The World's Worst Polluted Places

The Top Ten

A Project of the Blacksmith Institute

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Tracy Grant, University of Idaho
Jordan Bonomo, researcher
Meredith Block
The Blacksmith Institute Technical Advisory Board
David Hanrahan
Jennifer Spiegler

For questions, comments and feedback, please contact Blacksmith Institute in New York City at the following address:

Blacksmith Institute
2014 Fifth Avenue
New York, NY 10035
(646) 742 0200
info@blacksmithinstitute.org

Media enquires should be directed to Richard Fuller fuller@blacksmithinstitute.org, in New York, or to David Hanrahan dhanrahan@blacksmithinstitute.org in London.

This report is also available online at www.blacksmithinstitute.org

The Unfinished Challenge of Pollution

After decades of effort and attention, industrial pollution is now only an occasional worry for most of the developed world. Although there are a few remaining threats, pollution is generally regarded as a problem that is carefully regulated, managed and watched over by many.

This is not the case in the poorest countries. There, pollution continues to be a major source of death, illness and long-term environmental damage. Across the developing world, pollution kills thousands of people indiscriminately, shortens lives, damages children's development and growth, and creates a background of chronic illnesses that makes strong economic development nearly impossible.

Living in a town with serious pollution is like living under a death sentence. If the damage does not come from immediate poisoning, then cancers, lung infections and mental retardation are likely outcomes. Often insidious and unseen, and usually in places with deficient and exhausted health systems, pollution is an unacknowledged burden of the poor and unvoiced in the developing world. It is a major factor impairing economic growth, and a significant strain on the lives of already impoverished people.

It is worse in some places than others.

Most poor countries have cities or estates where industry is concentrated, usually well away from the capitals. In these places we find soil, air and water contamination not just from active enterprises (many of them antiquated), but also from the legacy of decades of uncontrolled emissions. There are soil and groundwater that have been poisoned, rivers that ooze toxins, and lakes that cannot be approached safely, let alone used for irrigation or drinking. There are some towns where life expectancy approaches medieval rates, where birth defects are the norm not the exception. In other places children's asthma rates are measured above 90 percent, or mental retardation is endemic. In these places, life expectancy may be half that of the richest nations. The great suffering of these communities compounds the tragedy of so few years on earth.

These areas are the most polluted places on earth. The world knows of the incidents at Chernobyl and Bhopal, but these other stories are never heard, never exposed or publicized. Instead, they have developed over time into horrific human disasters.

How did they get like this? For one thing, many developing countries have inadequate pollution controls. Even if sub-standard or antiquated factories were brought to modern requirements, the legacy of old contamination from the past would continue to poison citizens. These failings are compounded by a lack of knowledge at the local level and weakness in the capability of civil society to force justice when governments are negligent.

In Blacksmith's years of trying to help communities and local groups with their own specific problems, more than three hundred "polluted places" in over thirty countries have been nominated for remediation. Local and concerned people put these places forward as problems that need to be addressed urgently.

Which sites are the worst?

Despite the emotional and incomparable suffering of poor communities world wide, this report attempts to objectively expose sites that have the most extreme effects on human health. Despite isolation of the sites and complacency of those responsible, this list recognizes that the challenges of pollution are far from resolved for millions in the developing world.

This report is also intended to indicate that there are potential remedies for these sites. Problems like these have been solved in the developed world, and we have the capacity and the technology to spread our experience to our afflicted neighbors. This report's purpose is to highlight significant problem sites, and show that something can be done to begin to fix them. A discussion of solutions is presented later in this document.

For those who have other sites to recommend to the list, or have other feedback on the process, we welcome your input so that the next version can be more definitive.

This list of top horrors is not exact, but it's a start. More importantly, it's a start to a process that has a definitive and foreseeable end; a world where industrial development is no longer life-threatening.

About Blacksmith Institute

Founded in 1999, Blacksmith Institute is a non-profit organization committed to mitigating the human health effects of industrial wastes, air emissions and hazardous materials in the developing world.

Our strategy brings resources and expertise to local groups and agencies in developing economies in order to solve pollution problems, one community at a time.

For more information see www.Blacksmithinstitute.org

The Scale of the Problem

There are grisly side effects to many of the early advances of industrial society – and often those who do not see the benefits are the ones who suffer the most. The richer countries can afford to enforce high standards of environmental protection (although we continually see that the insidious effects of very low levels of pollution are often worse than expected). However, in many other countries there is not the understanding, the commitment or the resources to apply similar levels of protection.

The problems are often made worse when industrial (or mining or similar) facilities close down, normally because they are no longer making enough money for the owners (who may be private or public but are often hard to track down). Whatever employment opportunities existed – usually meager – are immediately lost, leaving contaminated workers, buildings and surrounding fields as an unwanted legacy. In the worst cases, the operators of noxious facilities have gone to considerable lengths to avoid having to deal with their dung. There are many cases of sludge being trucked away to end up in fields and wetlands, of midnight dumping to sewers and in even of toxic wastewater being pumped down wells in frightening displays of "out-of-sight" management.

The cumulative scale of these problems is immense. Work by WHO and the World Bank has produced estimates that perhaps 20% or more of the premature deaths worldwide are related to environmental factors. Dirty water and polluted air are the two biggest issues and WHO also notes lead (Pb) as one of the major environmental risks.

The real tragedies, however, are often at a local scale, where the contamination can be hundreds of times greater than global standards. In these communities impacts can be immediate and deadly as well as indicating slower poisoning. Examples can be found in all of the Top Ten and in other sites nominated for listing. In every location, legacy pollution levels exceed all local and international standards for toxic substances.

A particular concern in all these cases is the accumulation and long lasting burden to the environment and to the bodies of people most directly affected. Closing a factory or putting treatment on a discharge will stop the immediate cause and prevent further contamination. Despite the immense value these steps add, they do little to deal with what has already been released to the environment.

For this reason, a key focus of Blacksmith's work and a fundamental criterion for identifying the World's Worst, is the nature of the pollutants. The biggest concern is heavy metals, such as lead, chromium and mercury; and long lasting chemicals such as the "Persistent Organic Pollutants" or "POPs'. These are generated and released from a wide range of processes and industries, although there are a number of main "known offenders" and common patterns.

Choosing the Top Ten

The necessary process of prioritizing sites for remediation leads to debates about what makes one problem worse than another.

This Top Ten list was compiled with the inputs of Blacksmith's Technical Advisory Board (TAB) of experts with over 250 years of combined experience in this field and including specialists from Johns Hopkins, Hunter College, Harvard University, IIT India, University of Idaho, Mt. Sinai Hospital, and leaders of major international environmental remediation companies. The Board reviewed a list of 35 sites, developed from the more than 300 that had been nominated from across the continents, collected in the past six years of work by Blacksmith Institute.

The Board adopted a methodical approach to evaluating the 35 sites so as to highlight the locations where human health is most at risk, and where children's lives are especially threatened. Individual rankings from the Board members were collated, and the worst of the sites made the Top Ten list. In the end, it was agreed that identifying these ten was a significant achievement but that it was not realistic to put them into a final order from one to 10, given the wide range of location sizes, populations and other dynamics. Therefore, this report refrains from pointing the finger at just one place as being the worst on earth. Appearing on the final list of ten is bad enough.

The ranking in this report is not definitive and the nominations are almost certainly not comprehensive. Data on such places is hard to come by and Blacksmith Institute staff or Board members have not visited all of the nominated sites. We also acknowledge that the Top Ten list was finalized with a bias towards including point source and legacy issues. There was a consensus to include sites representative of certain types of pollutants, as well as sites that exemplify a common problem across the globe. More specifically, these selected sites illustrate the scope and scale of the problem, but unfortunately, are by no means isolated or unique.

The Selection Process

In order to guide the selection process and the advice of the experts, a methodical approach was adopted. As described in Appendix 3, a simple scoring system was used by all members of the TAB in preparing individual lists of the worst ten. The scoring system takes into account the following selection criteria:

- The size of the affected population
- Severity of the toxin or toxins involved
- Impact of children's health and development
- Evidence of a clear pathway of contamination
- Existing and reliable evidence of health impact

Different factors were accorded different weights, at the suggestion of the Technical Advisory Board. Given the lack of available data (and the difficulty of obtaining more) the experience and expert judgment of the TAB members was essential in estimating scores for each site.   Individual scores for the 35 sites on the were tabulated and this tabulation was then reviewed and discussed by the TAB as a whole, eventually arriving at a consensus on the Top Ten.

The Technical Advisory Board also decided to ensure that sites from all major regions of the developing world were included in the list. Some sites were also chosen because they highlight specific types of pollution that are to be found in many other locations. Air pollution in China, or lead poisoning from battery recycling are good examples.

The list is thus meant to be indicative of a broad range of pollution problems that cause serious harm to the poorest peoples of the world.

The Top Ten - Summary

Our list of the Ten Worst is as follows:

Location	Type	Pollutants	Legacy/ Active	Source	Cleanup Status
Linfen, China	Air, Water	Various Gases and Particulates	Active	Various Industries	Unknown
Haina, Dominican Republic	Soil	Lead	Legacy	Battery Recycling	None
Ranipet, India	Water, Soil	Chemicals	Legacy	Tanning Industry	Planned, but not begun
Mailuu-Suu, Kyrgyzstan	Soil, Water	Radioactive Waste	Legacy	Soviet-era Uranium Plant	Planned, with World Bank support
Dzerzhinsk, Russia	Water and Soil	Chemicals	Legacy, some Active	Soviet-era Chemical Weapons Production and others	Planning only
Norilsk, Russia	Air, Soil, Water	Sulfur Dioxide, Strontium-90, Caesium-137, Others	Active	Platinum Production, Other mills	Unknown
Rudnaya Pristan, Russia	Soil	Lead	Legacy and Active	Lead Mining	None
Chernobyl, Ukraine	Soil, Water	Radioactive Materials	Legacy	Soviet-era Power Plant Accident	Ongoing
Kabwe, Zambia	Soil	Lead	Legacy	Lead Mining	Early Days – process begun with World Bank support
La Oroya, Peru	Air, Soil	Lead	Active and Legacy	Metal Mining and Production	Unknown

Summary details of the other 25 sites that were on the long list are attached at Appendix 1.

Understanding the World's Worst

The Top Ten (and indeed the long list of 35 "candidates") clearly include a very wide range of different circumstances and conditions. However, while accepting the specific issues of each site, there are some patterns and trends that can be seen.

Size matters. The very large sites (such as a big city or a river basin) will always rank high on any list of polluted areas but the smaller sites often pose a much higher localized health risk. This question of scale versus intensity underlies all efforts to compare sites and also determines the approaches that can be taken to deal with an area. Small sites, with severe but localized contamination can be resolved at the local level with relatively limited resources. The citywide or river basin problems clearly require a programmatic approach with long-term support and funding. However, many cases fall somewhere in between these extremes and can be complicated to address and expensive to remedy, which may be why the problems have persisted.

The health focus strongly influences the rankings The clear evidence of toxicity and pathways puts the mining and smelting sites way up on the list. In the same vein, some well know sites (such as Vapi and Ankleshwar in India) ended up low on the consensus list for the Top 10. They may be creating environmental and economic costs in the ground and surface waters, but the immediate health impacts are less clear.

In most cases, the big Fortune 500 companies are not complicit. Almost all of the sites listed for consideration for the Top Ten do NOT have major multinational involvement. (Almost – there is just one site that does have multinational involvement (Doe Run Corp in La Oroya)). Instead, the worst pollution is from a range of sources:

- Old companies now long defunct and untraceable
- Government companies and activities, especially cold war activities
- Local or regional businesses, not international ones.
- Clusters of small artisanal activities

In fact, Blacksmith experience is that the presence of a large Fortune 500 or FTSE 500 company in a given sector in a developing country will often provide a role model for other industries, elevating the overall environmental performance for others in the neighborhood. Rarely are these companies responsible for sites or operations that pose really significant health risks.

Most of the worst places are not generally known, even in their own countries. Tucked away from the large capital centers for good reason, highly polluted places are often a forgotten sector of the community. While some of the sites achieve enormous notoriety because of their international focus (Chernobyl and Bhopal for example), the actual health risk may not be commensurate with their fame. The worst sites, such as Dzerzhinsk and Kabwe, are often unknown or ignored, even by their own governments.

Air pollution is pervasive, wherever it occurs. Outdoor air pollution is perceived as a major issue in many cities (it helps that the rich can't really avoid it). Given that fine particulates

(PM10 and PM2.5) are surprisingly toxic, cities with high levels of air pollution from old vehicles, 2-strokes, bad quality fuel, poor road surfaces and the like are high on most lists (e.g. Mexico, Linfen). This conclusion is fully consistent with the focus of World Bank and other agencies on reducing air pollution because of the large health benefits. However, this form of pollution is toxic in the short term but has little legacy effect. (Indoor air is actually the hidden killer – smoke from cooking and heating with poor fuels kills vast numbers of poor women and their children. These effects are literally hidden away and have only recently begun to receive serious attention.)

Soil contamination particularly affects children. Kids play in the dirt and are very highly exposed to contaminated material. The really small ones eat the stuff. It is usually the poor who grow food in these soil and as a result the food can become highly contaminated. This factor drives the high scores for the sites where heavy metals are prevalent.

Water pollution is complicated. In theory, it is straightforward to avoid polluted water, although the options (such a bottled water) are often limited or unrealistically costly. In reality, where major water systems are very heavily polluted, there are few alternatives and many people are exposed through drinking water. The location of the pollution is also relevant to the level of human impact. The Huai Basin in China scores high, because so many people use the river directly or via groundwater, while the immediate impact of Vapi in India is much lower because the pollution is well downstream and is mainly discharged to the sea (with serious ecological impacts).

Many other places have very similar problems. There are unfortunately many medium to large industrial cities which all score high on any index of overall pollution. The nominated list includes a number of such examples (in Russia, China and India, for example), and it was difficult to separate them on this list. Sadly, there are also many other cities around the world that would rank similarly. The Top Ten strives to reflect a reasonable geographic balance, and to include sites that are good representatives of a range of similar sites.

More specific information on the selected Top 10 of the World's Worst Polluted Places follows.

The Top Ten – More Details

DZERZINSK, RUSSIA

Potentially affected people: 300,000

Type of pollutants: Chemicals and toxic byproducts from Cold War-era chemical weapons manufacturing, including Sarin, VX gas, lewisite - the poisonous effect of which is owed to its arsenic trioxide content, yperite (mustard gas), prussic acid, phosgene, dioxins and other persistent organic chemicals. Lead, from an additives manufacturer, now closed.

Site description: In Dzerzhinsk, a significant center of the Russian chemical manufacturing, the average life expectancy is 42 years for men and 47 for women. Until the end of the Cold War, the city was among Russia's principal production sites of chemical weapons. According to figures from Dzerzhinsk's environmental agency, from 1930-1998, almost 300,000 tons of chemical waste were improperly disposed of. Of this waste, around 190 separate chemicals were released into the groundwater. These chemicals have turned the water into a white sludge containing dioxins and high levels of phenol – an industrial chemical which can lead to acute poisoning and death. These levels are reportedly 17 million times the safe limit.

The city draws its drinking water from the same aquifers into which these old wastes and unused products were pumped. Now that many of these industries are no longer in operation, the local groundwater has risen, along with the water level in the canal. This rise in the canal's water level threatens to dump arsenic, mercury, lead and dioxins into the Oka river basin, a source of drinking water for the nearby city of Nizhny Novgorod.

Despite the heavy toll on the population's health, a quarter of the city's 300,000 residents are still employed in factories that turn out toxic chemicals. According to a 2003 BBC report it is the young who are most vulnerable. In the local cemetery, there are a shocking number of graves of people below the age of 40. In 2003 it was reported that the death rate exceeded the birth rate by 2.6 times and it is easy to see why. The dioxins that get into the water as a by-product of chlorine production are reported to cause cancer even in minute doses.

Cleanup Activity: Following the support of a baseline research project in the area in 2004, Blacksmith, in cooperation with the local government, has funded the installation of water treatment systems in Pyra (population 4,000), and Gavirolvka, settlements whose groundwater is highly polluted, yet remains the sole source of drinking water. In addition, Blacksmith has funded the establishment of a steering committee led by a local NGO (DRONT) in cooperation with the Nizhniy Novgorod municipal government, to begin the design of a large-scale remediation and pollution mitigation plan for the entire affected area.

In 2004 the local government conducted an initial evaluation of the extent of the groundwater contamination in the city and reviewed subsequent engineering options to bring clean water in to Dzerzhinsk to replace use of the contaminated groundwater source in Gavrilovka and Pyra, two areas of the city

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LINFEN, SHANXI PROVINCE, CHINA

Potential population affected: 200,000

Type of pollutants: Fly-ash, carbon monoxide, Nitrogen oxides, PM-2.5, PM-10, Sulfur dioxide, volatile organic compounds, arsenic, lead.

Site Description : When asked to comment on the environmental conditions of Linfen, one environmental expert quipped, *"If you have a grudge against someone, let this guy become a permanent citizen of Linfen! Why? For punishment!"* Shanxi Province is considered to be the heart of China's enormous and expanding coal industry, providing about two thirds of the nation's energy. Within it, Linfen has been identified as one of Shanxi's most polluted cities with residents claiming that they literally choke on coal dust in the evenings, according to a BBC report.

China's urgent need for coal has led to the development of hundreds of often illegal and unregulated coal mines, steel factories and tar refineries which have diverted water and parched the land making farming in the province nearly impossible. Water is so tightly rationed that even the provincial capital receives water for only a few hours each day.

The Annual Report on Environmental Management and Comprehensive Improvement in Key Cities for Environmental Protection in 2003, by the State Environmental Protection Administration (SEPA), indicated that Linfen is the city with the worst air quality in China. The high levels of pollution are taking a serious toll on the health of the Linfen's inhabitants. Local clinics are seeing growing cases of bronchitis, pneumonia, and lung cancer. Lead poisoning was also seen at very high rates in Chinese children in the Shanxi Province. One resident was quoted in the BBC report claiming, "I feel like my throat is very dry, and the stuff coming out of my lungs is black." The severity of the air pollution in the cities of Shanxi is indicated by the fact that the levels of SO_2 and other particulates in the air exceed many times over the standards set by the World Health Organization. A growing number of resident deaths in recent years have been directly linked to this intense pollution.

Another epidemic found in this province is Arsenicosis, an environmental chemical disease caused by drinking elevated concentrations of arsenic found in water. Chronic exposure to this toxic chemical result in skin lesions, peripheral vascular disease, hypertension, blackfoot disease, and high risk of cancers. One study of Shanxi's well water published in Toxicology and Applied Pharmacology, found the rate of unsafe well water in the province to be 52% -- an alarming statistic. Worrying data such as this has caused the Chinese government to openly admit that one in five of its citizens lack safe drinking water.

Compounding the pollution problem is the city's economic dependence on the coal, steel, and tar industries as well as China's need for these resources in keeping with its rapidly growing economy. As with many environmental problems in China, strong resistance from business interests and corrupt officials has made improvement difficult to imagine in a short timeframe.

Cleanup Activity: Information on progress towards cleanup in this area is not currently readily available.

Note: Linfen acts in the Top Ten as an example of highly polluted cities in China. In terms of air quality, the World Bank has been quoted as estimating that 16 of the 20 most polluted cities in the world were in China.

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KABWE, ZAMBIA

Potentially affected people: 250,000

Type of pollutants: Lead, cadmium

Site description: Kabwe, the second largest city in Zambia is located about 150 kilometers north of the nation's capital, Lusaka. On average, children's' blood levels in Kabwe are 5 to 10 times the allowable EPA maximum. It is one of six towns situated around the Copperbelt, once Zambia's thriving industrial base. In 1902, rich deposits of lead were discovered here. Ore veins with lead concentrations as high as 20 percent have been mined deep into the earth and a smelting operation was set up to process the ore. Rich deposits of sulphide ore consisted of silicates, oxides and carbonates of lead, which averaged 34% in lead concentration. Mining and smelting operations were running almost continuously up until 1994 without the government addressing the potential danger of lead. This smelting process was unregulated during this period and these smelters released heavy metals in dust particles, which settled on the ground in the surrounding area. The mine and smelter is no longer operating but has left a city poisoned from debilitating concentrations of lead in the soil and water from slag heaps that were left as reminders to the smelting and mining era. Some of the lead concentrations in soil have been recorded at 2400 mg/kg. In one study, the dispersal in soil of lead, cadmium, copper, and zinc extended to over a 20 km circumference from the smelting and mining processes. The soil contamination levels of all four metals are higher than those recommended by the World Health Organization.

In the U.S., permissible blood levels of lead are less than10 mcg/dl. Symptoms of acute poisoning occur at blood levels of 20 and above, resulting in vomiting, diarrhea, and leading to muscle spasms and kidney damage. Levels of over ten are considered unhealthy and levels in excess of 120 can often lead to death. In some neighborhoods in Kabwe, blood concentrations of 200 or more micrograms/deciliter have been recorded in children and records show average blood levels of children range between 50 and 100 mcg/dl. Children who play in the soil and young men who scavenge the mines for scraps of metal are most susceptible to lead produced by the mine and smelter. A small waterway runs from the mine to the center of town and had been used to carry waste from the once active smelter. There is no restriction to the waterway, and in some instances local children use it for bathing. In addition to water, dry and dusty backyards of workers' houses are a significant source of contamination for the locals. One of the most common ways that workers and residents become exposed to toxic levels of lead is through inhalation of contaminated soil ingested into the lungs.

Cleanup Activity: After decades of contamination, the clean-up strategy for Kabwe is complex and in its primary stages. The first step is to educate the community about the risks of lead poisoning and their susceptibility to the pollutant. Precautionary measures have been taken in order to educate the population about the problem and to provide simple, concrete advice to avoid poison (such as to prohibit children from playing in the dirt and to rinse dust from plates and food etc.). Some areas of Kabwe require drastic remediation in which some entire neighborhoods may need to relocate.

Blacksmith has helped Kabwe's environment by establishing a local NGO, Kabwe Environmental and Rehabilitation Foundation (KERF) whose role is to bring educational services into each community with nursing support and expertise to locals as well. As a result of Blacksmith's local initiatives and involvement, the World Bank has stepped in. The Bank approved a $20 million grant to clean up the city and has just completed the scoping study that will lead to initial clean-up activity beginning in 2007.

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NORILSK, RUSSIA

Potentially affected people: 134,000

Type of pollutants: Air pollution – particulates including Strontium-90, Caesium-137, Sulfur dioxide, heavy metals (nickel, copper, cobalt, lead, selenium), particulates, nitrogen and carbon oxides, phenols, hydrogen sulfide.

Site description: An industrial city founded in 1935 as a slave labor camp, the Siberian city of Norilsk, Russia is the northernmost major city of Russia and the second largest city (after Murmansk) above the Arctic Circle. According to the Mines and Communities website the city is considered one of the most polluted places in Russia - where the snow is black, the air tastes of sulfur and the life expectancy for factory workers is 10 years below the Russian average. This city houses the world's largest heavy metals smelting complex, and over 4 million tons annually of cadmium, copper, lead, nickel, arsenic, selenium and zinc are dispersed into the air. Mining and smelting operation started in the 1930s, and is the worlds largest nickel producer. Norilsk Nickel, a recently privatized firm, is one of Russia's leading producers of non-ferrous and platinum-group metals. It controls one-third of the world's nickel deposits and accounts for a substantial portion of the country's total production of nickel, cobalt, platinum, and palladium. It is also a major polluter, ranking first among Russian industrial enterprises in terms of air pollution.

Due to the geographic location, reports on ecological impacts and contamination are infrequent from this location. In 1999, a report found elevated copper and nickel concentrations in soil up to a 60 km radius. The city population has been affected by air quality in this region of smelters, where it has been shown over half of all samples exceed the maximum allowable concentrations for both copper and nickel. A report in 1995 indicated that high levels of respiratory diseases have been observed in children around this area, and that these are most likely related to the air pollution from the smelter activity. Investigations evaluating the presence of ear, nose and throat disease among schoolchildren revealed that children living near the copper plant were twice as likely to become ill than those living in further districts. Similarly, children living near the nickel plant were shown to become ill at a rate 1.5 times higher than children from further districts. Analysis also showed that problems during the last half of pregnancy as well as premature births were much more frequent in Norilsk than in the Taimyr and Kransnoyark regions. Furthermore, mortality from respiratory diseases is considerably higher than the average in Russia, which is 28/1000 or 15.8% of all deaths among children.

Since November 2001, Norilsk has been shut to foreigners, one of 90 "closed towns" in Russia where Soviet-levels of secrecy persist.

Cleanup Activity

Many groups, some supported by international donors, have tried to address the problems. In the 1980's emission reductions were tried by building dust and gas removal facilities, and also electrostatic precipitators and liquid phase sulfur removals. These technologies aided in sulfate reduction, but studies proved that damage to forests and concentrations of metals remained a significant problem to date.

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HAINA, DOMINICAN REPUBLIC

Potentially affected people: 85,000

Type of pollutants: Lead.

Site description: This highly populated area known as Bajos de Haina is severely contaminated with lead from a closed down automobile battery recycling smelter. The Dominican Secretary of Environment and Natural Resources, since its creation in 2000, has identified Haina as a national hotspot of significant concern. Various studies have found alarming lead levels in the Haina community, with blood and soil levels several orders of magnitude over regular limits. The contamination is caused by the past industrial operations of the nearby Metaloxa battery plant. Although the company has moved to a new site (which is contaminating a new neighborhood, albeit less populous), the contamination still remains.

The most common symptom of Haina's pollution is lead poisoning, which affects children's health and development. Kaul tested children near the auto battery recycling plant in Haina. When the plant closed in March 1997, 116 children were surveyed, and again in August 1997, 146 children were surveyed. Mean blood lead concentrations were 71 µg/dL (range: 9–234 µg/dL) in March and 32 µg/dL (range: 6–130 µg/dL) in August. The study revealed that at least 28% of the children required immediate treatment and that 5% had lead levels >79 µg/dL. Only 9% of these children were under the WHO recommended 9 µg/dL for maximum concentration. The children were also at risk for severe neurologic consequences at the time of the study.

Another study released by the Chemical Institute of Autonomous University of Santo Domingo (UASD) found lead levels in inhabitants over 100 parts per million (ppm), whereas "normal" levels in children are considered to be 10 ppm and for adults 20 ppm. Birth deformities, eye damage, learning and personality disorders, and in some cases, death from lead poisoning have also been reported at a higher than normal rate due to contamination caused by the past operations of the battery plant.

Cleanup Activity: In early planning stages, with Blacksmith Institute advice and support.

INFORMATION

Note: This site is included in the Top Ten as an example of lead battery re-processing facilities. These factories can be found in many major third world cities, and often leave a legacy of lead poisoning in their host communities. Haina is the most severely polluted site of this kind known to Blacksmith Institute.

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CHERNOBYL, UKRAINE

Potentially affected people: Initially 5.5 million, now disputed levels of effect.

Type of pollutants: Uranium, Plutonium, Radioactive Iodine, Cesium-137, Strontium, and other metals

Site description: The world's worst nuclear disaster took place on April 26, 1986, when testing in the Chernobyl power plant, 62 miles north of Kiev, triggered a fiery melt-down of the reactor's core. Thirty people were killed in the accident, 135,000 evacuated, and one hundred times more radiation than the atom bombs dropped over Hiroshima and Nagasaki was released. To this day, the 19-mile exclusion zone around the plant remains uninhabitable.

Within seven months, the reactor was buried in a concrete casing designed to absorb radiation and contain the remaining fuel. However, the sarcophagus was only meant to be a temporary solution and designed to last 20 or 30 years. A program to re-contain the site is underway.

One major reason for the concern is that though an enormous amount of radiation was released during the disaster, most of the radioactivity remained trapped within the plant itself. Some estimate that more than 100 tons of uranium and other radioactive products, such as plutonium, remain to be released if there is another accident. Chernobyl is also thought to contain some 2,000 tons of combustible materials. Leaks in the structure lead experts to fear that rainwater and fuel dust have formed a toxic liquid that may be contaminating the groundwater.

Thyroid cancer in children surrounding this area is a main health problem. Over 4000 thyroid cases had been diagnosed since 2002. Most of these cases have been attributed to elevated concentrations of radioiodine found in milk. It is hard to project lethal cancer rates and other health risks associated with this fallout. What is known is more than five million people currently inhabit the affected areas of Belarus, Russia, and Ukraine, which have all been classified as 'contaminated' with radionuclides due to the Chernobyl accident (above 37 kBq m^{-2} of ^{137}Cs).

Furthermore, from 1992 to 2002 in Belarus, Russia and Ukraine more than 4000 cases of thyroid cancer were diagnosed among those who were children and adolescents at the time of the accident, the age group 0-14 years being most affected.

A recent WHO report has indicated that the impact on future generations from radioactivity is now quite low. However this report has been met with skepticism from local and international experts.

Cleanup Activity

Expert groups such have carried out work on health impacts, remediation effects, and socioeconomic status of the region surrounding Chernobyl. Plans for the 19-mile exclusion zone to be recovered for restricted industrial uses remain but an appropriate environmental impact assessment needs to be finished. Also, implementation of an integrated radioactive waste management program to ensure consistent management and facility capacity needs to be assessed before further development. Costs for remedial action can only be estimated, and experts have predicted these at hundreds of billions of dollars. To date, the costs of the cleanup have placed significant financial burdens on Belarus, Russian Federation, and Ukraine.

Note: Given its resounding infamy, despite the subsequent progress that has been made at this site, we felt Chernobyl must be included in this Top Ten list due to its residual environmental impact as well as its potential to further affect such an extensive region and population.

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LA OROYA, PERU

Potentially affected people: 35,000

Type of pollutants: Lead, copper, zinc, and sulfur dioxide.

Site description: Since 1922, adults and children in La Oroya, Peru - a mining town in the Peruvian Andes and the site of a poly-metallic smelter - have been exposed to the toxic emissions from the plant. Currently owned by the Missouri-based Doe Run Corporation, the plant is largely responsible for the dangerously high blood lead levels found in the children of this community. Ninety-nine percent of children living in and around La Oroya have blood lead levels that exceed acceptable amounts, according to studies carried out by the Director General of Environmental Health in Peru in 1999. Lead poisoning is known to be particularly harmful to the mental development of children. A survey conducted by the Peruvian Ministry of Health in 1999 revealed blood lead levels among local children to be dangerously high, averaging 33.6 micrograms/deciliter for children between the ages 6 months to ten years, triple the WHO limit of 10 micrograms/deciliter.

Sulfur dioxide concentrations also exceed the World Health Organization emissions standards by ten fold. The vegetation in the surrounding area has been destroyed by acid rain due to high sulfur dioxide emissions. To date, the extent of soil contamination has not been studied and no plan for reduction of emissions has been agreed or implemented.

Numerous studies have been carried out to assess the levels and sources of lead and other metals still being deposited in La Oroya. Limited testing has revealed lead, arsenic and cadmium soil contamination throughout the town. However, all of these studies were focused on outdoor contamination and suspected severe indoor air pollution has not yet been assessed in detail..

Cleanup Activity

Peru's Clean Air Act cites La Oroya in a list of Peruvian towns suffering critical levels of air pollution, but action to clean up and curtail this pollution has been delayed for the 35,000 inhabitants. In 2004, Doe Run Corporation asked the government for a four year extension to the plants environmental management plan. A concerted NGO movement is now underway to pressure the company and the government to develop effective strategies for implementation of site remediation agreements and to provide health care for affected residents.

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RANIPET, INDIA

Potentially affected people: 3,500,000

Type of pollutants: Tannery waste, containing hexavalent chromium and azodyes

Site description: Ranipet is located about 100 miles upstream from Chennai, the fourth largest urban area in India. Although Ranipet is a medium sized town, its problems also pose a potential risk to the population of the nearby city of Vellore. A factory in Ranipet manufactures sodium chromate, chromium salts and basic chromium sulfate tanning powder used locally in the leather tanning process. The Tamil Nadu Pollution Control Board (TN PCB) estimates that about 1,500,000 tons of solid wastes accumulated over two decades of plant operation are stacked in an open yard (three to five meters high and on 2 hectares of land) on the facility premises and contaminating the groundwater.

The contamination of the soil and groundwater with wastewater, as well as run off from solid wastes has affected the health, resources, and livelihood of thousands of people, in a residential colony about 1 kilometer from the factory. Three open wells, a dozen bore wells and about 25 public hand pumps have been abandoned due to high chromium levels in the water. Agricultural land about a kilometer from the factory has also been affected. There is widespread fear that if this pollution is left unchecked, the Palar basin, the main drinking water source in the region, could also be contaminated. Indian farmers who have the misfortune of cultivating this toxic land claim that the toxic waste from the nearby tanneries degrades the fertility of the land citing that " invariably, only one in five crops does well." Farmers also complain of the foul smells which emanate from the very water they use to irrigate their fields claiming that, "when we come in contact with the water we get ulcerations on our skins and it stings like an insect bite."

Cleanup Activity: In 1996 the government shut down Tamil Nadu Chromates & Chemicals Limited (TCC), the factory responsible for an estimated 1.5 million tons of untreated chromate sludge. In May 2005 Blacksmith Institute visited this site. The Tamil Nadu Pollution Control Board authorities have assigned the National Geophysical Research Institute (NGRI) and National Environmental Engineering Research Institute (NEERI) to design and implement remediation plans to cleanup this site.

An effective solution to tackle the issue of chromate leaching from the legacy site would be to encapsulate the waste dumpsite to prevent further leaching and treating the subsurface soil of the channel-flows.

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RUDNAYA PRISTAN/DALNEGORSK, RUSSIA

Potentially affected people: 90,000

Type of pollutants: Lead, cadmium, mercury, antimony

Site description: Dalnegorsk and Rudnaya Pristan are two towns in the Russian Far East whose residents suffer from serious lead poisoning from an old smelter and the unsafe transport of lead concentrate from the local lead mining site. According to the most recent study, lead concentrations in residential gardens (476-4310 mg/kg, Gmean=1626 mg/kg) and in roadside soil (2020-22900 mg/kg, Gmean=4420 mg/kg) exceed USEPA guidance for remediation by orders of magnitude. These data suggest that drinking water, interior dust, and garden crops also likely contain dangerous levels of lead. Water discharged from the smelter averages 2900 m3/day with concentrations up to 100 kg of lead and 20 kg arsenic.

Limited initial testing has revealed that children's blood lead levels are 8 to 20 times the maximum allowable U.S. levels. Preliminary biokinetic estimates of mean blood levels suggest that preschool children are at significant risk of lead poisoning from soil/dust ingestion with levels predicted to average 13-27 microg/dl. Annual air emissions found 85 tons of particulate matter with lead and arsenic concentrations being 50 and 0.5 tons, respectively.

Since 1930 there has not been any attempt to address associated health concerns by either an educational or a technical environmental program. In fact, as Sharov points out, the residents of the area were simply left to deal with their health risk problems on their own and are largely unaware of the risks. Furthermore, some residents in Rudnaya use old casings of submarine batteries that were recycled by the smelter in order to collect precipitation for watering their gardens.

Cleanup Activity

The lead smelter has now been voluntarily shut down, after Blacksmith presented the owner with data on the health risks to children of lead contamination. In addition, children's blood lead levels are being tested, and those with elevated levels are being treated with Blacksmith funding. This funding has also supported a program of education to all residents, and local education and testing through the community is ongoing. Next, a plan to remediate the worst of the contamination needs to be drawn up and implemented.

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MAILUU-SUU, KYRGYZSTAN

Potentially affected people: 23,000 immediate, millions potentially

Type of pollutants: Radioactive uranium mine tailings. Gamma radiation from the dumps measures in between 100-600 micro-roentgens per hour. Heavy metals, and cyanides.

Site description: There are twenty-three tailing dumps and thirteen waste rock dumps scattered throughout Mailuu-Suu, home to a former Soviet uranium plant. From 1946-1968 the plant produced and processed more than 10,000 metric tons of uranium ore, products which were eventually used to produce the Soviet Union's first atomic bomb. What remains now are not atomic bombs, but 1.96 million cubic meters of radioactive mining waste that threatens the entire Ferghana valley, one of the most fertile and densely populated area in Central Asia.

Due to the high rates of seismic activity in the area, millions of people in Central Asia are potentially at risk from a failure of the waste containment. Natural hazards such as earthquakes, landslides, and mudflows, all have the potential to exacerbate problems associated with the location and mismanagement of these tailing piles. It is feared that a landslide could disturb one of the dumps and either expose radioactive material within the core of the enormous waste piles or push part of them into nearby rivers. This fear that was nearly realized in May of 2002 when a huge mudslide blocked the course of the Mailuu-Suu river and threatened to submerge another waste site. In April of this year the Obschestvenny Reiting newspaper reported that about 300,000 cubic meters of material fell into the Mailuu-Suu River near the uranium mine tailings, the result of yet another landslide. Events such as these could potentially contaminate water drunk by hundreds of thousands of people in the Ferghana Valley, shared by Kyrgyzstan, Uzbekistan and Tajikistan.

The poor design and management of the waste areas also allows transfer of some material from these piles to surrounding areas by runoff. Research has found some groups getting very high doses of radon probably due to use of this runoff water in agricultural practices. Risk analyses have also been conducted to assess the radioactive contamination that could occur with more natural disasters, and have found these could lead to potential large-scale environmental contamination. A 1999 study conducted by the Institute of Oncology and Radioecology showed that twice as many residents suffered from some form of cancer than in the rest of the country.

Cleanup Activity: The World Bank has begun a project for Kyrgyzstan to "minimize the exposure of humans, livestock, and riverine flora and fauna to radionuclide associated with abandoned uranium mine tailings and waste rock dumps in the Mailuu-Suu area". The project includes uranium mining wastes isolation and protection, improvement to the national system for disaster management, preparedness and response and the establishment of real-time monitoring and warning systems, seismic stations and sensors. The total cost of the project is 11.76 million U.S. dollars, of which 6.9 million dollars will be provided by the bank's International Development Association, an institution that gives aid to the world's poorest countries.

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Hope for the Future

The sites listed here – and the many other similar ones not included – are nasty, dangerous and daunting to address. However, they are not entirely without hope. Many cities and industrial areas in the developed world were once also black and horrific and deadly (the famous "dark satanic mills" of literature). These are now largely controlled and present less of an apparent threat to health and the population.

This has been achieved by decades of agitation, awareness, scientific understanding and technological advances – as well as the investment of vast resources.

Those dealing with the World's Worst can learn lessons from the decades of experience. In fact, there are developing countries that have made considerable progress in finding the difficult balance between industrial growth, human development and environmental sustainability. However, the Top Ten examples show that the "grow first, clean-up later" model is not the one to follow.

The sites in the World's Worst typically arise from centralized efforts to push industrial development at the price of all other priorities or else they reflect very low quality technologies being used because of ignorance, poverty or just plain greed. In some cases, there are both causes in play.

There have been successes in coming to grips with these problems (and Blacksmith's website lists a number of such Success Stories that we have supported). On a small scale, an outside intervention can provide the impetus needed for local people, often working closely with those responsible for the problems, to find and implement simple solutions. These may not deal totally with the problem and may fall short of state-of-the-art technologies but achieve both an immediate benefit and a launching pad for longer-term efforts. Examples include digging up and moving a radioactive "beach" where children played and also ongoing efforts to reduce mercury use in small-scale mining.

In some cases the investments needed are beyond the resources that can be assembled locally and therefore national government or even international support is needed. The role of groups like Blacksmith is to help to find realistic and implementable solutions, working with local champions, and then to be intermediaries for the sources of major support. Large scale but definable problems such as mines and metal smelters typically fall into this category.

The most difficult to address of the hot-spots are the declining industrial cities or complexes, where a focus on rampant production in the past has left a trail of human and environmental problems, often intertwined as polluted water sources or poisoned soil. Unfortunately, there are too many of these "industry towns" still carrying on because there is no real alternative for the local population. The intervention in these places begins with supporting a core group of concerned people and officials to create a consensus and momentum, starting with some simple but visible improvements to show that progress is possible.

The Way Forward

Problems like these have been solved over the years in the developed world, and it can be done again, although it will take time, commitment, and resources. The good news is that there are technologies and proven strategies for dealing with much of this pollution. Experience shows that bringing together governmental agencies, technical expertise, funding resources and local champions can make a real and measurable difference. The challenge is to generate the will and commitment to deal with the problems – this is where interventions such as Blacksmith's can catalyze action.

One significant problem is the need for financial resources to address medium scale problems. Blacksmith's own resources, raised typically from private sector supporters, can begin to deal with some of the nasty, localized problems, such as lead re-smelting. In the same way, pilot schemes for dealing with contaminated water supplies can be implemented. However, larger versions of these problems, such as abandoned mines and smelters, or widespread water degradation, often require investments in the range of $500,000 to $10 million, which are too large for a non-profit and yet usually too small to attract the support of international funders.

To address this gap, Blacksmith has put forward the concept of a Polluted Places Fund, which would be supported by (and possibly managed by) international agencies. This Fund would provide investment (perhaps as matching grants) for selected priority remediation projects that fit in this awkward scale. Initial feedback from key potential supporters has been positive and the Fund outline is being further developed through discussions with relevant parties.

Much effort has been put into understanding the problems and identifying possible approaches. The goal now is to generate a sense of urgency about carrying forward real interventions to tackle these priority sites.

This initial World's Worst Polluted Places list is a starting point. The critical, most polluted sites must get the needed attention and support from the international community in order to remediate them.

Appendix 1: The Nominations that Did Not Make the Top Ten

Here are the 25 nominated sites that were included in the long list but not chosen for the Top Ten.

HUAI RIVER, CHINA

Potentially affected people: 165 million

Type of pollutants: industrial, agricultural and municipal pollutants

Site description: The Huai River basin covers 270,000 square km, and has become a significantly polluted waste outlet from industry, livestock, and rural and municipal sources. Basin water quality has deteriorated at an accelerating rate over the past twenty years, driven by sustained, rapid growth of industrial, agricultural and municipal pollutants. The Basin water control regime exacerbates pollution problems, because local governments close gates in the dry season to retain water for local supply. While the gates are closed they retain the pollutants in the return flows of irrigation, industrial and municipal waste water. When the first rains come, gate operators flush their sections of the river, but if done in too many tributaries at once, a surge of highly polluted water enters the main channel. Such a surge in 1994 resulted in massive fish kills, human illness, and the need to shut down municipal and industrial water intakes all along the river. China rates its waterways on a scale of 1 to 5, with 5 being most toxic. SEPA has rated this water at 5. A recent Chinese newspaper report cited death rates a third above average and cancer rates twice the provincial average for one major Huai tributary in Henan province. Equally troubling data have been reported for the Fuyang area in Anhui province.

Through the 1990's Huai River was known as the most polluted in China. According to the China Institute of Water Resources and Hydropower Research (IWHR), the total wastewater discharge increased 40% from 1980-1995. Health impacts seen are inflammation, swelling, and ulceration of the skin if there is water contact. Long-term exposure had high incidences in intestinal, pulmonary, and liver cancers. Mortality increased 60% in the 1990's due to increase in waste.

Cleanup Activities
In 1995, the State Council set a goal to remediate the Huai River by the year 2000, but over 200 serious water pollution accidents have happened in the years of 1989-2004. The area needs to build wastewater treatment plants in 256 cities in order for the river to meet water quality standards. The Chinese government has started many environmental initiatives including urban wastewater treatment, industry readjustment, industry emission control, watershed management, and so forth. Total project cost is estimated to be about $100 million. A World Bank loan would cover an estimated $50 million of that cost, with the remainder financed by Anhui province, benefiting enterprises, and HRBC.

SEPA intended to clean up Huai River to meet Class III standard (drinking and fishing). In 2001 SEPA announced that it had reached the goal, and the Huai Basin Pollution Control plan was recorded as a great success. In 2003, many water quality stations recorded wet season concentrations as 84.4%, still class V or worse. Furthermore, in 2004, the Huai River suffered a considerably large pollution incident with severe flooding in the upper stream. The pollution stretched 150 km with heavy loss of fish and shrimp. Further technical assistance will be carried out March 2005-2006 thru SEPA.

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KOLA PENINSULA, RUSSIA

Potentially affected people: 1.3 million

Type of pollutants: Radioactive and nuclear wastes

Site description: Kola Peninsula lies in far northwestern Russian Federation, between the Barents Sea and the White Sea. Administratively, it forms part of Murmansk oblast (region). The strategic importance of the peninsula led to the proliferation of military bases here during the Cold War. The major port of the region is Murmansk. During the Soviet period, Murmansk was a major submarine production center, and remains a chief naval headquarters in modern Russia. Currently there are 70 decommissioned nuclear submarines being moored in ports along the Kola Peninsula. Considered obsolete, damaged, or banned by strategic arms reductions treaties, these submarines have been largely abandoned after being stripped of their offensive armament. They are manned by skeleton crews and hold within their poorly maintained hulls a total of nearly 30 times the amount of nuclear fuel that was in Chernobyl Reactor Number Four when it exploded in 1986.

The Kola Peninsula as a whole suffered major ecological damage, mostly as a result of pollution from the military (particularly naval) production, as well as from industrial mining of apatite. There are currently about 250 nuclear reactors produced by the Soviet military on the peninsula, which are no longer in use but still generate radiation and leak radioactive waste.

Other investigations into the radiological doses in seafood surrounding the peninsula have linked the problems to nuclear weapons testing, nuclear reprocessing discharges and the Chernobyl accident.

Cleanup Activities: In 1999, the project direction shifted and became more focused as the Russian shipyard’s needs became better defined within the budgetary realities of the program. This shift inspired the creation of a Mobile Pretreatment Facility (MPF) to permit solid waste sorting, volume reduction and containerization at current storage locations on the Kola Peninsula prior to transfer to a central processing facility (CPF) for final treatment and disposal.

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SUMGAYIT, AZERBAIJAN

Potentially affected people: 275,000

Type of pollutants: Organic Pollutants, Oil, Heavy Metals

Site description: Sumgayit city was founded in the 1950's as a Soviet industrial center. It is the site of 23 factories which at one time were the major production site of industrial and agricultural chemicals for the Soviet Union. These factories provided a variety of products such as chlorinated pesticides and other agricultural, industrial and domestic chemical products. Like the Soviet oil industry, these industrial chemical plants did not practice adequate environmental safeguards leaving the surrounding areas heavily contaminated. In line with growing production demands, hundreds of thousands of tons of toxic wastes were annually released into the atmosphere or dumped into a creek that feeds into the Caspian Sea. To this day untreated sewage and mercury-contaminated sludge (from chlor-alkali industries) are dumped haphazardly into the sea creating dead zones. Outdated technologies, lack of pollution controls and the disposal and treatment of accumulated waste around the industries are the major problems here. In 1992, the city of Sumgayit was declared an environmental disaster zone. A 2006 study revealed that Sumgayit residents have an increased cancer burden as a consequence of intense occupational and environmental pollution from industry.

Cleanup activities
Sumgayit Centre for environmental Rehabilitation has started an education program for contamination and dangers associated. From 2003 the World Bank has been funding the cleanup of the chlor-alkali plant where the 1,566 tons of mercury have been spilled.

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CUBATAO, BRAZIL

Potentially affected people: More than 2 million

Type of pollutants: Chlorinated chemicals like hexachlorobenzene, hexachlorbutadiene, carbon tetrachloride, perchloroethtlene, and hexachlorethane, sewage.

Site description:
Cubatao, a city in the state of Sao Paulo in Brazil, is the location of the largest commercial harbor and also petrochemical and metallurgical industrial complexes. Led by huge state corporations like COSIPA (steel) and PETROBRAS (oil), the Cubatao valley developed into an industrial complex so large that by 1985 it accounted for 3 percent of Brazil's GDP. The Cubatao River has 130 industries sitting on the shoreline, and has discharged 10,000 kg monthly of industrial pollutants of zinc, phenols, mercury, and oil since the 1980's. The sewage problem is exacerbated from the population increase to 800,000 people, whereby only 90% have sewage treatment. Approximately 1.5 million tons of raw sewage is drained in the Cubatao River. A study conducted in 1999 (Medeiros) found hydrocarbons to be prevalent in the area with correlations pointing towards the Cubatao industrial complexes, sewage outfalls, and poorly designed storage units in the Santos city designed to hold petroleum products.

Researchers also found excessive cancer rates in Cubatao. Cancer of the nervous system, including the brain, are four times more likely while lung, throat, mouth and pancreatic cancer are twice as high compared to surrounding areas. During the late 70's and early 80's there was an epidemic of recorded births of infants born without brains, although researchers were never able to prove its relation to the industrial pollution. Half of Cubatao's residents were thought to suffer from respiratory ailments. In the early 1980s the city recorded the highest infant mortality rate in Brazil, and over one-third of the residents suffered from pneumonia, tuberculosis, emphysema, and other respiratory sicknesses.

Cleanup Activities
According to a World Bank report much has changed in the Cubatao Valley in the past 15 years as the result of progressive reforms by CETESB (the state's pollution control agency) furthered by the support of an aroused populace. Still, wastewater management as well as drinking water supply services are the most important issues facing Brazil today. To deal with this issue Brazil created the National Water Agency in July 2000. This marks an important milestone in the process of creating stable water resource management policies. This regulatory agency will establish a national system that will oversee water resource management at the regional and local levels. Brazil's goal is to not only ensure consistency in the water supply but also to protect the quality of the nation's bodies of water.

Considerable sums are being invested already. About US$1.1 billion has been used to clean up the Tietê River, which contained high concentrations of nickel and cadmium from untreated industrial wastewater and coliform bacteria from household waste. Over the next two years, another US$400 million is to be invested in the project, which will provide wastewater treatment to 400,000 families and increase control of industrial emissions, according to Geraldo Julião dos Santos, a representative from the Basic Sanitation Company of the State of São Paulo, a state-owned water company that is funding the Tietê Project along with the Inter-American Development Bank. According to dos Santos, the project was created in 1991 due to intense popular demand. Reports from that time indicated that the necessary investments required to make water supply and wastewater treatment services available to all Brazilians would amount to no less than US$14 billion, rising to US$22 billion when considering population growth through 2010.

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MAYAK and Lake Karachay, CHELYABINSK Russia

Potentially affected people: 50,000

Type of pollutants: Radiation

Site Description: "At one time, the most contaminated side of the small bog-like lake—just a few hundred meters across—was so "hot" that a 30-minute exposure would be fatal for 50% of humans," reports one expert who visited the site for *Environmental Health Perspectives*. Lake Karachay at Chelyabinsk-65, a

Russian nuclear weapon production site, contains 120 million curies of radioactivity, mostly cesium-137. In the past 45 years, about half a million people in the region have been irradiated in one or more of the incidents, exposing them to as much as 20 times the radiation suffered by the Chernobyl victims. From 1949 to 1956 members of the public were exposed via discharge of very large quantities of radioactive liquid wastes into the Techa River. Then, in 1957 further exposure came as the result of an explosion in the radioactive waste storage, coupled with numerous gaseous aerosol releases occurring within the first decades of the facility's operation. Residents of many villages downstream on the Techa River were exposed via a variety of pathways; the more significant included drinking of water from the river and external gamma exposure due to proximity to sediments and shoreline.

The Mayak weapons manufacturing complex had been using Lake Karachay as a dumping basin for its high level radioactive waste since 1951. In 1967, a drought reduced the water level of the lake, and gale-force winds spread the radioactive dust throughout twenty-five thousand square kilometers, further irradiating 436,000 people with five million curies, approximately the same as at Hiroshima. Russian doctors who study radiation sickness in the area estimate that those living along the Techa River received an average of four times more radiation than the Chernobyl victims. The river is the only source of water for the 24 villages which lined its banks. The four largest of those villages were never evacuated, and only recently have the authorities revealed to the population why they strung barbed wire along the banks of the river some 35 years ago.

Clean-up activities
Access to Lake Karachay has been cut off and the area isolated, to limit the risk to people.

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MEXICO CITY, MEXICO
Potentially affected people: 15 million

Type of pollutants: Ozone, SO2, SOx, NOx, pm2.5-pm10, HC, VOC, general exhaust

Site description: Mexico City has the worst air pollution in the country and ranks among the most polluted cities in the world. Its ozone levels exceed World Health Organization standards 300 days a year, and SEMARNAT has estimated that the air in the busy border town of Ciudad Juarez is 40% less contaminated than in the capital. Exhaust fumes from Mexico City's estimated 4 million motor vehicles, many of which are old and especially environmentally damaging, are the main source of air pollutants. The city's air problem is aggravated by its unique geography. Mexico City resides in a basin more than 7,400 feet above sea level and is surrounded on three sides by mountains. These isolate the city from regional weather disturbances and trap pollution.

Health is estimated at even 10% reduction in PM10 would save 3,000 lives and 10,000 new cases of chronic bronchitis. Ozone reduction by 10% would save 300 lives and 2 million minor restricted activity days.

Cleanup Activities:
In 2002, the Secretary of the Environment signed an agreement with World Resources Institute to implement a sustainable transport system in order to cut back on emissions. This will focus on bus transport systems and retrofit of diesel vehicles in order to cut back air pollutants.
Mexico City has achieved air quality regulation standards for four of the six main pollutants: lead, sulfur dioxide, carbon monoxide, and nitrogen oxides. The remaining problems are ozone and particulates.

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BAIA MARE, ROMANIA

Potentially affected people: 140,000

Type of pollutants: cyanide, copper, other heavy metals

Site Description: In January 2000, a breach in the tailings dam of the Aurul S.A. Baia Mare Company, released some 100,000 m³ of cyanide-rich tailings waste into the river system near Baia Mare in northwest Romania. This spill released an estimated 50-100 tons of cyanide, as well as heavy metals, particularly copper, into the Somes, Tisza and finally into the Danube Rivers before reaching the Black Sea. The company processes solid wastes from earlier mining activity to recover precious metals, especially gold and silver. The company started operation in May 1999, by processing an existing 30 year-old tailings dam (Meda dam) located near Baia Mare, to the west and close to the residential area. After extreme weather conditions (ice and snow on the tailing pond, high precipitation), the tailings deposited on the inner embankment became soaked. Stability was affected, causing local displacement, and this subsequently developed into breach of approximately 23 meters. The water released through the breach filled the area between the two embankments and spilled over the outer embankment. The volume of water released from the dam was estimated to be around 100,000 m3. Contamination of the Somes/Szamos stream, a tributary of the Tisza River, contamination and interruption of the drinking water in 24 locations and of 2.5 million people, massive fish-kill and destruction of aquatic species in the river systems, severe negative impact on biodiversity, the rivers' ecosystems, drinking water supply and socio-economic conditions of the local population

Cleanup Activity: Measures carried out immediately after the spill as well as currently implemented measures reflect the efforts of countries along the course of the river including, Hungary, Romania and Slovakia, to achieve current EC water-resources management standards with regard to water quantity, water quality, environmental standards, drinking-water quality, flood protection, navigation, etc., as soon as possible. For this purpose these countries are currently working on an integrated Tisa River basin management plan in compliance with the EC Water Framework Directive. Nevertheless, many tasks still remain to allow implementation of recommended action and prevention measures.

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COPSA MICA, ROMANIA

Potentially affected people: 10,000

Type of pollutants: lead, zinc, cadmium, SO_2, carbon dust

Site Description: Rapid expansion of industrialization in this valley from 1950s to 1990s was focused around a major factory producing carbon black (for dyes and tyres) and a large non-ferrous metal smelter. During the Ceausescu regime, Copsa Mica was one of the unfortunate sites where high polluting industries were focused. Unfortunately, the plants did not receive adequate resources and maintenance and as they fell into dis-repair both workers and the surrounding countryside were subjected to increasing levels of toxic pollution. Lead levels in the plants were reported to have reached 1,000 times allowable national limits.

After the communist era, efforts were made to deal with the problems. In 1993, the carbon black factory was closed and UNIDO brought in international expertise to help the Government to deal with the smelter. Cutbacks in production also had the effect of reducing emissions. However, the surrounding area remains polluted with toxic metals. There is widespread lung disease, impotence, a life expectancy that is 6 years below the national average, one of the highest infant mortality rates in Europe and other neurobehavioral problems typically associated with lead poisoning.

Cleanup Activities: Efforts to date have produced significant improvements but the smelter continues to operate, hampered by lack of resources to complete the needed environmental upgrading. Between 1993 and 2001, concentrations of all major pollutants decreased significantly, however, Copsa Mica remains extremely polluted. In the Tarnava Mare river, downstream from Copsa Mica, despite the considerable decrease that was noticed over the last decade, the lead concentration remains more than twice the maximum admitted value (MAV), zinc almost ten times, cadmium is close to MAV, and copper is about half of MAV.

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BHOPAL, INDIA

Potentially affected people: 150,000 at the time of the accident

Type of pollutants: VOCs, carbaryl, and BHC compounds

Site Description: The Bhopal Disaster of 1984 is considered the worst industrial disaster in history. It was caused by the accidental release of 40 tons of methyl isocyanate (MIC) from Union Carbide India, a pesticide plant located in the heart of the city of Bhopal, in the Indian state of Madhya Pradesh.

A holding tank with stored MIC overheated and released toxic heavier-than-air MIC gas, which rolled along the ground through the surrounding streets killing thousands outright. The gases also injured anywhere from 150,000 to 600,000 people, at least 15,000 of whom later died. In 2002 a comprehensive study was performed on the chemical stockpiles at the UCIL facility. Organic compounds detected in the solid wastes left unattended and insecure are toxic, persistent and bio-accumulative. For the human health concerns, both carbaryl and BHC compounds have been found in all piles which could be major contaminants of concern. Outside the factory, there were four samples taken from solar evaporation ponds that have also been very high in this contamination.

Cleanup Activity: Progress of this site is currently stalled. The factory was owned by Union Carbide, who sold the entire site to the Government of India in an agreement that included a fund for compensation of victims, and money to clean up the site. Union Carbide was subsequently purchased by Dow Chemical (without the Bhopal asset). NGO activists in India and elsewhere want to make Dow responsible for the clean-up, not the government, to set an international precedent. This has stalled clean-up activities, and has precluded most agencies from even entering the site.

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KOMI, RUSSIA

Potentially affected people: 46,000

Type of pollutants: Benzene, ethylbenzene, toluene, xylene and other petroleum related chemicals

Site description: The oil spill near the town of Usinsk in Northern Russia (Komi republic) is one of the most serious environmental disasters of the decade. The pipeline just south of the Arctic Circle had been leaking since February 1994 but the oil was contained within a dike built for this purpose. On October 1 of that year the dike collapsed because of cold and snow. Following the collapse, around 102,000 tons of oil began to pour onto the Siberian tundra. The spill reached the Kolva River, a tributary of the Pechora River, which falls into the Barents Sea. Life within the rivers as well as the fragile environment of the Artic have been seriously endangered by this oil spill. Experts estimate the spill to be eight times greater than the Exxon Valdez oil spill. The ruptured pipeline is the third largest oil spill in history. Along the oil pipelines, which experience hundreds of leaks and breakages each year, the ground is saturated with oil. Some of the oil has already seeped into the water table. The oil spread across 170 acres of streams and fragile bogs and marshland.

Local villagers have suffered for years from the effects of the petroleum pollution from the many oil spills in the region. Most natives are worried about the fish living in the Kolva River. Exclaimed one resident, "The river used to have lots of fish, now there are hardly any at all and when we cook them they smell bad...people here survive but they are worried about the future".

Cleanup Activities: The Russian government has assumed responsibility for the cleanup of this oil spill. The European Bank for Reconstruction and Development has lent the clean-up operation $25 million and the World Bank has provided $100 million. A US-Australian joint venture (AES/Hartec) was also hired to clean up the spill. Lake Schuchye was heavily polluted, but reductions with flotation technology reduced the hydrocarbons from 53,3 g/kg to 2.2 g/kg, removing 157 tons of crude oil.

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SPOLANA, CZECH REPUBLIC

Potentially affected people: 250,000

Type of pollutants: Dioxins, DDT, DDE, endrin, diendrin, lindane, benzene, 2,4,5-T, heptachlor, chloroform, HCB, HCH etc.

Site description: The chemical factory Spolana Neratovice is situated approximately 25 kilometres north of Prague on the river Elbe. From 1965 to 1968 it produced chlorine herbicide 2,4,5-T. During production, a huge amount of dioxins were created. Although these buildings were abandoned and closed more than 30 years ago, they contain remnants of contaminated facilities, raw materials and intermediates from the cancelled production. The ground water under Spolana is contaminated with dioxins, as well as other toxic chemical substances like: DDT, DDE, endrin, diendrin, lindane, benzene, 2,4,5-T, heptachlor, chloroform, HCB, and HCH.

The dangers of dioxins in the air of the contaminated buildings was proven by an experiment conducted by the Toxicology Department of the Military Medical Academy of J. E. Purkyne in Hradec Kralove. Chemical analysis proved an extremely high degree of contamination of building, air, soil and ground water.

Cleanup Activities: Altogether, approximately 35,000 tons of dangerous waste will be dug up and treated at an on-site heat plant constructed by SITA. The goal is to transform one of the worst pollution legacies - of the many left by the former communist regime - into a "clean industrial site" by the end of 2008, as demanded by the state holding company, the National Property Fund (FNM). The cleanup operation will cost around 2.7 billion CZK (US$120 million) and will be financed by drawing on funds from the sale of Spolana and its parent company, Unipetrol. Non-qualified workers will be paid around 10 euros an hour, well above the average Czech wage, according to SITA.

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NIGER DELTA, NIGERIA

Potentially affected people: up to 300,000

Type of pollutants: Benzene, ethylbenzene, toluene, xylene and other petroleum related chemicals

Site description: Oil production in Nigeria has had environmental and human consequences for the indigenous peoples who inhabit the areas surrounding oil extraction, specifically in the Ogoni Region. Large oil spills have turned areas of the Ogonis' homeland into wastelands. In mid-2001, for example, a United Nations Internet page described Yaata, an Ogoni village, an area where "dying vegetation in various shades of ochre stretch as far as the eye can see, poisoned by soil turned soggy and a dark, greasy hue since crude oil began seeping through over a month ago." On April 29, at the Royal/Dutch Shell Yorla oil field, a "quake-like tremor sent shockwaves onto Yaata and surrounding villages." (Nigeria: Focus, 2001) Within minutes, before people could guess the cause, jets of crude oil were already shooting up 100 meters, raining on the surroundings. Intense fumes of natural gas followed the oil plume, as the people of the village were forced to evacuate. The area suffered an average of 190 spills/year between 1989-1996, involving on average 319,200 gallons of oil from high-pressure pipelines that were laid above ground through villages and farmlands. The spilled oil seeped further into the earth, contaminating underground water for miles around, rendering hundreds of acres of once arable land, toxic.

Cleanup Activity: Many of the oil spills that plague the Niger Delta are believed to be the results of deliberate acts of sabotage. These acts are often political in nature and therefore it has been acknowledged that reforms to bring political stability to the region are a necessary first step in dealing with this problem. In response to spills in the fall of 2000, the multi-national oil company Royal Dutch Shell cut its production in Nigeria's Niger Delta region by about 130,000 barrels per day to prevent the spills from spreading. However, according to NGO reports, the company is doing little to cleanup the site, which accounts for 10% of Shell’s oil production, and is failing to invest in its infrastructure to prevent pollution.

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OMAI , GUYANA

Potentially affected people: 50,000

Type of pollutants: Cyanide, heavy metals

Site Description: A breach of a waste tailings pond in August 1995 at a mine site owned by Omai Gold Mines Ltd. (OGML), allowed an estimated 3.5 million cubic meters (120 million gallons) of toxic effluent containing cyanide and copper as well as other heavy metals into the Omai and Essequibo rivers. The spill was the fourth cyanide accident at the facility in 1995. Many of the 50,000 residents upstream, fish, boat, bathe and drink water from the river. Much of the biota in the Omai River was feared to have been killed, but it was hoped that the sheer volume of water flowing into the Essequibo during the wet season might rapidly dilute the poison. However, Amerindians, traders and miners living along the riverbank reported not only dead fish but also wild hogs floating belly-up and complaints about skin rashes and blistering from using river water endured for two months after the accident. The government issued warnings to all residents downriver of the mine to cease using the river for washing, drinking and fishing.

Cleanup Activity: No current information on cleanup activity is available.

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NEW ORLEANS, UNITED STATES

Potentially affected people: 500,000

Type of pollutants: Chemicals, petroleum residuals, VOCs, heavy metals such as lead, cadmium and nickel, diesel range organics, benzo(a)pyrene

Site Description: Since the levee breach in the Lower Ninth Ward, and subsequent flooding of the city, New Orleans now poses substantial health risks to those returning to the city. Thirty-seven percent of more than 200 samples taken in Orleans Parish exceed the Louisiana state cleanup level for soil in residential neighborhoods. There are seven locations in residential neighborhoods of Mid-City, Gentilly, Lakeview and New Orleans East where arsenic levels are more than 100 times higher than the EPA soil safety guideline and as much as 6.5 times higher than the Louisiana cleanup and investigation level. More than half of the samples collected in several neighborhoods, and more than 25 percent of the samples collected across the New Orleans area, likely meet the EPA's definition of a hazardous waste. NRDC's analysis identified "hot spots" of lead contamination at levels as much as three times higher than the Louisiana soil cleanup and investigation level in Gentilly, Bywater, Mid-City and the Lower Ninth Ward. As much as 91 percent of the EPA samples were found to contain significant amounts of diesel fuel ingredients. In fact, every EPA sample from the districts of Uptown/Carrollton and Central City/Garden exceeds the state cleanup and investigation standard for diesel contamination, as do more than 90 percent of the samples from Mid-City, Gentilly, Bywater, New Orleans East, and Arabi in St. Bernard Parish. NRDC also identified eight hot spots where levels of diesel-range organics are more than 100 times higher than the LDEQ soil cleanup and investigation standard for residential neighborhoods.

The analysis also found high levels of benzo(a)pyrene, one of the most toxic compounds in soot and petroleum products. Benzo(a)pyrene levels exceed Louisiana cleanup and investigation standards in 57 percent of the samples in Orleans Parish. In general, the neighborhoods with high levels of diesel fuel contamination also have higher levels of benzo(a)pyrene contamination. In New Orleans' Bywater neighborhood, where the Agricultural Street Landfill Superfund Site is located, the average level of this contaminant is more than 18 times higher than the applicable LDEQ cleanup and investigation standard, while the peak level is more than 50 times higher than the state soil cleanup level.

This conclusion is based on thresholds for acute exposures, typically experienced by emergency responders who are expected to interact with the contaminated area for limited duration. To date, the EPA has not assessed sediment-sampling data using long-term residential standards. These latter standards reflect long-term exposure typical to a family residing at the contaminated property. Consequently, contamination levels that are acceptable for short-term exposure by emergency responders are not necessarily at safe levels for habitability. As such, it can be surmised that current soil contamination levels surpass healthy levels for residency throughout the flood zone. Current contamination levels present an even higher risk to children, elderly, and other health-sensitive individuals.

Cleanup Activities
Beyond sediment sampling, neither EPA nor the Louisiana Department of Environmental Quality (DEQ) has conducted any soil remediation nor outlined a process by which this is to occur. Furthermore, no literature or guidance has been provided to residential or commercial property owners concerning soil contamination and options for property assessment and remediation. Lastly, no clearly defined procedures exist whereby property owners can report additional evidence of contamination nor request additional monitoring or information on options for assessment and remediation. Jeffrey Thomas, on behalf of the BNOB City Planning Committee, has identified three leading environmental health issues that must be addressed within the Master City Plan. They include monitoring, remediation, and redevelopment of soil contaminated properties, of mold generated by Hurricane Katrina flooding, and of Pre-Katrina contaminated properties, including superfund sites, brownfields, and other active or abandoned locations.

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MT. DIWALWAL, PHILIPPINES

Potentially affected people: 50,000

Type of pollutants: Mercury and cyanide

Site Description: Mt. Diwalwal is located in the Southeastern region of the Philippines. In 1982, the discovery of gold on this mountain triggered a gold rush to an area of 729 hectares. In the opinion of the Department of Environment and Natural Resources (DENR), it is the largest gold deposit in the world. An estimated $1.8 billion worth of gold reserves remain untapped in the 5,000-hectare mountain where some 30,000 small-scale miners operate, many illegally. The Naboc and Agusan rivers are grossly contaminated with mercury and cyanide from mining operations.

An op-ed item in September 2001 quoted a research finding that 86% of the miners in Diwalwal were contaminated with mercury. A study conducted by the University of Philippines and the Philippine General Hospital found 38% of the residents of Diwalwal had dangerous levels of mercury in their bodies. Another study by the Department of Health, National Poison Control Information Service and Department of Health, Environment and Occupational Health found that mercury exposure from artisanal gold mining had resulted in blood mercury levels in workers exceeding WHO standards. Health effects included poor memory, anosmia, abnormal gait and balance.

Another study found large concentrations of mercury in the Naboc River, in which was being used on the fields for irrigation. The mercury in the rice paddy soil exceeded the UK and Canadian soil quality thresholds for agricultural soil. The addition of rice, fish, mussels of the Naboc-Babag area dietary weekly sustenance averages 285 mg Methylmercury, which is over three times the recommended dietary dose.

Cleanup Activities: In 2002 the government assumed control of the mine site in an effort to manage the mining operations and better provide for the workers there. The environment department, in an effort to legitimize the operations of subsistence miners, signed service contracts, the legality of which are now being questioned.

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ARJO, ETHIOPIA

Potentially affected people: 13,000

Type of pollutants: DDT, Malathion, pirimiphos-methyl, and fenitrothion

Site description: The pesticides were brought to Arjo, Ethiopia, many years ago to control locusts and other pests, but they were never used. Located in a single story building and in a dilapidated old barn nearby, approximately 5.5 tons of old pesticides (including DDT, Malathion, Pirimiphos-methyl, and Fenitrothion} are stored in drums, boxes and bags. Some of the walls are cracked and toxic waste is leaking into the ground. The waste sites are secured only with a simple lock; there are no special security measures. Family huts, only a few meters away, surround the two dumpsites. Women prepare food nearby, while children play and goats and sheep graze around the perimeter of the buildings. The villagers complain about health problems, including headaches, nausea and coughing.

Cleanup Activity: In October 2002, the Global Environment Facility (GEF) pledged US$25 million to the Africa Stockpiles Program (ASP) which aims to clean up and safely dispose of over 50,000 tons of obsolete pesticides stockpiled throughout Africa. In officially endorsing phase one of the ASP program, the GEF Council funding pledge was made with the understanding that US$35 million in co-financing will be contributed by government aid agencies, the private sector and other donors. A condition of funding will be the ratification of the global Stockholm Persistent Organic Pollutants Convention. The African Stockpiles Program will take place over 12-15 years. The first phase will be completed in 2003-2006, and involve 15 countries.

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HANFORD, UNITED STATES

Potentially affected people: potentially130,000

Type of pollutants: Radioactive waste

Site description: From 1943 to 1987 Hanford produced plutonium for nuclear weapons, using a line of nuclear reactors along the Columbia River. Enormous amounts of radioactive and chemical waste were generated during the site's production period. Since the production of plutonium ceased, Hanford's only mission has been cleanup of the radioactive waste.

The Hanford Site includes approximately 53 million gallons of high-level liquid waste in 177 underground storage tanks, roughly the size of three-story buildings, buried in Hanford's central area, about 12 miles from the river. It also contains 2,300 tons (2,100 metric tons) of spent nuclear fuel, 12 tons (11 metric tons) of plutonium in various forms, about 25 million cubic feet (750,000 cubic meters) of buried or stored solid waste, and about 270 billion gallons (a trillion liters) of groundwater contaminated above drinking water standards, spread out over about 80 square miles (208 square kilometers), more than 1,700 waste sites, and about 500 contaminated facilities.

Over the years, 70 of the tanks have leaked about one million gallons of waste into the soil. At least some of the leaked tank waste has reached the groundwater, which eventually flows into the river. Estimated time for the tank waste to reach the river is anywhere from 7 years to a couple of generations. How badly it damages the river depends on how much gets there and when. According to a new federal study, men who grew up near the Hanford nuclear reservation in south-central Washington during the 1940s and 1950s have a slightly higher risk of developing thyroid disease.

Cleanup Activity: The Hanford site is reportedly costing Americans $1.4 million a day to build a facility that will safely treat millions of gallons of radioactive and toxic waste currently stored in leak-prone underground tanks, according to the *Seattle PI*. Construction is presently under way on the massive "vitrification" project, which eventually would turn the waste into a glassy compound in order to trap the radioactive material for safer storage. The department's contractor, however, has halted most of the building due to safety and technical problems. Inefficient management has pushed the projects completion date back from 2011 to possibly 2017 while driving up the cost of the project by billions, according to the Army Corps of Engineers.

Department of Energy: Hanford
http://www.hanford.gov/

"Study ties thyroid ills to Hanford." Seattle Times. (2006)
http://seattletimes.nwsource.com/html/health/2003155120_hanford27m.html

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http://seattlepi.nwsource.com/local/268605_hanford01.html

VOLGOGRAD, RUSSIA

Potentially affected people: More than 1 million

Type of pollutants: SO_2, sulfates, CO, NOx, phenol, particulates, HCl, ammonia, formaldehyde, magnesium, chlorides, phosphorus, copper, zinc, fluorides, oil products, organic pollutants, benzene, benzapyrene, chlorobenzene, cadmium, hydrocarbon tetrachloride, chloroform, hexavalent chromium, formaldehyde, nickel, vinyl chloride, polyvinyl chloride dust, benzapyrene sorbed on soot

Site description: Volgograd is a large industrial city situated on the Volga River. Active industries including oil refining, chemicals manufacturing, non-ferrous and ferrous metallurgies, coupled with pollution from transportation has rendered the air and water extremely polluted. Volgograd obtains its drinking water supplies from the Volga, which needs to be treated in order to meet health standards.

Motor vehicle exhaust accounts for 38% of all emissions, and are a major cause of environmental damage. Industrial production activities result in emissions of more than 1 million tons of toxic wastes into the atmosphere, only 18% of which are recovered and neutralized. Authorized dumps and waste disposal sites occupy 5200 hectares of land. Effluent discharge into small water bodies totals 268 million m3, including 51.6 million m3 of untreated, polluted water. Seventy-three companies with 114 on-site water outlets where scientific investigations are carried out are currently being monitored, as are the Volga and Don rivers. Damaged land covers an area of 2800 hectares. According to medical statistics for 1993-1995, more than 6 thousand cases of malignant tumors were registered in Volgograd annually.

Cleanup Activity: In mid-1993, Volgograd was chosen as the test site for the initial phase of a four-year Russia Air Management Program (RAMP). Operating from 1995 to 1998, the project aimed to test new methods of air quality management techniques and policies. The results of the program were then circulated throughout the Russian Federation. The program was managed by the U.S. Environmental Protection Agency in conjunction with the Institute for Sustainable Communities (ISC) and other Russian organizations.

The program created the Center for Environmental Training (CET), which promoted citizen participation through the education of NGOs, business and government leaders. Opening in October 1995, the CET continues to provide training to these various sectors of the Russian Federation.

"Description of ISC projects in Russia." Institute for Sustainable Communities. (2006)
http://www.iscvt.org/programs/psrussia.html

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"Shedding light on skin cancer" Environmental health perspectives. (1994). 102 (2).
http://www.ehponline.org/docs/1994/102-2/forum.html

MAGNITOGORSK, RUSSIA

Potentially affected people: 460,000

Type of pollutants: Lead, Sulfur dioxide, Heavy metals and air pollutants

Site description: In an area where it is rumoured unusual to give birth to a healthy baby, the local hospital estimates that only 1% of all children in Magnitogorsk are in good health. Magnitogorsk, located in Western Russia, lies on the banks of the Ural River. In the 1930's one of the largest Russian iron and steel works was established here that produced steel for half the Russian tanks during WW II. At optimum capacity it can produce up to 7.5 million tons of steel. The industry used to belch out 650,000 tons of industrial wastes, including 68 toxic chemicals, and polluted some 4,000 square miles of Russia. According to a steelworker, none of the filtering devices were in working condition. The highly increased cancer rates in the city are attributed to severe pollution from dioxides and benzopyrene. According to Nezavisimaya Gazeta, only 28% of infants born in 1992 were healthy, and only 27% had healthy mothers.

Cleanup Activity: in 2004 Blacksmith Institute's Technical Advisory Board reviewed the Magnitogorsk case. In 2005 the site was visited by Blacksmith Institute, which intends to fund health studies and plans to work with the plant to further reduce its pollution levels.

P. Green. "Breathing sulfur and eating lead: Magnitogorsk's children need oxygen cocktails." U.S. News & World Report. (1992) April 13.

http://www.highbeam.com/doc/1G1:12103833/Breathing+sulfur+and+eating+lead%7eC%7e+Magnitogorsks+children+need+oxygen+cocktails%7eR%7e+(includes+related+article%7eR%7e%7eR%7e%7eR%7e.html?refid=ency_botnm

Blacksmith Institute Polluted Places.
http://www.pollutedplaces.org/region/e_europe/russia/magnito.shtml

KANPUR, INDIA

Potentially affected people: 30,000

Type of pollutants: chromium, lead, and pesticides (γ-HCH and malathion, dieldrin)

Site description: The city of Kanpur located on the banks of River Ganges, with a population of around 2.4 million, is a major industrial hub in the Northern India, home to a large number of industrial tanneries. Noraiakheda, a nearby settlement of some 30,000 people, has developed over a groundwater plume of tannery chemicals, including dyes and hexavalent chromium (Cr VI) used in the preservation of leather. A basic chrome sulfate manufacturing plant for tanneries has left a legacy of chromium, lead, and pesticide (DDT and Lindane) pollution. Large amounts of the chemical waste produced here were buried on the grounds of the old plant. This contaminated material has polluted groundwater further spreading to wells and drinking water. A 1997 study conducted by the Central Pollution Control Board on the groundwater quality in Kanpur revealed chromium concentrations to range from 124 to 258 times higher than the permissible Indian limit for areas polluted by tanneries.

Another study confirmed this leakage of chromium, along with many other polluters associated with the tannery industry, by sampling along the river Ganga. Along this stretch of the river, the river becomes more polluted as the river flows downstream of Kanpur, taking along high concentrations, above Indian standards, of these industrial wastes.

Cleanup Activity: Blacksmith Institute supported Ecofriends, a local NGO in Kanpur to increase public awareness about the pollution problem in Kanpur and advocate for its cleanup. The NGO was successful in installing two systems in the Noraiakheda area for improved drinking water supplies.

The first pilot groundwater remediation project in India, initiated by Blacksmith Institute in cooperation with the Central Pollution Control Board of India and other Indian organizations to clean up hexavalent chromium, is slated to begin by the end of 2005.

N. Sankararamakrishnan, A. K Sharma, R. Sanghi. "Organochlorine and organophosphorous pesticide residues in ground water and surface waters of Kanpur, Uttar Pradesh, India." Environmental International. (2005). 31 (1) 113-120.

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BAIE DE HANNE, SENEGAL

Potentially affected people: 2 million

Type of pollutants: PCB, Heavy Metals, Chemicals, Tannery Waste, Sewage, Solid Waste

Site description: Hann Bay is the most polluted region of Senegal. The bay wraps around the industrial zone of the city of Dakar, Senegal. It is a highly populated area, with local residents bathing in the water, and numerous fishing boats along the crowded shore. Industrial pollution along the banks from 1968 – 1997 has rendered the bay exceedingly toxic. The seawater of the Hann Bay is reported to contain a concentration of fecal streptococci – a type of bacteria found in human excrement – at a level 17 times higher than the limit recommended by the World Health Organization.

Cleanup Activities: Blacksmith Institute is working to fund and support a group both within the Ministry of Industry and Ministry of Environment to create a credible implementation plan that will install an industrial waste treatment plan for the factories of the Hann region. Once the effluent treatment plant is in operation, work can begin to remediate legacy contamination from historical toxins. This plan will be submitted to multilateral development agencies such as the World Bank, who has already voiced their commitment to funding this project.

"Once pristine waters now a health hazard-Senegal" Science in Africa. (2005) June. http://www.scienceinafrica.co.za/2005/june/hannbay.htm

ANKLESHWAR, INDIA

Potentially affected people: 150,000

Type of pollutants: Heavy metals and chemicals

Site description: Ankleshwar Industrial Estate (AIE), established by the Gujarat Industrial Development Corporation, is the biggest industrial township in Asia covering 16 km^2 and housing nearly 1600 units in different sectors, including 400 chemical units. These chemical plants produce insecticides, specialty chemicals, paint, solvents, acids, and fuels to manufacture more than 25% of Gujarat's output of pharmaceuticals, chemicals, pesticides, dyes, and intermediaries. If the share of pollution is proportionate, AIE may be producing 5% of India's total chemical pollution in just 16 km^2. The plants in Ankleshwar process large quantities of basic chemicals,. AIE has estimated that its members generate between 250 million and 270 million liters of liquid waste per day (MLD), and roughly 50,000 tons of solid waste annually (TPA).

A preliminary investigation in communities living around Ankleshwar in 1998 had found over 65 polluted groundwater sources. During an investigation around the Ankleshwar industrial estate in December 2000, over 120 polluted ground water sources affecting a population of over 100,000 in about 50 communities were found. Many communities often had to use polluted water since no reasonable alternative source existed or it was too far.

Cleanup Activity: Currently there is no known active cleanup at this site.

V. Kathuria. "Monitoring and enforcement: Is two-tier regulation robust?—A case study of Ankleshwar, India." Ecological economics. (2006) 57(3) 477.

"What goes down must come up." Rainwater harvesting organization. (1999) August. http://www.rainwaterharvesting.org/Crisis/Groundwater-pollution.htm

VAPI, INDIA

Potentially affected people: 71,000

Type of pollutants: Chemicals and heavy metals

Site description: The town of Vapi marks the southern end of India's "Golden Corridor", a 400 km belt of industrial estates in the state of Gujarat. The Vapi industrial estate was established in 1967 and is made up of almost 2,500 companies mainly focused on chemical and chemical products production. The products include the production of petrochemicals, pesticides, pharmaceuticals, textiles, dyes, fertilizers, leather products, paint, and chlor-alkal. The waste products that are produced contain heavy metals, cyanides, pesticides, complex aromatic compounds (such as polychlorinated biphenyls), and other toxics Ankleshwar and Vapi were declared ''critically polluted'' by the Central Pollution Control Board (CPCB) in 1994. This followed a survey that revealed that there was no system in place to dispose of industrial waste at these estates.

Cleanup Activity: There has been considerable NGO activity and efforts by environmental authorities but currently there is no known active cleanup at this site.

D. C. Sharma. "By order of the court: Environmental Cleanup in India". Environmental Health Perspect. (2005) June; 113(6): A394-A397. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1257623

A. Agarwal. "When will India be able to control pollution?" CSE Washington. (2000) Jan. http://www.cseindia.org/hindu.htm

MARILAO, PHILIPPINES:

Potentially affected people: 250,000

Type of pollutants: Hexavalent Chromium, Heavy Metals, Pesticides, Sewage, Solid Waste, Tannery Waste.

Site description: The Marilao, Meycauayan and Obando River System is extremely polluted receiving wastes from tanneries, gold and precious metals refineries, Philippines largest lead smelter, and municipal dumpsites. Significant industrial waste is haphazardly dumped into the Meycauayan River, a source of domestic and agricultural water for the 250,000 people living in and around Manila. Substantial contamination comes from small-scale lead recycling facilities along the river at Marilao, and from the many tanneries that dump untreated hexavalent chromium wastewater into the river. Furthermore, investigations by Greenpeace show that from 2000 to 2001, New Zealand has been exporting used lead acid batteries to the Philippines for recycling at a lead smelting plant in Marilao which has long been the subject of complaints from concerned residents and ex-workers.

The leaking of lead into the river has had a severe effect on the health of the local population with complaints of nausea, burning eyes sensation, and various respiratory ailments, reports which have been confirmed by a series of Greenpeace investigations conducted in 1996. This river also feeds directly into the Manila Bay, and its effluents contaminate commercial fishing areas.

Current Activity: Blacksmith is currently supporting the creation of a coordinating body to encourage and guide clean up of this river. This body will include senior representatives of the Philippines federal government, the Asian Development Bank, the local municipality, industry representatives and local community groups. They will together design and implement remediation efforts over the next several years.

"Toxic Trash from New Zealand mocks global agreement to stop trade in hazardous waste:pollutes local communities in the process." Greenpeace (2003) July 2. www.ban.org/ban_news/2003/030702_toxic_trash_new_zealand.html

J. Emmanuel. "Cleaning up toxic wastes in the Asia Pacific region." US Working Group for Philippine Bases Clean-up. (1997) http://www.focusweb.org/publications/1997/Cleaning%20Up%20Toxic%20Wastes%20in%20the%20Asia%20Pacific%20Region.htm

Blacksmith Institute Polluted Sites. http://www.blacksmithinstitute.org/search3.php?project_id=27

PICNIC GARDENS, KOLKATA, INDIA

Potentially affected people: up to 50,000

Type of pollutants: Lead

Site Description: Tiljala lies in eastern Kolkata, the capital of West Bengal and is home to 34 small-scale secondary lead smelters operate here. In the Picnic Garden area, there are 27 lead factories producing lead ingots and lead alloys. These factories are located in close proximity to dense residential areas and open bodies of water exposing the local population of about 200,000 to heavily contaminated air and water. According to studies published by the School of Environmental Studies contaminants in the area include lead, arsenic, nickel, chromium and mercury. The concentration of lead in the soil, in dust on leaves and road dust is very high (5,000-20,000 ug/g). A study showed that the concentration of lead in the dust on dining tables exceeds 5,000 mg/g, according to Dr. Dipankar Chakraborty, director of the School of Environment in Jadavpur University.

The toxic products of these factories have grossly affected the health of the population. A survey conducted by the Chitranjan Cancer Research Institute revealed symptoms of upper respiratory problems found in 41.3% of urban and 13.5% of rural subjects, while lower respiratory tract symptoms were found in 47.8% of urban people in contrast to 35% of rural controls. Respiratory symptoms were most frequent during winter when the pollution level of the city with respect to Respirable Particulate Matter (RPM) was highest. However, the frequency of the symptoms during monsoon was greater than that of summer perhaps due to proliferation of microorganisms from elevated humidity during monsoon.

Cleanup Activities:
A study of the impact of lead contamination, and a plan for remediation are being developed with Blacksmith's support. The study will help to focus government efforts to upgrade or move these industries, and to remediate the area.

"Air pollution and human health" Parivesh: A Newsletter from central pollution control board. Ministry of Environment & Forests.
www.cpcb.nic.in/sept2001air2.htm

"Polluted places: India." Asian Development Bank (ADB). (2006).
http://www.adb.org/Projects/PEP/ind.asp#tiljala

N. Dasgupta. "Greening small recycling firms: the case of lead-smelting units in Calcutta." Environment and Urbanization. (1997) October. 9 (2) 289-305.

"Problems associated with development: towards the city of joy." GAIA: Environmental Information System. (1995-2002). http://www.ess.co.at/GAIA/CASES/IND/CAL/CALproblem.html

Appendix 2 – Technical Advisory Board Members

Listed in alphabetical order.

Margrit von Braun Ph.D. P.E.
Administrative Dean and Founder, Environmental Science Program, University of Idaho.

Dr. von Braun is Dean of the College of Graduate Studies and Professor of Chemical Engineering and Environmental Science at the University of Idaho. She received her BS in Engineering Science and Mechanics at the Georgia Institute of Technology in 1974, her MCE in Civil Engineering at the University of Idaho in 1980, and her Ph.D. in Civil/Environmental Engineering in 1989 at Washington State University. She was awarded the College of Engineering Outstanding Faculty Award in 1992. Dr. von Braun was a Kellogg National Leadership Fellow from 1993 to 1996. Her research areas include human health risk assessment, hazardous waste site characterization with a focus on sampling dust contaminated with heavy metals, and risk communication. She is establishing a network of international graduate students involved in assessing risks to community health from waste sites in the developing world.

Pat Breysse, M.D. *Director of the Division of Environmental Health Engineering Department of Environmental Health Sciences Johns Hopkins Bloomberg School of Public Health*

Pat Breysse is currently the Director of the ABET accredited Industrial Hygiene Program and is the Associate Director of the Center for Childhood Asthma in the Urban Environment. In this context, most of Dr. Breysse's research concentrates on exposure assessment with a resulting emphasis on public health problem solving particularly in the workplace. Exposure assessment research includes pollutant source characterization, exposure measurement and interpretation, development and use of biomarkers of exposure/dose/effect, and evaluating relationships between sources, exposures, doses and disease. Dr. Breysse's research contribution has included investigations of electron microscopic methods for asbestos analysis, and the development and evaluation of optical and electron microscopic analytical methods for synthetic vitreous fibers exposure assessments.

Jack Caravanos, Ph.D., CIH, CSP *Director, MS/MPH program in Environmental and Occupational Health Sciences Hunter College*

Jack Caravanos is an Assistant Professor at Hunter College of the City University of New York where he directs the MS and MPH program in Environmental and Occupational Health Sciences. He received his Master of Science from Polytechnic University in NYC and proceeded to earn his Doctorate in Public Health (Env Health) from Columbia University's School of Public Health in 1984. Dr. Caravanos holds certification in industrial hygiene (CIH) and industrial safety (CSP) and prides himself as being an "environmental health practitioner". He specializes in lead poisoning, mold contamination, asbestos and community environmental health risk.

Dr. Caravanos has extensive experience in variety of urban environmental and industrial health problems and is often called upon to assist in environmental health assessments (i.e. lead/zinc smelter in Mexico, health risks at the World Trade Center, ground water contamination in NJ and municipal landfill closures in Brooklyn). Presently he is on the technical advisory panel of the Citizens Advisory Committee for the Brooklyn-Queens Aquifer Feasibility Study (a NYC Department of Environmental Protection sponsored community action committee evaluating health risks associated with aquifer restoration).

Josh Ginsberg, Ph.D. *Director of Asia Programs, Wildlife Conservation Society*

As Director of Asia Programs at the Wildlife Conservation Society, Josh Ginsberg oversees 100 projects in 16 countries. He received a B.S. from Yale, and holds an M.A. and Ph.D. from Princeton. Dr. Ginsberg spent 17 years as a field biologist/conservationist working in Asia and Africa on a variety of wildlife issues. He has held faculty positions at Oxford University, University College London, is an Adjunct Professor at Columbia University, and is the author of over 40 reviewed papers and three books on wildlife conservation, ecology and evolution.

David Hanrahan, M.Sc. *Director - Global Programs, the Blacksmith Institute*

David Hanrahan oversees the technical design and implementation for Blacksmith of over 40 projects in 14 countries. Prior to joining Blacksmith, David worked at the World Bank for twelve years on a broad range of environmental operations and issues, across all the Bank's regions. During much of this time he was based in the central Environment Department where he held technical and managerial positions and participated in and led teams on analytical work and lending operations, including Acting Head of the department for a number of years.

Before joining the World Bank, he had twenty years of experience in international consultancy, during which time he also earned post-graduate degrees in policy analysis and in environmental economics. His professional career began in Britain in water resources for a major international engineering consultant. He then moved to Australia to build the local branch of that firm, where he helped to develop a broad and varied practice for public and private sector clients. He later returned to the UK and became Development Director for an environmental consultancy and subsequently Business Manager for a firm of applied economics consultants. In 1994 he was recruited by the World Bank to join its expanding Environment Department.

David Hunter, Sc.D. *Professor of Epidemiology and Nutrition, Harvard University School of Public Health*

Dr. Hunter received an M.B.B.S. (Australian Medical Degree) from the University of Sydney. He continued his formal education at Harvard University, receiving his Sc.D. in 1988. Dr. Hunter is a Professor of Epidemiology and Nutrition, Harvard School of Public Health. Dr. Hunter is involved with several large, population-based cohort studies, including the Nurses' Health Study (I and II), Health Professionals Follow-up Study, and the Physicians' Health Study. Among the goals of these large cohort studies is to investigate gene-environment interactions, including the impact of lifestyle factors, on disease causation. Disease endpoints of interest for some of these cohorts include cardiovascular disease, diabetes, and osteoporosis. He is also involved in long running studies of nutritional influences on HIV progression in Tanzania.

Donald E. Jones

Donald Jones is the founder of Quality Environmental Solutions, Inc. and was previously Director of the IT Corporation national program for clients with hydrocarbon-related environmental problems and development of environmental management programs. He has served as an elected Board of Health member and was appointed as Right-To-Know and Hazardous Waste Coordinator in the State of Massachusetts. Mr. Jones currently serves on the Local Water Board, as technical consultant to the local Facilities Board and provides editorial review of technical papers and publications for the National Ground Water Association.

Mukesh Khare

Dr. Mukesh Khare is a Professor at the Indian Institute of Technology in Delhi. He is a recognized consultant to many Indian and international bodies like the Central Pollution Control Board, Oil & Natural Gas Commission, National Thermal Power Corporation, Nuclear Power Corporation, (India); Associates in Rural

Development, Virginia, USA. He has published more than 30 research publications in international & national journals and conferences. Dr. Khare is listed in several prestigious biographical sources published by the American Biographical Institute, USA and International Biographical Center, UK.

Philip J. Landrigan, M.D., M.Sc. *Director, Center for Children's Health and the Environment, Chair, Department of Community and Preventive Medicine, and Director, Environmental and Occupational Medicine, Mount Sinai School of Medicine*

Dr. Landrigan is a member of the Institute of Medicine of the National Academy of Sciences. He is Editor-in-Chief of the American Journal of Industrial Medicine and previously was Editor of Environmental Research. From 1988 to 1993, Dr. Landrigan chaired a National Academy of Sciences Committee whose final report—*Pesticides in the Diets of Infants and Children*—provided the principal intellectual foundation for the Food Quality Protection Act of 1996. From 1995 to 1997, Dr. Landrigan served on the Presidential Advisory Committee on Gulf War Veteran's Illnesses. From 1997 to 1998, Dr. Landrigan served as Senior Advisor on Children's Health to the Administrator of the U.S. Environmental Protection Agency. He was responsible at EPA for establishing a new Office of Children's Health Protection. From 1970 to 1985, Dr. Landrigan served as a commissioned officer in the United States Public Health Service. He served as an Epidemic Intelligence Service Officer and then as a Medical Epidemiologist with the Centers for Disease Control in Atlanta. In his years at the CDC, Dr. Landrigan participated in epidemiologic studies of measles and rubella; directed research and developed activities for the Global Smallpox Eradication Program; and established and directed the Environmental Hazards Branch of the Bureau of Epidemiology. While at CDC, Dr. Landrigan also served for one year as a field epidemiologist in El Salvador and for another year in northern Nigeria. From 1979 to 1985, as Director of the Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute of Occupational Safety and Health in Cincinnati, he directed the U.S. national program in occupational epidemiology.

Dr. Landrigan obtained his medical degree from the Harvard Medical School in 1967. He interned at Cleveland Metropolitan General Hospital and completed a residency in Pediatrics at the Children's Hospital Medical Center in Boston. He obtained a Master of Science in occupational medicine and a Diploma of Industrial Health from the University of London.

Ian von Lindern Ph.D
CEO and Chariman, Terra Graphics Environmental Engineering, Inc.

Dr. Ian von Lindern received his B.S. in Chemical Engineering (1971) from Carnegie-Mellon University, Pittsburgh, PA; and his M.S. in Biometeorology and Atmospheric Studies (1973) and Ph.D. in Environmental Science and Engineering (1980) from Yale University, New Haven , CT. Dr. von Lindern has 30 years of environmental engineering and science experience in Idaho. He has directed over 30 major environmental investigations, involving solvent contamination of groundwater in the Southwest, an abandoned petroleum refinery, secondary smelters and battery processors, landfills, uranium mill tailings, and several major lead sites including: Dallas, TX; the Niagara and Riverdale Projects in Toronto, Canada; the Marjol Battery Site in Throop, PA; ASARCO/Tacoma, WA; East Helena and Butte/Anaconda in MT; Anzon Industries in Philadelphia, PA and the Rudnaya Pristan-Dalnegorsk Mining District, Russian Far East. Through TerraGraphics, Dr. von Lindern has worked continually for Idaho Department of Environmental Quality on various projects since the company's inception in 1984. He has been the lead Risk Assessor for the Bunker Hill Superfund Site in north Idaho, communicating associated risk issues at many public meetings in the community. In the last few years, Dr. von Lindern directed and completed the Union Pacific Railroad "Rails-to-Trails Risk Assessment;" the exhaustive Five-Year Review of the Populated Areas of the BHSS; the Human Health Risk Assessment for the Basin; and several other technical tasks.

Dr. von Lindern has served as a U.S. EPA Science Advisory Board (SAB) Member on three occasions: the Review Subcommittee for Urban Soil Lead Abatement Demonstration Project, 1993; the Subcommittee Assessing the Consistency of Lead Health Regulations in U.S. EPA Programs, Special Report to the

Administrator, 1992; and the Review Subcommittee Assessing the Use of the Biokinetic Model for Lead Absorption in Children at RCRA/CERCLA Sites, 1988. He also served on the U.S. EPA Clean Air Scientific Advisory

Bill Lorenz
Former Director, Environmental Resources Management, Young Leaders Programme Director, GIFT

Ira May

Ira May has worked as a geologist with the U.S. Army Environmental Center for more than twenty years. He has extensive experience with the clean up of hazardous waste sites at army facilities throughout the United States. Mr. May serves as a reviewer for the Groundwater magazine, a publication of the National Ground Water Association and is Vice Chairman of the Long Term Monitoring Committee of the Geotechnical Institute, American Society of Civil Engineers.

Paul Roux

Paul Roux is the CEO/founder of Roux Associates, Inc., a successful environmental consulting firm that ranked among the top 200 Environmental Consulting Firms in the July 2004 Engineering News Records. He has over 30 years of experience as a hydrogeologist and serves on the Board of Registration at the American Institute of Hydrology.

Leona D. Samson, Ph.D. *Ellison American Cancer Society Research Professor Director, Center for Environmental Health Sciences Professor of Biological Engineering, Massachusetts Institute of Technology*

Leona Samson received her Ph.D. in Molecular Biology from University College, London University, and received postdoctoral training in the United States at UCSF and UC Berkeley. After serving on the faculty of the Harvard School of Public Health for eighteen years, she joined the Massachusetts Institute of Technology in 2001 as a Professor of Biological Engineering and the Director of the Center for Environmental Health Sciences. Dr. Samson's research has focused on how cells, tissues and animals respond to environmental toxicants. Dr. Samson has been the recipient of numerous awards during her career, including the Burroughs Wellcome Toxicology Scholar Award (1993-98); the Charlotte Friend Women in Cancer Research Award (2000); the Environmental Mutagen Society Annual Award for Research Excellence (2001). In 2001, Dr. Samson was named the American Cancer Society Research Professor, one of the most prestigious awards given by the society. The ACS Professorship was subsequently underwritten by the Ellison Foundation of Massachusetts. In 2003, she was elected as a member of the Institute of Medicine of the National Academies of Science, and she will become the President of the Environmental Mutagen Society in 2004.

Appendix 3 – Scoring Criteria Document

Instructions to TAB Members

Each member of the TAB should complete the Excel spreadsheet attached to the nomination list and forward it to block@blacksmithinstitute.org.

Acknowledging that information related to each factor is often sparse, please give your best estimate for each factor. Do not leave a rating out – this will produce a false score for that site.

Factor #1

Number of People Potentially Affected

<1,000	1
1,000 to 10,000	2
10,000 to 100,000	3
>100,000	4

Factor #2

Severity of Carcinogen/Toxin

Group A (toxic) - *PCB's, coal/coke, fluorides, carbonate and organochloride pesticides, nitrates*	1
Group B (more toxic) - *mercury, cadmium, arsenic, asbestos, oil/petroleum, dioxin, PAH's*	2
Group C (highly toxic) - *lead, radionuclides, PM10 and PM 2.5, hexchromium, cyanide, VOC's, benzene, organophosphate pesticides.*	3

Factor #3

Large Numbers of Vulnerable Children, especially 3yrs to 12yrs

No	0
Yes	2

Factor #4

Clear Expectation or Evidence of Pathway to Human Contamination

No	0
Yes	2

Factor #5

Reliable Evidence of Health Impact

No	0

Yes	1

Factor #6

Geographical Size of Affected Area

Less than 1 acre	0
1 to 10 acres	1
More than 10 acres	2

Factor #7

Additional High Risk Element (TAB member discretion)

No	0
Yes	1

A total maximum of 15 points could be awarded for any one site.

Blacksmith Institute
2014 Fifth Avenue
New York, New York
10035, USA
www.Blacksmithinstitute.org