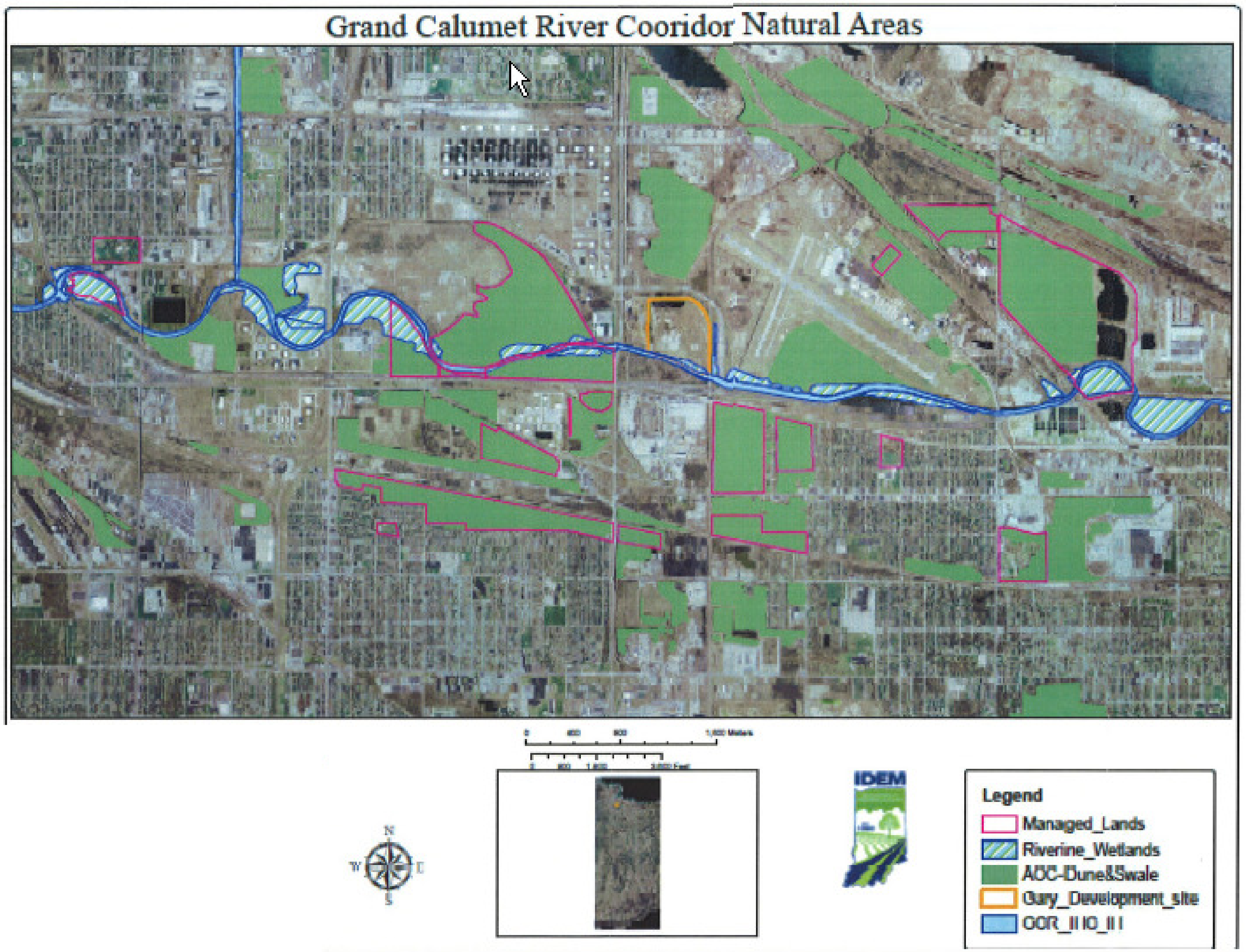
Figure 2: Images of landfill cover, drainage area, outbuilding, methane vent, and Grand Calumet River from site visit July 2011

Figure 3: Potential Hazardous Waste Source Areas Near Gary Development Landfill



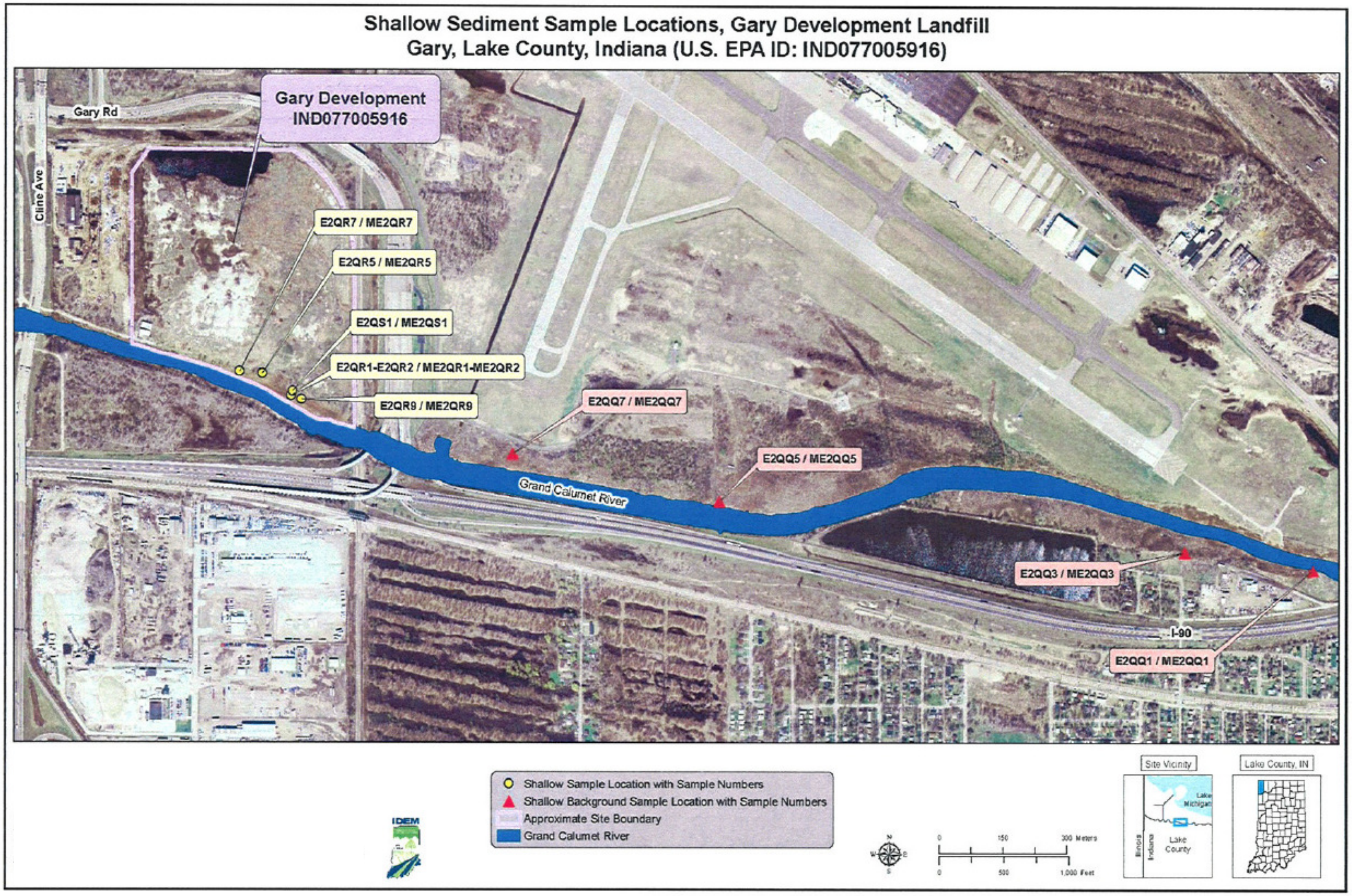
[USEPA 2011b]

Figure 4: Natural Areas near Gary Development Landfill



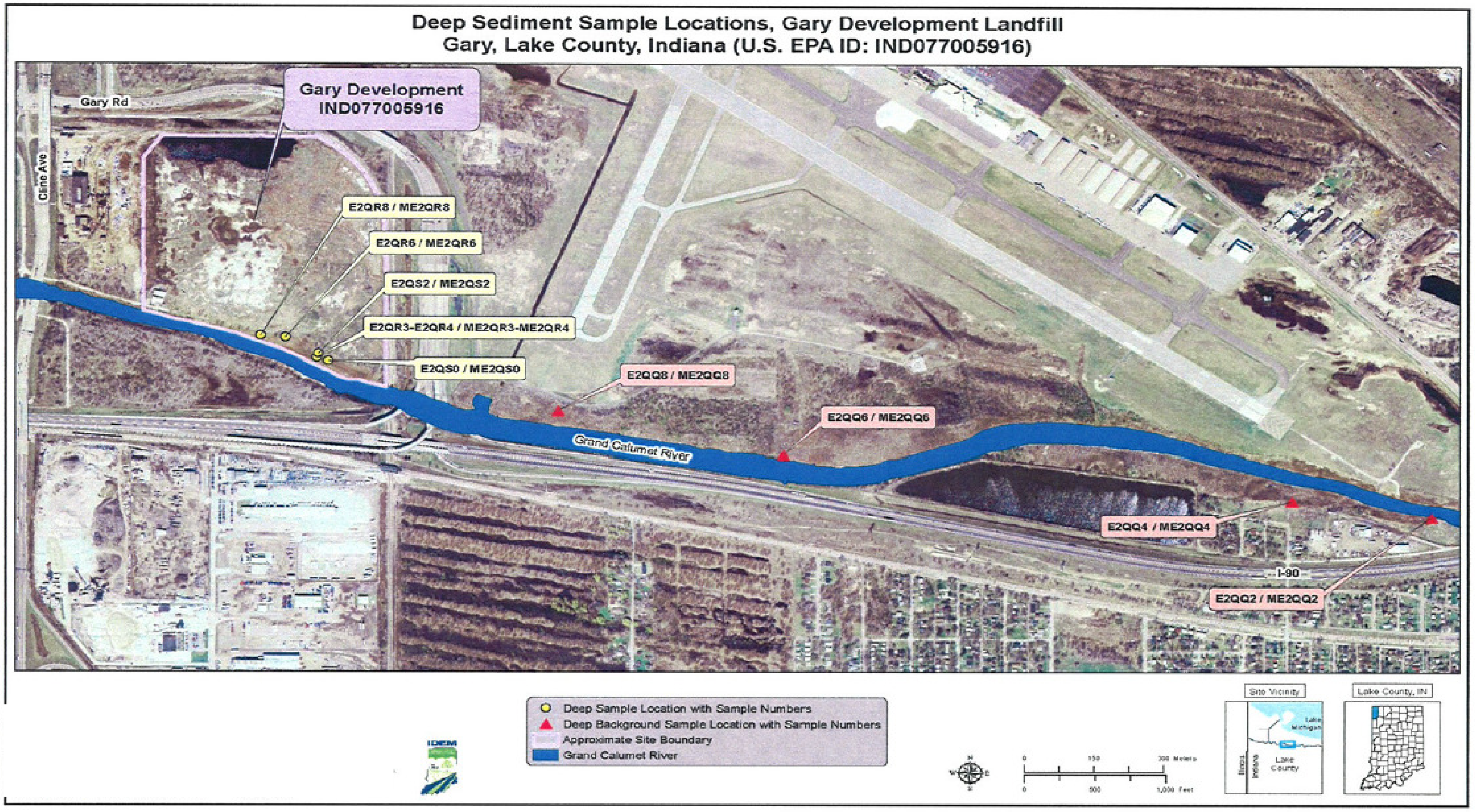
[IDEM 2009] -

Figure 5. Sample Locations for IDEM 2009 Shallow Sediment Samples



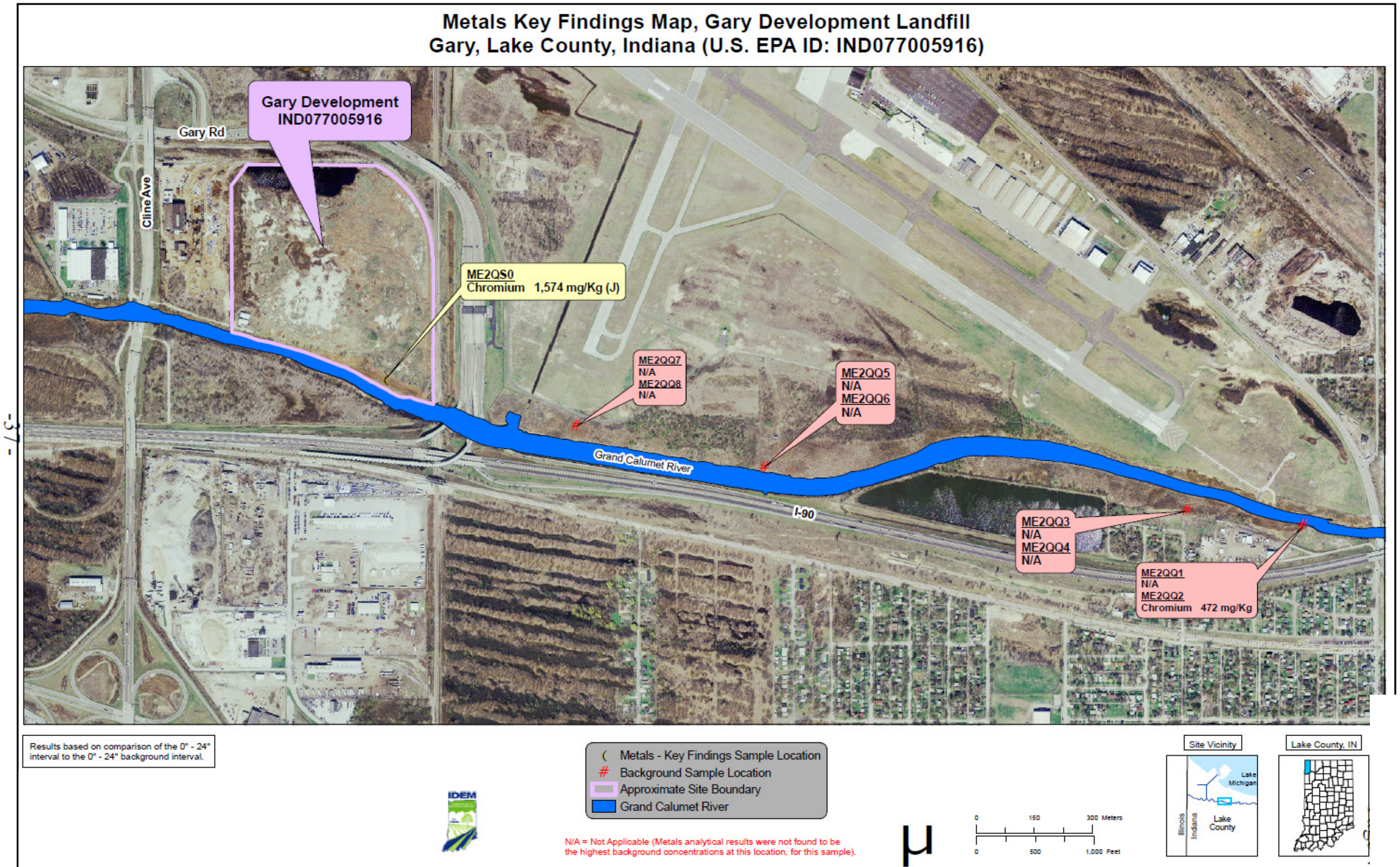
[IDEM 2009] -

Figure 6. Sample Locations for IDEM 2009 Deep Sediment Samples



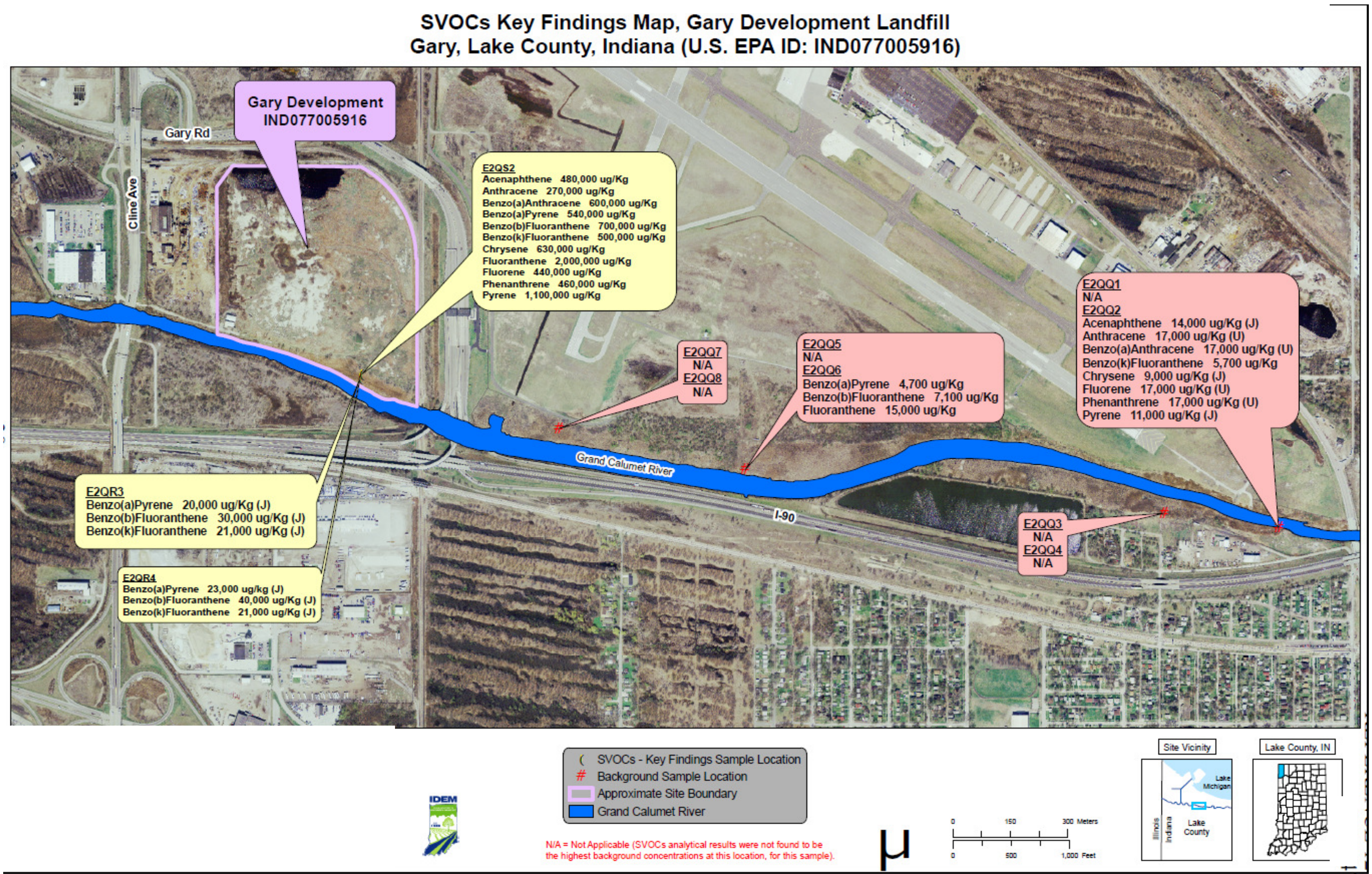
[IDEM 2009] -

Figure 7: Chromium detected near Gary Development Landfill



[IDEM 2009]

Figure 8: Semi-volatile organic compounds (SVOCs) near Gary Development Landfill

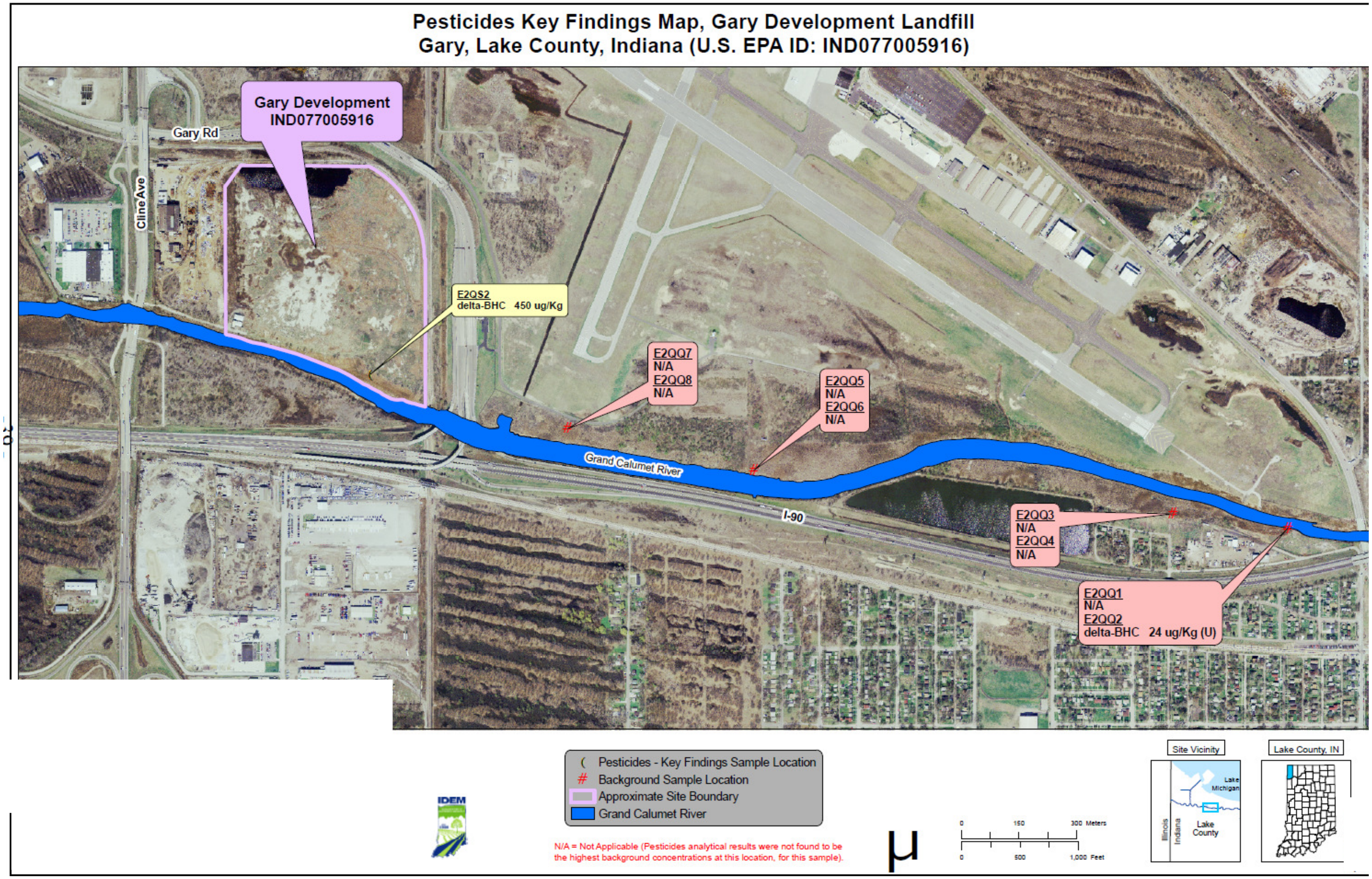


[IDEM 2009]

Figure 9: Picture of sample locations E2QR9 and ME2R9 **[IDEM 2009]**

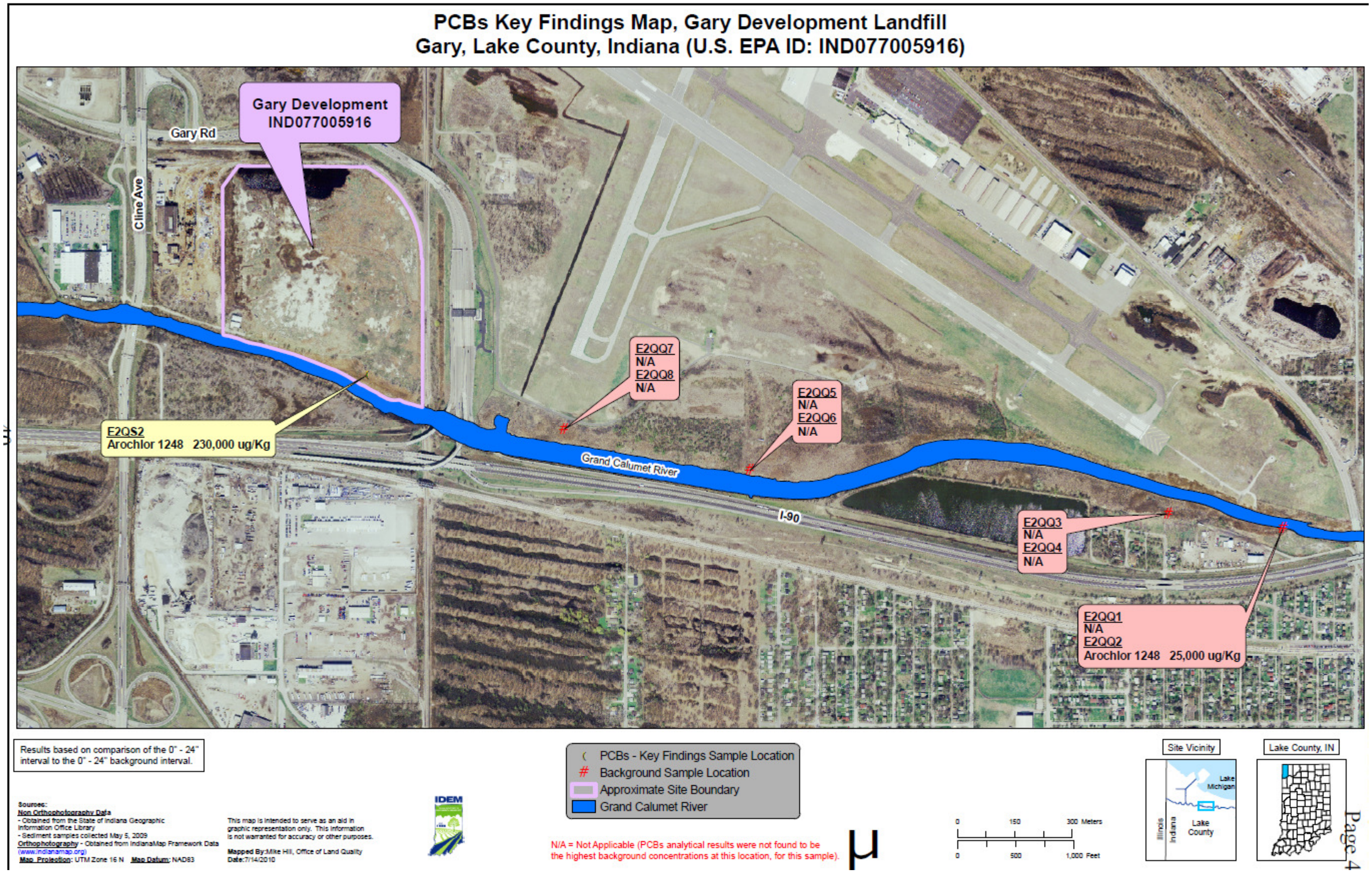
DATE: 5/5/09 **TIME:** 4:21 PM
EPA SAMPLE ID: E2QS2 & ME2QS2
IDEM SAMPLE ID: SDJ2
COMMENTS: Picture shows the area where sample E2QR9 and ME2R9 were obtained

Figure 10: Pesticides detected near Gary Development Landfill



[IDEM 2009]

Figure 11: Polychlorinated Biphenyls (PCBs) detected near Gary Development Landfill



[IDEM 2009]

[USEPA 1983]

Figure 12: Monitoring well locations at Gary Development Landfill in 1976

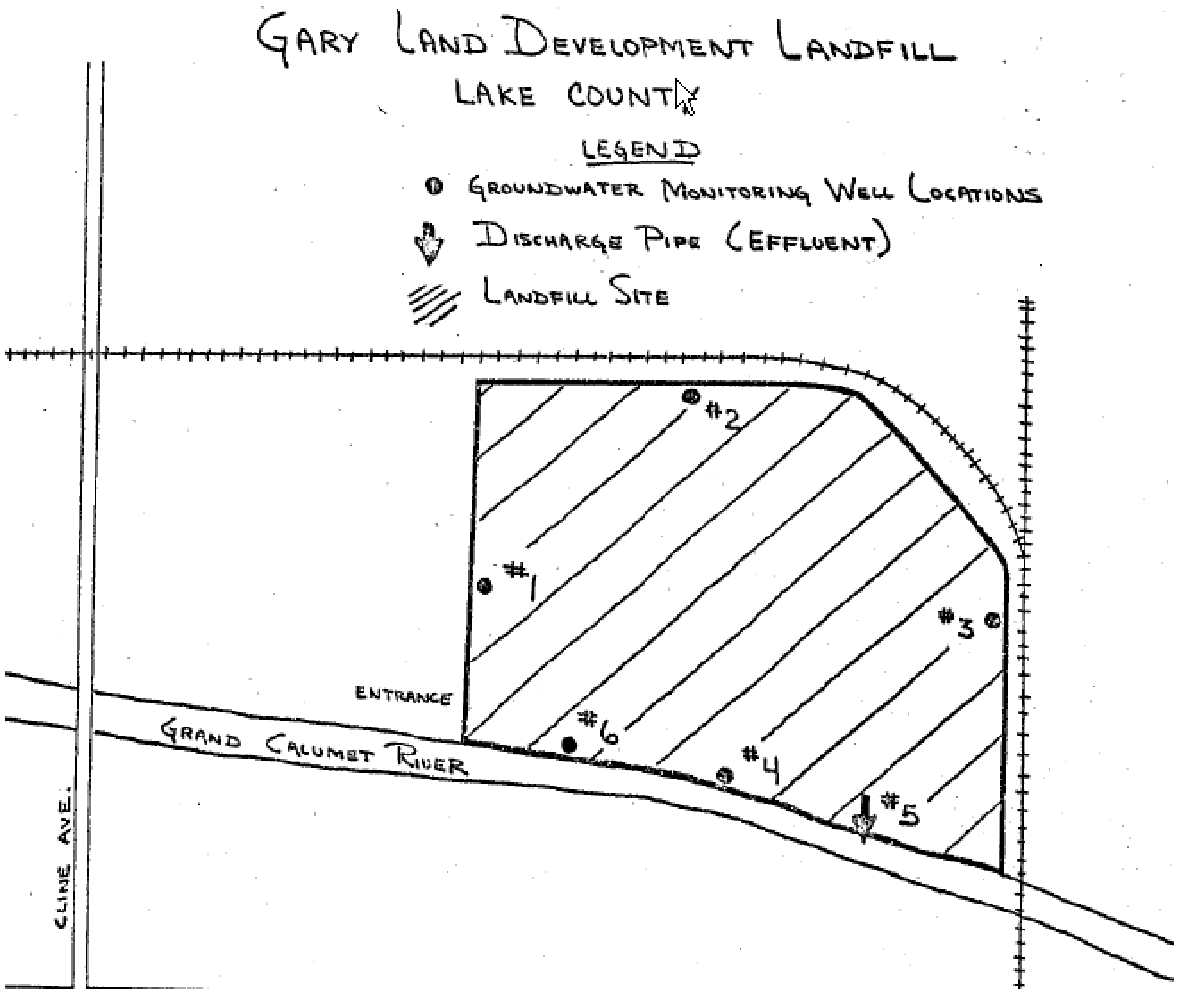
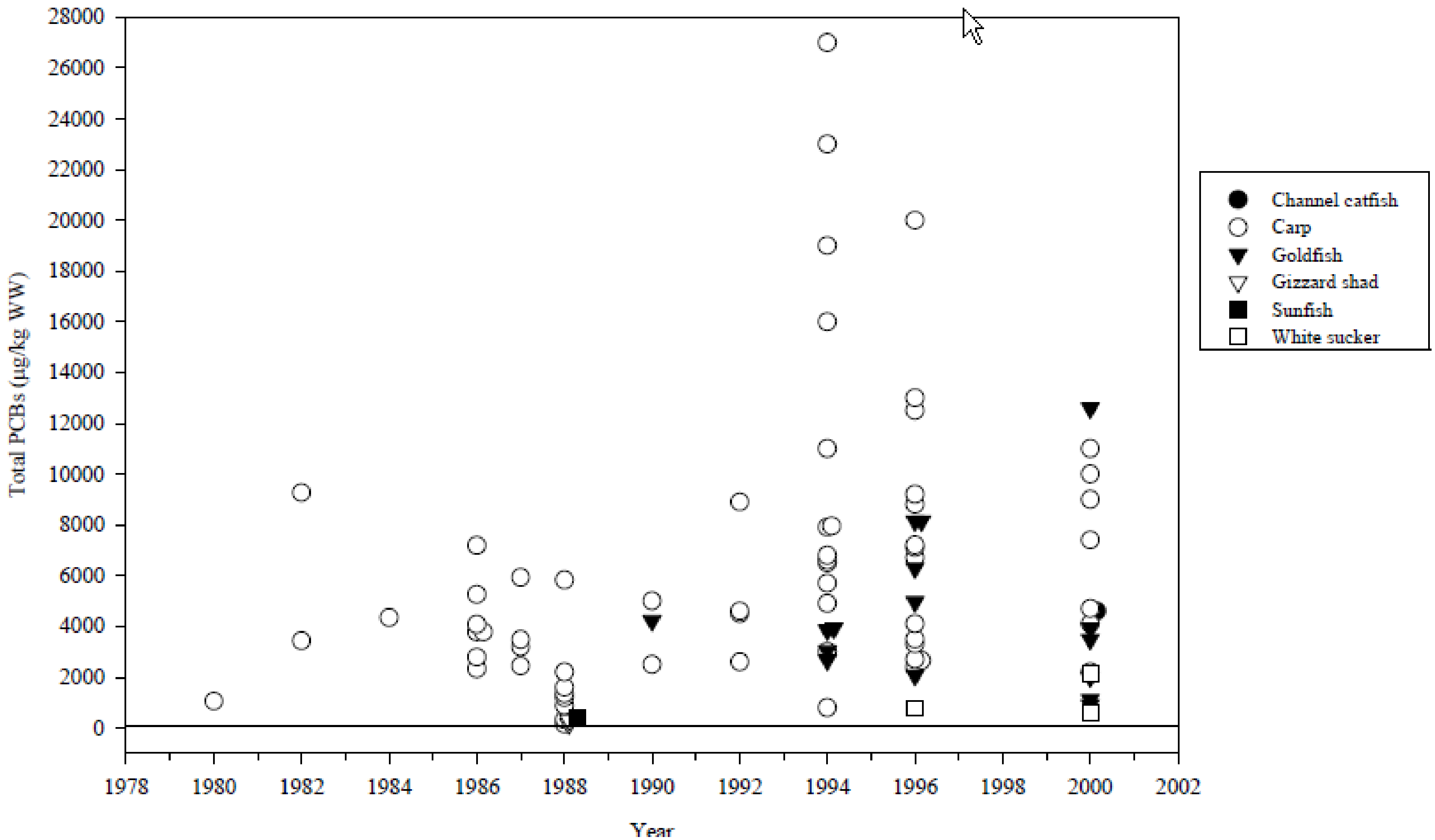


Figure 13: EPA Grand Calumet River Areas of Concern (AOC)

[USEPA 2011c]

Figure 14: Summary of PCBs in (edible) fish tissue from the Grand Calumet River and Indiana Harbor Canal



[FWS 2003b]

Tables

Table 1: Possible Hazardous Substances Associated with Waste Accepted at Gary Development Landfill

Adapted from [USEPA 1983, USEPA 2011, IDEM 2010]			
Waste	**Year**	**Quantity**	**Possible Hazardous Substances Associated with Waste**
Activated biological sludge	1977	Unspecified	Ammonia, phosphorus, sodium thiocyanate, and phenol
Aluminum Dross	1979	300 tons per day till 1980	Aluminum
American Petroleum Institute (API) separator bottoms	1977	200 cubic yards per year	Acenaphthene, Anthracene, Benzo(a)Anthracene Benzene, Benzo(a)Pyrene, bis(2-Ethylhexyl)phthalate, Chrysene, Di-n-butyl phthalate, Ethylbenzene, Fluorene, Naphthalene, Phenanthrene, Phenol, Pyrene, Toluene, Xylenes, Cyanides (Total), Chromium (Total), Lead, and Nickel
Asbestos Wastes	1980	Various one day and multi week approvals (50 to 700 cubic yard one time approvals, 40 cubic yards /week, etc)	Various Asbestos varieties (e.g., chrysotile, crocidolite, amosite, etc.)
Calcium Carbonate	1976	30 cubic yards per day	Calcium carbonate
Calcium sulfate	1977	1.5 tons/day	
Corn Syrup (Solid) Carbon Filters from Corn Syrup Filtering	1976	Unspecified	No known
Decanter Tank Tar Sludge (EPA Waste	1982	312,000 gallons	Benzene, Methyl Ethyl Ketone, Toluene, Xylenes, Acenaphthylene, Anthracene, Benzo(a)Anthracene, Benzenethiol, Benzo(b)Fluoranthene, Benzo(k)Fluoranthene, Benzo(a)Pyrene, Chrysene, Para-Cresol, Fluoranthene, Fluorene, Indeno(1,2,3-cd)Pyrene,

Adapted from [USEPA 1983, USEPA 2011, IDEM 2010]			
Waste	**Year**	**Quantity**	**Possible Hazardous Substances Associated with Waste**
Code K087)			Naphthalene, Phenanthrene, Phenol, Pyrene, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc, Cyanide, Fluoride, Sulfide, Styrene, Dibenzofuran, and 2-Methylnaphthalene
Dripolene[3]	1975	4 to 5 truckloads per day for 6 months	VOCs such as benzene and styrene and SVOCs such as dicyclopentadiene, pentene, 1,3 butadiene, etc (http://www.westlake.com/_filelib/FileCabinet/MSDS_-_ALL/Vinyls/Vinyls_-_Calvert_City/MSDS_AROMATIC_GAS_2_.pdf?FileName=MSDS_AROMATIC_GAS_2_.pdf)
Filter Cake & Kiln Scrubber Mud	1977	1,500 pounds per week & 3,000 pounds per week (temporary)	
Foundry Sand	1986	Unknown	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver, Copper, Iron, Manganese, Nickel, Sodium, and Zinc
Fly Ash	1980	95,000 cubic yards	Mercury, Arsenic, Boron, Cadmium, Lead, Selenium, Cobalt, Aluminum, Barium, Molybdenum, Antimony, Thallium, and Chromium
Gypsum wastes	1976	Unspecified	Gypsum
Herbicide	1977	120 cubic yards	2,4-D, 2,4-DB, 2,4,5-TP(Silvex), 2,4,5-T, Dalapon, Dicamba, Dichloroprop, Dinoseb, etc
Lead Battery Casings	1982	60 cubic yards	Lead
Lime slurry, sludges, and wastes	1976 1977	Up to 5,000 gallons/week 80,000	Lime

[3] A pyrolysis fuel oil-water emulsion liquid http://www.dtsc.ca.gov/SiteCleanup/Projects/upload/UnionCarbide_CEQA_dNegDec.pdf

Adapted from [USEPA 1983, USEPA 2011, IDEM 2010]			
Waste	**Year**	**Quantity**	**Possible Hazardous Substances Associated with Waste**
		gallons month (no more than 4,000 gallons day)	
Neutralized sludges	1975	Temporary approval	Unknown
Oil Sludge	1977	Unspecified	Various SVOCs as noted for API separator bottoms
Paint sludges	1976	25 cubic yards per day (99,000 gallons)	Lead, Chromium, Cadmium, Barium, Toluene, Methyl Ethyl Ketone
Water and Vegetable Oil	1978	4,000	No known
EPA Waste Code F001			Tetrachloroethene, methylene chloride, trichloroethylene, 1,1,1-Trichloroethane, Carbon Tetrachloride, Chlorinated Fluorocarbons
EPA Waste Code F002			Tetrachlorethene, methylene chloride, Trichlorethylene, 1,1,1- Trichloroethane, Chlorobenzene, 1,1,2-Trichloro-1,22-Trifluoroethane, Ortho-Dichlorobenzene, Trichlorofluormethane, and 1,1,2-Trichloroethane
EPA Waste Code F005			Toluene, methyl ethylketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane
EPA Waste Code U147			2,5 Furandione
EPA Waste CodeU031			1-Butanol
EPA Waste Code U112			Acetic Acid Ethyl Ester
EPA Waste Code U154			Methanol
EPA Waste Code D001			Characteristic of ignitable
EPA Waste Codes for Phenolic Waste			Phenolic wastes
EPA Waste Code K086 (Caustic Sludge and paint washings)			Acetone, Acetophenone, Bis(2-Ethylhexl) phthalate, etc.

Table 2: Background Concentration Table

(showing highest analyte concentration detected and the 3x background concentration value)						
CLP ID#	**IDEM ID#**	**Analyte**	**Concentration**	**Qualifier**	**Adjusted Value**	**3x Background Concentration**
METALS						
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Chromium (Total)	472 mg/kg			1,416mg/kg
E2QQ1/ME2QQ1	SDA1 (0-12 in)	Chromium (Total)	185 mg/kg			555 mg/kg
E2QQ1/ME2QQ1	SDA1 (0-12 in)	Zinc	1,020 mg/kg			3,060 mg/kg
E2QQ7/ME2QQ7	SDD1 (0-12 in)	Lead	362 mg/kg			1,086 mg/kg
PCBs						
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Arochlor 1248	25,000 ug/kg			75,000 ug/kg
PESTICIDES						
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	delta-BHC	24 ug/kg	U		72 ug/kg
E2QQ1/ME2QQ1	SDA1 (0-12 in)	beta-BHC	11 ug/kg			33 ug/kg
E2QQ1/ME2QQ1	SDA1 (0-12 in)	Endosulfan	11 ug/kg			33 ug/kg
SVOCs						
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Acentaphthene	14,000 ug/kg	J	17,000 ug/kg*	51,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Anthracene	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Benzo(a)anthracene	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDC2 (12-24 in)	Benzo(a)pyrene	4,700 ug/kg			14,100 ug/kg
(E2QQ2\ME2QQ2)	SDC2 (12-24 in)	Benzo(b)fluoranthene	7,100 ug/kg			21,300 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Benzo(ghi)perylene	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDC2 (12-24 in)	Benzo(k)fluoranthene	9,000 ug/kg			27,100 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Chrysene	17,000 ug/kg	J	17,000 ug/kg*	51,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Dibenzofuran	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDC2 (12-24 in)	Fluoranthene	15,000 ug/kg			45,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Fluorene	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Indeno(1,2,3-cd)pyrene	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Phenanthrene	17,000 ug/kg	U		51,000 ug/kg
(E2QQ2\ME2QQ2)	SDA2 (12-24 in)	Pyrene	11,000 ug/kg	J	17,000 ug/kg*	51,000 ug/kg
(E2QQ1\ME2QQ1)	SDA1 (0-12 in)	Fluoranthene	1,700 ug/kg	J	5,300 ug/kg*²	15,900 ug/kg
(E2QQ1\ME2QQ1)	SDA1 (0-12 in)	Pyrene	3,300 ug/kg	J	5,300 ug/kg*²	15,900 ug/kg

*E2QS2 Acenaphthene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to document an Observed Release and Observed Contamination*, November 1996.

*E2QS2 Chrysene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to document an Observed Release and Observed Contamination*, November 1996.

*E2QS2 Pyrene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to document an Observed Release and Observed Contamination*, November 1996.

*²E2QQ1 Fluoranthene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to document an Observed Release and Observed Contamination*, November 1996.

*²E2QQ1 Pyrene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to document an Observed Release and Observed Contamination*, November 1996.

Table 3: Key Metal Sediment Findings and Background Comparisons at Gary Development Landfill

Sample ID	Sample Type	Date	Hazardous Substance	Hazardous Substance Concentration (Adjusted Concentration)	Dilution Factor	Background Concentrations* (Adjusted Concentrations)
ME2QR3	Sediment	5/5/09	Chromium Iron	1,580 mg/Kg (J) (1,225 mg/Kg)* 262,000 mg/Kg	1x	185 mg/Kg 79,000 mg/Kg
ME2QR9	Sediment	5/5/09	Chromium Iron Lead Zinc	1,720 mg/Kg (J) 1,333 mg/Kg)* 242,000 mg/Kg 1,740 mg/Kg 6,340 mg/Kg	1x	185 mg/Kg 79,000 mg/Kg 362 mg/Kg 1,020 mg/Kg
ME2QS0	Sediment	5/5/09	Chromium	2,030 mg/Kg (J) (1,574 mg/Kg)*	1x	472 mg/Kg (J) (472 mg/Kg)*

The background concentration used for Potassium in samples ME2QR1, ME2QR3, ME2QR9, ME2QS1 were derived from background sample ME2QQ1. The background concentration used for Potassium in samplesME2QR2, and ME2QR4 were derived from background sample ME2QQ8. The background concentration used for Chromium in samples ME2QR3, and ME2QR9 was derived from background sample ME2QQ1. The background concentration used for Chromium in sample ME2QS0 was derived from background sample ME2QQ2. The background concentration used for Iron in samples ME2QR9 were derived from background sample ME2QQ1. The background concentration used for Magnesium in samples ME2QR5 and ME2QR7 were derived from background sample ME2QQ1. The background concentration used for Lead in sample ME2QR9 was derived from background sample ME2QQ7. The background concentration used for Zinc in sample ME2QR9 was derived from background sample ME2QQ1.

(J) The concentration is estimated.

- ME2QR3 Chromium Result Biased High and adjusted using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination,* November 1996.
- ME2QR9 Chromium Result Biased High and adjusted using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.
- ME2QS0 Chromium Background Concentration was not adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.
- ME2QS0 Chromium Result Biased High and adjusted using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination,* November 1996.

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Table 4. Maximum Sediment SVOC Concentration Onsite and Background Comparison

Sample ID	Sample Type	Date	Hazardous Substance	Hazardous Substance concentration (Adjusted Concentration)	Dilution Factor	Background Concentration* (Adjusted Concentration)
E2QS2	Sediment	5/5/09	Acenaphthene	480,000 ug/Kg	20X	14,000ug/Kg(J) (17,000ug/Kg) *
			Anthracene	270,000 ug/Kg		17,000 ug/Kg
			Benzo(a)Anthracene	600,000 ug/Kg		17,000 ug/Kg
			Benzo(a)Pyrene	540,000 ug/Kg		4,700 ug/Kg
			Benzo(b)Fluoranthene	700,000 ug/Kg		7,100 ug/Kg
			Benzo(g,h,i)Perylene	130,000 ug/Kg (J) (130,000 ug/Kg)*		17,000 ug/Kg
			Benzo(k)Fluoranthene	5,000,000 ug/Kg		5,700 ug/Kg
			Chrysene	630,000 ug/Kg		9,000 ug/Kg (J) (17,000 ug/Kg)*
			Dibenzofuran	220,000 ug/Kg (J) (220,000 ug/Kg)*		17,000 ug/Kg
			Fluoranthene	2,000,000 ug/Kg		15,000 ug/Kg
			Fluorene	440,000 ug/Kg		17,000 ug/Kg
			Indeno (1,2,3-cd)Pyrene	160,000 ug/Kg(J) (160,000ug/Kg)*		17,000 ug/Kg
			Phenanthrene	460,000 ug/Kg		17,000 ug/kg
			Pyrene	1,100,000 ug/Kg		11,000 ug/Kg (J) (17,000ug/Kg)*

*Background concentrations used in sample E2QR3 were derived from background sample E2QQ1. Background concentrations used in sample E2QS2 were derived from background sample E2QQ2 except for Benzo(a)Pyrene, Benzo(b)Fluoranthene, Benzo(k)Fluoranthene, and Fluoranthene that were derived from background sample E2QQ6.

(J) The concentration is estimated.

- E2QS2 Acenaphthene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.
- E2QS2 Chrysene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.
- E2QS2 Pyrene Background Concentration was adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination,* November 1996.
- E2QS2 Benzo(g,h,i)Perylene Concentration was not adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.
- E2QS2 Dibenzofuran Concentration was not adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.
- E2QS2 Indeno(1,2,3-cd)Pyrene Concentration was not adjusted when using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996.

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Table 5. Surficial Sediment Samples in the Grand Calumet River/Indiana Harbor Canal (µg/kg)

Compound	Arithmetic Mean	Minimum	Maximum
Benzene	2,847	18	7,586,957
Carbazole	71,490	49,107	117,647
Benz[a]anthracene	201,635	1,044	25,782,609
Benzo(a)pyrene	184,425	1154	16,695,653
Benzo(b)fluoranthene	178,273	3,071	15,454,545
Benzo(k)fluoranthene	115,058	2,143	12,260,870
Chrysene	236,773	1,153	25,478,261
Dibenz[a,h]anthracene	36,560	1,286	2,147,059
Indeno(1,2,3-cd)pyrene	118,774	2,944	14,695,652
2,4-Dichlorphenol	20,818	12,500	63,333
Polychlorinated Biphenyls (PCB)			
Arochlor 1242	18,320	57,959	526,316
Arochlor 1248	70,977	733	4,170,732
Arochlor 1254	17,739	117	539,823
Arochlor 1260	61,411	44	4,170,732
Pesticides			
Chlordane	2,100	367	17,083
Dieldrin	1,334	167	17,273
p,p'-DDD	535	53	4,336
p,p'-DDE	3,162	95	455,909
p,p'-DDT	999	12	20,000
Endosulfan,total	1,599	107	16,094
Endrin	169	42	1,597
Heptachlor	2,571	336	36,944
Heptachlor epoxide	1,950	353	25,733
Beta-hexachlorocyclohexane (HCH)	1,364	454	5,833
Lindane (gamma-HCH)	2,327	153	25,417
TCDD –TEQ (tetrchlordibenzo-p-dioxin-toxic equivalents	.47	.000003	6.2

[FWS 2003b]