The World's Worst Polluted Places

The Top Ten of The Dirty Thirty

A Project of the Blacksmith Institute

September 2007

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The Top Ten
(of The Dirty Thirty)

Blacksmith Institute
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The Pollution Challenge Remains Unfinished

In 2006, Blacksmith Institute launched the first assessment of the extent of toxic pollution in the developing world. This was published as *The World's Worst Polluted Places: The Top Ten*. Blacksmith Institute now presents its second annual review of the most polluted places in the world – sites where human health is severely affected.

The initial report pointed out that decades of effort and attention have reduced industrial pollution to no more than an occasional worry for most of the developed world. However, this is certainly not the case in the poorest countries where pollution continues to be a major cause of death, illness, and long-term environmental damage. In these parts of the world, pollution shortens lives, damages children's development and growth, causes chronic illnesses, and kills thousands of people indiscriminately. All this makes strong, sustainable economic development very difficult.

Pollution in developing countries is often hidden away from the casual visitor. In most countries the major polluting industries are concentrated in special estates or industrial cities, usually well away from the capitals. Mining and metals processing are frequently located where the ore deposits are found, often in remote and mountainous areas. In these places people are faced with ongoing soil, air and water contamination from antiquated enterprises and the legacy of decades of uncontrolled emissions. These are locations where soils and groundwater have been poisoned, where rivers are saturated with toxins, and radioactive lakes cannot be approached safely, let alone be used for irrigation or drinking. In some towns, life expectancy approaches medieval rates and birth defects are the norm, not the exception. In others, children's asthma rates are measured above 90 percent and mental retardation is endemic. In such places, life expectancy may be half that of the richest nations and these shortened, debilitated lives are miserable.

The developed world may find it scarcely credible that such medieval conditions continue to exist, although it is perhaps only fifty years since parts of Europe and North America were black and infernal. The levels of regulatory and management controls that protect people in modern industrial societies are not yet reflected in developing countries. Even if sub-standard or antiquated factories were brought to modern expectations, the legacy of old contamination from the past would continue to poison the local population. Inadequacies in formal controls are often compounded by weaknesses in civil institutions and the inability to hold governments accountable when they fail to take action.

The 2006 Top Ten Report summarised the present situation bluntly: "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 on the poor and marginalized in the developing world. It is a major factor impairing economic growth, and a significant strain on the lives of already impoverished people." Efforts are being made and some successes have been seen but far too many people still live under these debilitating circumstances.

The problems are major, but this does not mean that they are hopeless. There are decades of experience in industrial nations in cleaning up the most toxic sites and as well as a handful of successful projects that are being implemented in the developing world. Blacksmith's website lists a number of such "Success Stories".

Solving these problems can also be extremely cost effective in terms of health impact. A recent review of the cost effectiveness of a sampling of Blacksmith interventions made estimates of the resulting health impacts and the cost-benefits, using established epidemiological data and methodologies. The estimated benefits compare favourably to World Bank estimates of costs of lives saved on interventions related to water supply, improved cooking stoves, and malaria controls. This confirms that dealing with highly polluted sites is one of the most cost effective methods to improving life expectancy in the developing world. (See full report at http://www.blacksmithinstitute.org/docs/costEff1.pdf).

What Has Changed in a Year?

The worldwide publicity that followed the publication of the 2006 *Top Ten* succeeded in reaching politicians, industrialists and concerned citizens around the world. As a result of the exposure and newly invigorated public pressure, governments and polluters in several of the sites listed in the 2006 report have responded. Positive actions have been taken to clean-up many of these pollution problems and protect impacted communities. However, given the scale of the problems at the worst sites, it is going to take time for measurable improvements in the health conditions of the local populations to emerge.

A significant number of new sites were nominated from across the globe as potential candidates for the 2007 Top Ten list. Every nomination received was added to Blacksmith's database and considered for the 2007 review. The methodology for assessing the severity of polluted sites has also been refined to place more weight on the scale and toxicity of the pollution and on the numbers of people at risk.

There have been some changes in the Top Ten as a consequence of these adjustments but no major reshuffle. The details and implications of the changes are discussed below, after the presentation of the selected sites.

Despite ongoing efforts to make the survey of the world's most toxic places more comprehensive, the list of nominated sites is still incomplete.

Blacksmith will continue to review sites as they are nominated, continually improving and updating our yearly list until health in developing countries is no longer threatened by toxic industrial pollution.

Updating the Top Ten and Introducing the Dirty Thirty

The Top Ten list was compiled again this year with heavy reliance on Blacksmith's Technical Advisory Board (TAB) of experts, with over 250 years of combined experience in this field. The TAB includes specialists from Johns Hopkins University, Hunter College, Harvard University, IIT Delhi, University of Idaho, Mt. Sinai Hospital, and leading international environmental engineering companies.

Blacksmith began the Top Ten review process by surveying the existing database of polluted sites. Over the past seven years, Blacksmith has amassed a list of over 400 severely polluted locations from all regions of the world. The initial survey narrowed these down to about seventy sites - all with severe human health risks, all deserving the attention of the global community. In discussing feedback from last year's Top Ten, it became clear that the list needed to be more representative of the different types and locations of polluted sites.

To achieve this while maintaining an objective process of selecting the Top Ten, the initial seventy sites were presented as a matrix showing location and type. These seventy were then reduced to thirty while maintaining, as far as possible, a full range of diversity in the sites. These then became the "Dirty Thirty" which formed the basis of the Top Ten selection. The full Dirty Thirty are presented on page 7, in the matrix format.

The TAB used the revised methodical approach that places increased emphasis on the toxicity and scale of the pollution sources and also on the numbers of people at risk. This approach is presented in more detail in the Annexes. TAB members individually prepared their evaluations of the thirty sites and then discussed them in a conference. Based on the individual rankings and the consensus from the conference, the worst of the larger group made the final Top Ten list.

It is not realistic or feasible to put these sites into a final rank order from one to ten, given the wide range of location sizes, populations and pollution dynamics. This report refrains from pointing a finger at any one place as being the worst on earth and therefore this report lists polluted sites *alphabetically*, by country name.

One important caveat to be made is the relative weakness of the information on which the selection process is based. More and better data would greatly improve the assessment process but the reality is that good data is (at best) missing and (at worst) hidden or distorted. Efforts continue to improve the knowledge and understanding of the main sites. However, we must rely significantly on the qualitative judgements and experience of the TAB in ranking the worst sites.

The Top Ten – Summary Table
(NOT RANKED - listed alphabetically by country)

Site Name and Location	Major Pollutants and Sources	Scope of the Problem and Human Health Impact	Cleanup Status
Sumgayit, Azerbaijan	Organic chemicals and mercury, from petrochemical and industrial complexes	Dated technologies, a lack of pollution controls and improper disposal of industrial waste have left the city contaminated.	Various multilateral development agencies, international banks and governments have invested moneys to do the clean-up.
Linfen, China	Particulates and gases from industry and traffic	Expanding and unregulated industry based on local coal and other resources has resulted in the worst air quality in China. There are high incidences of respiratory and skin diseases and lung cancer.	The local government plans to shut down more than 200 factories by the end of 2007 and replace them with clean and better regulated facilities.
Tianying, China	Heavy metals and particulates; industry	Average lead content in the air and soil are up to10 times higher than national standards. Children suffer from birth defects and developmental challenges.	The State Environmental Protection Administration has ordered all lead processing firms to be shut down until they address environmental impacts.
Sukinda, India	Hexavalent chromium; chromite mines	Waste rock and untreated water from the mines impacts local water supplies. The air and soils are also heavily affected. Residents suffer from gastrointestinal bleeding, tuberculosis, and asthma. Infertility and birth defects are common.	Some piecemeal actions have been taken by mining companies but the scale of the problems is "beyond the means of the State to solve".
Vapi, India	Wide variety of industry effluents; industrial estates	More than 50 industrial estates discharge heavy metals, pesticides, and chemical waste. Mercury in the groundwater is 96 times higher than WHO standards. Very high incidences of cancer and birth complications have resulted.	A number of waste facilities have been constructed but serious problems persist, despite pressure from environmental agencies and NGOs. No comprehensive plan for the area has been proposed.
La Oroya, Peru	Lead and other heavy metals; mining and metal processing	Metal mining and smelting over 80 years has caused significant lead contamination. Blood lead levels for children average 33.6 µg/dl, triple WHO limits.	The current owner, Doe Run, has made some investments in the operating plant but the legacy issues have not been addressed.
Dzerzhinsk, Russia	Chemicals and toxic byproducts, lead; chemical weapons and industrial manufacturing	A major site for Cold War era manufacturing where industrial chemicals have been discharged into the local water supplies. Life expectancy is short and the death rate is significantly higher than Russia's average.	A number of isolated efforts have been undertaken in individual villages but no major clean-up activity has been undertaken.
Norilsk, Russia	Heavy metals, particulates; mining and smelting	Mining and smelting operations have devastated the area with particulates and heavy metal pollution. Norilsk Nickel is the biggest air polluting industrial enterprise in Russia.	Norilsk Nickel has begun to implement plans for some emissions controls. There is as yet little visible improvement.
Chernobyl, Ukraine	Radioactive materials; nuclear reactor explosion	The legacy of this most infamous of nuclear disasters lingers and has resulted in thousands of cancer deaths. Respiratory, ear, nose, and throat diseases are common ailments.	Most residents have moved and some remediation projects have been implemented. Future health impacts are possible.
Kabwe, Zambia	Lead; mining and smelting	Unregulated lead mining and smelting operations resulted in lead dust covering large areas. Children's' blood lead levels average between 50 and 100 µg/dl – up to ten times the recommended maximum.	The World Bank has begun a $40 million remediation program with the Government of Gambia, initiated with Blacksmith involvement.

The Dirty Thirty (including the Top Ten)

(listed by region and type)

2007 World's Worst Polluted Places – The Dirty Thirty Summary Matrix										
World Region	**Type of Pollutant/Source**									
	Mining	Metals	Petro-Chems	Nuclear	Weapons	Industrial Complex	SME Cluster	Urban Waste	Air Pollution	Other
Africa	**Kabwe, Zambia**							**Dandora Dumpsite, Kenya**		
China	**Wanshan China**	**Tianying, China**				**Huaxi, China**			**Lanzhou, China** **Linfen, China** **Urumqi, China**	
Eastern Europe and Central Asia	**Chita, Russia**	**Norilsk, Russia** **Rudnaya Pristan/ Dalneg'sk, Russia**	**Bratsk, Russia**	**Chernobyl, Ukraine** **Mailuu-Suu, Kyrgyzstan**	**Dzerzhinsk Russia**	**Sumgayit, Azerbaijan** **Ust-Kameno-gorsk, Kazakh-stan**			**Magnitogor sk, Russia**	
Latin America and the Caribbean	**Huancav' lca Peru** **La Oroya, Peru**	**Haina, Domincan Republic**	**Oriente, Ecuador**						**Mexico City, Mexico**	**Matanza-Riachuelo, River Basin, Argentina**
South Asia	**Sukinda, India**		**Hazarib'g Bangl'sh** **Ranipet, India**			**Mahad Industrial Estate, India** **Vapi, Gujarat, India**				
South-east Asia							**Meycaua-yan City and Marilao, Philippines**			

What Has Changed From the 2006 Listing?

Six of the ten sites that were on last year's list remain in this year's Top Ten:

Linfen (China),
La Oroya (Peru),
Dzerzhinsk (Russia),
Norilsk (Russia),
Chernobyl (Ukraine), and
Kabwe (Zambia).

Two sites that were on the longer list in 2006 have now moved into the Top Ten, as a result mainly of the revisions to the scoring methodology. These are

Sumgayit (Azerbaijan) and
Vapi (India).

The two following sites that were not on the nomination list in 2006 have now been included in the Top Ten. Their identification during the past year and their inclusion as top sites highlights the need for ongoing expansion and refinement of the overall database of polluted sites, in order to find other neglected candidates.

Tianying (China) and
Sukinda (Orissa).

As a consequence of the inclusion of four new sites at the top of the overall list, the following have dropped down lower into the Dirty Thirty listing.

Haina (Dominican Republic),
Ranipet (India),
Mailuu-Suu (Kyrgyzstan), and
Rudnaya Pristan (Russia).

The reasons for these lower rankings are fundamentally due to increased competition from new sites and changes in the methodology that reduced the ranking for smaller sites or for those where the risks are less clear. Remediation works have commenced at some of these sites but the clean-ups have not progressed to the point where they have reduced the impacts to a significant extent.

What Next?

As noted at the beginning of this report, there are cost effective interventions that can be undertaken to deal with highest priority "hot spots" within the Dirty Thirty. However, the level of investments required to deal with the top sites is beyond that

which can be assembled locally and therefore national government or even international support is needed. Blacksmith and other groups work with key local champions to identify realistic and practical solutions and then continue to be intermediaries in trying to identify major support. The kind of issues that are most amenable to this approach are large scale point-source problems such as mines and metal smelters.

More difficult to address are the declining industrial cities or complexes, where a focus on unfettered production in the past has left a legacy of human and environmental problems. Unfortunately, there are too many of these “industry towns” still carrying on where there is no economic alternative for the local population. The interventions in these places begin with supporting a core group of concerned people and officials to create a consensus and build momentum, starting with some simple but visible improvements to show that progress is possible. Blacksmith continues to support all of these approaches.

Details of the 2007 Top Ten World's Worst Polluted Places

(Sites Listed Alphabetically by Country)

Sumgayit, Azerbaijan

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
275,000	Organic chemicals, oil, heavy metals including mercury.	Petrochemical and Industrial Complexes

The Problem:

Sumgayit was a major Soviet industrial center housing more than 40 factories manufacturing industrial and agricultural chemicals. These included synthetic rubber, chlorine, aluminium, detergents, and pesticides. While the factories remained fully operational, 70-120,000 tons of harmful emissions were released into the air annually. With the emphasis placed on maximum, low-cost production at the expense of environmental and occupational health and safety, industry has left the city heavily contaminated. Factory workers and residents of the city have been exposed to a combination of high-level occupational and environmental pollution problems for several decades.

Untreated sewage and mercury-contaminated sludge (from chlor-alkali industries) continue to be dumped haphazardly. A continuing lack of pollution controls, dated technologies and the improper disposal and treatment of accumulated industrial waste are just some of the issues that plague the city.

Health Impacts:

Sumgayit had one of the highest morbidity rates during the Soviet Era and the legacy of illness and death persist. A study jointly conducted by the UNDP, WHO, Azerbaijan Republic Ministry of Health and the University of Alberta demonstrated that residents of Sumgayit experience intensely high levels of both cancer morbidity and mortality. Cancer rates in Sumgayit are 22-51% higher than average incidence rates in the rest of Azerbaijan. Mortality rates from cancer are 8% higher. Evidence suggests that lower reported cancer rates are flawed as a result of underreporting.

A high percentage of babies are born premature, stillborn, and with genetic defects like downs syndrome, anencephaly, spina bifida, hydrocephalus, bone disease, and mutations such as club feet, cleft palate, and additional digits.

Status of Clean-Up Activity:

The government of Azerbaijan has obtained international support for the economic and environmental rehabilitation of the city from several United Nations organizations, including the United Nations Development Programme (UNDP) and the World Health Organization (WHO). The UNDP helped to create the Sumgayit Centre for Environmental Rehabilitation (SCER) to research and prioritize the environmental problems and propose programs to address them. A number of environmental epidemiology courses were held in Baku to strengthen the capacity of local experts.

In 2003, the World Bank launched a US $2.7 million project for the cleanup of a chlorine producing plant where 1,566 tons of mercury were spilled, including the construction of a secure landfill. Other international projects funded by UK and Japan have also been implemented.

Reports indicate that only 20% of Soviet Era polluting factories are still operating and there are ongoing debates about closure of the remaining number. However, even if all the polluting industries are dealt with, there remains a significant legacy clean-up challenge.

Resources:

J.E. Andruchow, C.L. Soskolne, F. Racioppi, et al. "Cancer Incidence and Mortality in the Industrial City of Sumgayit, Azerbaijan". Int J. Occupational Environmental Health. (2006). 12 (3). 234-241. http://www.ijoeh.com/pfds/IJOEH_1203_Andruchow.pdf.

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12, 505-508.

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Andruchow, James Edward. Epidemiology Program, Department of Public Health Sciences, University of Alberta, January, 2003.
http://www.phs.ualberta.ca/staff/soskolne/PDF%20Files/Thesis-FINAL-UofA-Lodged-Jan6- 2003.pdf

Islamzade, Arif. Sumgayit: Soviet's Pride, Azerbaijan's Hell. Autumn 1994.

Linfen, China

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
3,000,000	Fly-ash, carbon monoxide, nitrogen oxides, PM-2.5, PM-10, sulfur dioxide, volatile organic compounds, arsenic, lead.	Automobile and industrial emissions

The Problem:

Shanxi Province is at the heart of China's enormous and expanding coal industry, providing about two thirds of the nation's energy. Within this highly polluted region, Linfen has been identified as one of its most polluted cities with residents claiming that they literally choke on coal dust in the evenings. In terms of air quality, the World Bank has stated that 16 out of 20 of the world's worst polluted cities are in China while the State Environmental Protection Administration (SEPA) has branded Linfen as having the worst air quality in the country. Levels of SO_2 and other particulates are many times higher than limits set by the World Health Organization.

Rapid development and unequivocal faith in industry has led to the development of hundreds of unregulated coal mines, steel factories and refineries which have not only polluted indiscriminately but have also diverted agricultural water sources. Water is so tightly rationed that even the provincial capital receives water for only a few hours each day.

Health Impacts:

The high levels of pollution are taking a serious toll on the health of Linfen's inhabitants. Local clinics are seeing growing cases of bronchitis, pneumonia, and lung cancer. The children of Shanxi Province also have high rates of lead poisoning. A growing number of local deaths in recent years have been linked to these overwhelming pollution levels.

Arsenicosis, a disease caused by drinking elevated concentrations of arsenic found in water is at epidemic levels in the area. Chronic exposure to this toxic chemical results in skin lesions, peripheral vascular disease, hypertension, blackfoot disease, and high cancer incidence rates. A study of Shanxi's well water published in *Toxicology and Applied Pharmacology* found the rate of unsafe well water in the province to be at an alarming 52%.

Status of Clean-Up Activity:

By the end of this year, the city of Linfen plans to shut down 160 of 196 of its iron foundries and 57 of 153 of its coal producing plants. Small, highly polluting plants will be replaced with larger, cleaner, more regulated facilities. Emissions will be cut further by shifting from coal to gas for central heating. Last year, Linfen's residents gained 15 more days of clean, breathable air as a result of newly implemented initiatives. In addition to air quality improvement, the local government also hopes to prevent serious coal mine accidents, which at this point are the cause of more than 10 deaths annually.

Resources:

China Internet Information Center. "Rivers Run Black in Shanxi Province." China Daily *(2006) July 17, 2006. http://service.china.org.cn/link/wcm/Show_Text?info_id=174874&p_qry=Linfen*

Qin Jize. "Most polluted cities in China blacklisted." China Daily. (2004) July 15. http://www.chinadaily.com.cn/english/doc/2004-07/15/content_348397.htm

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http://environment.guardian.co.uk/waste/story/0,,2042999,00.html#article_continue

http://www.chinadaily.com.cn/china/2007-05/24/content_879724.htm

http://www.gadling.com/2007/04/01/lifen-china-boosts-tourism-with-mask-give-a-way/

Tianying, China

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
140,000	Lead and other heavy metals	Mining and processing

The Problem:

Tianying in Anhui province is one of the largest lead production bases in China, with an output accounting for half of the country's total production. Low-level technologies, illegal operation and the lack of any serious pollution control measures in the firms have caused several severe lead poisoning cases in the region. It is also believed that there are numerous small scale recycling plants in the area, which are notorious for polluting. As a result of these indiscriminate practices, lead processing firms in Tianying have been pressured by local residents and officials to shut down their operations.

The average lead concentrations in air and soils were (respectively) 8.5 times and 10 times national health standards. Eighty-five per cent of air samples collected had lead concentrations higher than the national standards. Local crops and wheat at farmers' homes were also contaminated by lead dust, with some levels 24 times higher than national standards.

Health Impacts:

Residents, particularly children, are reported to suffer from lead poisoning and its related effects: lead encephalopathy, lower IQs, short attention spans, learning disabilities, hyperactivity, impaired physical growth, hearing and visual problems, stomach aches, irritation of the colon, kidney malfunction, anaemia and brain damage. Pregnant women have reported numerous cases of premature births and smaller/underdeveloped infants.

Status of Clean-Up Activity:

In June of 2000 SEPA (State Administration of Environmental Protection) designated this area as one of the eight worst polluted sites in China. The local administration ordered that all lead processing firms be shut down until they addressed their environmental impacts. The government has demanded that all lead processing firms move their operations to a specified industrial zone and improve their treatment facilities. New lead smelters in China will have to be large scale, modern and with adequate pollution controls. It is not known how effectively these orders are being implemented.

However, regardless of improvements made to ongoing plants, the legacy pollution from the tons of lead lost from badly run plants in the past will continue to negatively impact the local population for decades unless specific measures are implemented to remove or encapsulate the worst polluted dust and soils.

Resources:

http://bobwhitson.typepad.com/howlings/2004/10/river_without_f.html

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=12411081&dopt=Abstract

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Sukinda, India

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
2,600,000	Hexavalent chromium and other metals	Chromite mines and processing

The Problem:

Sukinda Valley, in the State of Orissa, contains 97% of India's chromite ore deposits and one of the largest open cast chromite ore mines in the world. Twelve mines continue to operate without any environmental management plans and over 30 million tons of waste rock are spread over the surrounding areas and the Brahmani riverbanks. Untreated water is discharged by the mines into the river. This area is also flood-prone, resulting in further contamination of the waterways. Approximately 70% of the surface water and 60% of the drinking water contains hexavalent chromium at more than double national and international standards and levels of over 20 times the standard have been recorded. The Brahmani River is the only water source for the residents and treatment facilities are extremely limited. The State Pollution Control Board has conceded that the water quality at various locations suffers from very high levels of contamination. The air and soils are also heavily impacted.

Health Impacts:

Chromite mine workers are constantly exposed to contaminated dust and water. Gastrointestinal bleeding, tuberculosis and asthma are common ailments. Infertility, birth defects, and stillbirths and have also resulted. The Orissa Voluntary Health Association (OVHA), funded by the Norwegian government, reports acute health problems in the area. OVHA reported that 84.75% of deaths in the mining areas and 86.42% of deaths in the nearby industrial villages occurred due to chromite-mine related diseases. The survey report determined that villages less than one kilometre from the sites were the worst affected, with 24.47% of the inhabitants found to be suffering from pollution-induced diseases.

Status of Clean-Up Activity:

Sukinda is a classic example of pollution where the wastes are spread over a large area and residents are affected by the chromium through multiple pathways. The pollution problem from the chromite mines is well known and the mining industry has taken some steps to reduce the levels of contamination by installing treatment plants. However, according to state audits from Orissa, these fail to meet agency regulations. The Orissa government has said, "It is unique, it is gigantic and it is beyond the means and purview of the [Orissa Pollution Control] Board to solve the problem."

Various organizations have carried out studies proving the debilitating health impacts of the toxic pollution. However, remediation actions remain piecemeal with no decisive plans to provide for effective health monitoring and abatement programs.

Resources:

http://www.geocities.com/envis_ism/news36_28.html http://mines.nic.in/anrep04-05/chapter7.pdf
http://cag.nic.in/reports/orissa/rep_2001/civil_overview.pdf

http://www.mmpindia.org/madhavan/pages/14.htm

http://www.atsdr.cdc.gov/tfacts7.html

http://www.rrlbhu.res.in/envis/Marine_pollution.html

http://www.mmpindia.org/madhavan/pages/14.htm

http://www.downtoearth.org.in/fullprint.asp

http://www.cesorissa.org/PDF/newsletter_vol_5.pd

http://rajyasabha.nic.in/book2/reports/petition/127threport.htm

Vapi, India

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
71,000	Chemicals and heavy metals	Industrial estates

The Problem:

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 which includes Nandesari, Ankleshwar, and Vapi. There are over 50 industrial estates in the region including more than 1,000 individual industries that extend over more than a thousand acres. Many of these are chemical manufacturing estates producing petrochemicals, pesticides, pharmaceuticals, textiles, dyes, fertilizers, leather products, paint, and chlor-alkali.

The waste products discharged contain heavy metals, cyanides, pesticides, complex aromatic compounds (such as polychlorinated biphenyls or PCBs), and other toxics. Vapi and the Ankleshwar area were declared ‘‘critically polluted’’ by the Central Pollution Control Board of India (CPCB) in 1994. This followed a survey that revealed that there was no system in place to dispose of industrial waste at these estates. *Down to Earth*, an environmental magazine based in India, conducted an analysis on the groundwater and found exceedingly high levels of mercury, lead and zinc. Mercury in Vapi’s groundwater is reported to be 96 times higher than WHO health standards. Effluents drain directly into the Damanganga and Kolak Rivers; water downstream of the Kolak is now unable to support much biological life. Active dumping is also reported in at least one industrial site. Air pollution results from emissions due to the improper handling of chemicals by industries.

Local produce has been found to contain up to 60 times more heavy metals (copper, chromium, cadmium, zinc, nickel, lead, iron) than non-contaminated produce in control groups. Heavy metal analyses have revealed that both the effluents and sediments collected were contaminated with cadmium, chromium, copper, lead, mercury, nickel and zinc. Sediment samples were found to contain 17 organohalogen compounds, including chlorobenzenes and PCBs as well as a range of other organic compounds including benzene derivatives and pesticides.

Health Impacts:

Many residents have no choice but to drink contaminated well water as other clean water sources are more than a mile away. The Indian Medical Association reported that most of the drinking water supplies are contaminated, because of the absence of a proper system for disposing industrial effluents. This has resulted in very high incidences of respiratory diseases, chemical dermatitis, carcinoma, skin, lung and

throat cancers. Women in the area report exceedingly high incidences of spontaneous abortions, bleeding during pregnancy, abnormal fetuses, and infertility. Children's ailments include respiratory and skin diseases and retarded growth.

Status of Clean-Up Activity:

In the late 1990s, Vapi Industries Association incorporated the Vapi Waste and Management Company to set up and operate a common effluent treatment plant to collect and purify effluents from the major plants. However, the operation of the plant has been determined to be unsatisfactory by the Supreme Court Monitoring Committee. The efforts to improve the local river and water quality are hampered by the haphazard dumping of sludge from the treatment plant and the widespread dumping of various industrial and hazardous wastes in the general area. There has been considerable NGO activity and efforts by environmental authorities effective cleanup at the various sites remains limited.

Several treatment, storage and disposal facilities (TSDFs) are now coming into operation in the area and can deal with some of the ongoing wastes but in the absence of a comprehensive and commited clean-up effort, the problems in Vapi will remain.

Resources:

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http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1257623

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http://www.cseindia.org/hindu.htm

http://timesofindia.indiatimes.com/articleshow/92657.cms

http://www.gujaratplus.com/environment/vapi.html

http://www.toxicslink.org/docs/06038_CETP_Report.pdf

La Oroya, Peru

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
35,000	Lead, copper, zinc, and sulfur dioxide.	Heavy metal mining and processing

The Problem:

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 and wastes from the plant. Peru's Clean Air Act cites La Oroya in a list of Peruvian towns suffering from critical levels of air pollution, but action to clean up and curtail this pollution has been delayed for area's 35,000 inhabitants. Currently owned by the Missouri-based Doe Run Corporation, the plant has been largely responsible for the dangerously high lead levels found in children's blood.

Health Impacts:

Ninety-nine percent of children living in and around La Oroya have blood lead levels that exceed acceptable limits, 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 µg/dL for children between the ages of 6 months to ten years, triple the WHO limit of 10 µg/dL. Neurologists at local hospitals state that even newborn children have high blood lead levels, inherited while still in the womb. Absurdly large rates of premature deaths are linked to noxious gasses from the smelter. Lung-related ailments are commonplace.

Sulfur dioxide concentrations also exceed the World Health Organization guidelines by a factor of ten. 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 clean up has been prepared.

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.

Status of Clean-Up Activity:

Doe Run Corporation asserts that an environmental management plan has been developed for the processing plant. However, the Corporation asked the government for a four-year extension to the plant's environmental management plan in 2004. 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. Some sampling and testing has been done in the local communities and the areas outside the plant to determine the levels of pollutants.

In response to the listing of La Oroya in the 2006 Top Ten, Doe Run sent a letter to Blacksmith Institute on May 2, 2007 stating that it has curbed its toxic emissions and has invested approximately $1 million yearly in joint program with the Peruvian Ministry of Health designed to lower blood lead levels in the region. Doe Run states that it has made significant capital investments in emission control systems, water treatment plants and changing rooms. The company asserts that it has also introduced occupational and population health programs and has made its environmental improvement efforts more public. They report emission levels to have fallen since these health programs and investments were made in new technologies. Sanctions against Doe Run are still expected, mainly for sulphur dioxide emissions that it was required to reduce by this year. Doe Run is also investing in community development and poverty alleviation efforts by implementing various job-training programs. Doe Run is the main driver of the local economy and hence able to exercise control over the livelihood of the population.

The government's national environmental council approved a Contingency Plan for States of Alert (CONAM) on August 10th of this year. Its purpose will be to limit the exposure of the affected population by issuing red alerts to stay inside in response to highly toxic air quality and weather conditions that exacerbate pollution levels. The mayor of the city of La Oroya states that the alert programme will remain in effect until Doe Run fully complies with pollution reduction measures. If the contingency plan was already implemented, a state of emergency would have been declared 183 days so far this year.

Resources:

"Development of an integrated intervention plan to reduce exposure to lead and other contaminants in the mining center of La Oroya, Peru". Centers for Disease Control and Prevention National Center for Environmental Health/ Agency for Toxic Substances and Disease Registry Division of Emergency and Environmental Health Services. (2005)
http://www.cdc.gov/nceh/ehs/Docs/la_oroya_report.pdf

"Crisis Deepens in La Oroya" Oxfam America. (2004) December 20.
http://www.oxfamamerica.org/newsandpublications/news_updates/archive2004/news_update.2004-12-20.4019587716

Dzerzhinsk, Russia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
300,000	Chemicals and toxic byproducts, including Sarin, VX gas, etc. Also lead, phenols.	Cold War-era chemical weapons manufacturing

The Problem:

Until the end of the Cold War, Dzerzhinsk was among Russia's principal production sites of chemical weapons. Today, Dzerzhinsk is still a significant center of Russian chemical manufacturing. The city was also home to a leaded gasoline factory that produced TEL, a potent toxin. However, little attention was paid to the impacts of all this production. According to figures from Dzerzhinsk's environmental agency almost 300,000 tons of chemical waste were improperly disposed between 1930 and 1998. In this waste, around 190 identified chemicals have been released into the groundwater. In places, the chemicals have turned the water into a white sludge containing dioxins and high levels of phenol – an industrial chemical that can lead to acute poisoning and death. These levels are reportedly 17 million times the safe limit. The Guinness Book of World Records has named Dzerzhinsk the most chemically polluted city in the world.

Because a number of industries are no longer in operation, the local groundwater has risen, along with the water level in the canal. This rise in the water level threatens to release massive amounts of arsenic, mercury, lead and dioxins into the Oka river basin, a source of drinking water for the nearby city of Nizhny Novgorod. Drinking water supplies in Nizhny Novgorod City and adjoining villages such as Gavrilovka and Pyra are heavily laced with contamination.

Health Impacts:

A quarter of the city's 300,000 residents are still employed in factories that produce 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, the death rate was reported to exceed the birth rate by 260%. The city's annual death rate, 17 per 1,000, is higher than Russia's national average of 14 per 1,000. In the city of 300,000, that translates to about 900 extra deaths annually. The average life expectancy is reported to be 42 years for men and 47 for women.

Status of Clean-Up Activity:

A number of isolated efforts have been undertaken to deal with individual plants and sources of contamination but there has been no concerted effort to deal with the huge problems in a systematic way. A local NGO (DRONT), supported by Blacksmith and in cooperation with the Nizhniy Novgorod municipal government, has brought together a steering committee to work on the design of a large-scale remediation and pollution mitigation plan for the entire affected area. Following support for a baseline study in 2004, Blacksmith Institute, in cooperation with the local government, funded the installation of water treatment systems in two villages where drinking water supplies were heavily contaminated – in Pyra and Gavirolvka. However, these are very small-scale initiatives relative to the efforts needed to remediate this devastatingly polluted area.

Local officials assert that no ecological disaster is present. However, it is likely that their tests only monitored pollution levels in the atmosphere and perhaps in surface waters and not the extent of legacy contamination. The health of local residents is still threatened by legacy pollution issues.

Resources:

Dzerzhinsk Chemical Plant Workers Call for Better Pensions: FBIS-TAC-97-119: 29 Apr 1997

Russian Chemical Weapons Sites Undergo Foreign Inspection: FBIS-TAC-98-068: 9 Mar 1998

M R. Edelstein. "Empowering Russian And American NGOs To Address Issues Of Future Sustainability" Final Project Report. Ramapo College of New Jersey (2005) http://phobos.ramapo.edu/facassem/edelsteinempoweringngos.html

"Dzerzhinksk" Global Security Organization. http://www.globalsecurity.org/wmd/world/russia/dzerzhinsk_cbw.htm

Tim Samuals, "Russia's Deadly Factories." BBC News. March 7, 2003. http://news.bbc.co.uk/1/hi/programmes/correspondent/2821835.stm

Norilsk, Russia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
134,000	Air pollution – particulates, sulfur dioxide, heavy metals (nickel, copper, cobalt, lead, selenium), phenols, hydrogen sulfide.	Major nickel and related metals mining and processing

The Problem:

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. Mining and smelting operations began in the 1930s and this city now contains the world's largest heavy metals smelting complex, where nearly 500 tons each of copper and nickel oxides and two million tons of sulphur dioxide are released annually into the air. The city has been accused of being 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. A 1999 study found elevated copper and nickel concentrations in soils in as much as a 60 km radius of the city.

Norilsk Nickel, the firm responsible for the pollution, 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 also ranks first among Russian industrial enterprises in terms of air pollution. The plants were constructed during the Soviet era, a period of non-existent environmental standards or controls.

Health Impacts:

The local population is severely affected by the air quality where air samples exceed the maximum allowable concentrations for both copper and nickel. Children suffer from numerous respiratory diseases. Investigations evaluating the presence of ear, nose and throat diseases 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. Mortality from respiratory diseases is considerably higher than the average in Russia, accounting for 15.8% of all deaths among children. Premature births and late-term pregnancy complications are also frequent. Sulfur dioxide emissions contribute to chronic diseases of the lungs, respiratory tracts, and digestive systems – and can result in lung cancer.

Status of Clean-Up Activity:

According to company reports, Norilsk Nickel has worked consistently to reduce emissions of major air pollutants. In 2006, the company reported investment of more than US $5m to maintain and overhaul its dust and gas recovery and removal systems. It asserts a commitment of nearly US $1.4m for its air pollution prevention plan. However, official statistics state that emissions remain extremely high.

Norilsk Nickel has been amenable to Blacksmith Institute's efforts to investigate the plant and facilities. Blacksmith representatives visited the site in July of 2007 and confirmed that, indeed, the company was making significant efforts to address the level of emissions. Norilsk Nickel stated their intention to move the nickel plant inside the city to a plant just outside. They also aspire to reduce the volume of sulphur dioxide emissions to 400 thousand tons by 2015 (which would result in normal atmospheric air) but admit that goal deadline is an extremely ambitious one.

Blacksmith staff also met with leading experts on environment and health while conducting this recent site assessment. These local experts confirmed extremely high levels of atmospheric contamination. They reported that although there have been some reductions in pollution levels, levels of SO_2, HS, phenol, formaldehyde, and dust had increased; levels of nickel and copper had increased by 50%. Morbidity rates are stable and death rates are decreasing.

Their reports on children's health confirmed much higher rates of respiratory, digestive and nervous illnesses and more abortions and premature births than other cities in the region. Incidences of cancer (especially lung) have increased. Some estimates state that air pollution is responsible for 37% of children's morbidity rates and 21.6% of adult morbidity.

Resources:

Norilsk Nickel. *Company Report on Air Pollution Reduction Measures in 2006 and Plans for 2007.*

S. M. Allen-Gil, J. Ford, B. K. Lasorsa, M. Monetti, et al. "Heavy metal contamination in the Taimyr Peninsula, Siberian Arctic". The Science of the Total Environment 301 (2003) 119-138.

J. M. Blais, K. E. Duff, T.E. Laing, J.P. Smol. "Regional contamination in lakes from the Noril'sk region in Siberia, Russia". Water Air Soil Pollut. (1999) 110 (3-4) 389-404.

O.N. Zubareva, L. N. Skripal'shchikova, N. V. Greshilova, and V. I. Kharuk. "Zoning of landscapes exposed to technogenic emissions from the Norilsk Mining and Smeltering works". Russian Journal of Ecology (2003) 34 (6) 375-380.

B. A. Revich. "Public health and ambient air pollution in Arctic and Subarctic cities of Russia". The Science of the Total Environment. (1995). 160/161 585-592.

Chernobyl, Ukraine

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
Initially 5.5 million, now disputed numbers.	Radioactive dust including uranium, plutonium, cesium-137, strontium, and other metals	Meltdown of reactor core in 1986

The Problem:

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 meltdown of the reactor's core. Thirty people were killed in the accident, 135,000 were evacuated, and one hundred times more radiation was released than by the atom bombs dropped over Hiroshima and Nagasaki. Twenty years later, the 19-mile exclusion zone around the plant remains uninhabitable.

Although an enormous amount of radiation was released during the disaster, most of the radioactivity has remained trapped within the plant itself. Some estimate that more than 100 tons of uranium and other radioactive products, such as plutonium, could 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.

Health Impacts:

From 1992 to 2002 in Belarus, Russia and Ukraine more than 4000 cases of thyroid cancer were diagnosed among children and adolescents, those under 14 years were most severely affected. Most of these cases have been attributed to elevated concentrations of radioiodine found in milk. More than five million people currently inhabit the affected areas of Belarus, Russia, and Ukraine, which have all been classified as ‘contaminated’ with radionuclides credited to the Chernobyl accident (above 37 kBq m^{-2} of ^{137}Cs). Skin lesions, respiratory ailments, infertility and birth defects were the norm for years following the accident.

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

Status of Clean-Up Activity:

Within several months of the accident, the reactor was enclosed in a concrete casing designed to absorb radiation and contain the remaining fuel. However, the sarcophagus was meant to be a temporary solution and designed to last only 20 or 30 years. A program to further secure the site is underway.

Researchers have carried out studies on health impacts, remediation effects, and the socioeconomic status of the region surrounding Chernobyl. Plans exist for the 19-mile exclusion zone to be recovered for restricted industrial uses. However, an appropriate environmental impact assessment needs to be finished before that can happen and an integrated radioactive waste management program needs to be put in place before further development. Estimates for remediation projects have been projected at hundreds of billions of dollars. To date, the costs of the cleanup have placed significant financial burdens on Belarus, Ukraine, and Russia.

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

Resources:

IAEA International Atomic Energy Agency. "Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts and recommendations to the governments of Belarus, the Russian Federation and Ukraine." The Chernobyl Forum: 2003-2005.
http://www.iaea.org/Publications/Booklets/Chernobyl/chernobyl.pdf

IAEA International Atomic Energy Agency. "Environmental consequences of the Chernobyl accident and their remediation: Twenty Years of Experience" Report of the Chernobyl Forum Expert Group 'Environment'. (2006)

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1239_web.pdf

Johnson, Eric. Green Cross Switzerland. 12 December 2005.

World Health Organization. "Health Effects of the Chernobyl Accident and Special Health Care Programmes." Report of the UN Chernobyl Forum Expert Group "Health". (2006)
http://www.who.int/ionizing_radiation/chernobyl/WHO%20Report%20on%20Chernobyl%20Health%20Effects%20July%2006.pdf

Kabwe, Zambia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
255,000	Lead, cadmium	Lead mining and processing

The Problem:

Kabwe, Zambia, is located about 150 kilometres north of the nation's capital, Lusaka, and is one of six towns in close proximity to the Copperbelt, once Zambia's thriving industrial base. In 1902, rich deposits of zinc and lead were discovered there. Mining and smelting commenced soon after and ran almost continuously until 1994 without addressing the potential dangers of lead contamination. The mine and smelter are no longer operating but have left a city poisoned by debilitating concentrations of lead dust in the soil and by metals in the water. In one study, the dispersal in soils of lead, cadmium, copper, and zinc extended over a 20 km radius at levels much higher than those recommended by the World Health Organization.

A small waterway runs from the mine to the center of town and has been used to carry waste from the once active smelter. There are no safeguards or restrictions on use of the waterway and local children use it for bathing. In addition to contaminated water, dry, dusty, lead-laced soils near workers' home are a significant source of contamination for the locals. Most workers and residents are exposed to toxic levels of lead through inhaling dust in these areas.

Health Impacts:

In some neighbourhoods in Kabwe, blood concentrations of 200 µg/dl or more have been recorded in children and records show average blood levels of children range between 50 and 100 µg/dl. On average, children's blood lead levels in Kabwe are 5 to 10 times the permissible EPA maximum and in many cases are close to those regarded as potentially fatal. 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.

Status of Clean-Up Activity:

After decades of widespread contamination, the clean-up strategy for Kabwe is complex and implementation is in its primary stages. Blacksmith has helped by supporting a local NGO (KERF) to bring information and educational services on lead poisoning into the local communities. Measures include simple, concrete advice to avoid poisoning, such as prohibiting children from playing in the dirt and rinsing dust from plates and food. However some areas of Kabwe require drastic

remediation and entire neighbourhoods may need to relocate.

In response to local initiatives initiated by Blacksmith, the World Bank has allocated about US $40 million under the Zambia Copperbelt Environmental Project (CEP) to clean up waste and to resettle people living in hazardous areas of the Copper Belt region. CEP also received a $10 million grant from the Nordic Development Fund (NDF). Work is expected to commence soon and real health benefits should then begin to be seen. This followed a 2006 Kabwe scoping and design study conducted by Water Management Consultants for the World Bank which outlined the massive and debilitating health impacts suffered by the local community in Kabwe due to lead levels in the environment far exceeding any acceptable international standards.

Resources:

"The Silent Death: Lead Poisoning in Kabwe, Zambia" Blacksmith Institute. 2001. http://www.blacksmithinstitute.org/kabwe.shtml

Penny Dale. "Zambia's child poisoning tragedy" BBC, Nov. 6, 2003. http://news.bbc.co.uk/2/hi/africa/3241037.stm

B. Leteinturier, J. Laroche, J. Matera, and F. Malaisse. "Reclamation of lead/zinc processing wastes at Kabwe, Zambia: a phytogeochemical approach." South Africaln Journal of Science 97 Nov/Dec (2001) 624-627.

B. D. Tembo, K Sichilongo, J. Cernak. "Distribution of copper, lead, cadmium, and zinc concentrations in soils around Kabwe town in Zambia." Chemosphere (2006) 63 497-501.

Water Management Consultants, ZCCM Investments Holdings PLC, and Copperbelt Environment Project. *Kabwe Scoping & Design Study, Project Synthesis*. May 2006.

The Remainder of the Dirty Thirty
(Sites Listed Alphabetically by Country)

Matanza-Riachuelo River Basin, Argentina

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
Up to 4.5 million	Organic contamination, heavy metals such as lead, mercury, chromium and other industrial residues	More than 3500 polluting industries

The Problem:

The 64-kilometer Matanza-Riachuelo River flows from western Buenos Aires into the Río de la Plata Estuary. The river basin is Argentina's worst environmental hotspot with more than 3,500 polluting tanneries, oil, chemical, and metal plants, illicit sewage pipes and 42 open garbage dumps along the river. Uncoordinated government action and a lack of environmental controls have allowed industries to dump their effluents into the river indiscrimately.

Health Impacts:

One area is known as the “flammable slum” because it lies above a toxic dump. Reportedly, half of the children here have lead poisoning, along with respiratory and dermatological problems. One study by the Japanese International Cooperation Agency found that 50 percent of the children aged seven to eleven have traces of lead in their blood and 10 percent have chlorine in their urine. Overall health statistics for the residents are poor.

Status of Clean-Up Activity:

In June 2006, the Argentinean Supreme Court demanded that the national government assist the governments of the province and the city of Buenos Aires to develop an integrated sanitation plan for the Matanza-Riachuelo watershed within 30 days. The Court also demanded that 44 polluting companies present environmental impact assessments on the effluents discharged into the river and associated treatment systems within the month. The national government has presented legislation to create a new river basin authority, designed to circumvent the jurisdictional rivalries that have prevented progress. The authority is expected to be functional sometime this year.

Resources:

http://www.farn.org.ar/docs/d01/index.html

http://ipsnews.net/interna.asp?idnews=34500

http://ipsnews.net/news.asp?idnews=34610

http://www.planetark.com/dailynewsstory.cfm/newsid/37851/newsDate/28-Aug-2006/story.htm

wwwesd.worldbank.org/bnwpp/index.cfm?display=display_activity&AID=469

http://www.americas.org/item_29436

http://www.avelaboca.org.ar/english-01.php

http://ipsnews.net/news.asp?idnews=34722

World Bank, Argentina, Matanza-Riachuelo Environmental Plan

Hazaribagh, Bangladesh

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
500,000	Metals including hexavalent chromium and organic chemicals	Tanneries

The Problem:

Ninety percent of Bangladesh' 270 registered tanneries are located in Hazaribagh, on just 62 acres of land. Many of these tanneries use non- or semi-mechanized systems and employ antiquated processing methods. The tanneries generate 7.7 million litres of liquid waste and 88 million tons of solid waste every day; 15,000 cubic meters of this untreated chemical waste flows directly into the Buriganga River.

Health Impacts:

Environment and Human Development (SEHD), a Dhaka-based non-governmental organization has reported that about 90 percent of tannery workers in Hazaribagh die before they reach the age of 50 due to a toxic working environment. A study surveying the health of 179 workers from six tanneries in the city found that more than half suffered from ulcers, nearly a third developed various skin diseases, more than a tenth suffered from rheumatic fever and nearly a fifth had jaundice.

Other ailments include dizziness, headaches, weakness, abdominal pain and vision problems.

Status of Clean-Up Activity:

The Hazaribagh Tannery Relocation Project (HTRP), has been under implementation by the Ministry of Industry since 2003 to remedy the effects of toxic tannery pollution in the capital city and the Buriganga River. The government is bearing the entire cost of the project while the Bangladesh Small and Cottage Industries Corporation (BSCIC) is implementing this project in Kantiboilapur, Chandranarayanpur and Charnarayanpur. The project has not been completed to date and tanneries at Hazaribagh continue to blatantly disregard environmental regulations by discharging their untreated wastes.

Resources:

http://www.sdnpbd.org/sdi/international_days/wed/2005/bangladesh/industry/industry.htm

http://www.elaw.org/resources/text.asp?id=1779

http://www.scielosp.org/scielo.php?script=sci_arttext&pid=S0042-96862001000100018

http://www.financialexpress-bd.com/index3.asp?cnd=10/23/2005&section_id=5&newsid=4669&spcl=n

http://www.atimes.com/ind-pak/BF23Df01.html

http://www.thedailystar.net/2005/11/21/d511212504121.htm

http://www.sos-arsenic.net/english/environment/leatherindustry.html

http://www.bcas.net/Env.Features/Pollution/2005/May2005/15%20to%2030.htm

http://fem.onthefrontlines.com/documents/whitepaper.pdf

Huaxi, China

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
53,000	Heavy metals and chemicals like trifluralin and TGIC	Huaxi Industrial Park

The Problem:

Located in Zhejiang Province, Huaxi town is in the southwestern section of Dongyang City. Since 2001, the Huaxi government has been leasing nearly 2500 acres to the Huaxi Industrial Park, housing thirteen chemical estates. On April 1, 2005, the Dongyang Municipal Government ordered the closure of these thirteen industries as a result of intense public protest over pollution stemming from them. Six of these factories were ordered to move out of the town entirely. There are reports of drums of chemicals being abandoned inside the factory premises and untreated wastewater simply being covered over with concrete slabs. Severe agricultural losses have been reported in the area.

Health Impacts:

Stillbirths have been frequently reported are assumed to be linked to pollution exposure from the chemical industries. The Huaxi Junior Secondary School and Huaxi Elementary School lie just 400 meters away from the industrial park and children report eye irritation, likely due to the factory emissions.

Status of Clean-Up Activity:

There are anecdotal reports of the industries remaining operational under the pretext of carrying out tests. Public protests, with more than 20,000 participants, have continued with the assertion that petitions have not be addressed. The Zhejiang provincial party committee and government are purported to be attentively following developments. The Dongyang City government organized a special meeting on April 19, 2005 to discuss the environmental problem and then accepted the proposed environmental protection program. Legacy pollution issues continue, even as a number of factories are said to be non-operational.

Resources:

http://www.washingtonpost.com/wpdyn/content/article/2005/06/12/AR2005061201531.html

http://www.asianews.it/index.php?art=3036&l=en

http://www.nytimes.com/2005/04/13/international/asia/13cndriot.html?ex=1183780800&en=329498fa3b473d05&ei=5070

Lanzhou, China

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
3,000,000	Air pollution, chemical/heavy metal river pollution	Automobile and industrial emissions

The Problem:

Lanzhou, the capitol of China's Gansu province, is one of the most polluted cities in China and was once named by World Resources Institute as one of the world's most polluted cities. The city is highly industrialized although not nearly as prosperous as many of China's other major cities. Major industries include petrochemical manufacturing and oil refineries. Heavy industrial emissions and the use of coal as the primary fuel source are the main sources of pollution. Illegal industrial discharges are commonplace and frequently reported in the local press. Lanzhou is on a tributary of the Yellow River and is a major contributor to increasing pollution problems.

The city is located in an arid valley and wind circulation is minimal. Frequent sandstorms (thirteen in 2006) and a major lack of precipitation further aggravate the climatic conditions. These natural circumstances, together with industrial and automobile emissions combine to produce intolerable air pollution. The mayor has made public calls for residents to walk to work.

Health Impacts:

Respiratory ailments are commonplace, as can be expected. A study comparing three polluted Chinese cities found that Lanzhou had the highest rates of respiratory diseases, including pneumonia.

Status of Clean-Up Activity:

Given the notoriety of Lanzhou's problems, various efforts have been underway to improve conditions, although the meteorological circumstances are very unfavourable. In 2005, the city government implemented a pollution control ban to change the fuel used in buses, taxis, and boilers. A shift from petrol, diesel and coal to natural gas is expected. Since 1998, the discharged volume of smoke and dust has been reduced by 17,000 tons, while sulfur dioxide has been reduced by 2,100 tons.

There has been inadequate investment in the city's civil infrastructure, hampering improvements in the collection and treatment of municipal waste. The city government asserts that it plans to invest nearly US$255 million by 2010 to combat

pollution issues. Progress on that front is likely to be slow as city budgets are extremely stretched. The National Development and Reform Commission (NDRC) has chosen Lanzhou as one of the ten demonstration cities under the 'cleaner production' initiative.

Resources:

http://www.time.com/time/asia/magazine/99/0927/lanzhou.html

http://www.chinadaily.com.cn/bizchina/2007-01/17/content_785649.htm

http://www.iges.or.jp/kitakyushu/sp/air/Lanzhou%20(Air%20Pollution).pdf

http://www.worldwatch.org/node/4809

http://www.cctv.com/english/news/20011128/73674.html

Effects of Air Pollution on Children's Respiratory Health in Three Chinese Cities - Archives of Environmental Health, March, 2000 by Zhengmin Qian, et al.

Urumqi, China

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
200,000	Air pollution	Automobile and industrial emissions

The Problem:

The rapidly growing urban center of Urumqi, capital of the Xinjiang Uygur Autonomous Region, is a large city in the northwest of China. Air pollution has emerged as a serious threat to the residents of the city. A report released in 1998 by the World Health Organization on poor air quality in 272 cities worldwide named Urumqi in its top ten. It rivals Linfen and Lanzhou as the city with the worst air pollution in China.

Suspended particulates including PM10, sulfur dioxide and nitrous oxides cloud the air. Anthropogenic, mainly industrial, activities paired with large scale automobile emissions and particularly stagnant air conditions contribute to the high concentration of air pollutants.

Health Impacts:

Serious respiratory diseases have been reported.

Status of Clean-Up Activity:

The local government has recently implemented the Blue-Sky Project, an attempt to replace old boilers and to utilize cleaner burning fuel sources and central heating. Urumqi has also strengthened its vehicle emissions controls. Gas-fueled (as opposed to diesel) vehicles have recently been introduced into the city.

The city has provided 65 CNP and LPG filling stations and replaced 9,714 oil-fueled vehicles with gas-fueled counterparts. However, the total number of vehicles in the city continues to increase, further polluting the air.

Resources:

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http://environment.guardian.co.uk/waste/story/0,2042999,00.html
http://environment.guardian.co.uk/climatechange/story/0,2042944,00.html
http://www.vecc-sepa.org.cn/eng/news/news_detail.jsp?newsid=08700http://www.zhb.gov.cn/english/SEPA/newsletter/2000-10.htm
http://www.xinjiang.gov.cn/1$002/1$002$013/352.jsp?articleid=2005-10-31-0008

Wanshan, China

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
100,000	Mercury	Mercury mines

The Problem:

Guizhou Province is located in southwestern China in the Global Circum-Pacific Mercury Belt. Mercury emissions from 13 large-scale mercury mines are estimated to count for 12% of global anthropogenic emissions into the atmosphere. Wanshan, located within this Province, has been termed the 'Mercury Capital' of China because more than 60% of the country's mercury deposits were discovered there. More than 20,000 tons of mercury was produced in Wanshan between the 1950s and 1990s. Mercury contamination extends throughout the city's air, surface water systems, and soils. Concentrations in soil range from 24.3 to 348 mg/kg (16 to 232 times the maximum national standards for mercury contamination).

Health Impacts:

Health problems reported by miners include decreased life expectancy, an elevated occurrence of cancer of the trachea, bronchus, lung, stomach, and liver, pulmonary tuberculosis, silicosis, and pleural disease, as well as insect-borne diseases like malaria and dengue fever, noise-induced hearing loss, bacterial and viral diseases; and diseases of the blood, skin, and musculoskeletal systems. Although the mines have now been shut down, villagers are still exposed to the mercury from the wastes that remain behind. Digestion problems, tremors, and weight loss are also commonplace.

The local population is affected by mercury through air inhalation and by consuming mercury-contaminated food (rice and fish, in particular) and water. Mercury concentrations in blood serums have been found to be nearly 40 times that of control groups. Mean urine concentrations are almost 75 times the level of control groups.

Status of Clean-Up Activity:

Tremendous national and international attention has been given to mercury pollution in the province and various efforts have been made to deal with different aspects o the problem. The population mostly at risk is that living in the vicinity of the smelters, mining activities and waste disposal sites. Although mercury-mining operations ceased in 2001, more than 100 million tons of calcines and other waste rocks remain behind.

Resources:

http://pbc.eastwestcenter.org/Abstracts2005/Abstract2005FengXinbin.htm

http://www.envsci.rutgers.edu/info/seminar/abstracts/spring2006/feng.shtml

www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16310915&dopt=Abstract

pubs.acs.org/subscribe/journals/esthag/40/i12/html/061506feature_jiang.h ml

http://lib.bioinfo.pl/auth:Liya,Q

Haina, Dominican Republic

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
85,000	Lead	Lead battery re-processing facility

The Problem:

The densely populated city of Bajos de Haina is severely contaminated with lead from a closed down automobile battery recycling facility. The Dominican Secretary of Environment and Natural Resources has identified Haina as a national hotspot of significant concern. Various studies have found alarming lead pollution in the Haina community, with blood and soil levels several orders of magnitude above accepted 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 neighbourhood, albeit less populous), the contamination still remains.

Health Impacts:

Lead poisoning from the smelter area is affecting children's health and development. When the Metaloxa plant closed in March 1997, 116 children living near the area were sampled, exposing a mean blood lead concentration of 71 µg/dL (range: 9–234 µg/dL). Another survey was conducted in August 1997 with 146 children revealing levels of 32 µg/dL (range: 6–130 µg/dL). The study revealed that at least 28% of the children required immediate treatment and that 5% had lead levels above 79 µg/dL. Only 9% of these children were under the WHO recommended 10 µg/dL for maximum tolerable concentrations. The children were also at risk for severe neurological 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.

Status of Clean-Up Activity:

Blacksmith Institute has initiated a stakeholder process that cooperatively includes the local community, government and Metaloxa. The government, community groups, industry and local and international scientists have begun to work together to design and implement a clean-up program. Metaloxa has insisted that it is not to be held accountable for the entire extent of the pollution since other industries have

also polluted this industrial town but is discussing the clean-up of their old site. A Blacksmith Institute assessment team surveyed the site with community leaders in order to determine an appropriate remediation response.

Blacksmith Institute has organized stakeholders' meetings along with municipal authorities, the Ministry of Environment and the Inter-American Development Bank. The stakeholders' group expects to have remediation completed within a year's time. Haina was in last year's Top Ten listing but has dropped down into the Dirty Thirty because of the recent remediation efforts and the size of its affected population relative to other sites in the Top Ten.

Resources:

J. Caravanos, R. Fuller. "Polluted Places—Initial Site Assessment". Blacksmith Institute. (2006) February 22. http://www.blacksmithinstitute.org/docs/haina1.doc

B. Kaul, R. S. Sandhu, C Depratt, and F Reyes. "Follow-up screening of lead-poisoned children near an auto battery recycling plant, Haina, Dominican Republic". Environmental Health Perspectives. (1999). 107 (11)

"Industrial Waste Minimization in the low Haina River Basin" IWCAM/2nd%20Steering%20Cmttee%20Meeting/Dominican%20Republic%20Demo%20Submission%20040130.doc

Oriente, Ecuador

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
30,000	Oil and toxic waste	Oil exploration

The Problem:

From 1964 to 1992, Texaco (now Chevron) built and operated oil exploration and production facilities in the northern region of the Ecuadorian Amazon, known as the "Oriente". After three decades of activity, the company left behind 600 open waste pits and allegedly dumped 18.5 billion gallons of toxic waste into Ecuador's rainforest. Crude oil dumped in open waterways is allegedly some 30 times worse than the Exxon Valdez spill.

This toxic dumping is reported to affect not only an indigenous population of 30,000 people but also 2.5 million acres of rain forest.

Health Impacts:

Increased cancer incidence, reproductive problems and birth defects are the major health effects. According to a local nurse, 27 town residents have died of cancer since Texaco began its operations in the area. The entire population of San Carlos is only 500 people, she said, prompting residents to call it the “cancer zone”. Five separate peer-reviewed academic studies have documented rates of cancer several times higher than those in other parts of the Amazon where Texaco did not operate. One study found rates of childhood leukaemia four times higher in San Carlos than in other areas.

Water used by local residents for drinking and bathing contains nearly 150 times the safe exposure levels to hydrocarbons.

Status of Clean-Up Activity:

Texaco is facing a billion dollar legal battle for polluting significant portions of the Ecuadorean Amazon. The company is accused of using inadequate extraction techniques and spilling waste products as a consequence. It is also alleged to have left more than 1,000 open-air toxic waste pits in the Amazonian rainforest. The company has vehemently denied the accusations and insisted that local authorities have absolved it of any guilt. An independent damage assessment, estimating the cost of clean-up to be around US $6.14 billion. Accounting for personal damages could raise the cost to more than US $10 billion.

Resources:

http://www.iht.com/articles/2004/01/13/edcesar_ed3_.php

http://www.texacotoxico.org/eng/index.php?option=com_content&task=view&id=47&Itemid=2

http://www.ipsnews.net/news.asp?idnews=36940

http://www.chevrontoxico.com/article.php?id=340

Mahad Industrial Estate, India

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
300,000	Heavy metals and organic pollutants	Industrial estate

The Problem:

According to a survey conducted by the Supreme Court Monitoring Committee, approximately 1,800 tons of hazardous sludge has accumulated at the Mahad Industrial Estate CETP. There are also reports of hazardous wastes being dumped illegally on the premises of now defunct industries including Raksha Chemicals Ltd. and Shri Mahesh Chemicals. The industrial estate of Shri Mahesh Chemicals Ltd. houses an abandoned H-acid plant. The Raksha Chemical Estate houses not only its own toxic waste but also hazardous materials for a nearby industrial operation in Karnataka. The hazardous waste has not been properly contained within the premises of the industrial estate as asserted by various industrial managers and has instead leached out into the surrounding area contaminating soil and groundwater.

Health Impacts:

The resident population in the area is being adversely affected by severe contamination of the local soils and waterways. We are not aware of any health surveys being conducted in the area but the impact is presumed to be extreme. The Indian Supreme Court Monitoring Committee has stated that it is pursuing more detailed information on the serious and chronic health situations that may result.

Status of Clean-Up Activity:

India's Supreme Court Monitoring Committee directed Mahad CETP to replace pipelines carrying effluents out into the surrounding area in 2004. The Committee also ordered that the Mahad treatment plant conform to standards outlined by the Maharashtra Pollution Control Board (MPCB). The MPCB and the Maharashtra Industrial Development Corporation are partnering to ensure that Mahad CETP executes the mandates of the Monitoring Committee. Reports suggest that disposal of the toxic sludge from the industrial estate began in January of 2005 with a planned completion date of March of 2005. We have not learned of any definitive reports or studies confirming that this work was indeed completed.

Resources:

http://mpcb.mah.nic.in/images/5thATR.pdf

http://web.ebscohost.com/ehost/pdf?vid=5&hid=8&sid=17129ca4-c36c-467a-a2d0-3359ca79204c%40sessionmgr3

Ranipet, India

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
3,500,000	Hexavalent chromium, Azodyes	Tanneries

The Problem:

Ranipet is located about 100 miles upstream from Chennai, the fourth largest urban area in India. Ranipet is a medium sized town but its pollution problems pose a potential risk to a larger population due to its proximity to the city of Vellore. A factory in Ranipet manufactured sodium chromate, chromium salts and basic chromium sulfate tanning powder that is 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. These lie without check in an open yard (three to five meters high and on nearly five and a half acres of land) on the facility premises and easily leach into the groundwater.

Health Impacts:

The contamination of the soil and groundwater, along with run off from solid wastes has affected thousands of people in a residential colony about 1 kilometre 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. Local farmers claim that the waste from the nearby tanneries degrades the fertility of the land and that, invariably, “only one in five crops does well.” Farmers also complain of the foul smells that emanate from the water they use to irrigate their fields and that they suffer from skin ulcerations from direct contact with the water.

Status of Clean-Up Activity:

In 1996 the government shut down Tamil Nadu Chromates & Chemicals Limited (TCC), the factory responsible for the estimated 1.5 million tons of untreated chromate sludge. 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 clean up this site.

One solution to tackle the issue of chromate leaching from the legacy site would be to encapsulate the waste dumpsite in order to prevent further leaching. Subsurface

soils also need to be treated. However, it is understood that no real progress has been made on tackling the problems.

Resources:

http://www.tehelka.com/story_main13.asp?filename=Ne071605Tanneries_pollute.asp

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http://www.pollutedplaces.org/region/south_asia/india/ranipet.shtml

"Polluted Places: India Initial site assessment and photos". Asian Development Bank ADB (2006)
http://www.adb.org/Projects/PEP/ind.asp

Ust-Kamenogorsk, Kazakhstan

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
300,000	Heavy metals, air pollutants, radioactive waste	Copper smelters, nuclear power and testing facilities, power plants, metallurgy

The Problem:

One of the most severely polluted sites in Kazakhstan, Ust-Kamenogorsk sits at the confluence of the Ulba and Irtysh rivers in the northeastern region of the country. It is home to the regional center of East Kazakhstan Oblast, one of the biggest industrial estates in the nation. The notorious Semipalatinsk Nuclear Testing Range, just 250 km away, has left a number of environmental disaster zones in its wake. Radioactive contaminants litter the surrounding area and may be airborne. Balkash Copper Smelter, idle for a long period, has restarted its operations in the area and is now polluting the air with sulphur and nitrogen dioxides and with metallic particulates.

Extensive industrial operations for over fifty years under careless or absent environmental standards have led to widespread pollution and hazardous waste deposits. In the year 2000, roughly a third of the industrial enterprises had no emissions controls or safe zones. As a result, a considerable population living in these industrial centers is directly impacted by these pollutants.

Health Impacts:

The concentration of benzaperene is at a level 16 times the maximum admissible concentration. Lead levels are 170% higher than maximum admissible concentrations. High morbidity and mortality rates have been reported for the region.

Status of Clean-Up Activity:

Although industrial production levels have been somewhat reduced in recent years, air pollution remains at a very high level in Ust-Kamenogorsk. No formal clean-up efforts are known to be under way.

Resources:

http://www.congress-on-science-in-school.de/2005/congress_e.php?ID=abstracts&Subj=kamenogorsk

http://www.globe-net.ca/procurement_notices/listing.cfm?ID_Region=7&ID_Opportunity=2638

http://wbln0018.worldbank.org/RMC/PHRD/proc%20planning.nsf/01815e2162015aa085256c1b00521ce9/11285849aa2936b385256c1b0064494d?OpenDocument

http://www.greensalvation.org/English/Publish_eng/Herald_2003-2004/2004_08.htm

http://www-esd.worldbank.org/bnwpp/index.cfm?display=display_activity&AID=427&Item=5

http://www.oieau.fr/anglais/international/russia_kazakhstan.htm

http://www.atasu.org/eng/projects/docs/FASEP-Final%20Report_brief.pdf

http://72.14.209.104/search?q=cache:wlMSGyrGhBEJ:www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2004/07/19/000104615_20040721104846/Original/Ust0Kamenogorsk0PCN0ISDSFinal.doc+ust+kamenogorsk+pollution&hl=en&gl=us&ct=clnk&cd=26

http://www.counterpart.org/Default.aspx?tabid=340&metaid=F8FK0759-781&skin=cs

http://www.jstage.jst.go.jp/article/jrr/41/1/41_35/_article/-char/en

Dandora Dumpsite, Kenya

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
100,000	Heavy metals, chemical waste, PCBs, POPs	Municipal and industrial waste

The Problem:

Nairobi produces an estimated 2000 tons of garbage a day, somewhere between a half and three-quarters of which rots uncollected close to its source. The rest is carted away to the Dandora dumping ground on the arid plains to the south of the city. Established by the city council in the mid 1980s, the Dandora dumpsite sprawls over a disused quarry and the grounds once allocated to "Sector 6" – the last, unsuccessfully executed phase of a World Bank-Kenyan Government experiment in low-cost housing designed to accommodate 100,000 people. However, Dandora is now home to a quarter of a million Nairobi residents. The dumpsite is 30 solid acres of garbage. The sky over Dandora is dark with noxious smoke, the result of the city council's half-hearted attempts at incineration. Concentrated methane gasses regularly result in spontaneous dump fires. Waste consistently leaches into the Nairobi River, which runs through the lower edge of the dump before passing through the city slum.

As many as 2,500 people, mostly children, but also men and women, scavenge here. Once a week, a city council bulldozer arrives to push the unsorted garbage into a massive heap that sits at the edge of the quarry. The heap is then set on fire, releasing even more toxic gases into Nairobi's air.

Health Impacts:

Although the effects of constant exposure to the dump's stench and fumes on the residents and scavengers of Dandora remain unknown, doctors do report a high incidence of respiratory tract infections. According to the principal of a local school downwind from the site, nearly all of her 800 students have chronic respiratory problems. Only 10-15% of children living in the region could be described as healthy.

According to a University of Nairobi study conducted in early 2007 and surveying the health of schoolchildren, 50% of children sampled have blood lead levels of over 10 micrograms per decilitre. The haematological systems of most children were showing signs of damage with 12.5% of children having haemoglobin below normal levels.

The most exhaustive study of the Dandora dumpsite was published in 1998 by the Japanese International Co-operation Agency (JICA) as part of an assessment of

solid waste management in Nairobi. But the report is vague on the environmental hazards that the site poses, citing only "a high risk of air pollution, which may affect the health of scavengers and neighbouring residents," and suggesting a possible threat to ground water pollution.

Status of Clean-Up Activity:

The local government admits that the dumpsite must be relocated though no concrete plans have been implemented or even proposed.

Resources:

Block, Meredith. *Initial Site Assessment: Dandora Dumpsite*. Blacksmith Institute, June 2007.

Mailuu-Suu, Kyrgyzstan

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
23,000 immediately, but millions potentially	Radioactive waste, heavy metals, cyanides	Legacy Soviet uranium plant

The Problem:

Dozens of waste rock dumps are scattered throughout Mailuu-Suu, home to a former Soviet uranium ore mining and processing complex. From 1946-1968 the plant produced more than 10,000 metric tons of enriched uranium ore, which was eventually used to produce the Soviet Union's first atomic bomb. What remains now are 1.96 million cubic meters of radioactive mining waste that threatens the entire Ferghana Valley, one of the most fertile and densely populated areas 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 efforts. 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 force them into nearby rivers. This fear was nearly realized in May of 2002 when a huge mudslide blocked the course of the Mailuu-Suu River and threatened to submerge one waste site. In April of 2006, 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. The Kyrgyzstan National Sciences Academy (KNASA) surveyed 170 sites in Mailuu-Suu and concluded that high levels of radioactivity were indeed present.

Health Impacts:

The poor design and management of the waste areas allows for transfer of some material from these piles to surrounding areas by runoff. Research has found some residents getting very high doses of radon probably due to use of this runoff water in agriculture. Risk analyses have also been conducted to assess the radioactive contamination that could occur with further natural disasters and potentially lead to 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 in Mailuu-Suu than in the rest of the country.

Status of Clean-Up Activity:

The World Bank has begun a project for Kyrgyzstan to minimize human and environmental exposure to radionucleides. The project includes isolating uranium mining wastes, improving the national system for disaster management, preparedness and response and establishing real-time monitoring and warning systems, seismic stations and sensors. The total cost of the project is $11.76 million, of which the bank's International Development Association, an institution that gives aid to the world's poorest countries, will provide $6.9 million.

In addition, the Japanese Government has allocated $2 million, the Global Environment Fund has allocated $1 million and the Kyrgyzstan Government has allocated $1.8 million for remediation efforts. The National Ecological and Emergency Ministry has reported that over 20 local and foreign firms have expressed interest in committing funding. Kyrgyzstan has established the Control Centre of Crisis Situations (CCCS) under the Ministry of Emergency Situations to deal with such regional problems. Projects currently underway to remediate Mailuu-Suu are slated to be completed by 2009 but Kyrgz officials assert that more than $30 million would be needed to complete the work.

Resources:

IRIN News Org. "KYRGYZSTAN: Landslide close to Mailuu-Suu uranium dump". UN Office for the coordination of Humanitarian Affairs. (2005) April 14.
http://www.irinnews.org/report.asp?ReportID=46641&SelectRegion=Asia&SelectCountry=KYRGYZSTAN

IRIN News Org. "KYRGYZSTAN: Mailuu-Suu closely monitored following recent landslide." UN Office for the coordination of Humanitarian Affairs. (2005) May.
http://www.irinnews.org/report.asp?ReportID=46933&SelectRegion=Asia

Sarah MacGregor. "Finding a Solution for Uranium Waste in Kyrgyzstan." OSCE. (2004) February 4.
http://www.osce.org/item/181.html

Environment News Service (ENS). "Kyrgyz Republic Funded to Secure Uranium Waste Dumps"
Mines and Communities Website. (2004). June 17.
http://www.minesandcommunities.org/Action/press375.htm

M. Kozlova. “Worries Fester over radioactive tailings”. Asia Water Wire. http://www.asiawaterwire.net/node/74

“Safety of Uranium Dumps in Kirghizia Calls For Attention of International Community” Pravada (2003) April 21. http://newsfromrussia.com/world/2003/04/21/46158.html

Nurlan Djenchuraev. Current Environmental issues associated with mining wastes in Kyrgyzstan. Master of science. Department of Environmental Sciences and Policy of Central European University. (1999). http://enrin.grida.no/case_studies/nucFergana/kyrgyz_12.pdf

I. A. Vasiliev, D. S. Barber, V. M. Alekhina, et al. “Uranium levels in the Naryn and MAiluu-Suu rivers of Kyrgyz Republic”. Journal of Radioanalytical and Nuclear Chemistry. (2005) 263 207-212.

H. Vandenhove, L. Sweeck, D. Mallants, et al. “Assessment of radiation exposure in the uranium mining and milling area of Mailuu Suu, Kyrgyzstan”. Journal of Environmental Radioactivity (2006) 88 118-139.
http://www.irinnews.org/report.aspx?reportid=26451

http://www.asiawaterwire.net/taxonomy/term/29

Mexico City, Mexico

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
15 million	Air pollution: Ozone, SO2, SOx, NOx, pm2.5-pm10, HC, VOC	Automobile and industrial emissions

The Problem:

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 it is 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 models and especially damaging to the environement, 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 thus trap pollution.

Health Impacts:

Severe respiratory problems have expectedly developed across the local population. It is estimated that even a 10% reduction in PM10 in the air would save 3,000 lives annually and prevent 10,000 new cases of chronic bronchitis. Reducing the presence of ozone by 10% would save 300 lives.

Status of Clean-Up Activity:

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 retrofitting of diesel vehicles in order to cut back air pollutants. Mexico City has recently met 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. Considerable efforts must be exercised in order to make this city more habitable.

Resources:

"Index of Leading Environmental Indicators: The nature and sources of ecological progress in the US and the World" The Pacific Research Institute. (2006). http://www.pacificresearch.org/pub/sab/enviro/06_enviroindex/27_mexico.html

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Huancavelica, Peru

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
40,000	Mercury	Legacy mercury mines

The Problem:

Huancavelica is the largest mercury processing district in the Western Hemisphere. The majority of the mines at Huancavelica have been operating since the Spanish colonial period 150 years ago but have been closed for 30 years. At the time, Huancavelica was crucial to Spain's silver mining operations, providing the mercury used to extract silver from ores in the Potosi silver mines in upper Peru (now Bolivia). Legacy mercury pollution lines the city's open trenches and waterways. The residents here have been living with mercury for nearly 400 years. Some of the locals do still mine mercury on a small scale and the entrance to the main mercury mines remains open to this day.

Health Impacts:

The effects of the mercury legacy are shown by the fact that the risk of dying is three times higher in Huancavelica than in nearby El Callao. Life expectancy at birth is only 56.8 years in Huancavelica, compared to 78.0 years in El Callao. Respiratory diseases are common, especially among the locals who continue to engage in mining efforts.

Status of Clean-Up Activity:

The people of Huancavelica are extremely poor and without resources to manage their own cleanup efforts. Thirty-eight percent of the population is illiterate and 80% of the children suffer from malnutrition. The government of Peru has so far failed to deal with this serious pollution issue.

Resources:

http://www.martinbarofund.org/projects/1998.htm

Meycauayan City and Marilao, Philippines

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
250,000	Hexavalent chromium, other heavy metals, pesticides, sewage, solid waste and tannery waste	Automobile and industrial emissions

The Problem:

Industrial waste is haphazardly dumped into the Marilao, Meycauayan and Obando River system, a source of drinking and agricultural water supplies for the 250,000 people living in and around this suburb of Manila. The river system is extremely polluted due to wastes received from tanneries, gold and precious metals refineries, and legacy lead smelting waste, and numerous municipal dumpsites. Substantial contamination also results from small-scale lead recycling facilities along the river and from the many tanneries that dump untreated hexavalent chromium-laced wastewater into the river.

Health Impacts:

The dumping of toxic wastes into the river has had a severe effect on the health of the local population with complaints of nausea, eye irritation, and various respiratory ailments. The river also feeds directly into the Manila Bay, and its effluents contaminate local fishing areas, further endangering health.

Status of Clean-Up Activity:

There has been considerable local effort to deal with the main sources of pollution, resulting in the creation of a coordinating body to encourage and guide clean up of this river. This stakeholder group, which has been instigated and supported by Blacksmith, includes senior representatives of the federal government, the local municipality, industries from the area and community groups. A process has been started to collaboratively implement private and public remediation efforts over the next several years and efforts are ongoing to obtain national and international financial assistance. 2006 successes include a tannery waste treatment plant paid for by the Manila Tanneries Association. In addition, Stakeholder group members, Philippines Recyclers Incorporated (PRI), has committed to strictly regulate treatment of lead battery waste stockpiles. Strong support from political leadership in the Philippines has been very important in generating momentum for the clean-up process.

Resources:

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http://www.focusweb.org/publications/1997/Cleaning%20Up%20Toxic%20Wastes%20in%20the%20Asia%20Pacific%20Region.htm

Bratsk, Russia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
2.8 million	Mercury and other heavy metals, chemicals	Chemical and Aluminium Plants

The Problem:

The Usolye and Sayansk Chemical Plants have used mercury in the production of caustic soda and other cleaning agents since the early 1970s. The Usolye Chemical Plant has admitted to discharging 2.5 tons of metallic mercury into the Angara River each month. Mercury from the stream has travelled several miles downstream and concentrating in the sediments of the Bratsk Reservoir, which was once used for drinking water. The Angara then flows into the Yenisei, which empties into the Arctic Ocean.

According to Yuri Udodov, head of the Federal Committee on Ecology (FCE) in the state of Irkutsk, this region has "the highest rate of discharge of metallic mercury into the environment [in] all of Siberia." If the FCE's figures are accurate, the discharge rate may be the highest in the world.

The Bratsk Aluminium Plant has been polluting its surroundings to such great degree that the town of Chikanovskiy was evacuated in 2001 due to repeated health emergencies. It has been declared an ecological disaster zone.

Health Impacts:

The amount of mercury in local children's hair is almost nine times higher than normal levels. Incidence rates of cancer and respiratory, vascular and urinary disorders are massively high as is the occurrence of severe birth defects. Life expectancy in the region is reported to be 44 years.

Status of Clean-Up Activity:

Local activist groups are attempting to educate people about this urgent problem while seeking to identify methods to end mercury use and clean up the pollution. The problem, however, may be unmanageable for any small-scale clean-up plans for mercury. The extent of pollution in the ground around Bratsk is said to be equal to half the total global production of mercury in 1992.

Recently, the U.S. Trade and Development Agency (TDA) financed a study at a cost of $850,000 on modernization at the Bratsk smelter. Emissions levels have recently been reduced due to an upgrade in smelter operating technologies.

Resources:

http://www.10000yearsinstitute.org/10k_pdf/Selenga_River.pdf

http://se2.isn.ch/serviceengine/FileContent?serviceID=7&fileid=45316A02-8F2A-5890-EA01-35B93519A52E&

Chita, Russia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
400,000	Radioactive decay products	Gold and uranium mines

The Problem:

This remote region of Siberia is the site of Russia's greatest mineral wealth where many extensive gold, thorium, and uranium deposits have been mined for decades. In Chita, Krasnokamensk is the last major uranium mine still operating in Russia. Operations produced five million pounds of uranium in 1995, and at least five million tons of waste and uranium mill tailings in the process. Uranium and waste production at this rate (and higher) has occurred for the past 30 years. Massive volumes of acidic tailings are leaking uranium decay products and heavy metals. Krasnokamensk has generated fifty to seventy-five million tons of tailings, making it the largest waste stream at a uranium production site in the world.

A survey in the community of Balei has documented hundreds of homes with radiation levels as much as 10-20 times permissible levels. Nearly 1000 homes have radiation levels that far exceed international standards.

Health Impacts:

In some affected areas, nearly 95% of children have been diagnosed with one or more chronic or inborn diseases or handicaps. There are also high incidences of babies born without limbs and various other genetic mutations. More than 95 percent of the children in Balei are mentally deficient, according to a report by the east Siberian branch of the Russian Academy of Sciences. Rates of stillbirths are five times higher than the Russian average; child mortality rates are 2.5 times higher, miscarriages and congenital defects in newborns are 1.4 times higher and incidences of Downs Syndrome are four times higher.

Status of Clean-Up Activity:

Addressing the impacts of this radioactive waste will require extensive decontamination and significant groundwater restoration efforts if the polluted areas are to be remediated effectively. A comprehensive plan should also include the installation of a new tailings repository for future wastes to replace the present containment system which is unsound. No such plans have yet been made public.

Resources:

http://www.earthisland.org/project/reportPage2.cfm?reportContentID=13&subSiteID=1&pageID=71

http://www.sric.org/mining/docs/Chitafin.html

http://www.zenhell.com/GetEnlightened/links/nukehell.htm

http://www.kluweronline.com/article.asp?PIPS=5143902&PDF=1

http://www.dartmouth.edu/~dujs/2002F/uranium.pdf

Magnitogorsk, Russia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
460,000	Sodium oxides, nitrogen oxides, benzopyrene, various heavy metals	Iron and steel works

The Problem:

Located in Western Russia, Magnitogorsk lies on the banks of the Ural River. In the 1930's, one of the largest Russian iron and steel works was established here, producing steel for half the Russian tanks during WWII. At optimum capacity it could produce up to 7.5 million tons of steel. The industry was purported to emit 650,000 tons of industrial wastes, including many toxic chemicals, thereby polluting around 4,000 square miles. According to steelworkers, none of the filtering devices were in working condition.

Health Impacts:

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. The massively high cancer rates in the city are attributed to severe pollution from dioxides and benzopyrene. Only 28% of infants born in 1992 were healthy, and only 27% had healthy mothers. High incidences of bronchitis, asthma, and lung cancers are reported. The results of a study conducted by the Chelyabinsk Provincial Institute for Public Health and Environment in 1994 were so extraordinary that the provincial Ministry for the Environment classified Magnitogorsk as an ecological disaster zone.

Status of Clean-Up Activity:

Plant managers have asserted that much of their equipment has been upgraded in recent years. Funds for such new investment are reported to exist at an excess of US $15 million annually. Emissions per ton of production have indeed been reduced by about 60%. However, production levels have increased by 39%. Smoke plumes still hang over the city and the threat of pollution-related disease remains pressing. Many residents assert that pollution is at its worst.

Resources:

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

Rudnaya Pristan/Dalnegorsk, Russia

Potentially Affected People:	Type of Pollutant:	Source of Pollution:
90,000	Lead, cadmium, mercury, antimony	Legacy smelter and mine

The Problem:

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 and in roadside soil exceed USEPA guidance for remediation by large orders of magnitude. Data suggests 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 of arsenic.

Health Impacts:

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 at an average of 13-27 µg/dl. Annual air emissions levels include 85 tons of particulate matter, 50 tons of lead and 0.5 tons of arsenic concentrations. Since 1930 there has not been any attempt to address associated health concerns by either an educational or a technical environmental program.

Status of Clean-Up Activity:

The lead smelter was voluntarily shut down after Blacksmith Institute presented the owner with data on the health risks of lead contamination to children. 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 education programs for all residents. A plan to remediate the worst of the contamination is being developed in detail and the first stage of work is commencing in mid 2007, with initial funding from Blacksmith Institute and Green Cross Switzerland, and with support from the University of Idaho.

Resources:

M. C. von Braun, I. H. von Lindern, N. K. Khristoforova, and et a. "Environmental lead contamination in the Rudnaya Pristan--Dalnegorsk mining and smelter district, Russian far East". Environmental Research Section A (2002) 88, 164-173.

A. N. Kachur, V. S. Arzhanova, P. V. Yelpatyevsky, M. C. von Braun, and I.H. von Lindern. "Environmental conditions in the Rudnaya River watershed—a compilation of Soviet and post-Soviet era sampling around a lead smelter in the Russian Far East". The Science of The Total Environment (2003) 303:1-2 171-185

P.O. Sharov, Lead Contamination of Environment in Rudnaya Pristan, Russia and associated Health Risks. Far Eastern Health Fund. Vladivostok Dalnauka, 2005.

About Blacksmith Institute

Founded in 1999, Blacksmith Institute's vision is a clean planet for our children. We develop and implement solutions for pollution-related problems in the developing world. We work cooperatively with partnerships of donors, governments, NGO's and others, and provide strategic, technical, and financial support to local champions as they strive to solve specific, pollution-related problems in their communities.

Blacksmith's Strategy

Hazards of Pollution

Industrial wastes, air emissions, and legacy pollution from old industry affect billions of people around the world. Women and children are especially at risk. Tens of thousands of people are poisoned and killed each year. Others have reduced neurological development, damaged immune systems, and long-term health problems. The World Heath Organization, in conjunction with the World Bank, estimates that 20 percent of deaths in the developing world are directly attributed to environmental factors from pollution.

Focus on Highly Polluted Places

The priority of Blacksmith is to work in locations throughout the developing world where human health is most affected by pollution. Our programs involve a multi-step process of:

- Identifying polluted places in the developing world, with nominations received from members of the international community and through the internet;

- Assessing the health risks at those locations by reviewing nominations with a Technical Advisory Board of leading international specialists on a rolling monthly basis and visiting candidate sites with likely high health risk implication, and conducting an Initial Site Assessment, a triage protocol that validates likely health implications, and enables the design of an intervention.

- Designing and implementing a remediation strategy tailored to the specifics of the site in question, using local champions to implement the project in a cooperative fashion.

Support

Blacksmith supports its local partners with more than just grants. We provide assistance in other ways so that our partners can initiate solutions to their pollution problems in the most cost effective and direct manner. Blacksmith provides:

Technical Research: We bring the necessary resources to research a pollution problem and its proposed solutions thoroughly. We partner with scientific and

technical groups in the US (and also in Europe) that have demonstrated expertise in areas relevant to pollution remediation.

Strategic Assistance: We provide help with project planning and implementation planning, using our experience in similar projects to enable local champions to describe a credible methodology for site remediation, and move forward with it.

Networking Capabilities: We develop collaborative networking opportunities for our partners, linking them to the most appropriate resources to meet their needs, including organizations such as the World Bank.

Financial Support: Through the generosity of our personal and institutional funders, we provide both seed money and continuing support to projects, offering long-term core support, whenever possible, to projects that have demonstrated clear successes (or the potential for success) in the pollution remediation field.

Blacksmith Institute is a lean organization with hard-working core staff, an active board, and significant in-kind contributions from our founder. We are committed to putting as many resources as possible into the hands of local champions and their organizations in the developing world.

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.

Timothy Brutus, M. Sc.
Risk Management Specialist for the New York City Department of Environmental Protection

Mr. Brutus is currently the Risk Management Specialist for the New York City Department of Environmental Protection for the downstate reservoirs that bring all of the water into New York City. His previous experience is on complex multi-technology remediation projects with CH2M Hill, Inc. He has extensive site investigation experience including, but not limited to, indoor and outdoor air sampling, multiple groundwater and soil sampling techniques and technologies. He has also contributed to other non-profit organizations restoring contaminated brownfields to their former use as wetlands and worked in analytical laboratories in New York and New Jersey.

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

Jack Caravanos is 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 J. Green
Owner and CEO of Phoenix Soil, LLC; United Retek of CT LLC; American Lamp Recycling, LLC; Green Globe, LLC; and Jayjet Transportation, LLC.

David Green received his M.ed in chemistry and has owned and operated hazardous waste remediation companies since 1979. His companies have conducted in-situ and ex-situ treatments of hazardous materials on over 16,700 sites in the US, China, UK, and central Europe. The technologies incorporated include, low temperature thermal desorption, solidification/stabilization and chemical treatment. Mr. Green serves as Chairman of the Local Emergancy Planning Commision and the Director of Operations for the Connecticut's Department of Homeland Security USAR Team.

David Hanrahan, M.Sc.
Director of Global Programs, Blacksmith Institute

David Hanrahan oversees the technical design and implementation for Blacksmith of over 40 projects in 14 countries. Prior to joining Blacksmith, Mr. Hanrahan 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.

Eric Johnson
Member of the Board of Trustees, Green Cross Switzerland

Eric Johnson has a broad perspective on the environment and chemical contamination. He began his career as an editor of *Chemical Engineering* and *Chemical Week* magazines. He then became involved in the selection, assessment and remediation of industrial sites. One of his major projects was the remediation and conversion of a former aluminum smelter to alternate land-use. Mr. Robinson was an early adopter of life-cycle assessment. That, combined with his experience in environmental impact assessment, led to his 1996 appointment as editor of *Environmental Impact Assessment Review* – a leading peer-reviewed journal in the field.

Mr. Johnson has analyzed numerous environmental issues that touch on the chemical industry including: alternative fuels, brominated flame retardants, CFCs and replacements, ecolabels (for detergents, furniture polishes, hairsprays and personal computers), GHG emissions and trading, plastics recycling, PVC and the chlorine-chain, REACH, socially-responsible investing, tri-butyl tins and TRI and environmental reporting. In 1994 he organized the first Responsible Care conference for plant managers in Europe. Currently his main work is in comparing the carbon footprints of various sources of energy. He has worked internationally, concentrating mainly on the US and Europe. Mr. Robinson is an active member of the Board of Green Cross Switzerland.

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, Ph.D.
Professor, Environmental Engineering & Management, Department of Civil Engineering, Indian Institute of Technology Delhi, Former Atlantic LNG Chair (Professor) in Environmental Engineering, University of West Indies, St. Augustine Campus, Trinidad & Tobago.

Dr. Mukesh Khare is Professor in the Department of Civil Engineering at Indian Institute of Technology Delhi, India. Professor Khare received his PhD from the Faculty of Engineering (Specialized in Air Quality) from the University of Newcastle Upon Tyne, UK in 1989. He has

published more than 45 refereed articles to date in professional journals, 30 articles in refereed conferences/seminars, and two books: *Modelling Vehicular Exhaust Emissions***,** WIT Press, UK; *Artificial Neural Networks in Vehicular Pollution Modelling*, Springer, USA. Additionally, he has published nearly 20 technical reports on research/consultancies conducted for government agencies and private industries. Dr Khare continues to serve as peer reviewer for several government ministries grants programs and state programs and consultant/advisor to the Government of NCR Delhi. He is also serving as casual reviewer to many journals and publishing houses in and outside the country. Professor Khare is on the editorial board of International Journal of Environment and Waste Management and is guest editing one of its special issues on Urban Air Pollution, Control and Management.

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.

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 Chairman, 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.

Stephan Robinson, Ph.D.
Director of the International Disarmament Program, Green Cross Switzerland

Stephan Robinson holds a PhD in experimental nuclear physics from Basel University. In 1994, he joined Green Cross Switzerland where he serves today as International Director of its Legacy of the Cold War Programme. The Programme addresses the full implementation of arms control and disarmament agreements; the safe and environmentally sound destruction of weapons arsenals; the conversion and clean-up of military facilities and lands; reduced environmental impacts of military practices; improvements in the areas of public health, education, and social infrastructure in regions affected by military legacies; stakeholder involvement on military-environmental issues; and the building of a civil society. Since 1995, the facilitation of chemical weapons destruction in both Russia and the U.S. has been a focus point of the Programme, which includes the operation of a network of eleven local and regional public outreach offices, the organisation of a Russian National Dialogue on chemical weapons destruction, but also practical community projects aiming at improving emergency preparedness and the health infrastructure. Other activities include the clean-up of a major oil spill at a nuclear missile in the Baltic area; the scientific investigation of a site of former chemical weapons destruction (open pit burning site); different risk assessments of military facilities; an inventory of the Soviet nuclear legacy; and epidemiological studies of public health impacts by chemical weapons storage. Stephan Robinson is regularly in Eastern Europe for on-site visits of projects and for meetings with various groups of stakeholders from government officials to local citizens.

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.

The World's Worst Polluted Places Selection Criteria for the Technical Advisory Board – Revised for 2007 Review

Selection Process

The process for the 2007 Top Ten World's Worst Polluted Places is very similar to the one used last year and is intended to be logical, practical and robust. The starting point was the full database of sites nominated for Blacksmith consideration. Blacksmith staff initially screened the nominations in order to identify sites with clearly documented problems. These were then reviewed in greater detail to produce a long list of sites to be reviewed by the TAB. About half of the long list has been flagged as the most serious contenders for the Top Ten. However, any nominated site may be proposed as a contender for the Top Ten by any TAB member, based on his or her individual review.

The nomination and selection process has been refined for 2007, following a day-long TAB conference. It still remains heavily dependant on the experience and professional judgment of TAB members.

Nominations

The structure of the database of nominated sites has been upgraded and a number of new sites have been added. This brings the total number of sites in our database to nearly 400 but there remain many sites across the world that have not yet been identified. A focused effort is being put in place to expand the coverage. However, it is not expected that the database will be regarded as complete for some time yet. The 2007 World's Worst review is based on a better, but still incomplete, list of nominations.

A key factor in this year's process is that of representative-ness. The TAB review recommended that the sites put to the full TAB for selection of the World's Worst should be representative in terms of both the types of sites in the database and also their geographical distribution. The long list has therefore been presented in the form of a matrix of candidate sites.

Scoring

The scoring system again involves an algorithm that takes into account the same basic selection criteria as last year. This approach is based on basic hazard assessment logic that can be summarized as:

IMPACT = POLLUTANT & PATHWAY & PEOPLE

Each of these essential links in the causal chain is represented by criteria that are included in the scoring methodology presented below. Details of the

factors and the weights attached to them have been reviewed and revised from the 2006 version, based on the advice of the Technical Advisory Board.

REVISED CRITERIA

A. POLLUTANT

Factor #A1 Severity of Toxin

	Score
Group A – Toxins that are not assessed as acute or systemic. *e.g. organics such as toluene or xylene*	1
Group B - Organics that are probable carcinogens (USEPA Class 2 and 3) or substances with some systemic toxicity. *e.g. VOC's, PAHs, PCBs, air pollutants such as PM10 and PM 2.5*	2
Group C - Known carcinogens or chemicals with significant systemic or organ system toxicity. ***e.g*** *vinyl chloride, benzene, lead, radionuclides, hexchromium, cadmium, organophosphate pesticides.*	3

Note: these are broad categories: TAB members are asked to use knowledge and experience of the specific pollutants to judge the weighting to be given in any instance.

Factor #A2 Amount or scale of pollutant source

Limited	1
Moderate	1.5
Large	2

These two factors are taken as multiplicative and so the overall score for this element is as follows:

SCORE A = A1xA2

B. PATHWAY

Factor #B1 Evidence of Human Exposure Pathway

Clear pathway	1
Multiple pathways	2

Factor #B2 Reliable Evidence of Health Impact

No	0
Yes	1

These two factors are taken as additive and so the overall score for this element is as follows:

SCORE B = B1+B2

C. PEOPLE

Factor #C1 Number of People Potentially Affected

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

Factor #C2 Level of exposure

Low	1
Medium	1.5
High	2

Factors C1 and C2 are taken as multiplicative

Factor #C3 Large numbers of children particularly at risk

No	0
Yes (e.g. play areas, schools)	1

This factor is taken as additive to the other two and so the overall score for this element is as follows:

SCORE C = (C1xC2)+C3

DISCRETIONARY ELEMENT

Factor #D Additional High Risk Element (TAB member discretion)

No	0
Yes	1

TOTALS

On the above basis, the total score is calculated as:

SCORE = [A1xA2] + [B1+B2] + [(C1XC2)+C3] + D

On this basis, the maximum score that could be assigned to a site is 17, as follows:

MAX SCORE = (3x2) +(2+1) + (3x2+1) + 1 = 6+3+7+1 = 17

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