1.0 INTRODUCTION

This report, for the *Regional Capacity Building Program for Health Risk Management of Persistent Organic Pollutants (POPs) in South East Asia* (POPs Project) provides a screening level Human Health Risk Assessment for the project case study area in Laos PDR – the Electricite du Laos (EDL), Sok Pa Loung repair shop and training facility ("the SPL site"), Vientiane, Lao PDR.

Hatfield Consultants Partnership (Hatfield) was contracted by the World Bank to implement key technical activities under the POPs Project. The goal of the POPs Project is to enable officials responsible for POPs management to increase their understanding and their use of risk-based approaches for management of POPs and other chemicals, and prioritize POPs interventions to reduce local health impacts, particularly on the poor and vulnerable. Funding for the POPs Capacity Building Project is provided by the Canadian International Development Agency's POPs Fund, and is implemented by the World Bank.

The four countries participating in the POPs Project include Cambodia, Lao PDR, Malaysia, and Thailand. However, China, Indonesia, Japan, Philippines and Viet Nam are also included in regional activities under the program. Risk assessment reports have been prepared for each of selected study sites in Cambodia, Lao PDR, Malaysia and Thailand.

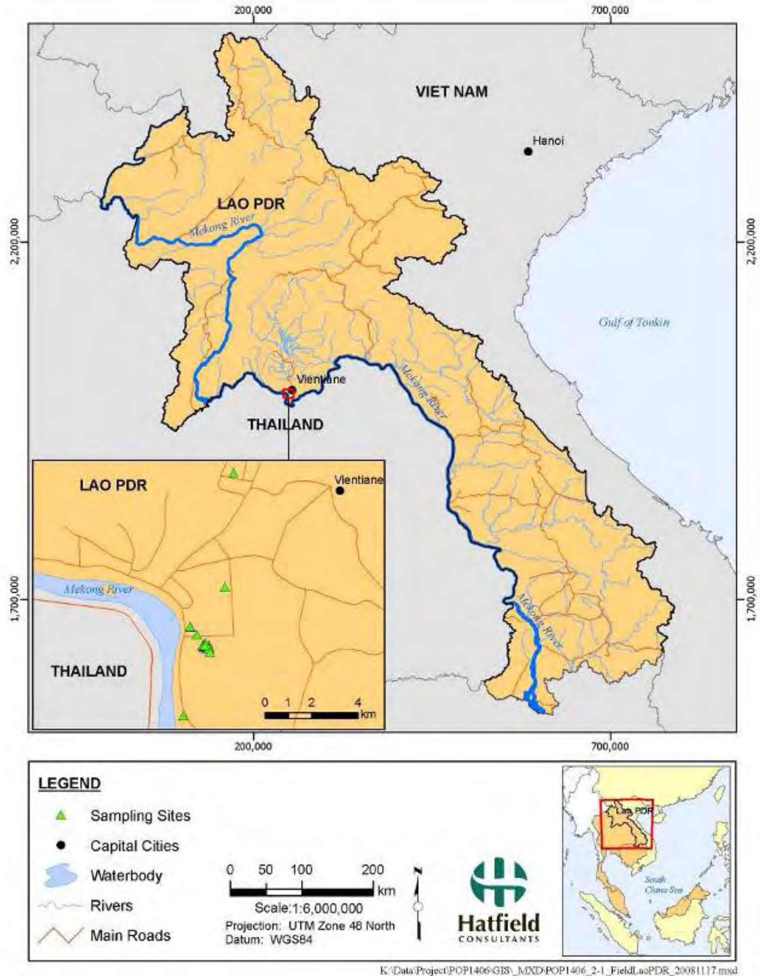
The overall Approach and Rationale for Human Health Risk Assessment (HHRA) was approved at the Launch Workshop in Luang Prabang on April 3, 2008. The detailed Approach and Rationale for HHRA was approved by the World Bank together with the Progress Report 1 in July 2008. A Canadian approach to HHRA is employed as the underlying technical basis for the POPs Project.

The draft risk assessment for the SPL site was presented and discussed at the National Training Workshop on POPs Risk Assessment and Management which took place in Vientiane, Lao PDR from 28 – 31 January 2009. This Final Report has been updated based on the participants' valuable comments and suggestions.

1.1 SELECTED SITE

The EDL Sok Pa Loung compound, Vientiane, Lao PDR (Figure 1.1 and Figure 1.2) was selected by Water Resources and Environmental Research Institute (WRERI), Water Resources and Environment Administration (WREA) as an illustrative case study for a human risk assessment concerning PCBs. The SPL site contains facilities for collection, storage and repair of electrical equipment including transformers, capacitors and their oil, and for training EDL employees. The site also hosts the head administrative offices for EDL. The primary source of PCBs is the workshop where transformers are received and serviced and waste oil is temporarily stored. An additional source is an area where transformers are stored.

Figure 1.1 Location of selected SPL site, Vientiane, Lao PDR.



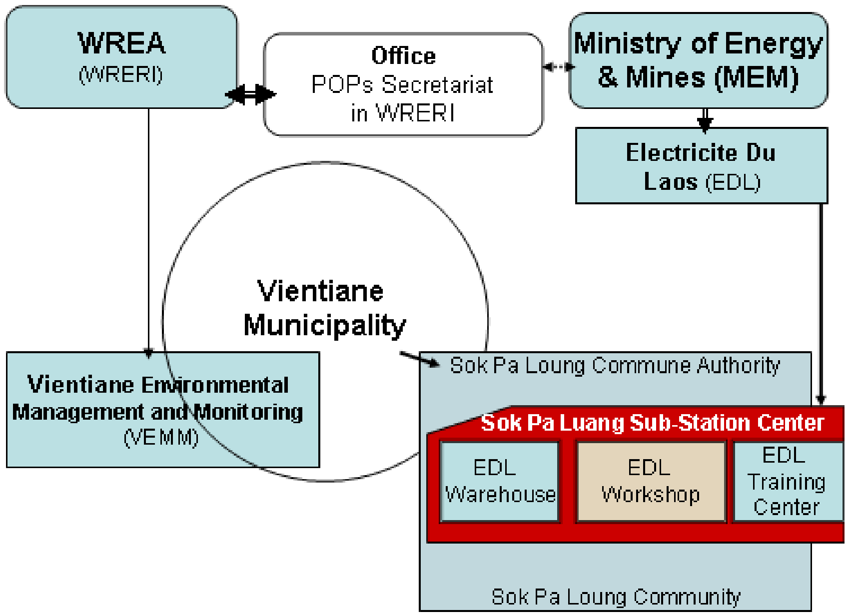
The SPL site is located centrally in Vientiane capital (Sok Pa Loung Road and Lao-Thai Friendship Road; UTM 48Q 0248767; 1985320). The entire SPL compound covers an area of over 5 hectares. The repair workshop is ~30 m × 20 m. The Workshop has been operating since February 1, 1982.

1.1.1 Operation and Ownership

The study site is managed and owned by the EDL. It is an autonomous State Owned Enterprise (SOE) whose major activities are for generation, transmission and sale of electricity. It is under an overall jurisdiction of the Ministry for Energy and Mines (MEM) however is also subject to influences and activities of the Vientiane municipal administration Figure 1.3).

Figure 1.2 Location of SPL Site in Vientiane and its immediate vicinity.

Figure 1.3 Management structure of SPL Site, Vientiane.



The Site is located in Thong Kang village, Sok Pa Loung Commune, Vientiane Capital, an important residential, business and political centre of the country. The site is located near residential lands, foreign diplomatic missions, as well as international and national training centres. There are 3 major national schools in the vicinity, including:

1. Kietisack International School (to the North);
2. National University of Laos (city campus) and High School (to the East); and
3. Centre for Vocational Training to the West.

The topography surrounding the site is generally flat. Observations during the site visit indicate that surface water run off from the site is to the east. Drainage canals from the repair shop site carry surface water east and then south, to a fish pond and then to the rice fields off-site. The pond, located in the southeast corner of the compound, is man-made, originally created for aquaculture.

Surface water runoff from the site appears to eventually drain to rice paddies located to the south and east of the compound.

1.1.2 Surrounding Property and Land Use

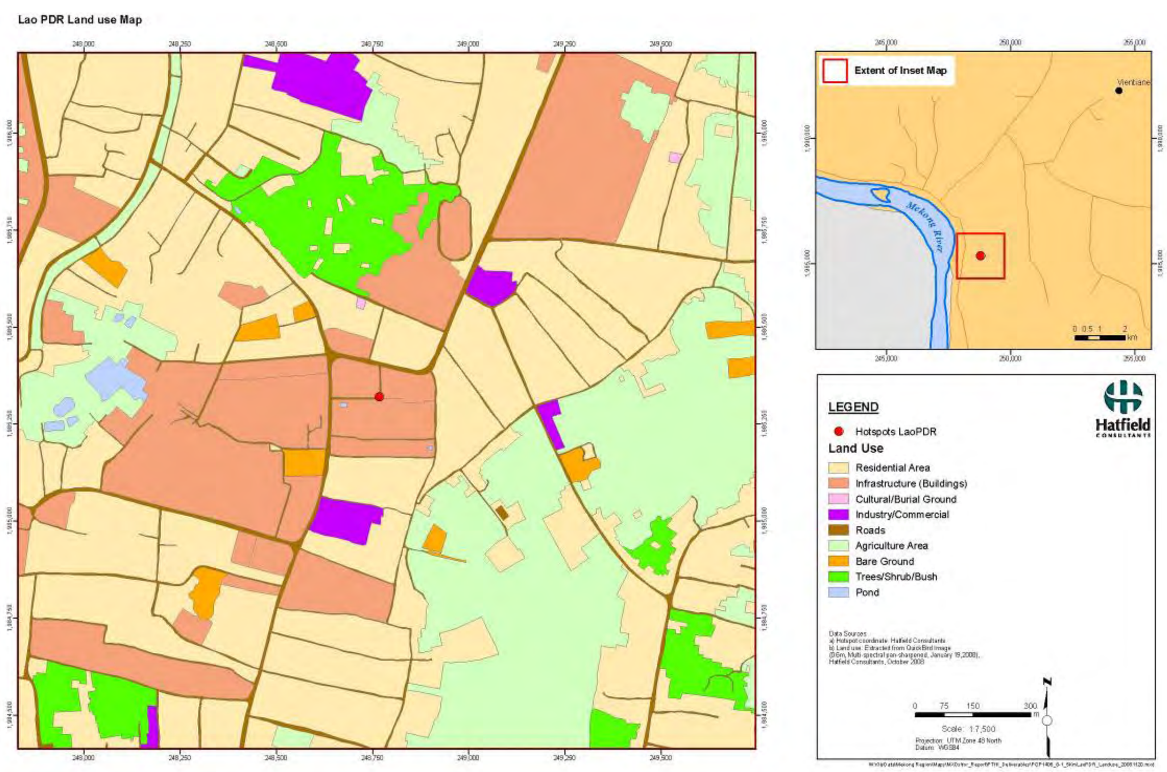
Table 1.1 and Table 1.2 below show major classes of land use in the vicinity of the site:

Table 1.1 Major land use classes within 1 km radius from the SPL site[1].

Land Use	Area (Ha)	Area (Percentage)
Agriculture Area	67.4	21.5%
Bare Ground	4.6	1.5%
Cultural	0.1	<0.1%
Industry/Commercial	6.2	2.0%
Roads	13.7	4.4%
Infrastructure (Building)	58.6	18.7%
Residential Area	148.4	47.3%
Trees/Shrub/Bush	13.5	4.3%
Water Body (Pond/River/Canals)	1.5	0.5%
TOTAL	314.0	100%

The major land use classes within 3 km^2 are dominantly residential area and agricultural land: 47% and 21%, respectively. Infrastructure (buildings) comprises 19% of the total land area. This land use is expected to further evolve towards residential and infrastructure in the next 5 years.

Figure 1.4 Land Use Map of the SPL Site, Vientiane, Lao PDR.



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[1] Quickbird high resolution satellite imageries (0.6 meter resolution) covering an area of 25 km^2 were used as data input for land-cover delineation over the selected study sites in Cambodia, Lao PDR, Thailand and Malaysia. Projection: UTM 48N WGS1984 (Cambodia and Lao PDR); UTM 47N WGS1984 (Thailand and Malaysia). Imaging Dates - Cambodia: 20 June 2007; Lao PDR: 19 January 2008; Thailand: 10 January 2005; and Malaysia: 07 May 2007. The project team applied ‘heads-up’ digitizing approach (manual on-screen classification) for extracting land cover classes from satellite imagery, based on the general land cover types observed over the study sites.

1.1.3 Climate

The climate is dominated by two monsoons from the southwest and northeast. The southwest monsoon from May to October brings heavy and frequent rains and high humidity. The northeast monsoon from November to May brings little precipitation and low humidity. The average monthly maximum temperatures range from 25 to 35 ^{o}C. March and April are the hottest months. During dry season months of October – February, wind is predominantly from the North and North East. The wind speed in November and December ranges from 6–10 m/s.

1.1.4 Suspected Contaminants

The site has been used to collect, store and repair used transformers since 1982. Dielectric fluids are tested, old oil is removed and replaced, and transformers are repaired. Recycled oil (contaminated and new oil) is transferred and mixed into 45-gallon drums, and is re-used. It may also possibly be sold to people in Vientiane as cooking fuel and as an insecticide. Interviews and observations made during the site reconnaissance indicated oils are mixed with wood chips/coconut husks for burning in a number of residences. Some oils are also mixed with diesel fuel for vehicles. Accordingly, PCBs, coplanar (dioxin-like) PCBs and dioxins/furans are contaminants of concern for the site.

Hiyoshi Corporation (Hiyoshi, Japan) previously analyzed two samples from the site in 2007. Results suggested potentially high concentrations of PCBs at the site. An additional sample (dust extracted from the repair shop floor) was collected during a site reconnaissance by Hatfield staff (April 2008) and yielded high concentrations of PCBs.

The scope of interest was limited to PCBs, dioxins/furans and organo chlorine pesticides, and consistent with the objectives (noted below) no other contaminants (e.g., metals, hydrocarbons, or solvents) were considered.

1.2 RISK ASSESSMENT OBJECTIVES

The objectives of the present study were:

1. To illustrate, using the Sok Pa Loung (SPL) Case Study Site, the application of the environmental risk assessment process as applied to contaminated sites; and

2. To determine if PCBs and associated health risks are present in the vicinity of the SPL compound, based on existing and supplementary data.

The analysis focused on POPs as the key contaminants of interest for training purposes; the site sampling, chemical analyses and risk assessment provide preliminary insight to assess need for potential management interventions respecting POPs. However, it should be recognized that while the case study provides new insights to the SPL site, its primary purpose is for capacity building. Accordingly, other potential contaminant classes not investigated presently (e.g., metals, solvents, petroleum hydrocarbons etc.), and their relevance to both human and ecological risks, may need to be considered beyond the present assessment before a final risk management position may be formulated for the site.

The results from the assessment are to be used to inform decisions about potential management interventions to mitigate potential human health impacts.

The Canadian approach to HHRA (Health Canada 2004) was applied and adjusted to allow for meaningful quantification or comparison of health risks while relying to the extent possible on available country data about POPs, the study site, and potentially exposed populations.

The project team, together with the key national stakeholders, defined the appropriate type of investigation and analyses that should be undertaken for the selected site.

1.3 APPROACH

The study design covers four main stages as shown in Table 1.2 below.

Table 1.2 Risk Assessment Design for the SPL Site, Lao PDR.

Stage	Definition	Questions that need answering	Methods
Problem Formulation	Defining contaminant sources, concentrations, transport pathways and potential receptors	What hazards (POPs contaminants) are present? What are their properties? What ecological receptors or groups of people may be exposed? What pathways might exist linking the chemical hazard and potential receptors?	Reviewing existing data and supplementary field data
Toxicity (Effects) Assessment	Determine consequences of hazard exposure, including identifying dose-response relationships	What types of health effects are possible? What is the contaminant toxic potency (i.e., toxicity reference value)?	Review of existing international agency toxicity databases
Exposure assessment	Evaluate plausibility of the hazardous chemical coming into contact with receptor, estimate the probability, magnitude and duration of contaminant intake rates from exposure	How might the receptors become exposed to the hazards? What is the probability and rate of exposure?	Use numerical exposure equations to estimate chemical intake rate via different environmental media and exposure routes
Risk estimation	Quantify consequences of exposure with reference to effects and dose - probability of hazardous effects; and, expressed over a range of spatial and temporal scenarios	What is the probability and scale of harm or effect?	Calculate risk estimates in the form of exposure ratios (hazard quotients) or incremental lifetime cancer risks

The team reviewed available information collected through a site reconnaissance and reports submitted by the Lao National Consultants to: i) determine basic site characteristics; ii) identify potential exposure pathways and exposure points; and, iii) help determine data needs (including modeling needs). Site information was obtained through: i) scoping information in the National Implementation Plan (NIP), POPs inventory reports, National Profile for POPs Management, and other official literature; ii) site inspection data (site reconnaissance visit and field observation notes); iii) photographs and remote sensing data; iv) records on site management; and v) information on amounts of hazardous substances disposed (e.g., from site records).

To fill data gaps and augment existing site data respecting potential presence of POPs and releases from the site to the environment, supplemental investigations were undertaken. The field program was designed to gather enough contaminant information to assess human health risks within project budget constraints.

The Project Team worked closely with key national stakeholders during the risk assessment process. This included sampling design, sample collection and analysis, quality control, and use of the results for developing case studies. Collected data were then integrated into a quantitative statement of human health risk at the site. Computer-simulated exposure modeling was used to predict risks to human health.