Assessment of Informal Used Lead Acid Battery Recycling and Associated Impacts in Bangladesh

Produced for: United Nations Environment Programme
Produced by: Pure Earth with input from the Environment and Social Development Organization and the International Lead Association
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Executive Summary

Bangladesh's economy has evolved rapidly from one based primarily on agriculture to a more diversified service and manufacturing economy. While this evolution has helped Bangladesh move up the income scale, it has also created new pollution control and environmental health challenges that may be outpacing the government's capacity to regulate industries and mitigate environmental health risks. This challenge is particularly acute with respect to the used lead acid battery (ULAB) recycling industry and the exposures to toxic lead pollution that result from informal and substandard recycling.

Bangladesh is believed to have more than 1,100 informal and illegal ULAB recycling operations across the country. To date, 270 of these locations have been identified and assessed by environmental health professionals from the non-profit organization Pure Earth and the Department of Geology of the University of Dhaka (see site list in Annex A). These assessments reveal high concentrations of lead surrounding informal ULAB recycling operations and severe public health risks to nearby residents. The environmental and demographic data captured through these assessments is publicly available in an online database at www.contaminatedsites.org. Based on these findings, informal and unsound ULAB recycling is believed to be a significant contributor to lead exposures across the country and the primary contributor to lead pollution hotspots.

The average concentration of lead in children's blood in Bangladesh is estimated to be among the highest in the world at approximately 8 micrograms per deciliter (µg/dL). This concentration is significantly above the "reference level" of 5 µg/dL that triggers government intervention and case management for a child in the United States. A recent meta-analysis suggests that nearly 28.5 million children in Bangladesh have blood lead levels above 5 µg/dL, and that more than 21 million have BLLs above 10 µg/dL (Ericson, 2020). At these levels, it would be reasonable to expect significant IQ reductions among the tens of millions of chronically exposed children. In 2017, exposures to lead were responsible for 4.3% of deaths in the country.

A study on economic impacts from lead exposures estimates that each year Bangladesh loses US $15.9 billion in GDP from reduced lifetime earning potential among the exposed population. This figure includes only lost earning potential due to IQ decrements, and does not include healthcare costs, lost earnings from premature death, or lost taxes from illegal ULAB recycling operations.

Based on the extraordinary public health and economic toll, investments in lead exposure reduction programs in Bangladesh would likely yield significant returns on investment, resulting in a more productive, healthier and resilient population.

Introduction and National Context

The generation of used lead acid batteries (ULABs) in Bangladesh has grown considerably in the last decade, as demand for lead acid batteries (LABs) increased in several sectors. LABs are in high demand in the transportation sector as well as for power storage in solar energy collection systems or in backup systems where there is unreliable grid electricity service. Figure 1 shows the type of LABs used by major consumers in Bangladesh.

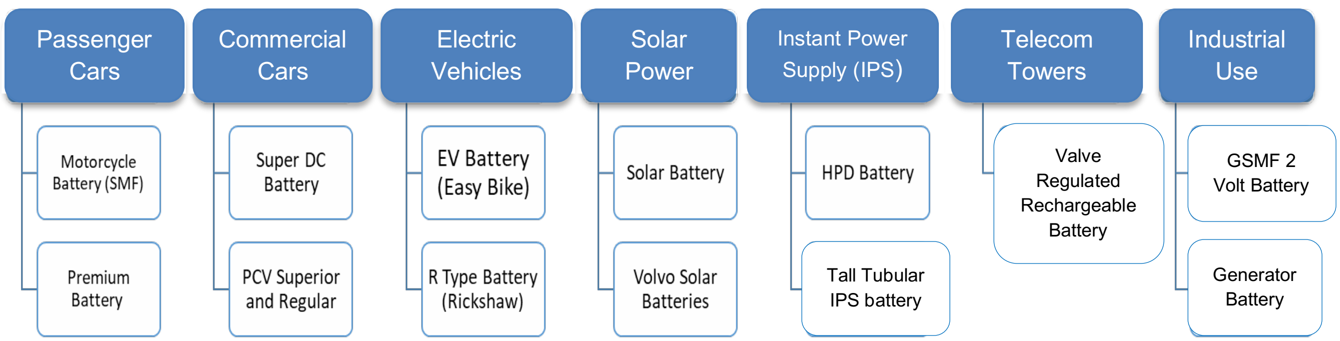

Figure 1: Sectors using Lead Acid Batteries in Bangladesh

In the transportation sector, the number of registered vehicles in December 2019 stood at 504,130, along with 2 million motorcycles (ILA, 2020). While it is expected that conventional 'vehicle starting battery' consumption will rise as the number of motor vehicles increases, there have also been a phenomenal growth of battery-run rickshaws and battery operated autorickshaw (locally known as 'easy-bikes') in the last decade (see box 1). These vehicles use a set of five batteries with a capacity of 60V, which consume 1kW of electricity daily and take 4-5 hours to be fully charged (Rasel, 2017).

Pooled ride-shares in these vehicles have generated employment opportunities for urban dwellers in towns outside Dhaka. While there are no estimates on the number of these type of rickshaws operating in the country, the market forces driving their adoption are similar to those in the context of neighboring India (Goel & Singh, 2019). These vehicles operate in the narrow roads off the highways serving the last miles for passengers. While it is difficult to estimate the total number of easy-bikes and battery-run rickshaws in the country, as registration for these vehicles with Bangladesh Road Transport Authority (BRTA) is not mandatory, it is reasonable to assume that these vehicles account for more than two-third of the demand for LABs.

Battery-run rickshaw

- Similar to electric bikes with pedal assist motors.
- Motor drive mechanism is directly controlled by a hand throttle
- Uses four 12V 20Ah lead acid batteries, placed under passenger seat
- Seating capacity = 2 passengers

Battery-run auto-rickshaw (easy-bike)

- Similar to tuk-tuks. Costs 150000 taka.
- Brushless DC motors with automatic gearbox
- Uses 5-6 12V lead acid batteries, placed under driver & passenger seats
- Seating Capacity = 5-7 passengers

Box 1: Distinguishing between battery-run rickshaws and easy-bikes

In the absence of a comprehensive regulatory framework for the environmentally sounds management and recycling of ULABs, this waste stream is becoming an increasing environmental and health concern for Bangladesh. Based on a LAB inventory analysis and the various life cycles for each category of LAB and their respective applications, it is estimated that the annual generation of ULAB is 118,000 metric tons (mt) (ILA, 2020). Figure 2 show the major sectors generating ULABs in Bangladesh, distinguishing between easy-bikes and battery-run rickshaws.

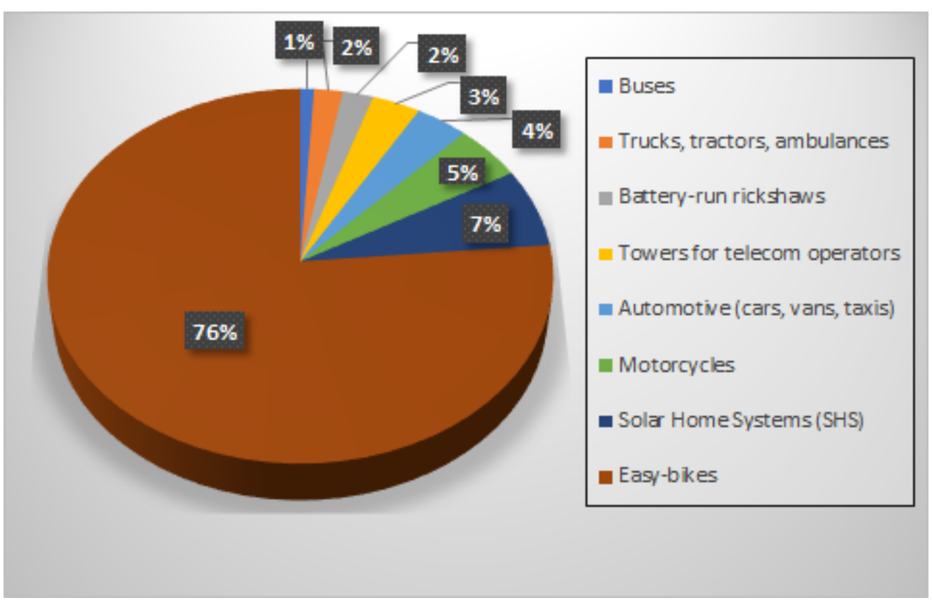

Figure 2: Estimated annual generation share of ULABs (ILA, 2020)

Estimates of the relative volume of LABs used across different sectors should be considered as indicative, rather than precise, as data is incomplete and the context for LAB usage is always evolving. For example, Batteiger (2015b) estimated that ULABs from Solar Home Systems (SHS) have crossed 10,000 mt in 2016, whereas ILA (2020) estimates 8,000 mt. Recent trends also suggest that ULABs generated from SHS may be entering the waste stream earlier than previously expected. Bangladesh has seen impressive growth in rural grid electrification since 2015, with monthly new connections in the range of 300,000–500,000 per month (Muzammil & Ahmed, 2019). As more households get connected to the grid (a cheaper alternative to SHS), the market for SHS is already slowing (Parvez, 2020), and it can cause existing SHS households to discard ULABs and other components prematurely.

The formal sector ULAB recycling capacity has not grown to cater to the volume of ULABs generated, although it was expected in earlier studies (Marro & Bertsch, 2015). Only four battery manufacturers have their own recycling facility, and there are another two authorized recyclers operating in the country as part of the formal industry. The known formal sector ULAB recyclers are:

- Rahimafrooz Batteries Ltd. - Zirani Bazar, Zirani Kashimpur Road, Panisail, Dhaka
- Panna Battery Ltd. – West Rasulpur, Ramrangirchar, Dhaka
- Khorshed Metal Industries (HAMKO Group) - Bangladesh Small and Cottage Industries Corporation (BSCIC) Industrial Area, Khulna
- RIMSO Battery - Masabo, Borpa, Narayanganj
- Kishan Accumulators Ltd. – Kashiyara, Uzirpur, Bokultala, Narail
- BengalXpo Ltd - Pabna

The locations of these recyclers near major towns and cities also poses a challenge, as they are located far away from many end-users. This and other factors have enabled the growth of hundreds of unauthorized recyclers as part of an informal economy, posing risks to the environment as well as occupational safety for the workers involved. Hotspot areas of illegal smelting have emerged in Tangail, Jessore, Bogura, Dhaka, Dinajpur and Pabna.

The terms “informal sector” and “informal economy” describe the unregulated, unlicensed, and often illegal economic activity within an economy. The informal sector includes undocumented laborers, street hawkers, sellers of banned products, and other small to medium-scale industries operating outside of the law. In the case of informal ULAB recycling in Bangladesh, such operations employ more than 100,000 people throughout the country. In the village of Raksha, in Bera Upazila of Pabna District, the informal battery recycling sector is the major employer.

Market Forces Influencing the ULAB Trade

The diffusion of Solar Home System (SHS) units has had a significant influence on the battery industry and ULAB recycling in Bangladesh. There are about 5.8 million SHS units installed in the country (SREDA, 2020) out of which 4.1 million SHS have been installed in off-grid households through Partner Organizations (POs) of the Infrastructure Development Company Limited (IDCOL, 2018). IDCOL is the implementing agency receiving financial support from the World Bank, KfW Development Bank, Asian Development Bank and other development agencies through the highly successful Rural Electrification and Renewable Energy Development (RERED) project, which is in its second phase, and is scheduled to end in 2021 after two decades (Batteiger, 2015a).

Although the RERED program's main objective was CO_2 mitigation, as attention increased on other environmental impacts such as spent batteries, IDCOL released a policy guideline in 2005 on the disposal of warranty expired batteries (ULABs). The regulations of the Department of Environment (DoE) on expired batteries came out in 2006, and the final report of the World Bank stated that the RERED project helped to improve standards in battery recycling and influenced the subsequent DoE regulations (Batteiger, 2015a). IDCOL ensured that batteries supplied under their SHS program came from ISO 14001 and OHSAS 18001 compliant facilities. Out of the 17 battery suppliers to IDCOL, only four have recycling plants (IDCOL, 2019), while the rest have entered into arrangements with the existing recycling plants to use their facilities (Marro & Bertsch, 2015).

IDCOL's policy guidelines stipulate that consumers have to sell their expired batteries exclusively to Partner Organizations, which are responsible for collecting batteries and transporting them safely to the regional offices of battery manufacturers. Manufacturers are then responsible for collecting the units from these offices and transporting them to sites where the batteries will be recycled in an environmentally friendly manner. Recyclers collect the batteries without the acids in order to reduce weight during transit (Batteiger, 2015a). IDCOL pays up to US $10 for each returned warranty-expired battery as an incentive to the battery recyclers and the Partner Organizations. To incentivize consumers for returning expired batteries to Partner Organizations and not to backyard smelters, a 24% rebate of the new battery price is offered when they return old batteries (Marro & Bertsch, 2015). However, not all expired batteries end up with the Partner Organizations, especially in the rural areas where they are recycled by the informal sector (Batteiger, 2015a). The actual share of users returning their warranty-expired battery to the Partner Organizations is low. The market share of the informal battery shops is around 50% (Batteiger & Rotter, 2018). Brossmann (2013) identified three main reasons for this behavior based on focus group discussion of end-users. Firstly, local battery shops offer more diversified services at lower prices compared to the Partner Organizations. These services include repair of broken batteries by replacing lead plates and substituting the acid, which is cheaper than purchasing a new battery recommended by most Partner Organizations. Secondly, consumers trust the local battery shop owners more as they are locally embedded as opposed to field agents of Partner Organizations who might change employers or local branches. Finally, the interest level is low among Partner Organizations to communicate with users about expired battery disposal (Brossmann, 2013). Although the estimated generation of ULAB is low from SHS, the studied effects on the growth of the informal sector in rural areas are relevant in understanding how that sector also caters to other major ULAB sources such as motorbikes and battery-run auto rickshaws.

What is certain in both rural and urban contexts is that the collection channels of the informal sector are more dispersed and effective compared to the formal recyclers. Another reason batteries flow to the informal sector is that informal recyclers pay a higher price compared to formal sector recyclers. In the informal sector, depending on the condition of ULABs, each and every part of the old batteries is usable and therefore has value (Chakraborty & Moniruzzaman, 2017), whereas the formal sector is primarily interested in the lead. This cycle of higher price offering continues down the supply chain (Waste Concern, 2006) until it eventually makes its way to battery manufacturers.

ULAB Collection Practices and Reverse Logistics

The environmentally sound recycling of ULABs requires a reverse logistics supply chain or collection system that ultimately delivers ULABs to licensed and properly operated formal sector recyclers. Figure 3 illustrates the collection chain of ULABs in both the formal and informal sector. The less prominent route is that from user to smelter directly, and it is mainly practiced by institutional users such as government vehicle pools, corporate offices etc. The more dominant route is through small buyers in the form of battery repair shops, auto and tire repair garages as well as urban ‘feriwallas’ collecting old electronics through barter and trade. A survey by Chakraborty & Moniruzzaman (2017) found presence of 106 secondhand battery shops in Dhaka city alone, offering new and old batteries for vehicles, Instant Power Supply (IPS) units and SHS. Approximately 250 - 15000 kg of battery waste is sold in each shop per month, which the shop then resells for 72-75 taka per kg. The monthly collection of old batteries from these Dhaka-based shops range from 10-100 tons (Chakraborty & Moniruzzaman, 2017). A broker transfers these ULABs from small buyers to re-builder or 'vangari' shops, some of whom also operate as smelters. A cluster of these rebuilders are also situated in *Nobabgonj* and *Kamrangir Char* area of Dhaka. They have deals with the secondhand battery shop dealers and auto mechanics to purchase old batteries and collections are carried out using trucks.

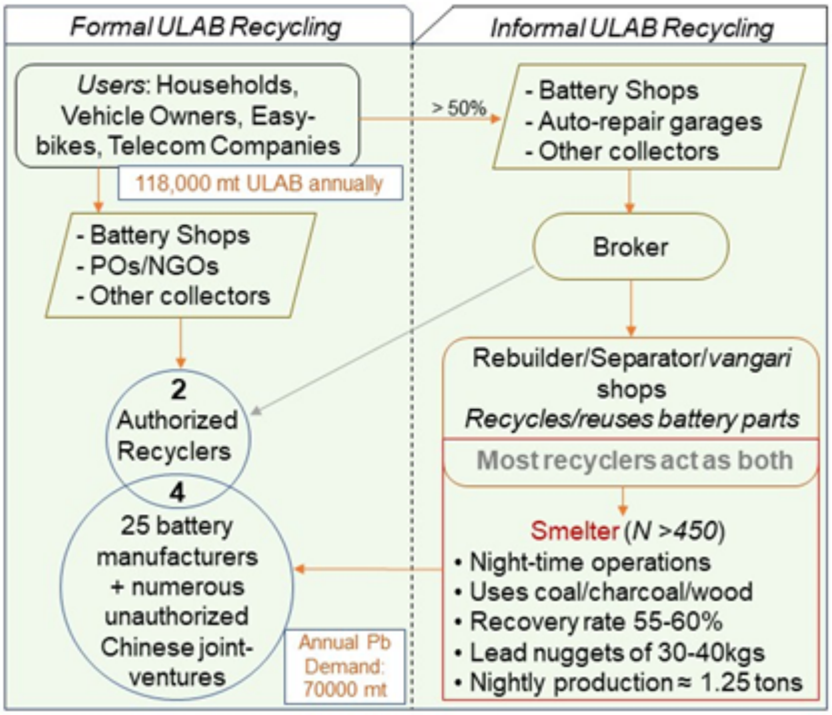

Figure 3: Collection chain of ULABs in formal and informal sector

According to Waste Concern (2006), the price of a used battery increases by about 100% in each stage of the transfer. The variation between the first and last stage is due to profit margins at the broker level and carrying cost of batteries to destinations. Another reason for value appreciation is that each of the components of a separated used battery is reused or recycled in bulk. The vangari/smelters are interested in ULABs because they can reuse hard containers, and partially reuse the negative plates and separators along with the lead. Smelters also use bad plates as raw materials for smelting, whereas rebuilders/vangaris can reuse good plates for battery repair. If an entrepreneur wants to open up a ULAB recycling facility in the formal sector, the price offered for an old battery must be equal to or higher than the average price of a separated battery to ensure supply of sufficient batteries for recycling (Waste Concern, 2006).

Scope and Scale of Informal ULAB Recycling

The informal economy represents a substantial portion of Bangladesh's workforce and productivity. The Bangladesh Bureau of Statistics and the Asian Development Bank estimate that in 2012, 89% of the labor force in Bangladesh was employed in the informal economy (Asian Development Bank, 2012). Small-scale picking, sorting, cleaning, trading and processing of inorganic recyclables is traditionally tolerated in Bangladesh without official authorization. Authorities are tolerant as the informal recycling sector helps reduce the volume of waste disposed of in landfills. Informal recycling is also acknowledged in the national *Reduce, Reuse and Recycle* strategy as an important source of income for the urban poor. Despite the hazardous and unstable working conditions in the informal sector, such activities contribute to poverty reduction, which is a government priority (Matter et al., 2015). The decentralized nature of the informal economy poses regulatory challenges which have implications for environmental quality and health. Because unlicensed ULAB recycling is illegal, it is conducted in secret, outside of the view of law enforcement, and thus regulators cannot enforce other standards related to pollution control and worker safety.

Bangladesh is believed to have more than 1,100 informal and illegal ULAB recycling units across the country, putting more than one million local community members that live in close proximity to these sites at risk (World Bank, 2018). Approximately one quarter of these sites (more than 250 individual recycling sites) have been identified and assessed through the Toxic Sites Identification Program, as discussed below in the section titled Contaminated Sites. A baseline study by the Bangladesh Bureau of Statistics estimated that in 2003, there were 12,207 battery recycling/recharging operations in Bangladesh and that 34% of these establishments were found in or near Dhaka. The study did not distinguish between recycling—a process likely to create relatively severe environmental health risks—and recharging—a process that is unlikely to create significant risks. Across Bangladesh, 22,480 individuals were engaged in the battery recharging or recycling establishments and 24.6% of them were child workers ages of 5 and 17 years (Bangladesh Bureau of Statistics, 2004). A study of workers engaged in the opening and breaking of ULABs for recycling found a mean blood lead level (BLL) of 66.77 μg/dL among the 118 study participants (Ahmad et al., 2014).

The plots of land used for smelting are typically leased from local owners and are not valuable for agricultural production. Recyclers tend to offer relatively high rates for the land and do not always disclose their intended use. News reports suggest that such smelting operations also take place in homestead forests away from dwellings (Rahman, 2018b), residential areas within small towns (Alam, 2015), abandoned poultry farms (BDnews24, 2019), flour mills and filling stations (Prothom Alo, 2016). During the day, operators break and sort battery parts, while smelting is conducted secretly at night. A mid-sized informal smelter typically employs 8-10 people (Hossain, 2019), and child labor is prevalent in the breaking, sorting and furnace preparing activities (Ahmed & Hasan, 2020). In terms of wages, the smelting expert is paid the highest wage, at 600-1300 taka per night. Other workers can earn 400-500 taka per day (Prothom Alo, 2019), but the earnings can vary by tasks. For example, unloading of batteries from trucks/boats can pay 1.5 tk./kg while loading of lead ingots pays 9 tk./kg. Children involved in breaking batteries can earn 4.5 tk. per kg of recovered lead, and typically extracts 30-40 kg daily (Ahmed & Hasan, 2020).

While locals are often aware and tolerant of the ULAB piles stocked for breakage/separation, they often object to the night-time smelting activities due to smoke and acidic smells. The most visible impact triggering local protest against smelters is the death of domestic cows and goats living near the site. Lead ash contaminated grass and other feed can be fatal for these animals and has resulted in large numbers of deaths within a short period (Farazi, 2019; Prothom Alo, 2016; and Rahman, 2018b). Protests and complaints to local authorities at times result in dismantling furnaces either officially (Uddin, 2019) or through mobs (Rahman, 2018b). Arbitration is sometimes arranged by local leaders or police to compensate the aggrieved parties (Ashraf, 2018; Kaler Kontho, 2019). If the operators cannot resume their practice, they often move to another site, creating a second contaminated area.

Informal ULAB Breaking and Lead Smelting Process

In Bangladesh, informal ULAB recycling typically takes place in residential backyards, rural lots, river deltas locally known as ‘chars’ and unplanned and unregulated industrial areas. Before batteries arrive at recycling operations, sulfuric acid electrolyte inside the battery case is typically dumped on the ground or into a drainage canal or sewer. This acid is a hazard in its own right but is also contaminated with lead, and possibly poses a groundwater or surface water contamination risk. Even battery recyclers from the formal sector do not collect ULABs with the electrolyte, pouring it indiscriminately to reduce transportation cost (Batteiger, 2015b).

Once a battery arrives at a recycling site, the casing of the battery is broken open using an axe or machete. The lead plates, which make up 60% of the battery by weight, are pulled out by hand and dumped onto the ground. The casings are washed in a concrete tank, which eventually turns black due to regularly washing lead dust and acid. Washing is done by hand exposing workers to occupational hazards and this water is discharged into water bodies without treatment (Ahmed & Hasan, 2020). The plastic containers are sometimes reused by battery manufacturers and repair shops (Waste Concern, 2006;

Chakraborty & Moniruzzaman, 2017) while the remaining containers and covers are shredded into chips and flakes for recycling. Polyethylene separators that sit between each lead plate are thrown into a pile and their fate is determined by their quality. Good separators are used in reconditioned batteries; medium quality ones are sometimes used in making PVC pipes; and the lower quality ones are either burned during smelting or disposed of in unofficial dumpsites.

The melting of lead is done using a very simple setup. The lead plates are placed into a hole dug in the ground which is typically two feet deep and one and a half feet in diameter. The earth around each hole is paved with bricks and coal/charcoal is heaped around to be used for melting lead. Each furnace has a blower run by a diesel engine to keep the coal burning high. A long metal spoon is used by an expert smelter laborer to stir the lead and maintain the required heat. Impurities are scraped from the top of the molten lead and tossed to the side. Lead losses in this 'pit smelting' process practiced by the informal sector can be as high as 40-45% (Waste Concern, 2006; Batteiger, 2015a). The processing takes place for 3-4 hours, after which the lead is scooped out and poured into half-round molds to be cooled. Once hardened, the lead nuggets (round ingots) each weigh about 40 kg (Ahmed & Hasan, 2020). Loaders carry the heavy nuggets on their bare head to trucks that take them to refiners and battery makers. The price of this lead can vary from 45 to 135 taka per kg (Hossain, 2019; Ahmed & Hasan, 2020).

Contaminated Sites

While the Government of Bangladesh has taken steps to reduce ambient concentrations of lead, for example, by banning leaded petrol, anthropogenic sources and contamination hotspots remain prevalent and may be causing even greater exposures than leaded petrol. Among these sources, informal and substandard recycling of ULABs is believed to be the largest contributor to lead pollution hotspots in Bangladesh today.

The informal recycling of ULABs creates highly localized contamination hotspots and severe risks to children that live, play, or go to school near the recycling site. From a health perspective, the dominant environmental health hazard related to informal ULAB recycling is the lead itself. Lead dust is released on site through the breaking and separating of battery components and is released to the air as dust and vapor through the melting of lead plates. Lead dust released directly to the site can migrate to nearby communities on clothes of workers, in their hair, on shoes, on vehicle tires, through storm water runoff, by wind, and through the off-site disposal of contaminated waste. Lead dust and vapor released to the air during the melting process goes up into the air, and, because lead is quite heavy, generally falls back to the ground within several hundred meters of the source. Contaminated site remediation projects conducted by the non-profit organization Pure Earth have shown that lead released during informal recycling generally stays within the top 5mm of local surface soils.

Informal ULAB recycling activities are often carried out in or near residential communities where lead dust can accumulate in high-risk areas such as paths, roads, sports fields, playgrounds, schools, homes, and other areas where dust is likely to be agitated and then ingested or inhaled. The breaking of lead-acid batteries and the disposal of associated wastes can release lead into water, although contamination of groundwater with lead does not appear to be a common issue due to non-solubility of the lead released during the recycling process.

One of the most robust sources of information about the location, contamination levels, and potential public health risks of chemical contamination hotspots in Bangladesh is the database of the global Toxic Sites Identification Program (TSIP). TSIP is designed and managed by the international non-profit organization Pure Earth, and implemented in Bangladesh in partnership with the Department of Geology of the University of Dhaka, and in consultation with the Bangladesh Department of Environment. The TSIP database of contaminated sites is publicly accessible at www.contaminatedsites.org.

The TSIP endeavors to identify and assess industrially contaminated sites in low- and middle-income countries with a potential human health impact. As part of the TSIP, more than 3,600 sites have been assessed in 47 countries since 2009. The purpose of TSIP is to quantify the approximate scope and severity of industrial soil and water contamination in a given country. Using the information gathered during on-site investigations, high priority sites can be targeted for more detailed assessment and for intervention to mitigate exposures.

The TSIP utilizes a rapid assessment protocol known as the Initial Site Screening. The Initial Site Screening is completed on site over a period of 1-2 days by professionally trained investigators and is designed to collect information related to human health risks. Investigators collect various types of qualitative and quantitative data, including an analysis of soil and/or water samples collected from points of likely public exposure. Data from completed Initial Site Screenings are entered into an online database that is shared with relevant government agencies, donors, development agencies, and other interested stakeholders. The full TSIP Initial Site Screening Protocol in included in this report as Annex B.

The TSIP in Bangladesh began in 2011. Since then, several phases of the Program funded by different development partners have been completed. While some of these phases looked at a broad spectrum of chemical contaminants, more recent phases have focused specifically on lead contamination from ULAB recycling. As such, the national TSIP database for Bangladesh contains a significant amount of data on lead contamination, but comparatively little on other chemicals.

TSIP project leaders identify sites for screening through a variety of methods, including consultations with DoE and other national agencies and civil society groups, information collected from national and international reports on chemicals and waste, newspaper articles, suggestions by local officials, and through recommendations by local residents and workers received in the processes of conducting screenings.

As of April 2020, the TSIP in Bangladesh had resulted in more than 340 Initial Site Screenings at contaminated sites across the country. Of these sites, 289 are contaminated with lead resulting from informal or substandard ULAB recycling. The Government of Bangladesh does not maintain an independent database of lead-contaminated sites. A complete list of lead-contaminated sites assessed through the TSIP is included as Annex A.

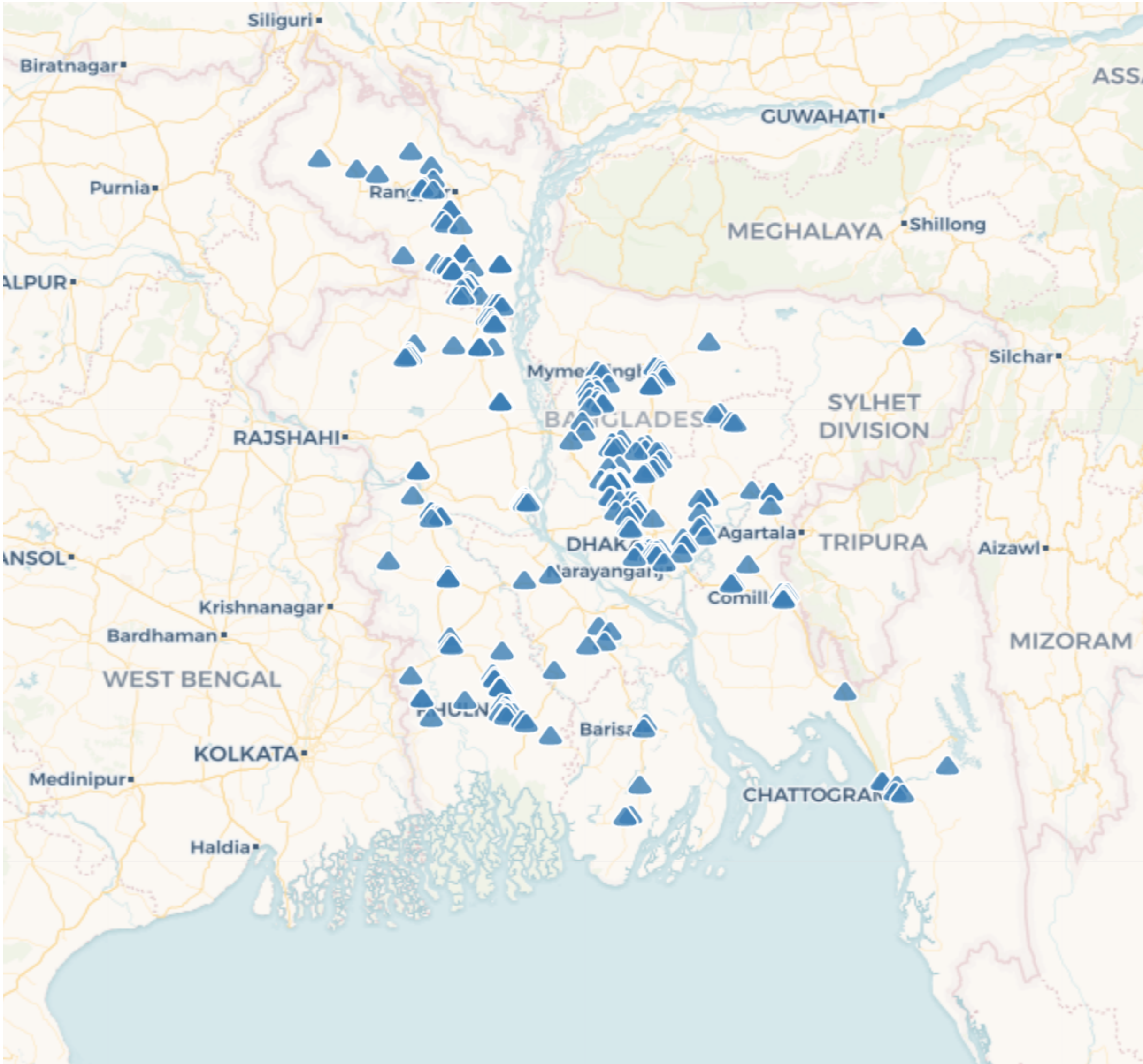

Figure 4. Sites contaminated with lead in Bangladesh that have been assessed through the Toxic Sites Identification Program (Pure Earth, 2020).

Health and Economic Impacts from Lead Exposures

Lead is a well-studied developmental and systemic neurotoxin that affects the central nervous system and brain development and is particularly harmful to children. Acute exposures to lead can cause comas, hearing loss, convulsions and even death. At lower levels of exposure, lead can affect a child's neurological development, resulting in permanently reduced intelligence quotient (IQ), lower educational attainment, reduced lifetime earnings, and increased violent behavior (Nevin, 2000; Schwartz, 1994). In adults, exposures to lead earlier in life can result in heart disease, stroke and kidney disease. In 2017, more than one million global deaths from adult onset diseases were attributable to exposures to lead, accounting for nearly 2% of all deaths that year (IHME, 2017). This figure does not capture the damage to children's intellectual development. The World Health Organization has concluded that there is simply no safe level of lead in blood (WHO, 2017).

According to the findings of the Global Burden of Disease study by the Institute for Health Metrics and Evaluation, in Bangladesh, more than 38,000 deaths annually are attributed to exposure to lead—nearly 4.3% of all deaths nationally—making Bangladesh one of the most severely lead-impacted countries on earth (IHME, 2017). The same study suggests that lead exposures in Bangladesh are responsible for roughly 15% of deaths from ischemic heart disease, 11% of deaths from strokes, 18% of deaths from hypertensive heart disease and 8% of deaths from kidney disease. Again, these figures account only for adult deaths and do not capture the impacts on children. Through these negative health outcomes, lead exposures are responsible for an annual loss of 888,000 years of health life across the population of Bangladesh (IHME, 2017).

Despite the large public health toll related to lead exposures, public understanding of the dangers of lead appear to be very low. A 2019 study found that among automobile repair shop workers who work directly with LABs, only 20% had any knowledge of the harmful effects of exposures to the metal (Uddin, 2019). In many of informal recycling units, children are involved in breaking and separating of ULABs exposing them to lead dust for a prolonged time. Indeed, it is the impacts to children that are perhaps the most concerning, and the most consequential for the future development of the country.

A troubling trend in Bangladesh is that the public health impacts from lead exposures appear to be getting more severe despite the ban on leaded petrol. Morbidity and mortality rates associated with lead exposures (expressed as deaths and disability adjusted life years [DALYs] per 100,000 people) have been rising for the last 20 years.

Recently, the death rate from lead exposures has exceeded that from unsafe water sources.

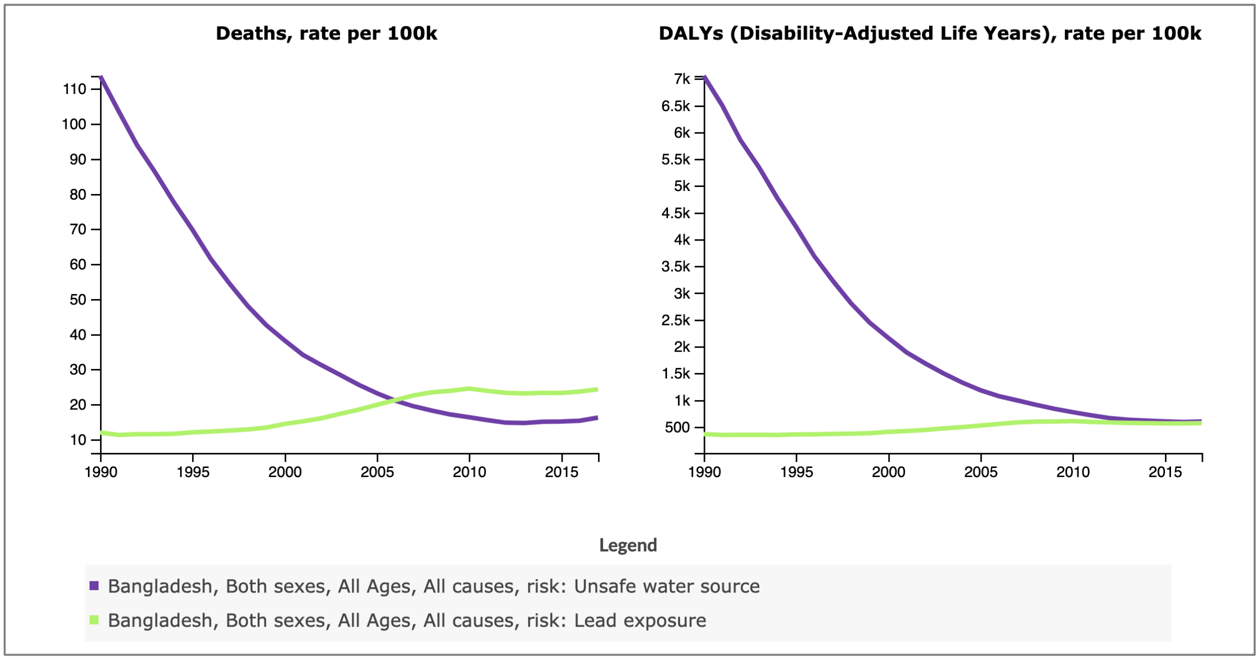

Figure 5. Death and DALY rates per 100K people between 1990 and 2017 associated with lead exposures (green) and unsafe water sources (purple) (IHME, 2017)*.*

A recent meta-analysis of studies of blood lead levels among populations in low- and middle-income countries suggests that the mean blood lead level in Bangladesh is approximately 8µg/dL (Ericson et al., 2020). The same study finds only six countries with higher mean BLLs among children under 14 years old. The U.S. Centers for Disease Control and Prevention have set a reference BLL level of 5 µg/dL, above which children receive case management. Ericson's study suggests that nearly 28.5 million children in Bangladesh have BLLs above 5 µg/dL (66% of all children under 14), and that more than 21 million have BLLs above 10 µg/dL (48% of all children). At these levels, it would be reasonable to expect significant IQ decrements among the tens of millions of chronically exposed children.

A study of the economic impacts of IQ losses associated with lead exposures estimates that each year Bangladesh loses US $15.9 billion in GDP from impacts resulting from lead exposures (Attina & Trasande, 2013). While these economic costs are not all associated with battery recycling, informal ULAB recycling is a significant contributor to these underlying exposures since batteries producers and recyclers are the largest lead users in the country. This economic loss figure includes only lost earning potential due to IQ decrements, and does not include lost earnings from other diseases, healthcare costs, lost earnings from premature death, or lost taxes from illegal ULAB recycling operations.

Environment hazards associated with different stages of recycling activities are summarized in Table 1, and are based on field observations, inputs from recyclers in the informal sector, and expert opinions.

Table 1: Environment hazards through the stages of ULAB recycling

Actors	Aspects
Small Buyer/Broker	• Acid disposed near drains and adjacent areas
Collection Points	• Lack of acid-resistant containers and concrete ground cover can lead to leakage • Hazardous fume accumulation in the absence of exhaust ventilation
Separator	• Acid of sealed batteries are hazardous to workers • Lead dust, particulates and acid mists • Lead & acid contaminated water due to repeated washing of batteries in the same tank.
Smelting	• Lead fumes and dust • Fuel smoke due to coal/wood/charcoal burning • Burnt coal with lead slag which is disposed on adjacent lowlands

Unsound ULAB recycling is believed to be a noteworthy contributor to elevated blood lead levels in Bangladesh, but the exact relative contribution of this activity versus other sources of exposure is not known. It is likely that unsound ULAB recycling is a major driver of exposures in communities near ULAB production, repair, and recycling sites, and minor contributor in areas where no formal or informal battery-related industries are present. A recent study suggest that spices adulterated with lead additives (lead chromate, lead carbonate, and lead sulfate) may be the primary contributor to elevated blood lead levels among rural Bangladeshis (Forsyth, 2019). However, it is possible that the lead used in these additives is illegally sourced from informal ULAB recyclers, thus implicating both two industries in the spice-related exposures.

Regulations Related to ULAB Recycling and LAB Production

While there are no dedicated laws governing use and recycling of ULABs in Bangladesh, enforcement of separate Statutory Regulatory Orders (SROs) is carried out under the *Environmental Conservation Act 1995*. In 2006, SRO No. 175-Act/2006 (dated August 29, 2006) laid out instructions on collection and recycling of used/non-functional batteries to control and prevent environmental pollution. According to this SRO, no recycling of batteries will be permitted without environmental clearance of the Department of Environment (DoE). Restrictions were imposed on improper disposal of used batteries or any parts of used batteries in open space, water bodies, waste bins, or other unlicensed disposal facilities. All used batteries must be sent to DoE-approved battery recycling operations at the earliest convenience and no financial transaction is allowed for used or non-functional batteries. However, this SRO was amended 2008 (SRO No. 29-Act/2008 dated February 11, 2008) to allow financial transactions on mutually agreed fixed cost (IDCOL, 2017). In 2018, another amendment to this SRO was proposed and stakeholder meetings were organized jointly by the DoE and Accumulator Battery Manufacturers & Exporters Association of Bangladesh (ABMEAB). While details of the amendment are not available yet from these institutions, it is expected to attempt to rein in the activities of unauthorized recyclers by compelling battery manufacturers to only buy lead from authorized recyclers (Channel i News, 2018).

DoE also applies the *Hazardous Waste and Ship-Breaking Waste Management Rules 2011* to battery recyclers. Use of this law is justified due to the fact that by-products of secondary production of lead (e.g. lead-bearing residue, lead ash/particulate from flue gas) are considered hazardous waste under the Basel convention (Ahmed & Hasan, 2020). The rules bind the battery recyclers to submit information periodically about the volume of recycled products, recycling processes and environmental impacts. The rules also direct the parties (transport included) to follow environmentally sound processes—failure of which can result in penalties according to Section 15 of the *Environment Conservation Act 1995*. The DoE does not maintain or publish any information on enforcement activities they carry out against battery recyclers, although they acknowledge that more than 250 unauthorized recyclers operate in the country (Ahmed & Hasan, 2020).

Battery manufacturers must also abide by DoE guidelines as stipulated through the issuance of an Environmental Clearance Certificate. Manufacturers are required to install effluent treatment plants and air treatment plants to minimize environmental damage, as well as follow other factory-specific management plans outlined in the Clearance Certificate. However, enforcement is lax, and there are cases of factories operating without this permit. Geli Industrial Company Ltd., located in Sreepur, Gazipur is a notorious case of lax enforcement. It has been operating since 2016 without an Environmental Clearance Certificate. The application of this permit must contain a *no objection certificate* from the local administration, and a nearby school running since 1968 objected to its location (Dhaka Times, 2018). DoE is aware that the factory does not have a permit but has tolerated its continued operation (Akand, 2018). Locals allege that the factory recycles ULABs and produces new ones within its premises, and the smoke and acidic fumes are harming schoolchildren and killing animals (JagoNews24, 2018). The principal of the school has repeatedly pleaded to the authorities to act, but to no avail (Dhaka Times, 2018). Locals have demonstrated multiple times demanding a halt to activities (Bangla Tribune, 2018). In July 2018, DoE issued a one-time fine of 50,000 tk. (Akash, 2018), which is equivalent to approximately US $600, and is unlikely to serve as a deterrent (Haque, 2018).

National Battery Production Market

Battery manufacturers have been operating in Bangladesh since early 1950s catering to the demands of passenger and commercial vehicles. Production of industrial batteries by local manufacturers started in mid 1980s, and these were mainly flat plate and tubular plate batteries. In 2008 the industry experienced a big change with the introduction of maintenance free (MF) battery, where manufacturers exclude any means of maintaining the electrolyte/distilled water in the battery. Thus, when a battery dries out the only option available is to replace it instead of refilling it. At first, MF batteries were used only by telecom operators where this type of specialized batteries were required for heavy-duty backup as alternative power solution. Subsequently, this type of battery was adapted for the automotive purposes.

The size of the market for LAB assembled in Bangladesh is approximately US $129M (BDT 11B, or 11,000 crore) (Babu, 2020) and growing at a rate of 12% (Ahmed & Hasan, 2020). The market for LAB in Bangladesh has grown by three to four times in the last ten years. Currently around 25 local companies are catering to domestic needs by manufacturing batteries for three-wheelers, hybrid and electric cars, scooters, commercial vehicles, cars, instant power supply (IPS), and SHS. The level of competition is high, and companies have also carved out a niche area in the market. These companies are also exporting LABs to 60-70 countries, and exports are incentivized by the Government of Bangladesh offering a 15% cash incentive for the export of LAB. Figure 6 illustrates the state of the market in Bangladesh. ABMEAB is currently in talks with the government to allocate a special economic zone (industrial area) for battery makers in order to establish an environmentally sustainable industrial sector (Bangladesher Khabor, 2019).

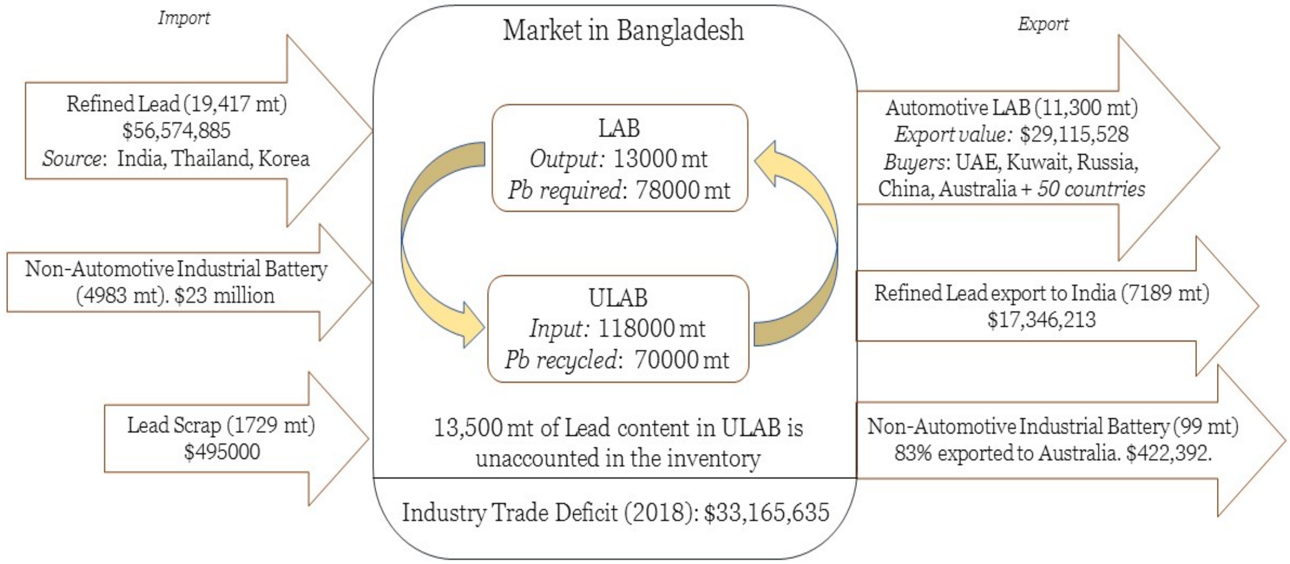

Figure 6: Summary of LAB market (ILA, 2020)

Major LAB Producers

Rahimafrooz Batteries Ltd is the largest lead-acid battery manufacturer in Bangladesh, producing 1,500,000 batteries per year. The company makes around 200 different types of LAB for a variety of transport and UPS applications. The company is also one of the leading regional players, exporting to around 60-70 countries. Rahimafrooz factories are located at Ishwardi in Pabna, and Birulia and Zirani Bazar of Savar in Dhaka. Its major brands are Globatt, Lucas and Spark. Rahimafrooz has seen tremendous growth in its exports, and now dominates the LAB export market, accounting for approximately US $38M of the country's US $40M export market. Although Rahimafrooz has been in the battery business for 65 years, the company started its export in 1992. Currently, they are exporting to 70 countries including Singapore, Australia, Russia, India, Chile and Middle East (Hasan, 2019). Rahimafrooz dominated that national battery market until the year 2000. After 2000, large-scale businesses such as Hamco, Navana, Rangs and Panna Group began to increase their market share.

Panna Battery Ltd started producing batteries on a small scale in 1980 at *Kamrangir char* in Dhaka. The company started marketing batteries branded as 'VOLVO' in 2006. The company now exports batteries to countries including Nepal, Bhutan and Singapore. Saif Powertec Ltd started producing batteries in 2017 and the company is now exporting batteries on a small-scale. Saif Powertec enjoys approximately 10% of the local market, manufacturing 50,000 batteries every year for automobiles, IPS and solar panels.

Major players in the LAB production market (which may also have ULAB recycling facilities) include, but are not be limited to:

- Rahimafrooz Batteries Ltd and Rahimafrooz Accumulators Ltd, both concerns of Rahimafrooz Group
- Panna Battery Ltd
- Saif Powertec Ltd
- Hamko Corporation
- Navana Batteries Ltd of Navana Group
- General Battery Company Ltd
- Rimso Battery & Co Private Ltd
- Silva - Abdullah Battery & Co (Pvt) Ltd (HAMKO Group)
- Eco Batteries Ltd
- White Products & Electronics Ltd of Rangs Group
- Confidence Electric Ltd
- Electro Battery Co Ltd
- J Co Battery Engineering Works
- Suntec Energy Ltd
- A&P Battery Industries Ltd
- Dong Jin Longevity Industry Ltd
- Geli Industrial Co Ltd
- Silicon Power Ltd
- Rangs Power
- DJDC-Dong Jin Longevity Industry Ltd.

Additional firms that either produce or recycle batteries in the Dhaka area include:

- Fatema Traders Lead Smelting
- Asia Battery Ltd.
- Gaston Battery Ltd.
- Jannat Battery
- Mollah Metal Works
- Confidence Electric Ltd.

The Growth of Foreign-Owned Firms

The rise of the battery-powered rickshaws and easy-bikes has rapidly transformed the market and dramatically expanded the demand for LABs. Around Tk 8,000 crore ($92 million) worth of batteries are bought for easy bikes annually. This market demand has also invited unregistered, non-compliant and clandestine battery factories that have now captured 70% local market share (Babu, 2020). According to Munawar Misbah Moin, president of ABMEAB, these illegal factories take no responsibility for the standard of their products, business compliance, and sustainability, which helps them maintain abnormally low prices for their products. Easy bike owners also prefer informally produced batteries as they cost less when compared to compliant batteries (Babu, 2020). The emergence of these illegal factories has significant implications for ULAB recycling as they have now become the major buyer of recycled lead and will happily purchase lead from low-cost, informal recyclers.

In a statement to the Dhaka Tribune, Panna Group Managing Director, Md Lokman Hossain, said that about 30 Chinese-owned companies operate in Bangladesh illegally (Hasan, 2019). According to ABMEAB, there are around 50 battery factories operating in Bangladesh apart from the registered ones, producing 500,000-600,000 units a year and depriving revenue to the government. These cheap batteries are offered without warranties (AmaderShomoy, 2018). These unauthorized battery manufacturing factories—located in Khulna, Bagerhat, Narsingdi and around Dhaka city—neither have permission to install such plants nor have license from Bangladesh Standards and Testing Institution (BSTI) for purchase, use or storage of acid. An example of such irregularities is the illegal operation of Xiangshu Xinding Storage Company Ltd (XXSCL) in Narsingdi. XXSCL has the capacity to produce around 15,000 batteries a month but it does so illegally using electricity from a nearby captive power plant owned by a textile mill (Rahman, 2018a). Last year, the minister of industries assured ABMEAB that legal action (known locally as “mobile court drives”) will be taken against these illegal operators to bring them into the regulatory framework (Bangladesher Khabor, 2019).

LAB Export Market

The Government of Bangladesh offers a 15% cash incentive for the export of LAB, which has helped to expand exports and has drawn new players into the export market. Bangladesh companies are believed to export to approximately 60-70 countries, and in 2018 nearly 11,300mt of batteries were exported earning 29 million USD (ILA, 2020). Rahimafrooz Batteries Ltd. is believed to lead the export market, accounting for approximately US $38M of the country’s US $40M export market.

According to Munawar Misbah Moin, President of the Bangladesh Accumulator and Battery Manufacturers' Association, Bangladesh currently exports batteries worth US

$40–50 million to around 60 countries. In future, the country will have the capacity to meet the global demand of US $1-2B.

LAB Import Market

The 10% of LAB demand that is served by imports is partially made up of "valve regulated" LAB (VRLAB) used in mobile telephone networking towers. Imported VRLAB are perceived to be of higher quality. Bangladesh imposes a 25% import duty, 20% supplementary duty and 3% regulatory duty on imported batteries, according to the National Board of Revenue. 92% of the imported LAB came from China presumably because the GSM stations operated by the telecom companies were also manufactured in China (ILA, 2020).

Battery Material Inputs

Industry insiders suggest that approximately 50% of the raw materials used to produce lead-acid batteries are imported from Korea, Singapore, Malaysia, Thailand, India and China. The remaining 50% comes from national ULAB recycling. As Bangladesh does not have indigenous supply of lead, shortfall in supply is met by importing refined lead ingots (92%) or scrap lead (8%). In 2018, 19417mt of refined lead ingots were imported by the industry, out of which 47% were imported from India (ILA, 2020).

Conclusion

Emerging research suggests that Bangladesh has one of the highest average childhood blood lead levels of any country, with tens of millions of children experiencing chronic exposures. Estimates from the World Bank on the total number of informal ULAB recycling operations are supported by the assessments from the Toxic Sites Identification Program and suggest that informal battery recycling plays a significant contributing role in exposing the population to lead.

The prevalence of unsound ULAB recycling is driven by several factors, including: the explosive growth in demand for LAB, particularly among three-wheeled vehicles; a lack of capacity and reverse logistics systems in the formal recycling sector; and lax regulatory enforcement.

While informal economic activities provide valuable opportunities for low-income and marginalized populations, ULAB recycling is simply too dangerous to conduct outside of a licensed, regulated, and environmentally responsible facility. The equipment, sanitary controls, standardized processes, and monitoring necessary to prevent occupational and public exposures to lead are not available in informal operations, which are typically simple, clandestine operations that use crude processes and lack basic safety protections. While LAB recycling can be accomplished in a completely closed loop system that captures and reuses all materials, lead losses through informal recycling are creating toxic sites and driving increases in non-communicable diseases.

Addressing the informal ULAB recycling sector in Bangladesh by shifting ULABs into the formal recycling supply chain and ensuring environmentally sound recycling within the formal sector will result in a more sustainable economy, an improved environment, and a healthier, more prosperous population.

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Annex A – Lead Contaminated Sites Assessed Through the Toxic Sites Identification Program

Site ID#	Site Name	Est. Pop. At Risk	Blacksmith Index Score	Latitude	Longitude	Key Pollutant	Max Soil Sample Value (ppm)
BD-4781	Lead-Acid Battery Recycling, Santahar, Adamdighi, Bogra	5715	10	24.80793	88.98219	Lead	149682.1
BD-4802	Doyaganj ULAB market, Doyagonj, Jatrabari, Dhaka	12810	10	23.70965	90.42577	Lead	297785.6
BD-4820	ULAB Sales & Servicing Shops, Ponchoboti, Fatullah, Narayanganj	14110	10	23.6311	90.47626	Lead	88030.25
BD-3041	Jewellery Studios at Tanti Bazar, Dhaka	12700	9	23.70918	90.40506	Lead	903
BD-4822	Mollah Metal Works, Sadhapur, Bongaon, Savar, Dhaka	2260	9	23.82584	90.27508	Lead	272529.7
BD-4831	Fatema Lead Smelting Factory, Goalbari, Shimulia, Savar, Dhaka	2740	9	23.98172	90.21246	Lead	117323.8
BD-4591	ULAB Recycling Factory, Rosulpur, Kamrangir Char, Dhaka	4650	8	23.7227	90.3698	Lead	330001
BD-2027	Chittagong	10000	7	22.32213	91.83156	Lead	803.5
BD-2470	Bangshi River, Savar	26890	7	23.9335	90.2563	Lead	77250
BD-4921	ULAB recycling and smelting works, Pahloanpara Kathgora, Ashulia, Savar, Dhaka	7555	7	23.91941	90.29231	Lead	680872.4
BD-5012	ULAB recycling and smelting works, Boktarpur Bashbari, Varenga, Bera, Pabna, Rajshahi	3993	7	23.9805	89.6442	Lead	191678.4
BD-4599	ULAB Recycling and Smelting Factory, Matuail, Jatrabari, Dhaka.	2305	6	23.7198	90.4528	Lead	19565.65
BD-4653	ULAB Recycle site, Nawabgonj, Lalbag, Dhaka	14160	6	23.72173	90.37595	Lead	245307.2
BD-4779	Ratan Metal Works, Hasnabad, South Keraniganj, Dhaka	3300	6	23.67689	90.43214	Lead	159262
BD-4782	Boubazar Battery Works, Boubazar, Kahaloo, Bogra	1578	6	24.86765	89.2281	Lead	88367.01

BD-4785	Genzir mill area, Santahar, Bogra	2510	6	24.81277	88.97894	Lead	52382.58
BD-4807	Yasfa Metal Works, Shakta, Keraniganj	2960	6	23.69527	90.32592	Lead	267214.3
BD-4808	Jamal Engineering Works, Sheikhpara, Khulna	3900	6	22.81807	89.55534	Lead	142763
BD-4815	Khorshed Metal Works, BSCIC Industrial Area, Shiromoni, Khulna	2080	6	22.9161	89.50577	Lead	185689.8
BD-4823	ULAB Recycling and Smelting Works, Pandua, Ashulia, Savar, Dhaka	3060	6	23.89308	90.25671	Lead	231980.2
BD-4830	ULAB Recycling and Smelting Factory, Kalampur, Dhamrai, Dhaka	1760	6	23.92526	90.19065	Lead	278166.2
BD-4836	ULAB Recycling Works, Zero Point, Khulna City,	6150	6	22.79895	89.52802	Lead	92013.56
BD-4839	Bashbari Lead Smelting Site, Harinatana, Khulna	620	6	22.77986	89.50608	Lead	16353.59
BD-4845	ULAB recycling and smelting works, Diabari, Yearpur, Savar, Dhaka	1770	6	23.93814	90.32331	Lead	293496.2
BD-4860	ULAB recycling and smelting works, Bagbari, Kashimpur, Gazipur	1770	6	23.96071	90.32066	Lead	262275.1
BD-4896	smelting works, Sardagonj Hatimara, Kashimpur, Gazipur Sadar, Gazipur, Dhaka	4930	6	23.98293	90.29431	Lead	62028.04
BD-4909	smelting works, Shoildanga Misarbag, Kashimpur, Gazipur Sadar, Gazipur, Dhaka	1695	6	23.95565	90.30291	Lead	3957.33
BD-4920	smelting works, Mondolpara Pirozali, Maona, Sreepur, Gazipur, Dhaka	1070	6	24.14361	90.36124	Lead	39204.09
BD-4923	ULAB recycling and smelting works, Hatkhola Bazar Pirozali, Maona, Sreepur, Gazipur	2330	6	24.1414	90.35464	Lead	2028.4

BD-4926	smelting works, Endropur, Maona, Sreepur, Gazipur, Dhaka	1200	6	24.16573	90.40667	Lead	65070.14
BD-4927	ULAB recycling and smelting works, Gorgoria Masterbari, Maona, Sreepur, Gazipur, Dhaka	2100	6	24.18891	90.41227	Lead	53699.67
BD-4928	ULAB recycling and smelting works, Taltoli Purbopara, Telihati, Sreepur, Gazipur, Dhaka	2250	6	24.2651	90.45234	Lead	18663.8
BD-4938	Badi Mia ULAB Recycling Works,Mohammadnagar,Khulna	1030	6	22.78877	89.53468	Lead	175093.3
BD-4942	Sayed Battery Works, Battery Potti, Jessore municipality, Jessore	3755	6	23.16203	89.22247	Lead	168935.4
BD-4944	Sachibunia Lead Smelting Site,Charka-khali, Labancara,Khulna	785	6	22.78022	89.54577	Lead	465252.4
BD-4955	smelting works, Satanibazar Dhonua, Gazipur, Sreepur, Gazipur, Dhaka	4730	6	24.27298	90.36716	Lead	1094.93
BD-4957	smelting works, Noyapara, Gazipur, Sreepur, Gazipur, Dhaka	730	6	24.29245	90.34584	Lead	31858.49
BD-5013	breaking works, Notunbazar, Varenga, Bera, Pabna, Rajshahi	1835	6	23.98469	89.64031	Lead	62483.78
BD-5014	ULAB recycling and smelting works,Varenga High school area Varenga, Bera, Pabna, Rajshahi	1740	6	23.98847	89.6394	Lead	86978.63
BD-5099	Lead Smelting Works, Chandaikona, Raiganj Upazila, Sirajgonj	2510	6	24.54715	89.51225	Lead	137187.1
BD-5160	smelting works, Purbopara Madrasha road, Char kalibari, Kotoali, Mymensingh sadar, Mymensingh, Dhaka	610	6	24.74731	90.42762	Lead	222701

BD-5299	Shokor Ali Lead Battery Smelting, Gossogram, Rajigonj, Dinajpur	13300	6	25.28527	89.23199	Lead	37076.8
BD-5302	Smelting, Polerhat, Goaldighi Union, Khanshama Upazila, Dinajpur.	2940	6	25.82707	88.77819	Lead	62580.94
BD-7375	Chuadanga ULAB recycling house,Chuadanga Bus Stand,Chuadanga.	2045	6	23.64841	88.84212	Lead	77184
BD-7382	ULAB Battery works,Kolaroa,Satkhira	5000	6	22.85724	89.04189	Lead	54410
BD-2026	(KPM)	4500	5	22.47528	92.14278	Lead	337.27
BD-4651	Rahim Afrooz Batteries Limited, Zirani Bazar, South Kashimpur, Gazipur	6225	5	23.99401	90.25868	Lead	9381.36
BD-4655	Lion Metal Works, Muslimbag, Kamrangir char, Dhaka	15150	5	23.71087	90.38933	Lead	5748.94
BD-4778	General Battery & Rimso Battery, Kodomtoli, Shyampur, DTI Industrial Area	7920	5	23.68115	90.43969	Lead	10686.57
BD-4784	Works, Bashipur, Santahar, Bogra	630	5	24.82207	88.97261	Lead	6309.44
BD-4799	Ismail Iron Market, Sheikh Para, Khulna City, Khulna	4700	5	22.81656	89.55318	Lead	20058.73
BD-4806	Works, Abhaynagar, Jessore	820	5	22.92852	89.51531	Lead	37240.78
BD-4812	Baganbari Battery Works, Khulna City, Khulna	5715	5	22.82097	89.5549	Lead	16562.14
BD-4813	Shiromoni Battery Works, Shiromoni Bazar, Khulna	3750	5	22.91534	89.50249	Lead	17790.29
BD-4814	Lead Smelting Works, Halfrasta, Phultala, Khulna	795	5	22.98338	89.46986	Lead	114217.2
BD-4834	Lead Smelting Works, Kuwait Mosque Area, Labanchara , Khulna	2180	5	22.78241	89.55493	Lead	97073.27
BD-4841	smelting works, Roghunathpur, Dhamrai, Dhaka	1190	5	24.00458	90.16773	Lead	144276.1

BD-4842	ULAB recycling and smelting works, Dhantara, Dhamrai, Dhaka	840	5	24.01127	90.15006	Lead	204890.8
BD-4849	Lead Smelting Works, Shipyard area, Labanchara, Khulna	3330	5	22.78111	89.58092	Lead	31920.02
BD-4859	Lead Smelting Works, Sunagar, Rakhalgachi, Bagerhat	2203	5	22.71685	89.65495	Lead	119243.1
BD-4908	ULAB recycling and smelting works, Surabari, Kashimpur, Gazipur Sadar, Gazipur, Dhaka	1574	5	23.96289	90.3155	Lead	138274.6
BD-4943	Malek Battery works, Sonadanga, Khulna City, Khulna	1685	5	22.81493	89.54145	Lead	55986.18
BD-4948	Lead Smelting Works, Naruli, Bogra	1380	5	24.85666	89.38671	Lead	30847.96
BD-4950	Lead Smelting Works, Paigram, Kasba, Phultala, Khulna	917	5	22.99867	89.45871	Lead	205778.6
BD-4951	ULAB recycling and smelting works, Taltoli Poschimpara, Telihati, Sreepur, Gazipur, Dhaka	2630	5	24.26545	90.43359	Lead	5009.22
BD-4952	ULAB recycling and smelting works, Bashbari, Gazipur Bazar, Sreepur, Gazipur, Dhaka	730	5	24.27185	90.3122	Lead	74468.59
BD-5016	ULAB smelting works, Ghoshghata char (Island), Varenga, Bera, Pabna, Rajshahi	101	5	23.98433	89.6702	Lead	153740
BD-5017	ULAB smelting works, Ghosher char, Varenga, Bera, Pabna, Rajshahi	387	5	23.98441	89.6712	Lead	47271.64
BD-5018	ULAB smelting works, Baghmara char (Island), Varenga, Bera, Pabna, Rajshahi	211	5	23.97714	89.67135	Lead	98453.64

BD-5019	ULAB recycling and smelting works, Varenga Bazar, Varenga, Bera, Pabna, Rajshahi	2275	5	23.9915	89.6409	Lead	44719.35
BD-5021	Ltd, City Gate Area, Sitakund Upazila, Chittagong	10665	5	22.38281	91.76854	Lead	2072.51
BD-5026	ULAB recycling and breaking works, Shimultola Batiakhora, Varenga, Bera, Pabna, Rajshahi	1050	5	23.99624	89.64273	Lead	17406.44
BD-5035	Lead Battery Works, Kapashgola, Chalkbazar, Chittagong	4765	5	22.36	91.84201	Lead	28304.42
BD-5082	breaking works, Sluice Gate bazar Koitola, Varenga, Bera, Pabna, Rajshahi	1380	5	24.00686	89.65243	Lead	103298.8
BD-5093	ULAB recycling and breaking works, Sonapodda Rakhsha, Varenga, Bera, Pabna, Rajshahi	2700	5	23.99003	89.64426	Lead	37774.93
BD-5094	ULAB recycling and breaking works, Rakhsha bazar, Varenga, Bera, Pabna, Rajshahi.	2400	5	23.98846	89.6485	Lead	11972.18
BD-5102	breaking works, Gopalpur, Shaara, Ishurdi, Pabna, Rajshahi	1710	5	24.15489	89.02348	Lead	1148.2
BD-5104	ULAB recycling and breaking works, Arambaria bazar Arambaria, Shaara, Ishurdi, Pabna, Rajshahi.	1605	5	24.15736	89.02468	Lead	72809.64
BD-5124	Lead Battery Works, Chandaikona, Raiganj Upazila, Sirajgonj	1941	5	24.54945	89.50977	Lead	143027.8
BD-5166	ULAB recycling and smelting works, Dholpur Shalikabazar, Mohishmara, Modhupur, Tangail, Dhaka	160	5	24.53958	90.11336	Lead	85470.24
BD-5176	smelting works, Kustha, Balla, Kalihati, Tangail, Dhaka	488	5	24.37824	90.00173	Lead	200409.2

BD-5201	breaking works, Ghatakchar, West pherpur, Madaripur sadar, Madaripur, Dhaka	288	5	23.17771	90.12621	Lead	28356.99
BD-5204	ULAB smelting works, Sreenadi Hat, Bahadurpur, Madaripur Sadar, Madaripur, Dhaka	80	5	23.26923	90.08605	Lead	263270.4
BD-5245	ULAB smelting works, Shenkhali, Amgram, Rajoir, Madaripur, Dhaka	207	5	23.15919	90.01912	Lead	9125.67
BD-5308	Continental Battery Industry,Samta,Sharsha,Jessore	960	5	22.9853	88.97941	Lead	19809.76
BD-5311	smelting works, PEKS Eye Hospital, Boalia, Gobindaganj, Gaibandha, Rajshahi	405	5	25.14659	89.38719	Lead	48076.31
BD-5313	ULAB breaking and smelting works, Sripotipur, Mahimagonj, Gobindaganj, Gaibandha, Rajshahi	400	5	25.10998	89.48923	Lead	77720.95
BD-5350	Lead Battery Smelting, Gossogram, Ranigonj, Dinajpur.	4440	5	25.28145	89.23301	Lead	10418.66
BD-5452	ULAB breaking & smelting works, Masimnagar Shilmandi, Shibpur, Narsingdi, Dhaka	226	5	23.91162	90.68285	Lead	145904.1
BD-5459	Recycling Works,BCIC,Kawnia,Barisal	1080	5	22.71972	90.35988	Lead	41779.52
BD-5463	ULAB breaking & smelting works, BSCIC Industrial area, Khadimnagar, Sylhet	885	5	24.91682	91.94269	Lead	61318.54
BD-7156	ULAB recycling factory, Boyra Bazar, Gouripur, Mymensingh	61	5	24.70959	90.46876	Lead	131421
BD-7165	ULAB Breaking and Smelting Site, Near Kamalapur Rubber Garden, 8 No Daugaon Union, Muktagacha, Mymensingh	600	5	24.64498	90.14752	Lead	22266

BD-7287	ULAB breaking and smelting factory, Barmies market, Razabari, Gorai, Mirzapur, Tangail	464	5	24.08554	90.16428	Lead	195371
BD-7292	ULAB breaking and smelting works, kharapara, Ajgana, Mirzapur, Tangail	313	5	24.1099	90.2144	Lead	143712
BD-7294	ULAB breaking and smelting factory, Aijgona Bazar, Mirzapur, Tangail	240	5	24.11094	90.21406	Lead	151214
BD-7302	ULAB smelting site, tikri, koralia union, modhupur upazila, tangail	300	5	24.57334	90.07482	Lead	78341
BD-7303	ULAB breaking site, goru bazar, modhupur pouroshova, tangail	2000	5	24.60996	90.02936	Lead	16274
BD-7354	Smelting site, Kalidash, Tetulia Chala, Bohonia Union, Shokhipur Upazila, Tangail	500	5	24.28997	90.15492	Lead	100000
BD-7355	Smelting site, Kalidash, Khamar Chala, Bohonia Union, Shokhipur Upazila, Tangail	500	5	24.29172	90.1899	Lead	100000
BD-7362	ULAB breaking works, Gourogobindopur, Shakhipur pouroshova, Shakhipur, Tangail	380	5	24.31953	90.16455	Lead	72931
BD-7404	ULAB breaking and smelting works, Roghunathpur, Phulakipur, Ghoraghat, Dinajpur	300	5	25.31794	89.20415	Lead	132712
BD-7428	ULAB Battery works Barkhada, Kushtia.	500	5	23.92815	89.09374	Lead	25934
BD-7439	ULAB breaking and smelting works, Shantipara, Mominpur, Rangpur Sadar, Rnagpur	170	5	25.74512	89.1103	Lead	135279
BD-7546	smelting works, Tajhat, Darshana, Rangpur Sadar, Rnagpur	355	5	25.3875	89.28098	Lead	48288
BD-7565	ULAB Pappu Battey house, Kumarkhali, Kushtia.	1500	5	23.90258	89.14429	Lead	30761

BD-8094	Leader Battery Manufacturing Factory Ltd, Jurain, Dhaka	3765	5	23.69437	90.43706	Lead	100000
BD-2767	Lead Poisoning in Tongi Municipal Area	20000	4	23.89003	90.40729	Lead	24.58
BD-4652	Limited, South Panishail, Kashimpur, Zirani Bazar, Gazipur, Dhaka	7400	4	23.99119	90.26098	Lead	364.07
BD-4654	Borogram, Kamrangir char, Dhaka	21700	4	23.71702	90.37673	Lead	267.03
BD-4786	Tilokpur, Akkelpur, Joypurhat	3780	4	24.88005	89.00322	Lead	2039.86
BD-4803	Basta, Konakhola, Keraniganj	1950	4	23.69485	90.34709	Lead	905.71
BD-4809	Avishek Metal Works, Shakta, Keraniganj, Dhaka	1420	4	23.69661	90.32409	Lead	2051.38
BD-4838	Bannex Battery Manufacturing, Satkhira, Khulna	2785	4	22.74703	89.09847	Lead	7770.6
BD-4895	Ujilab Paschimpara, Maona, Sreepur, Gazipur, Dhaka	9800	4	24.21826	90.45322	Lead	567.81
BD-4929	Hamko Industries Limited, Town Noapara, Fakirhat, Bagerhat	3045	4	22.73834	89.63803	Lead	8421.2
BD-4946	Smelting Works, Kamalpara, Mahimagonj, Gaibandha	970	4	25.08629	89.51718	Lead	1455.84
BD-4961	Lead Battery Works, Truck Terminal Area, Naogaon Sadar, Naogaon	3670	4	24.80474	88.95596	Lead	12455.08
BD-5027	recycling works, Batiakhora bazar, Varenga, Bera, Pabna	3500	4	24.00383	89.64866	Lead	1295.35
BD-5062	ULAB breaking and Recycling Works, Majompur, Kushtia,Khulna	3000	4	23.90686	89.12119	Lead	2237.87
BD-5083	ULAB recycling and breking works, Joynogor Koitola, Vaenga, Bera, Pabna, Rajshahi.	1750	4	24.00882	89.65057	Lead	990.94

BD-5129	Recycling Works, Boro Station Road,Kushtia,Khulna	1220	4	23.90229	89.14505	Lead	4744.04
BD-5152	ULABs Recycling And Breaking Works,Raiganj Upazila, Sirajgonj	735	4	24.55259	89.50462	Lead	997.96
BD-5159	smelting works, Char kalibari, Kotoali, Mymensingh sadar, Mymensingh, Dhaka	155	4	24.74934	90.42684	Lead	23426.44
BD-5254	SB Agro Industries limited, Jhenaidaha BSCIC, Jhenaidaha Sadar, Jhenaidaha, Khulna	770	4	23.53958	89.19836	Lead	6916.05
BD-5293	smelting works, Shunshungir more, Ballamjhar, Gaibandha sadar, Gaibandha, Rajshahi	575	4	25.32502	89.51354	Lead	4452.65
BD-5294	ULAB breaking and smelting works, Jineshwar, Ballamjhar, Gaibandha sadar, Gaibandha, Rajshahi	405	4	25.32678	89.5097	Lead	8479.71
BD-5298	Lead Smelting Works,Mostofar Mor, Dumuria,Khulna	610	4	22.82358	89.51812	Lead	21211.52
BD-5300	Fulahar Lead Battery Smelting, Fulahar Masjid Para, 2-katabari,Gobindogonj,Gaibandha	3140	4	25.21997	89.31591	Lead	1098.31
BD-5301	Nayeb Ali Lead Battery Smelting, 2-Katabari, Gobindogonj, Gaibandha	1080	4	25.20761	89.30825	Lead	3869.8
BD-5312	ULAB breaking and smelting works, Gopalpur, Mahimagonj, Gobindaganj, Gaibandha, Rajshahi	1130	4	25.10947	89.47346	Lead	11942.4
BD-5339	Samad Battery Works, Chuknagar, Keshabpur, Jessore	840	4	22.84423	89.29913	Lead	9118.9

BD-5343	ULAB breaking and smelting works, Soighoria, Mahimagonj, Gobindaganj, Gaibandha, Rajshahi	410	4	25.11256	89.49057	Lead	17320.21
BD-5348	smelting works, Rupshi Fakirhat Ranipukur, Mithapukur, Rangpur, Rajshahi	231	4	25.63592	89.20424	Lead	4510.09
BD-5351	Lead Battery Smelting, Mission Road, Gobindogonj, Gaibandha.	810	4	25.19262	89.3095	Lead	8075.08
BD-5368	ULAB breaking and smelting works, Sholdanga, Uttar Kalikapur, Kachukata, Nilphamari Sadar, Nilphamari, Rajshahi	480	4	25.95411	88.97281	Lead	11601.67
BD-5440	smelting works, South Sadhar Char, Ward no-7, Block-B, Shibpur, Narshingdi, Dhaka	205	4	23.9943	90.68212	Lead	26111.85
BD-5447	ULAB smelting works, Khilgao Mohishasura, Narshingdi sadar, Narshingdi, Dhaka	220	4	23.85044	90.70036	Lead	46961.6
BD-5453	Asia Battery (BD) Ltd, Purandia bazar, Shibpur, Narshingdi, Dhaka	840	4	24.00817	90.73698	Lead	14073.58
BD-5457	ULAB breaking & smelting works, Baroi Algii, Shibpur, Narshingdi, Dhaka	305	4	24.00551	90.73016	Lead	9594.67
BD-5458	Suntec Energy Limited, BSCIC Industrial area, Khadimnagar, Sylhet	1115	4	24.91604	91.94235	Lead	18248.26
BD-7157	smelting factory, Shomvuganj, Kotoali, Mymensingh sadar, Mymensingh	110	4	24.76101	90.43991	Lead	183912
BD-7205	ULAB Smelting works, Jotabari, Madhupur Paurashava, Madhupur, Tangail	600	4	24.63853	90.03071	Lead	9897

BD-7280	works, 25 no. word, rupatoli, barishal sadar, Barishal	1000	4	22.67994	90.34885	Lead	12499
BD-7301	smelting site, Gobodia, Kakraid union, Madhupur Upazila, Tangail	500	4	24.62004	90.07421	Lead	5893
BD-7363	Used Lead-Acid Battery (ULAB) breaking works, Shakhipur pouroshova, Shakhipur, Tangail	479	4	24.3155	90.16999	Lead	36395
BD-7381	smelting works, Birahimpur, Ghoraghat, Dinajpur	208	4	25.28109	89.23258	Lead	51850
BD-7384	ULAB breaking and smelting works, Bulakipur, Ghoraghat, Dinajpur	221	4	25.32768	89.19746	Lead	42887
BD-7406	ULAB breaking and smelting works, Moheshpur, Mominpur, Rangpur Sadar, Rnagpur	450	4	25.79557	89.10766	Lead	13131
BD-7552	smelting works, Chakirhat, Bara Alampur, Pirganj, Rnagpur	169	4	25.3875	89.28098	Lead	124121
BD-7564	ULAB Battery works jugia, Kustia	500	4	23.92327	89.09947	Lead	23489
BD-7581	ULAB breaking works, Hatkhola bazar, Birganj, Dinajpur	787	4	25.85442	88.65505	Lead	10435
BD-7608	ULAB breaking and smelting works, Shahapara, Masimpur, Mithapukur, Rangpur	177	4	25.55393	89.18462	Lead	153214
BD-8152	Jewelry Ashes, Baluaghat, Khalpar, Chittagong sadar, Chittagong	2647	4	22.34138	91.84469	Lead	34938
BD-4658	Rupa Metal Works, Jhillmil Housing, Chanditola, South Keraniganj, Dhaka	1980	3	23.68392	90.39935	Lead	2849.65
BD-4810	Recycling Factory, Ruhitpur, BSCIC, New Shonakanda, Keraniganj, Dhaka	1129	3	23.66493	90.30153	Lead	2663.13

BD-4832	Hasan & Harun Metal Works, Ekuria, South Keraniganj, Dhaka	1720	3	23.68329	90.41319	Lead	1297.04
BD-4835	Tetultala, Batiaghata, Khulna	2238	3	22.75134	89.53566	Lead	1517.78
BD-4924	Power Pack Battery Manufacturing,BSCIC,Bagerhat	510	3	22.64312	89.79849	Lead	1277.45
BD-4947	Lead Battery Breaking and Smelting Works, Vudhghora, Gabtoli, Bogra	252	3	24.85332	89.46596	Lead	13607.73
BD-4954	Lead Smelting Works,Damodar,Phultala,Khulna	415	3	22.96601	89.47717	Lead	4391.43
BD-5015	Kaisar char (island), Varenga, Bera, Pabna, Rajshahi	98	3	23.98967	89.6698	Lead	8524.33
BD-5131	Lead Battery Breaking and Smelting Works, Rampur, Muradnagar, Comilla	125	3	23.52322	90.87834	Lead	2955.12
BD-5164	ULAB breaking and recycling works, Poschimpara Lalkuthi Dorbarsharif road, Charkalibari, Kotoali, Mymensingh sadar, Mymensingh, Dhaka	2105	3	24.75348	90.42509	Lead	1433.16
BD-5167	ULAB recycling and smelting works, Bramhan shoshan, Shamna, Ghatail, Tangail, Dhaka	235	3	24.4364	89.99337	Lead	5907.45
BD-5177	smelting works, Chinamura, Elenga, Kalihati, Tangail, Dhaka	54	3	24.32751	89.92845	Lead	23178.44
BD-5203	ULAB recycling and smelting works, Hobiganj, South Berangul, Bahadurpur, Madaripur Sadar, Madaripur, Dhaka	115	3	23.24494	90.15757	Lead	10285.31
BD-5246	smelting works, Shomeshpur, Koijuri, Faridpur Sadar, Faridpur, Dhaka	114	3	23.56034	89.80068	Lead	5810.03

BD-5255	Limited (Panna group), Porikhitpur, Modhukhali, Faridpur, Dhaka	451	3	23.53637	89.65268	Lead	3917.12
BD-5292	Tamim Battery Limited, Pobahati, Jhenaidah Sadar, Jhenaidah, Khulna	124	3	23.56525	89.19861	Lead	5086.75
BD-5295	smelting works, Middle Dhangora, BSCIC area, Gaibandha sadar, Gaibandha, Rajshahi	130	3	25.32539	89.5084	Lead	9443.22
BD-5346	ULAB breaking and smelting works, Pearapur, Sakhahar, Sadullapur, Gaibandha, Rajshahi	365	3	25.14984	89.28149	Lead	3744.79
BD-5365	ULAB breaking and smelting works, Shothibari, Latifpur, Mithapukur, Rangpur, Rajshahi	160	3	25.54215	89.27483	Lead	4496.67
BD-5448	ULAB breaking & smelting works, Shimulerkandi Nuralpur, Narshingdi sadar, Narshingdi, Dhaka	128	3	23.83298	90.67982	Lead	3145.17
BD-7175	ULAB selling and recycling shop, J.C. Guha Dash Road, Kotoali, Mymensingh shadar, Mymensingh	3809	3	24.75225	90.4151	Lead	356
BD-7296	smelting factory, Noyapara, Ajgana, Mirzapur, Tangail	87	3	24.12127	90.21084	Lead	24714
BD-7405	ULAB breaking and smelting works, Dighipara, Ghoraghat, Dinajpur	300	3	25.31529	89.20243	Lead	1138
BD-7593	Lead Smelting site Kalipura, Borguna.	500	3	22.18371	90.2713	Lead	1034
BD-7629	smelting works, Ishidoho, Bogra Sadar, Bogura, Rajshahi	342	3	24.86331	89.38516	Lead	121621
BD-7637	ULAB smelting works, Amjhupi, Sayedpur, Shibganj, Bogura,Rajshahi	397	3	25.02472	89.43415	Lead	73691
BD-7643	smelting works, Korpur, Digdair, Sonatala, Bogura, Rajshahi	264	3	24.99679	89.47307	Lead	132141

BD-7654	smelting works, Laksmi Narayanpur, Sonatala, Bogura, Rajshahi	97	3	24.9874	89.46837	Lead	135131
BD-8091	Metal Recycling Works, Majhar road, Postogola, Dhaka	4400	3	23.69058	90.42757	Lead	654
BD-8095	Globe Chemical Company Ltd, Keraniganj, Dhaka	2520	3	23.67768	90.42856	Lead	146
BD-8100	Factory Limited, College road, Pubail, Gazipur, Dhaka	1050	3	23.93308	90.46623	Lead	1676.35
BD-8102	China Jingju Battery Manufacturing Company LTD, Ghoshbag, Zirabo, Ashulia, Savar, Dhaka	2450	3	23.91771	90.31349	Lead	624.43
BD-8103	Accumulators, Khagan, Birulia, Savar, Dhaka	1820	3	23.86645	90.31052	Lead	2110.56
BD-8108	Gold Recycling from Jewelry Ashes, Charigram, Singair, Manikganj, Dhaka	1464	3	23.76551	90.12952	Lead	10037.87
BD-8109	Jewelry Ashes, Malipara, Charigram, Shingair, Manikganj, Dhaka	1370	3	23.76779	90.13251	Lead	5841.47
BD-8113	Electronic Waste Market, Mathambari, Bhatiary, Shitakunda, Chattagram	3400	3	22.43489	91.73978	Lead	3057.82
BD-8132	Gold Recycling from Jewellery Ashes, Ailapara, Gobindail, Singair, Manikganj, Dhaka	470	3	23.80038	90.13512	Lead	10478.46
BD-8151	Gold Recycling from Jewelry Ashes, Chauhat, Chalkpara, Dhamrai, Dhaka	770	3	24.02961	90.08159	Lead	9154
BD-8154	Gold Recycling from Jewelry Ashes, Haria, Mirzapur, Tangail Dhaka	720	3	24.03726	90.08989	Lead	13222
BD-5310	ULAB smelting works, Dhangora, BSCIC area, Gaibandha sadar, Gaibandha, Rajshahi	155	2	25.32489	89.50742	Lead	1531.15

BD-5441	Aluminum breaking and smelting works, Chalak Char, Araihajar, Narayangonj, Dhaka	265	2	23.78047	90.71409	Lead	1151.29
BD-8096	Manufacturing Factory Limited, Ruhitpur BSCIC, Keraniganj, Dhaka	500	2	23.66453	90.30635	Lead	548
BD-8097	Rubber Recycling & Processing facroy Limited, Ruhitpur BSCIC, Keraniganj, Dhka	495	2	23.6656	90.30324	Lead	772
BD-8104	Berger Paints Company LTD, Mirjanagar, Nabinagar, Savar, Dhaka	1840	2	23.91777	90.24703	Lead	40.83
BD-8106	Fan Manufacturing Factory(Kashmir Fan) LTD, Shyampur Industrial area, Syampur, Narayanganj, Dhaka	2870	2	23.67549	90.44639	Lead	192.02
BD-8153	Jewelry Ashes, Boxirhat, Chittagong sadar, Chittagong	1382	2	22.34012	91.84153	Lead	35193
BD-8156	Gold Recycling from Jewelry Ashes, Noyakandi Nabipur, Muradnagar, Cumilla, Chittagong	1595	2	23.63217	90.94157	Lead	144
BD-4816	Gilatala Battery Works, Gilatala, Phultala, Khulna	577	1	22.92021	89.51068	Lead	744.97
BD-4960	Lead Smelting Works, Sultanpur, Naogaon Sadar, Naogaon	2820	1	24.7973	88.94565	Lead	285.64
BD-5023	Kalarpole, Patiya, Chittagong	830	1	22.31332	91.87534	Lead	427.74
BD-5024	Latifur, Sitakund, Chittagong	1805	1	22.37683	91.7612	Lead	292.85
BD-5025	Lead Battery Works, Bariarhat, Mirsurai,Chittagong	9630	1	22.89276	91.53528	Lead	257.72
BD-5081	Lead Battery Works, Station Road , Comilla Sadar Upazila, Comilla	5420	1	23.46056	91.16888	Lead	233.1

BD-5086	Jangaliya Bus Stand, Comilla South Sadar Upazila, Comilla,	1380	1	23.43523	91.17198	Lead	176.9
BD-5100	Lead Battery Works, Elliotganj, Daudkandii, Comilla	2150	1	23.51409	90.86784	Lead	97.13
BD-5101	Lead Battery Works, Paduarbazar, Bissoroad, Comilla	2000	1	23.41912	91.17362	Lead	641.51
BD-5120	Lead Battery Works, Shaktala, Laksam Road, Comilla	2110	1	23.44638	91.17638	Lead	164.6
BD-5121	Lead Battery Works, Gudirpukorpar, Nurpur, Comilla	1050	1	23.46002	91.20116	Lead	251.86
BD-5123	Lead Battery Works, Chandaikona Bazar, Raiganj Upazila, Sirajganj	3045	1	24.55036	89.50626	Lead	372.12
BD-5130	Road, South Chartha, Comilla	6600	1	23.44988	91.18266	Lead	375.86
BD-5345	smelting works, Shahargachi, Rajahar, Sadllapur, Gaibandha, Rajshahi	107	1	25.14492	89.25742	Lead	610.02
BD-5352	Lead Battery Smelting, Korihata, Votala Polashbari, Gaibandha.	1090	1	25.21646	89.33201	Lead	521.84
BD-8157	Jewelry Ashes, Noyakandi Purbopara Nabipur, Muradnagar, Cumilla, Chittagong	450	1	23.63384	90.94604	Lead	220
BD-2888	Industrial Pollution in Hemayetpur and Savar	10000	0	23.83365	90.2591	Lead	9.05
BD-5546	ULAB breaking and smelting works, Malipara, Jampur, Sonargaon, Narayanganj, Dhaka	530	0	23.74817	90.59996	Lead	124351
BD-5547	smelting works, Baliapara, Rupgonj, Narayangonj, Dhaka	295	0	23.77398	90.58337	Lead	132142

BD-5550	Gaston Battery Limited, Brahmmonbagha,Mohojompur, Sonargaon, Narayangonj, Dhaka	670	0	23.73846	90.59539	Lead	11700
BD-5551	smelting works, Srirampur, Bondor, Narayangonj, Dhaka	135	0	23.68154	90.56712	Lead	102351
BD-5552	Arabi Traders, Used plastic recycling factory, Vinglabari, Debidwar, Comilla, Chittagong	305	0	23.62847	90.97023	Lead	293
BD-5553	ULAB breaking and smelting works, BSCIC Industrial area, Nondonpur, Brahmanbaria, Chittagong	289	0	24.03731	91.11216	Lead	143212
BD-5554	ULAB smelting works, Suhilpur, Nondonpur, Brahmanbaria sadar, Braahmanbaria, Chittagong	348	0	24.03956	91.10867	Lead	120219
BD-5555	works, Noyonpur, Word no-9, Brahmanbaria Pourosova, Brahmanbaria, Chittagong	125	0	23.95256	91.09837	Lead	153213
BD-5619	ULAB breaking and smelting works, 2 no ward, Bhairabpur, Bhairab, Kishoregonj, Dhaka	580	0	24.04898	90.98413	Lead	62475
BD-5620	smelting works, Chowdhuryhat Nilgonj, Kishoreganj sadar, Kishoreganj, Dhaka	235	0	24.48487	90.80072	Lead	132512
BD-5621	smelting works, Katabaria, Kishoreganj Sadar, Kishoreganj, Dhaka	208	0	24.47528	90.7682	Lead	4999
BD-5622	ULAB breaking and smelting works, Jhautolibazar, Karimganj, Kishoreganj, Dhaka	305	0	24.42909	90.88562	Lead	623
BD-5633	ULAB breaking and smelting works, Bhuiyabazar, Karimganj, Kishoreganj, Dhaka	348	0	24.44039	90.86361	Lead	470

BD-5634	ULAB breaking works, East Char Kalibari, Kotoali, Mymensingh sadar, Mymensing, Dhaka	140	0	24.75206	90.42991	Lead	154623
BD-5636	Lead smelting works, Beparipara, Char Nilaxmia, Mymensingh sadar, Maymensingh, Dhaka	91	0	24.73172	90.46322	Lead	134213
BD-5637	ULAB breaking and smelting works, Kandapara, Char Niloxmia, Mymensingh, Dhaka	60	0	24.73786	90.45425	Lead	64676
BD-7149	Dubaliapara, Hobirpur, Valuka, Mymensingh, Dhaka	455		24.30611	90.37853	Lead	3102
BD-7164	Recycling Factory, Near Netrokona Railway Station, Ukilpara, Kotoali, Netrokona			24.88687	90.73342	Lead	1850
BD-7171	Boilore More, Trishal, Mymensingh	131		24.63418	90.39945	Lead	113297
BD-7172	Uzan Boilore, Trishal, Mymensingh	94		24.63447	90.39786	Lead	210312
BD-7173	ULAB breaking and smelting works, Kazir Shimla, Dewanbari, Trishal, Mymensingh	57		24.65815	90.40196	Lead	152319
BD-7174	Lead Smelting works, Kaishar char (Khechur more), Modhyapara, Gopalpur, Mymensingh	56		24.69086	90.46995	Lead	34736
BD-7195	ULAB Braking Site, Nagpara Mor, Ward No. 2, Madhupur Paurashava, Madhupur Upazila, Tangail			24.62877	90.02489	Lead	100000
BD-7206	Kestopur beside Mymensingh railway station, Kotoali, Mymensingh			24.74707	90.41379	Lead	261
BD-7237	Angulkata Smelting Site,Amtoli,Borguna	662		22.1817	90.2387	Lead	13793
BD-7239	Madhugram smelting site,Noapara,Jessore	1850		23.2104	89.20605	Lead	92164

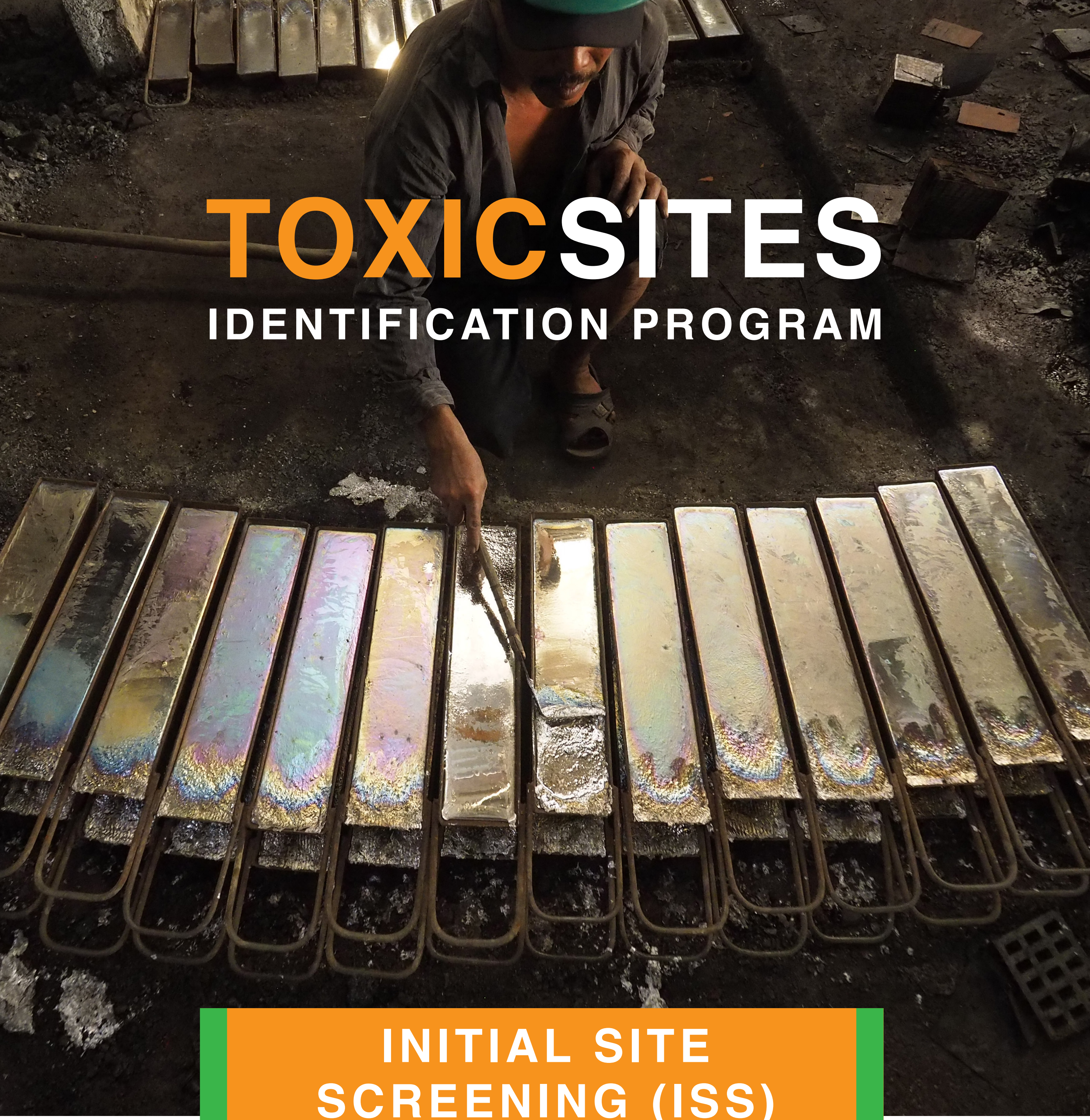
BD-7253	Jakir battery breaking site,Ghop,Jessore.	5600		23.17396	89.21401	Lead	5632
BD-7264	ULAB smelting works, Trimohon Firingipara, Latifpur, Mirzapur, Tangail	122		24.11091	90.09876	Lead	163214
BD-7265	ULAB breaking and smelting factory, Rajabari, Nischintopur, Gorai, Mirzapur, Tangail	565		24.08489	90.16382	Lead	203121
BD-7278	Battery Breaking and Smelting site Bakultola, Uzirpur,Narail.	4800		23.13024	89.51848	Lead	2314
BD-7288	smelting factory, Lalbari Sohagpara, Gorai, Mirzapur, Tagail	565		24.09021	90.15697	Lead	187128
BD-7289	Janata Battery breaking site,Kumarkhali,Kushtia.	5350		23.8964	89.15208	Lead	45887
BD-7293	ULAB smelting factory, Daphla, Namapara, Mirzapur, Tangail	57		24.09932	90.21288	Lead	153011
BD-7295	ULAB breaking and smelting factory, Pakarmatha Majidpur, Ajgana, Mirzapur, Tangail	21		24.11624	90.20506	Lead	28401
BD-7297	Smelting site, Naubola, Alukdia union, Madhupur upazila, Tangail			24.57206	90.02763	Lead	80778
BD-7298	Smelting site, 9 No Kakraid Union, Madhupur Upazila, Tangail			24.63524	90.06051	Lead	100000
BD-7299	ULAB Breaking and Smelting Site, Horindhora, Sholakuri Union, Madhupur Upazia, Tangail			24.7298	90.08124	Lead	80778
BD-7300	ULAB Smelting Site, Kakraghoni Bazar, Sholakuri Union, Madhupur Upazila, Tangail	480		24.70486	90.1075	Lead	50935
BD-7304	Battery works BSCIC,Jhinaidah.	1070		23.53928	89.1973	Lead	42565
BD-7312	BSCIC,kushtia	1930		23.88319	89.10287	Lead	77184
BD-7314	Jibon battery works Kolaroa,Satkhira.	11050		22.85977	89.04469	Lead	23062

BD-7315	smelting factory, Borochala, Peuka, Khaliajhuli, Mirzapur,	85		24.17858	90.14687	Lead	50970
BD-7316	smelting works, Gairabetul, Bashtoli, Mirzapur, Tangail	105		24.18312	90.20438	Lead	2057
BD-7350	Habib battery breaking and smelting site, BSCIC,Gopalganj.	2000		23.0141	89.82951	Lead	23521
BD-7353	Dholpur, Mohishmara Union, Madhupur Upazila, Tangail	1998		24.54268	90.11269	Lead	23778
BD-7356	Sunlite Battery Manufacturing, Kashem Dry Cell Company Ltd, Gorai, Mirzapur, Tangail	615		24.0977	90.15613	Lead	264
BD-7357	smelting works, Attarampara, Gorai, Mirzapur, Tangail	475		24.1056	90.14981	Lead	5052
BD-7364	ULAB smelting works, Kochuya bazar, Purbopara, Shakhipur, Tangail	35		24.33442	90.21589	Lead	62990
BD-7365	smelting works, Kalidas bazar, Kalidas, Shakhipur, Tangail	69		24.29643	90.21033	Lead	87031
BD-7366	smelting site, khagrata, shondhanpur union, ghatail thana, Tangail			24.51496	90.02829	Lead	90230
BD-7367	ULAB Breaking and smelting site, beside bongshi river, korail union, modhupur upazila, tangail			24.56016	90.08144	Lead	23482
BD-7380	smelting works, Khamarchala, Kalidas, Shakhipur, Tangail	23		24.29643	90.21033	Lead	153931
BD-7385	smelting works, Damadorpur, Ghoraghat, Dinajpur	1000		25.31901	89.17352	Lead	14262
BD-7386	ULAB breaking and smelting works, Mohipur Jotbari, Birampur, Dinajpur			25.37516	88.93257	Lead	28190
BD-7393	Shatata Battery House,Vheramara,Kushtia	3820		24.01748	88.99358	Lead	38140

BD-7403	smelting works, Moheshpur, Nobabgonj, Vaduria, Dinajpur			25.33859	89.13609	Lead	3719
BD-7407	Majompur,Jhaotola,Kushtia.	2700		23.90682	89.12038	Lead	20245
BD-7482	smelting works, East Kauna chara, Sayar, Traganj, Rnagpur	147		25.75003	89.04163	Lead	89982
BD-7489	smelting works, Chaklarpar, Sayar, Traganj, Rnagpur	662		25.75959	89.05206	Lead	26252
BD-7569	ULAB breaking and smelting works, Sholagari, Kabilpur, Pirganj, Rnagpur	135		25.30856	89.34298	Lead	44257
BD-7570	ULAB breaking and smelting works, Mondolpara, Garagram, Kishoreganj, Nilphamari	260		25.88041	89.09917	Lead	46004
BD-7578	smelting works, Shialdangipur, Pirganj, Thakurgaon	62		25.91601	88.43687	Lead	132512
BD-7605	ULAB breaking and smelting works, Helencha, Balua Masimpur, Mithapukur, Rangpur	50		25.56762	89.16365	Lead	8086
BD-7614	smelting works, Rupshi Fakirhat, Mithapukur, Rangpur	92		25.63595	89.20415	Lead	58254
BD-7615	ULAB breaking and smelting works, Fulohar, Gobindaganj, Gaibandha	72		25.2199	89.31591	Lead	7442
BD-7618	ULAB smelting works, Jhirai, Shapmara, Gobindaganj, Gaibandha	132		25.18102	89.27639	Lead	351
BD-7620	Patuakhali sadar,Patuakhali.			22.36373	90.33055	Lead	925
BD-7624	ULAB breaking works, Sabgram, Nurali, Bogura Sadar, Bogura.	207		24.85772	89.38461	Lead	20736
BD-7636	ULAB Smelting works, Korotoa, Ishidoho, Bogura Sadar, Bogura	69		24.86484	89.38482	Lead	148123

BD-7640	ULAB breaking and smelting works, Jhinarpar, Balua, Sonatala, Bogura	223		25.02826	89.44533	Lead	142161
BD-7649	smelting works, College road, Dohopara, Sonatala, Bogura	56		25.00252	89.45663	Lead	13805

Annex B – Initial Site Screening Protocol of the Toxic Sites Identification Program



TOXICSITES IDENTIFICATION PROGRAM

INITIAL SITE SCREENING (ISS) PROTOCOL

European Commission

PMEH POLLUTION MANAGEMENT & ENVIRONMENTAL HEALTH

USAID FROM THE AMERICAN PEOPLE

PURE EARTH BLACKSMITH INSTITUTE

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Acronyms

GPS – Global Position System
ISS – Initial Site Screening
LMIC - Low and Middle Income Country
NGO – Non Governmental Organization
PMEH – Pollution Management and Environmental Health
pXRF – Portable X-Ray Fluorescence instrument
TSIP – Toxic Sites Identification Program
TSIP – Toxic Sites Identification Program
VOC – Volatile Organic Compound
WGS – World Geodetic System

About the Toxic Sites Identification Program and Initial Site Screening

Pure Earth

Pure Earth is a New York based not-for-profit organization that partners with governments, NGOs and community groups to mitigate health risks at contaminated sites in low- and middle-income countries.

Toxic Sites Identification Program

The Toxic Sites Identification Program (TSIP) endeavors to identify and screen industrially contaminated sites in low- and middle-income countries (LMICs) with a potential human health impact. As part of the TSIP more than 3,400 sites have been screened in 47 countries since 2009. The TSIP program has been supported by the United States Agency for International Development, the European Commission, the United Nations Industrial Development Organization, the United Nations Development Program, the Food and Agriculture Organization of the United Nations, the Asian Development Bank, and the World Bank.

The purpose of TSIP is to quantify the approximate scope of industrial soil and water contamination in a given country. In some cases, high priority sites are targeted for intervention to mitigate exposures.

The program aims to assess sites that have:

- Toxic pollution
- From a "point-source" (a fixed location, not air pollution from cars and trucks)
- In concentrations or levels that can cause adverse human health impacts
- Where there is a migration route and exposure pathway to humans
- In low- and middle-income countries

The Initial Site Screening

The Toxic Sites Identification Program (TSIP) utilizes a rapid assessment protocol known as the Initial Site Screening (ISS). The ISS is completed on site over a period 2-3 days by professionally trained investigators and is designed to collect information related to human health risk. Completed ISSs are entered into an online password-protected database (tsipdatabase.org). The ISS is not a comprehensive assessment tool and is insufficient to fully characterize health risks. The ISS is not designed as the basis for epidemiological studies. Results should be considered indicative rather than definitive with regard to human health outcomes.

The ISS is limited by a number of factors including cost, available analytical methods, and existing data on contaminated sites. These limitations result in geographic and thematic biases. Thus certain pollutants or geographic areas may be overly represented in the TSIP database. Additionally, individual quality of assessments varies. Users of the

TSIP database are cautioned to note the ISS status of individual site entries. Sites coded as approved are the most technically robust, while sites in other categories are in various states of completion.

The protocol provided herein is intended is to supplement instruction site investigators have received at a TSIP training. Alone it is not sufficient guidance for the assessment of contaminated land.

Structure of This Document

This document contains five major sections: the Risk Model; the ISS Questionnaire; Estimating Exposed Population, Sampling and Lab Analysis, and Operational Guidance. In the first section, Risk Model, the conceptual background of the TSIP approach is explained. Investigators are encouraged to read and understand this content before advancing onto the later operational sections.

In the second section, the ISS Questionnaire, every question contained in the protocol is listed. For questions with predefined finite responses, those possible responses are listed. Guidance is provided for each question.

In the third section, Estimating Exposed Population, guidance is provided to assist investigators in determining the number of people that are exposed at a given site. This estimation is perhaps the most challenging aspect of conducting an ISS. Hence it receives special attention in this section.

In the fourth section, Sampling, guidance is given for collecting and analyzing samples in a manner consistent with the ISS protocol.

In the fifth major section, Operational Guidance, instructions are given on preparation for site visits. This section is directed at the individual site investigator and is intended to help the investigator mitigate common issues that emerge during the site assessment process.

Finally, in addition to the main text, the protocol includes a number of potentially useful annexes intended to support field investigators in identifying and assessing sites.

Risk Screening Model: Pollutant – Migration – Pathway – People

Central to the TSIP's approach is the model of Pollution-Migration-Pathway-People as the basis for understanding and assessing risks at a particular site. This model is consistent with risk screening approaches used internationally but is simplified for the purpose of conducting rapid risk screenings.

The TSIP is focused on people's health. However, many health impacts from pollution are chronic and are difficult to attribute directly to one source. In the context of an Initial Site Screening (ISS) it is unusual to be able to demonstrate clearly the health consequences of a particular site. What can be done is to show that there is a credible risk attached to the site and that this risk deserves further investigation, as part of the design of an intervention.

In simple terms, the health impact of a compound on an individual is a function of its toxicity and the dose received by people. The dose is a function of the concentration of the toxic compound, the time that people are exposed, and the pathway into the body. There are three basic pathways: inhalation – entry into the body through breathing; ingestion – entry through eating or drinking; and dermal – entry through skin contact and absorption.

The existence of a public health risk at a site depends on three components: 1) There must be a source of pollution with a severe enough toxicity and a high enough level or concentration to be hazardous; 2) There must be a migration route for the pollution get to an area used or occupied by people; and 3) There must be a pathway into the body whereby people have the contaminant in their bodies for a long enough time for a significant dose to occur. The ISS is the process by which these components are identified and assessed at a site.

Pollutant

There are many substances that are hazardous to peoples' health. In the experience of the TSIP there are a relatively small number of key pollutants that occur repeatedly. These include heavy metals, some organic chemicals, and in certain places, radionuclides.

The form and characteristics of the pollutant are important (mercury, for example, is relatively harmless as a solid but toxic as a vapor). The amount of the pollutant is also critical. Investigators try to estimate the total area affected by a hazardous material and the level of contamination. A key factor here is the concentration, which is measured by sampling and subsequent testing. The critical parameter is the "over-standard" – the factor by which the concentrations of the pollutant exceed relevant international standards. This is the quantitative indicator of the hazard posed by the site.

Migration Route

The migration route should not be confused with the "pathway." Pathway relates to how a substance enters the body. Migration route refers to how a contaminant is spread from a source to a community or the environment. Common migration routes include:

- Airborne emission of dust or vapors from a specific source
- Spread of dust by wind from waste piles or contaminated areas
- Spread of dust or contaminated waste or soil by direct transport, such as by trucks carrying waste
- Spread of dust or contaminated soil by water, such as in storm runoff, and then deposition in an area used by people
- Transport of soluble toxics or very fine particles in surface or ground water, to places where the water is used as a drinking water source (such as a well, pond or stream)
- Uptake of toxic contaminants into plants or animals, most often from contaminated water, which then enter the food chain of people

Pathway

A pathway is the physical mechanism by which pollution enters the body. This can happen through ingestion (swallowing, often in food or water), through inhalation (as dust or vapor), or by direct dermal (skin) contact. Radioactivity can, in some forms, act at a distance without direct contact and so proximity itself is a pathway. Note that most dust, unless of a very small size (less than 2.5 microns), actually enters the body through ingestion. Dust that is inhaled in is often caught in nose, throat and lung tissue and then coughed up and swallowed.

In practical terms, people can be directly exposed to toxic chemicals from a waste site if they inhale or ingest dust or vapor from the site, get dust or vapor from the site on their skin, or drink groundwater or surface water flowing under or through the site. People can be indirectly exposed if they eat food (plants or animals) grown on land contaminated by dust or vapor from the site or irrigated with water contaminated with toxic chemicals from the site.

People

A hazard becomes a risk when a population is actually exposed to or is impacted by the pollution at a dose high enough to potentially cause health impacts. A challenge for the investigator is to identify the relevant population, as the levels of contamination, substance toxicity, migration routes and pathways that exist will determine the exposure. The first step is to identify all the population groups within the probable area of influence of the polluted site, starting with populations immediately adjacent to the site, as well as those downstream and downwind from the site. This is best done using a local map and local information to identify nearby villages and urban areas (with estimated populations). Not all of these people will be at risk: that depends on the pollutant, migration route and pathways.

The overall result of going through this logic is to be able to identify the populations that are potentially affected though the Pollution-Migration-Pathway-People connection. These people are the population at risk.

Public health risk is easier to demonstrate when the migration routes are direct, the pathways are clear and the data on contamination is good. However, the objective of the ISS is not to conclusively prove or quantify a specific health impact. It is to identify a credible and significant risk to a population. Further studies are generally necessary to evaluate and quantify the risks and health impacts, which then hopefully lead to interventions to reduce the risks and impacts. Note that interventions can be focused on any or all of the components creating a toxic contamination problem. These could include: elimination of the source (such as waste removal or elimination of use of a toxic substance in a process); control of migration routes (such as installation of pollution control equipment or covering waste piles); elimination of pathways (such as covering or paving contaminated areas or providing clean drinking water sources); or reducing the people in contaminated areas (such as by fencing off disposal sites).

ISS Questionnaire

At the heart of the TSIP program is the online database accessible at tsipdatabase.org. All questions in the online database are listed below, organized by section.

Part 1. Screening Risk Assessment

ISS Complete: This box should be checked after all required fields have been completed.

Site Name: Select a name that identifies the source of pollution AND the location (city and state). For example: "John's Lead Smelter, Kisongo, Arusha." If the site is a whole village with many sources or no clear source, please use the village name. For example: "Bati Village, Thumen Country, Trivoli State."

Country: Select the appropriate country.

Province: Select the appropriate province.

ISS Date: Date of actual site visit (not the date of data entry).

Site Coordinates: Using decimal degrees WGS 1984, input a latitude and longitude for the source of contamination (or approximate center of multiple sources). Note: Decimal degrees are formatted with as follows: 40.8703124,-74.2145468. Include a minimum of 6 digits after the decimal. Another common format, degree minutes seconds, is not acceptable and is formatted as: 40°52'13.12", -74° 12' 52.37".

Issue: Please select if the issue is an isolated site or if it is a regional problem. A regional problem is defined as: one source impacting different locations (for example several villages) or several small sources (for example several small mining operations) affecting a whole region.

For instance, artisanal gold mining commonly occurs across regions. It is not necessary for our purposes to assess every village where artisanal and small-scale gold mining is occurring. Rather, assess the health exposures in one of the affected villages, and estimate the exposed population in the region; in this case, mark the "regional problem" check box. Similarly, contaminated river basins occur in many major cities around the world, and can impact millions of people. The pollution is diffuse and the sources are often disparate. In these cases, mark "regional problem" and estimate the population exposed. By contrast "local site" is categorized as having a well-defined population and clear pollution source. Several small-scale battery recyclers in a **single** village would compose a "local" site.

Abstract: Please enter a 3 to 5-sentence description of the problem. Clearly identify the source, the pollutant, the migration route and the pathway. For example: "A leather tannery in the town of Smithville dumped chromium waste behind the facility. The waste is not protected by walls or covered from rain or wind. The waste is leaching chromium into the local surface waters and groundwater. The local community uses wells dug into the contaminated groundwater aquifer as a potable water source."

Key Pollutant: Please select the key pollutant for the site from the drop down menu. The "Key Pollutant" is the contaminant that both has known toxicological effects and exceeds the recommended level. You are likely to encounter multiple sites where several pollutants are present. In these cases it is your responsibility to select the appropriate chemical as the key pollutant.

Consider the following example. Residential soil in a community has become contaminated by wind blown dust from nearby mine tailings. Samples collected and analyzed show copper at very high levels. They also show arsenic slightly below the recommended level, and lead (Pb) at 1.5 times the recommended level. Arsenic is a known carcinogen and its levels are clearly elevated, though they are still within international standards. Copper levels well exceed international standards, though the toxicological effects of copper are not as significant. Finally, lead (Pb) has known neurological and cardiovascular effects and exceeds the international standard. Therefore lead (Pb) is the Key Pollutant. Select "Lead" from the drop down menu on the Screening Risk Assessment page. Enter sample results for lead and arsenic in the next section. Finally, originals of all sampling data (including that for copper) should be uploaded as an attachment.

If the pollutant is a "Poly Aromatic Hydrocarbon," "Pesticide," or a "Volatile Organic Compound," select the specific pollutant from the drop-down menu. If the pollutant is a "Radionuclide" enter details in the free text field. If the pollutant is not listed, please select "other" and enter the pollutant name in the free text field.

It is essential that the Key Pollutant field be properly completed. Direct any questions to the appropriate executing agency representative.

Recommended Level: This value will usually populate automatically. If a local standard exists, please enter it in the adjacent free text field. The default recommended levels used by the TSIP can be accessed at the following link: http://www.pureearth.org/wp-content/uploads/2014/12/Maximum-Recommended-Levels.xls

Sample Matrix:
***Please review and understand the sampling and population estimate guidelines below before attempting to complete this section.**
After you have selected the "key pollutant" please enter the following information in the matrix for each sample you have taken. A minimum of 15 readings should be taken using the pXRF, and a range of 5 to 10 soil samples per site should be taken if you are using laboratory analysis.

Sample sector: Indicate the sector from which the sample was acquired.
Sample type: Indicate if the sample is a composite or a targeted sample.
Media: Select the type of substance that was sampled (air, soil, water, urine, hair, blood, etc.)
Pathway: Please select how the population enters in contact with the pollutant.
Population: See the relevant section below for instructions on estimating the population at risk.
Test Results: Please enter the pollutant concentration from each sample. The measurement units will be automatically entered once you select a "media". Please ensure that the sampling data you enter uses the same units that are automatically generated.
Coordinates of Sampling Data: Using decimal degrees WGS 1984, input a latitude and longitude for each sample. Note: Decimal degrees are formatted with as follows: 40.8703124,-74.2145468. Include a minimum of 6 digits after the decimal. Another common format, degree minutes seconds, is not acceptable and is formatted as: 40°52'13.12", -74° 12' 52.37".

Upload XRF File: Format XRF (or other sampling data) appropriately and upload via this link. The appropriate format may be downloaded in the database adjacent to the Upload XRF File link.

Additional Possibly Exposed Population: Follow population estimate instructions below.

Population estimate confirmed with local authority: Check this box if the population estimates were confirmed by a local authority (e.g. mayor or school principal).

Data Source Type: Select the category of source used to get the sample results.

Data Source Citation: Please include a detailed description or citation of your data source.

Upload Data Source: Upload original report or publication as an attachment, if applicable.

Test Data Certainty: Please use your best judgment to indicate the reliability of the data source. For example, if you took samples that were analyzed in a certified lab, the certainty should be high. If the data is old, or comes from a local advocacy group, the certainty may be low.

Population estimate explanation: Explain three to five sentences how the population affected was estimated. For example, "Only people living within 300m^2 around the source were included, national census data from 2009 was used. DDT is not highly water soluble and is therefore unlikely to migrate far beyond the secure storage area."

Population estimate confirmed with local authority: Check this box only if population estimates were verbally confirmed by a local authority.

Part 2. Physical Description

Location & Site Description: Please write at least four detailed paragraphs addressing the following: Geography, Source, Migration, Pathway, and Receptor.

- **Geography:** Location and geographical description of the site (size, topography, distance from town, nearby rivers, lakes, mountains, etc.)
- **Source:** Detailed description of the pollution source (is it a factory? Is it abandoned? What did it make? How many people worked there? What kinds of wastes did it produce? Where were they dumped?)
- **Migration:** Description of the contaminant migration route (fugitive dust carried off-site from a lead smelter to the neighboring community; contaminated soil dumped in the open next to a school; or a surface stream contaminated by storm runoff from a sludge pile)
- **Pathway:** Description of the pathway into the human body (dust inhalation or ingestion, surface water ingestion, contaminated food ingestion, etc.)
- **Receptor:** Description of the population that is affected (Where do they live? Where do they get their drinking water? What kind of houses do they have? Are there many kids? Do the kids have direct contact with the pollution? Are they downwind from the pollution source? Do they pass the source on their way to work or school?)

Size of Contaminated Areas: Select the approximate size of the contaminated area:

- $<100m^2$
- $100\text{-}500m^2$
- $500\text{-}1{,}000m^2$
- $5{,}000\text{-}1000m^2$ (1 hectare);
- 1 hectare-5 hectare;
- 5 hectare.

Estimated Depth of Contamination: Enter value in meters if known. Leave blank is unknown.

Was a test pit dug to determine the depth of contamination: Select yes or no.

Is there a strong smell associated with the site attributed to contamination: Select yes or no.

Soils and Geographic Data: This section populates automatically and is intended to guide estimates of site investigators. It cannot be edited.

Land use: If the contaminated area is on land, please select the category that best describes use given to land.

List the number of people in the following categories: Enter population data into the 4x3 table (4 categories of location and 3 categories of activity). Note: categories are exclusive; populations should not be entered in two separate boxes.

Site accessibility to animals that are later consumed by humans: Choose which best describes the area

- food animals/fish on site
- food animals/fish within 100m,
- accessible to occasional food animals

How far are crops produced from the contaminated area:

- No crops are produced within 100m
- Crops are produced within 100m of contaminated area
- Crops are produced within 10m of contaminated area
- Crops are produced in contaminated area

If water at the site is contaminated, is there another source of clean water available?: Select yes or no

Describe the access to the contaminated area:

- Controlled access; entry difficult
- Remote locations; less accessible
- Moderate access; entry more difficult
- Easy access; few barriers to entry

Describe the ground cover over the contaminated area:

- The site is covered by a concrete slab or other type of engineering
- The site is covered with concrete or other type of engineering in very poor condition
- There is complete grass cover and other vegetation
- There is sparse grass cover
- The contaminated area is bare

Source Industry: Choose the *primary* industry that is the source of the pollution. Please read the full list of industries. Some industries are very similar, for example “mining and ore processing” and “artisanal mining.” Please choose carefully.

Active, Legacy, or Both: An “active” site is one where the industrial process or facility is open and active. A “legacy” site is one where the facility or process has ended or is closed. A “Both” site is one where the facility or process is open and active, but where soil or groundwater pollution exist from years of past industrial activities. For example, an active facility that is the source of years of heavy metal pollution in soil and sediments is a “both.”

Formal or Informal Industry: Select appropriate category

Documented Health Effects: Select yes or no.

Describe credible health impact of pollutant: Please describe the health impact of the pollutant and its particular pathway to the population at risk. Anecdotal, peer-reviewed, or media accounts of any health effects on local pollution are accepted. Attach any existing studies (scan and pdf).

Part 3. Release Risk

Is there permanent surface water on the site: Select yes or no

Possible Groundwater Contamination: This box should be checked if the investigator feels the site may pose a significant risk to groundwater, regardless of whether that groundwater is currently used by area residents.

What is it used for?:

- Other
- Unknown
- Irrigation
- Fishing
- Bathing/Washing
- Drinking

Is there evidence of a high water table or ground water downstream of the contaminated site: Select yes or no

Depth of the water table:

- Shallow <2m
- Medium 2 – 10m
- Deep 10-50m
- Very Deep >50m

Is the site in a flood plain: Select yes or no

Distance to the closest river or water body:

- 0 to 300m
- 300m-1k
- 1-5km
- >5km

Type of Water Body:

- Not specified
- Not Applicable
- Pond (less than 1 hectare)
- Small lake (1-10 hectares)
- Large Lake (more than 10 hectares)
- Estuaries
- Ocean
- Small River/ Stream
- Large River
- Wetland

Distance to the closest well:

- No well in vicinity
- Within 500m of contamination;
- Within 100m of contamination
- Within 50m of contamination

In which direction:

- North
- Northeast
- East
- Southeast
- South
- Southwest
- West
- Northwest

Use of the Well:

- Water supply
- Irrigation
- Livestock water supply
- Not known

Position of the contaminant(s) relative to the slope: This question is asking where the contaminant is relative to the slope of the ground. Is it on the surface (above ground) or deeper in the soil (below ground)? The second part of the question is asking if the site is on a hill and if that hill is steep. **Please choose the description that fits best:**

- Contaminants above ground level and slope is steep
- Contaminants at or below ground level and slope is steep
- Contaminants above ground level and slope is intermediate
- Contaminants at or below ground level and slope is intermediate
- Contaminants above ground level and slope is flat
- Contaminants at or below ground level and slope is flat
- Not known

Is this a storage facility for chemicals such as pesticides?: Select Yes or No

If "yes," a new series of questions will appear automatically:

- **Number of Containers.** Please enter how many containers are on site.
- **Additional Sources**
  - Uncontained piles,
  - Residue or spills only,
  - Not applicable (containers only)
- **Please list the chemicals stored at the site:**
- **If Uncontained piles, estimate quantity:** Indicate quantity in cubic meters
- **Size of Containers:** Estimate size in liters (if applicable)
- **Type of Container:**
  - Steel or metal drum
  - Metal can or pail
  - Plastic drum
  - Paper container
  - Bags
  - Other
- **Container Age:**
  - 1-5 Years,
  - 5-10 Years
  - 10- 20 Years
  - >20 Years

- **Formulation:** Check appropriate boxes
  - Liquid,
  - Powder
  - Solidified
  - **If Liquid Identify Dilutant:**
    - Water
    - Oils
    - Volatile Solvents
    - Nonvolatile solvents

- **Please describe the floor:**
  - Concrete or similar (good condition)
  - Concrete or similar (poor condition)
  - Soil, or other permeable surface

- **Specify concentration of Pesticide if known:** in ppm
- **Identification Method:**
  - Good, legible labels
  - Inventory or written records
  - Unreliable labels
  - Verbal or Informal records
  - **Location:**
  - Inside building with good roof,

- Inside building with poor roof
- Outdoors
- Below ground

- **If Building, select:**
  - Good walls
  - Incomplete or poor walls
  - Not applicable (Outside)

- **If cover, select:**
  - Not applicable
  - Tarpaulin or plastic in good condition,
  - Other or poor cover,
  - No cover

Please provide any additional information about the facility you think may have not been captured by the questions above:

Part 4. Site Stakeholders – Meeting Details

Please identify all relevant government agencies, non-profit organizations and business that have any authority or interest in the site. If any government official accompanied you to the site visit, please document his/ her name and title in this section.

At a minimum, you must indicate the total number of stakeholders interviewed and their gender.

Part 5. Linked Reports and Images

Upload relevant files and provide descriptions
Minimum requirements
At least 10 photos of the site, source, pollution, exposure pathways and affected population (ask permission before taking photos of people).
A site map (copied or drawn) showing the boundaries of the site, location of the source of pollution, the location of the affected population, the pathway to people and the most contaminated areas (scan and pdf).

Beneficial Additions
Studies of health impacts, if (scan and pdf).
Other reports or articles with relevant information (scan and pdf).
Any Internet links to source of data, media information, etc.

Public View: Certain sections of the TSIP database are accessible to the public, including linked reports and images. Therefore, when uploading documents, you are given the option of whether or not to make that particular document accessible to the public. Please exercise caution in choosing “yes.” Documents that include any biological samples results or names of any people should NOT be made public. Images of people should also be checked “no.”

Published papers and images of the site (that do not include people) can be made public, as can maps and other documentation that describes the site in general.

Estimating Exposed Population

Source, Pathway, Receptor

The ISS uses a source–pathway–receptor model common in risk assessment. In short, a site must have a source of contamination (e.g. a leaking underground petroleum tank), a human exposure pathway (e.g. a proximate well) and a receptor (e.g. a residential neighborhood using the well) to pose a risk. All three must be present for the hazard (i.e. the petroleum) to become a risk. The number of receptors is synonymous with the exposed population.

Estimating Exposed Population Per Sector

This is the most straightforward of the population estimates the investigator is charged with developing. It is defined as the number of people living or working within the relevant sector and coming into contact with the pathway defined for the sector. For the purpose of illustration, consider a sector for which the investigator has collected one composite surface soil sample. The sample is taken as indicative of exposure for the sector as a whole. If the contaminant is a metal, the exposure pathway is likely ingestion of contaminated soil as dust. If the contaminant is a volatile organic compound (VOC), the exposure pathway might be inhalation as well as ingestion. The investigator is asked to consider and elect the most dominant pathway.

Now consider that the sector includes a school with 70 students, 3 houses and mechanic's shop. Regarding the houses, the investigator might inquire about the occupants to determine the number of residents, or simply make an educated guess as to their number. In most cases, 2-5 residents per house is an acceptable estimate. In some countries the number is closer to 5-7, this often varies from rural to urban areas. Investigators are asked to choose the best estimate for their specific case. The following table presents regional averages and can be used as a guide.

Region	Household Size
Africa	3–6
Central Asia and Eastern Europe	2–4
Central America	3–5
South America	2–4
South Asia	4–7
Southeast Asia	3–5

Regarding the school, consider the students, but also consider the teachers, the staff and anyone else spending significant time at the school. Finally, regarding the mechanic's shop, consider the workers. In general, visitors should not be counted here as the duration of exposure is simply too short to be comparable with the risk posed to residents or workers. Take the sum of these receptors as the total population exposed.

School	70 students + 2 teachers + 1 care taker	= 74
Houses	4 residents per house x 3 houses	= 12
Mechanics shop	1 mechanic + 2 assistants	= 3
	Total Exposed Population (Sector 1)	= 89

Estimating Exposed Population Per Target Sample

As a general rule, in the case of soil samples this number should be very small (<10 people). It is the number of people estimated to come into direct contact with the area where the target sample was taken. It is not indicative of the sector as a whole. For water samples, this number might be much larger. A tap sample from a well used by a whole community is indicative of exposure for that whole community. Thus, in the case of water this number could also be several hundred people. In communities where several homes have their own taps but rely on the same aquifer or water distribution system, samples should be taken at multiple taps (>3) to confirm the source of contamination. The results of that analysis would inform the decision on the size of the exposed population.

Estimating Additional Possibly Exposed Population

In many cases it will not be practical for the site investigator to visit and collect samples from the full extent of the contaminated area. In these cases, the additional possibly exposed population should be determined. This is defined as the population coming into contact with the pollutant outside of the sample sectors. These exposure are likely far less severe than those within the sectors. Visitors to schools or shops within a sector might be included in this group. Populations regularly eating food grown or stored within the contaminated area might also be considered. In some cases these exposures may exceed those closer to the site in severity. Consider a lead smelter with good emissions controls but a poor worker safety regime. Smelter workers that return home in their work clothes can contaminate the home environment.

As a general rule, investigators should be conservative when estimating the size of exposed population in all categories. Isolated site populations rarely exceed 1000 people. Estimates exceeding 1000 receptors should receive special attention. Regional problems by contrast often exceed 1000 receptors. In this case, population estimates above 5000 receptors should receive special attention. The database includes a population density field. This automatically populates based on the coordinates of the sites. Depending on the quality of data available, this this estimate can vary widely in quality. Use cautiously if attempting to guide your estimate with this value.

Confirming Population Estimate with Local Authority

Once you have developed your population estimates, confirm them with a local authority. This may be the mayor, a local school principal or community leader. Census data is often rare or non existent. In these cases, the community leader may be your best source of information.

Samples and Lab Data

High quality sampling and analysis, like population estimates, is fundamental to the ISS. In many cases, a separate agency may have already carried out sampling at a site. When these samples are available, credible and recent, the results can be used in lieu of additional site sampling.

If no sampling data exists, investigators should conduct sampling according to the guidelines below. Each sample should come from a known or suspected human exposure area and should relate to an identifiable pathway. For example, samples collected from a drinking water source are preferred to those from an industrial effluent pipe. Similarly, samples from soil inside a community are preferred to those inside an industrial estate or workshop.

Before samples are collected, a reliable and certified regional laboratory should be identified. The laboratory will have specific handling instructions for the contaminant and medium. These instructions should be followed when collecting and transporting samples. Tell the laboratory which parameters/pollutants to test for based on which pollutants are most harmful to human health and your investigation of the pollution source.

If samples are being analyzed with field equipment such as a pXRF or mercury vapor analyzer the investigator should ensure that the analysis is done in a manner consistent with the manufacturer's instructions. All sampling data should be entered in the database as described above.

Be sure to clean your equipment between each sample. Usually a thorough wipe with a paper towel wetted with bottled water is sufficient. For water samples, rinse the bottle only if there is no additive or agent.

As a general rule, begin collecting samples away from the source and working your way closer as you collect more samples. This will help reduce the risk of cross-contamination.

Investigators should wear latex gloves during sampling. Additional PPE may be required before visiting sites. Investigators should check with executing agency before visiting a site to discuss PPE requirements.

At no time should investigators enter confined spaces. Certain types of sites present acute hazards and require specialized PPE and training (e.g. pesticides stores and radioactive sites). Consult with your executing agency before visiting such sites.

SOIL SAMPLING PROTOCOL FOR METALS (XRF)

HEALTH AND SAFETY

Follow health and safety guidelines detailed in the Investigator Handbook.

MATERIALS REQUIRED

- GPS device if available
- XRF (with Troubleshooting Guide)
- Camera
- Map of site; Notepad and pen
- Clear, polypropylene bags or other collection method as specified by lab
- Permanent marker (preferably Sharpie®)
- Sample Log
- Metal spoon (1); Spatula (1); Shovel (not usually required)
- Gloves
- Personal Protective Equipment (PPE) as needed

MAPPING

A map should be made of the site that properly indicates sampling locations and key features (Schools, homes, and the pollution source). Electronic maps are preferable, though a scan or photograph of a hand-drawn map is perfectly acceptable.

INTERVIEWING

Interviews with local residents and community leaders are key to understanding the pathways present. Try to understand which areas are commonly used and which are rarely used. This will help guide how you divide sectors.

ESTIMATING POPULATION

Estimate the approximate number of people coming into contact with the pollutant in each sector. Make note of the groups at risk (such as children, workers, elderly). Refer to Population Table in the Handbook.

XRF READINGS

Divide the site into 'sectors' based on use (residential; public; agricultural; school; industrial). Larger sites may require as many as 6 sectors, smaller sites may be covered in as few as 2 (See Figure 1).

Sampling not only determines concentration of contamination, but it also helps to determine how far from a source contamination has spread. Thus, when possible radial sequential sampling is to be used in each sector:

•Establish lines from the source of contamination in the direction that the contamination may have spread*

•Take readings along each line, typically one every 5 m for 50 m, for a total of 10 readings

fig. 1

•If contaminant is present in the first 50m, take 10 more readings along the same line for the next 50m, and so on until contamination is not detected or until 200 m is reached (indicating widespread contamination; going further is not recommended due to time limitations)

•Record results in Sample Log

NOTE: AT ANY SITE A MINIMUM OF 15 SAMPLE MEASUREMENTS IS REQUIRED

*Choosing the lines needs to be done with care. At a site in the open with no notable features in the area, one would choose four lines in the cardinal directions – north, south, east, west. However, other factors need to be taken into consideration:

•A village or other inhabited area nearby (beyond 100m away), in which case a line toward that village is desirable to know how close contamination comes to village

•Prevailing wind direction in areas where wind-spread dust is a concern, a line in the down-wind direction is desirable

HUMAN EXPOSURE PATHWAY

Note that samples should only be taken from areas with a potential human exposure pathway.

Samples should NOT be taken from areas without a human exposure pathway. For instance, the inside of a pesticides container is NOT an acceptable sampling location. Similarly, a secure area that is sufficiently fenced off with appropriate signage is NOT a suitable sampling location.

INVESTIGATOR PRECAUTIONS

- Wear appropriate Personal Protective Equipment (PPE) as needed
- Wash hands before eating
- Do Not - under any circumstance - enter confined areas. These are areas large enough for a person to enter but with limited ventilation and/or limited or restricted means of entry or exit (e.g. wells, tanks, pits, vessels, sewer systems, pipelines).
- Be cautious in areas that may be slippery due to water, mud or stepp slopes.
- Be cautious if using ladders or stairways.
- Be cautious in exposed elevated areas
- Be aware that hazardous material and toxic contamination may look harmless – take precautions anyway. Do not assume that because people (e.g. local community members) are living in the area without any protection or without presenting any obvious adverse health symptoms that there is no hazard.

SOIL SAMPLING PROTOCOL FOR METALS (LAB)

HEALTH AND SAFETY

Follow health and safety guidelines detailed in the Investigator Handbook.

MATERIALS REQUIRED

- GPS device if available
- Camera
- Map of site; Notepad and pen
- Clear, polypropylene bags or other collection method as specified by lab
- Permanent marker (preferably Sharpie®)
- Sample Log
- Labels for bags, printed and cut
- Metal spoon (1); Spatula (1); Shovel (not usually required)
- Gloves
- Personal Protective Equipment (PPE) as needed

MAPPING

A map should be made of the site that properly indicates sampling locations and key features (Schools, homes, and the pollution source). Electronic maps are preferable, though a scan or photograph of a hand-drawn map is perfectly acceptable.

INTERVIEWING

Interviews with local residents and community leaders are key to understanding the pathways present. Try to understand which areas are commonly used and which are rarely used. This will help guide how you divide sectors.

ESTIMATING POPULATION

Estimate the approximate number of people coming into contact with the pollutant in each sector. Make note of the groups at risk (such as children, workers, elderly). Refer to Population Table in the Handbook.

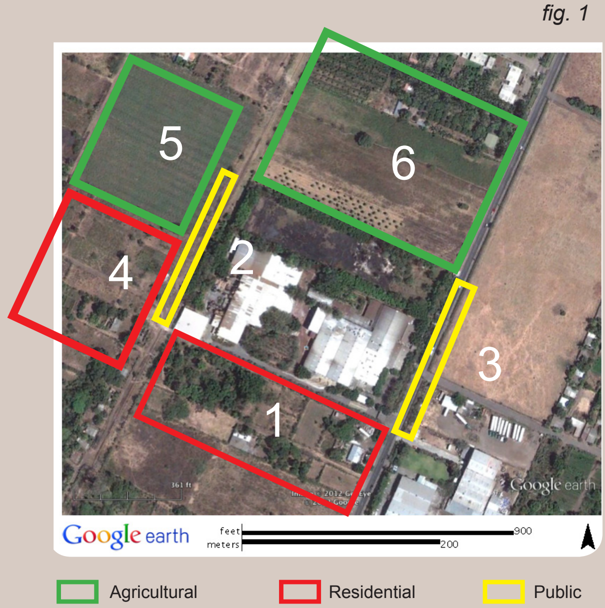
COMPOSITE SAMPLING

Divide the site into 'sectors' based on use (residential; public; agricultural; school; industrial). Larger sites may require as many as 6 sectors, smaller sites may be covered in as few as 2 (See Figure 1).

Depending on sector size, collect from 3 to 10 samples of surface soil per sector, evenly distributed. Note that larger sectors will require more samples. Each sample should be about one half teaspoon (2.5 cubic cm, 5 grams). Combine all the samples in the same bag and blend the material to form a 'composite.' Label according to Labeling Samples instructions on reverse.

For Composite Sampling, record one set of GPS coordinates using decimal degrees. Use the centermost point of your collected

fig. 1



TARGETED SAMPLING

In addition to composite sampling, up to 4 target samples should be taken (See Figure 2). Target samples should be individual surface soil samples of 25 to 30 grams* and should be taken from suspected 'hotspots,' such as residential areas adjacent to a contamination source. GPS coordinates should also be taken for each targeted sample. Label samples according to instructions below (Labels should be pre-printed and cut).

*Make sure to confirm with local lab the specified amounts and/or other special handling requirements they may have.

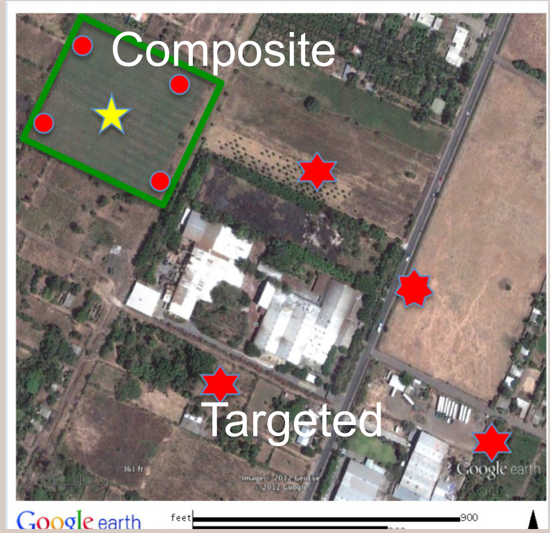


fig. 2

HUMAN EXPOSURE PATHWAY

Note that samples should only be taken from areas with a potential human exposure pathway. Samples should NOT be taken from areas without a human exposure pathway. For instance, the inside of a pesticides container is NOT an acceptable sampling location. Similarly, a secure area that is sufficiently fenced off with appropriate signage is NOT a suitable sampling location.

LABELING SAMPLES

Each sample should be labeled in the following order:

1. Sample #
2. Site Name (Town)
3. Date
4. GPS Coordinates

Labels should be pre-printed and cut. Samples should be double bagged with labels placed in between bags.

INVESTIGATOR PRECAUTIONS

- Wear appropriate Personal Protective Equipment (PPE) as needed
- Wash hands before eating
- Do Not - under any circumstance - enter confined areas. These are areas large enough for a person to enter but with limited ventilation and/or limited or restricted means of entry or exit (e.g. wells, tanks, pits, vessels, sewer systems, pipelines).
- Be cautious in areas that may be slippery due to water, mud or stepp slopes.
- Be cautious if using ladders or stairways.
- Be cautious in exposed elevated areas
- Be aware that hazardous material and toxic contamination may look harmless – take precautions anyway. Do not assume that because people (e.g. local community members) are living in the area without any protection or without presenting any obvious adverse health symptoms that there is no hazard.

WATER SAMPLING PROTOCOL

In the event that water samples are required, take 1- 2 samples from a Human Exposure Pathway (e.g. a drinking water tap or a river used for fishing).

For Semi-Volatile Organics:
Use amber glass solvent-cleaned certified bottles with Teflon lined cap (250 or 500 mL).

STEPS:

1. Flush the tap for 1 minute
2. Rinse the bottle with water from the tap being sampled
3. Fill bottle to the brim
4. Cover with seal
5. Transfer to a lab within 2 days (keep cool if possible)

Operational

Before Your Site Screening

Before visiting a site, the following preparations should be made.

Step 1: Coordinate your site screening with the executing agency to make sure your plans are consistent with the regional priorities, budget, and timeline. Discuss any potential health and safety issues at the site.

Step 2: Research the site. Look for sampling data from other research projects. Examine available maps, such as those from Google Maps, Google Earth or government sources, to familiarize yourself with the area and key features such as the locations of roads, residential areas, industrial or mining areas and water bodies. Do your best to ensure the site is within the scope of the TSIP program. Key criteria include the following:

1. Chemical pollution (including heavy metals, POPs, radionuclides, dioxins, PCBs, POPs, VOCs, among others—not biological pollution, such as from poor sewage treatment)
2. Pollution occurring in concentrations above internationally accepted levels
3. Point source pollution (not cars and trucks, or multi-source contamination ad in an entire river system)
4. Likely migration to areas occupied or used by people
5. A likely exposure pathway to humans

Step 3: Identify a local contact or guide. Call local people to schedule interviews, including interviews to take place at the field site on the day of testing. Try to meet with:

1. Local authorities (mayor, environmental agency, health agency)
2. Local organizations and community groups
3. Local health professionals
4. Local residents affected by the problem

Step 4: Prepare your equipment. You will need:

1. **A camera.** Please check your batteries and set your camera to take large, high-resolution photos.
2. **Program Summary.** Bring information about the TSIP project to share with local officials and residents.
3. **A notepad and pen.** Please take detailed notes.
4. **A map** of the site (these can be printed from Google Earth)
5. **GPS** device (if you have access to one)
6. **Personal protective equipment.** Protective equipment is necessary if the investigator could be exposed to the pollutant. If you need to

purchase protective equipment, please contact the relevant executing agency. Additional instructions are provided in Appendix A: Health and Safety.

Step 5: Identify Laboratories and Prepare for Sampling

1. **Identify likely contaminants** and the relevant sampling method and analysis methods.
2. **Identify the laboratory to be used.** In general, the executing agency should advise investigators on which laboratories should be used. Where possible these will be certified laboratories. If no certified lab is available, the labs should be the best environmental lab readily available, which may be connected to government health or environmental departments or universities.
3. **Obtain prices for sample analyses and alert the laboratory that they may be receiving samples**. Confirm that they can do the desired analysis. Ask about and record the method they intend to use. When you receive the price quote from the lab, contact the executing agency to see if the price is acceptable.
4. **Ask the laboratory about any specific requirements** regarding sampling containers, quantities needed and sample preservation requirements. Also ask the laboratory about labeling or packaging requirements for the samples.
5. **Prepare Sampling equipment.** The equipment will depend on the pollutant and the type of sampling (soil, water, food, etc.). Follow the laboratory instructions. Generally, you will need:
   - Something to collect samples (e.g. shovel, spoon, bottle)
   - A permanent pen to mark samples (e.g. Sharpie)
   - Storage containers for samples (bags for soil, bottles for water)

During Your Site Screening

Please take lots of notes and pictures, and keep all receipts for expenses.

Step 1: **Interview**. Meet with local people that understand the site and may be aware of health impacts from the site or community health problems. Ask them about the source, the migration routes, pathways, and the points where people are exposed. These local people could be a Mayor, employees of environmental organizations, a local doctor or nurse, the owner of the site, local school officials or other residents.

Ask these locals if they have any reports, studies, maps, about the site. If they have these, make copies there. Upload these documents to the online database when you return.

Step 2: **Explore Site.** Walk around site to understand the source, the pollutant, the migration routes, the pathways and the impacts. Use appropriate personal protective equipment if necessary. Take lots of pictures (at least 10) of the pollution source, migration routes, and the contaminated areas (such as streams, storm runoff channels or off-site waste piles). If there are people in or near the impacted area, please take pictures to show that potential for contact between the pollution and people (ask their permission to be photographed). Define the areas that might be impacted by the pollution and which should be considered part of the "site."

Step 3: **Map.** The map can be drawn by hand or made using free mapping software (Google Earth, Bing, ESRI etc.) Divide the map into sectors based on land use: Agriculture; Critically Sensitive Receptors (Schools, Hospitals, Etc.); Dumpsite; Housing/Residential; Industrial (active); Industrial (vacant or closed facility); Natural Area; Vacant Land. On your map, mark the location of the pollution source, the migration route, the local neighborhoods that are affected, the location of your samples, and any other important landmarks or sites. It is important to include orientation (i.e. a north arrow) and scale.

Step 4: **GPS**. If you have a GPS recording unit, record GPS coordinates for:

- The center of the affected area (you will enter these coordinates into the database).

Step 5: **Sample**. If there are no credible test results from other reports, please take samples (see the Sampling Guides above). Please record your sampling locations on your map and record the GPS coordinates for each sampling location. If you are collecting target samples, please take the GPS coordinate of each sample. If you are collecting a composite sample, take the GPS at the center of each sector.

Step 6: **Estimate Population at Risk.** See instructions above.

After Your Site Screening

Step 1: **Enter Data.** Enter your notes and data into the online database as soon as possible. It is best to enter you screening into the database on the same day.

Step 2: **Upload**. Upload your photos, notes from interviews, maps, reports, and any other documents into the online database.

Step 3: **Contact Laboratory**. If you took samples, contact the laboratory previously identified for use, and inform them of the number of samples collected and the contaminants for which the samples are to be analyzed. Bring or ship the samples to the laboratory according to their instructions. Confirm the cost for the analysis and how long it will take to receive results. Be clear and specific as to whom the results should be sent and how (such as a specific name and email address). Follow up with the laboratory if results are not received when expected.

Step 4: **Finalize and Notify**. Once your site screening is entered into the online database, mark “ISS Complete” in the online site screening and inform the executing agency.

Frequently Asked Questions

What is the definition of a "site"?
A "site" typically includes the pollution source (which may be an active or legacy site), the migration route, and any areas where people can be exposed to pollution above standards.

How is the information in the database used?
The database is used to help national governments evaluate existing and potential environmental health problems, analyze trends, and set priorities for cleanup.

Will my site screening lead to a cleanup project at the site?
One goal of the inventory is to help local governments identify sites that require immediate attention. There is never a guarantee that your site screening will lead to a cleanup project, but if the screening indicates there is a significant public health risk, it is a possibility. Investigators should explain the program goals to any curious locals, but should not promise any further action or create expectations among the local population that the site will be cleaned.

How do I locate polluted sites to assess?
There are many ways to identify sites. Here are some good sources:

- Ask the executing agency for a site list.
- Ask a local environmental organization or university environmental studies department.
- Ask the local government (starting with the pollution control agency or health agency). Specifically ask about industrial areas.
- Search newspaper records for articles about polluted sites.
- Search for reports from the government, World Health Organization, United Nations Environment Program, or other relevant organizations.
- Search for peer-reviewed journal articles about polluted sites.

What if a site does not currently affect people, but could in the near future?
Some sites do not have immediate chemical exposures to humans but may pose a risk to people in the near future. For example, a rusting storage tank of ammonia is threatening to burst and poison a local population. While there are no test results that show an immediate pathway to a population, clearly this site is a risk to human health.

In this case, list the affected population as the number of people at risk if the tank were to fail. List as much information related to the potential hazard as you can – describing the issue to others so they can visualize the problem, and your thinking on your screening.

What language should I use when I enter information into the database?
You are free to enter information in your local language or English. If you enter your screening in your local language, we will translate it and paste English text next to your original text. We will not delete your text.

What is the Blacksmith Index?
The Blacksmith Index is a score from 0-10 that indicates the relative human health risk posed by a site (10 indicates the highest risk). The Pure Earth Index is automatically generated from data about pollutant types, pollutant concentrations, pathways, and populations at risk that investigators enter into the database.