1.0 INTRODUCTION

The enclosed 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 Thailand – the Metropolitan Electricity Authority (MEA) Facility in Samut Prakan ("the MEA Facility", or "the site").

Hatfield Consultants Partnership (Hatfield) was contracted by the World Bank to implement key technical activities under the POPs Project. Complementary program activities will be implemented by national consultants or World Bank staff. 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 MEA Facility in Samut Prakan was presented and discussed at the National Training Workshop on POPs Risk Assessment and Management which took place in Hue Hin, Thailand from January 26 -27, 2009. This Final Report has been updated based on the participants' valuable comments and suggestions.

1.1 SELECTED SITE

The National Focal Point Thailand POPs Team selected the Metropolitan Electricity Authority (MEA) Facility in Samut Prakan as an illustrative case-study site for a human health risk assessment concerning PCBs (Figures Figure 1.1, Figure 1.2, and Figure 1.3).

The site was established on August 1, 1958 under the *Metropolitan Electricity Authority Act* of 1958 over a land area of 4,400 m^2. The site is used for collecting and storing old transformers and capacitors, electrical equipment and poles. It has also been used as a storage site for used PCB-containing capacitors and transformers since 2003.

The study site is located at the end of Suksawat 53 - UTM N 13.61713; E 100.54781 - south of downtown Bangkok on the banks of the Chao Phraya River (about 5 km from the river mouth where the Chao Phraya drains into the Gulf of Thailand). Because the area is subject to tidal flooding, most local residents live in houses elevated on stilts. Most of the local residents work in the garment industry in the area. There are some small fish ponds in the area that are used for recreation as well.

The site is partially paved with concrete and asphalt. Transformers and transformer parts are visible in several areas of site, and based on visual observations alone appear to have been used as fill material. The topography surrounding the site is generally flat. Observations during the site visit indicated that a number of man-made ponds and canals are located just off-site, which receive most of the rainfall run-off from the site. The site and its surrounding area are also influenced by the tidal effects from the Gulf of Thailand.

Figure 1.1 Location of MEA Facility, Samut Prakan, Thailand.

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Figure 1.2 Location of the MEA Facility and adjacent properties, Samut Prakan, Thailand.

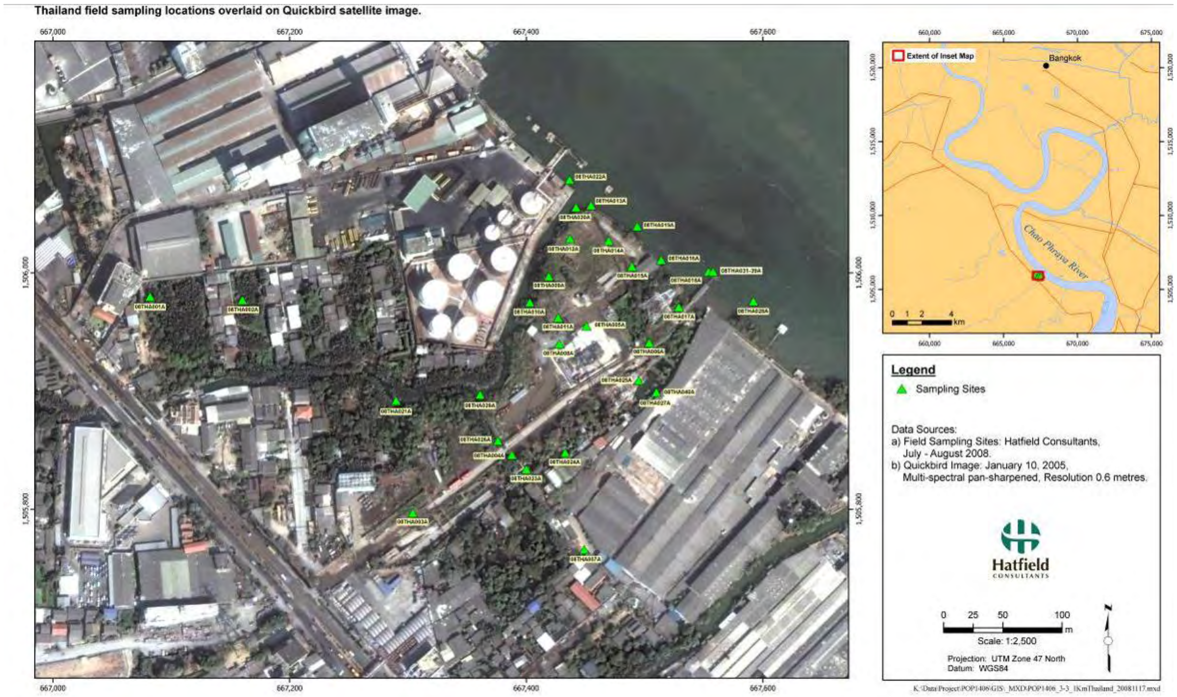


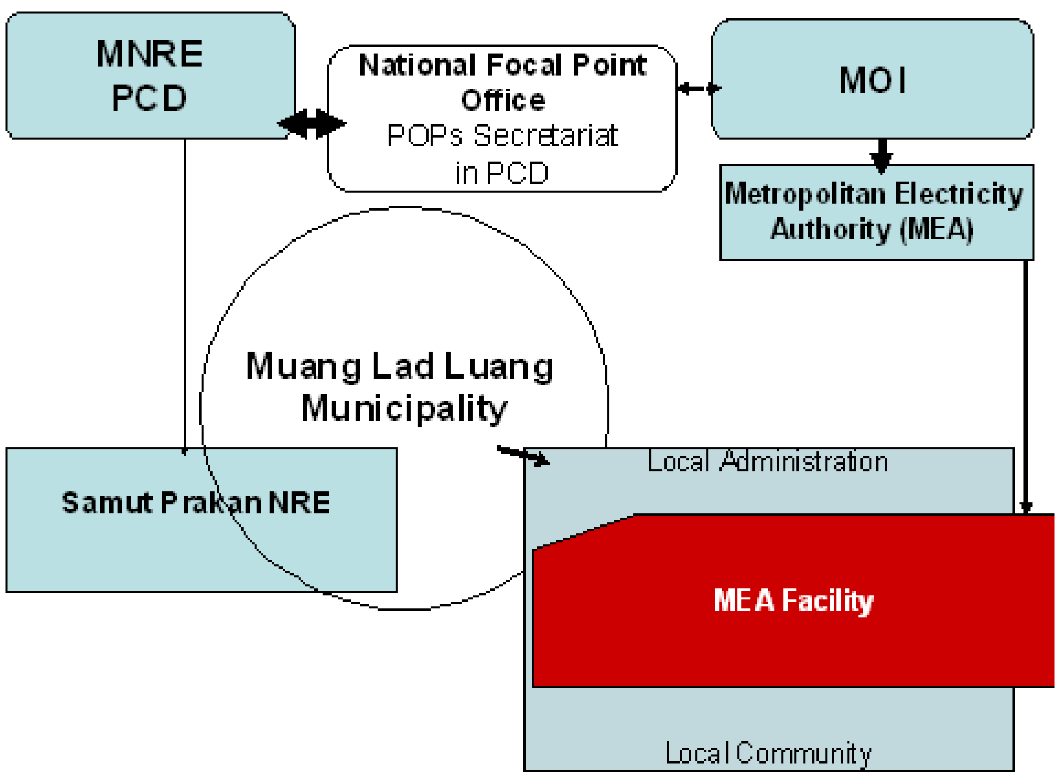
Figure 1.3 MEA Facility, Samut Prakan, Thailand.

The area is heavily industrialized - immediately adjacent to the MEA Facility is an asphalt factory, a garment factory, and a fuel storage depot. The soils within and around the facility have been heavily disturbed. Directly opposite the site on the other side of the Chao Phraya River are Watt Bang Fai and the South Bangkok Power Plant. Immediately to the north of the site is an asphalt manufacturing facility, separated from the site by a stream.

1.1.1 Operation and Ownership

The site has been owned and operated by the Metropolitan Electricity Authority (MEA) for at least 20 years (Figure 1.4). MEA is a state-owned enterprise in charge of distributing electrical power in the Bangkok Metropolitan area, which serves under the overall jurisdiction of the Ministry of Interior (MOI).

Figure 1.4 Management structure of the MEA Facility, Samut Prakan, Thailand.



1.1.2 Surrounding Property and Land Use

Table 1.1 and Figure 1.5 below show major land use classes in the vicinity of the site:

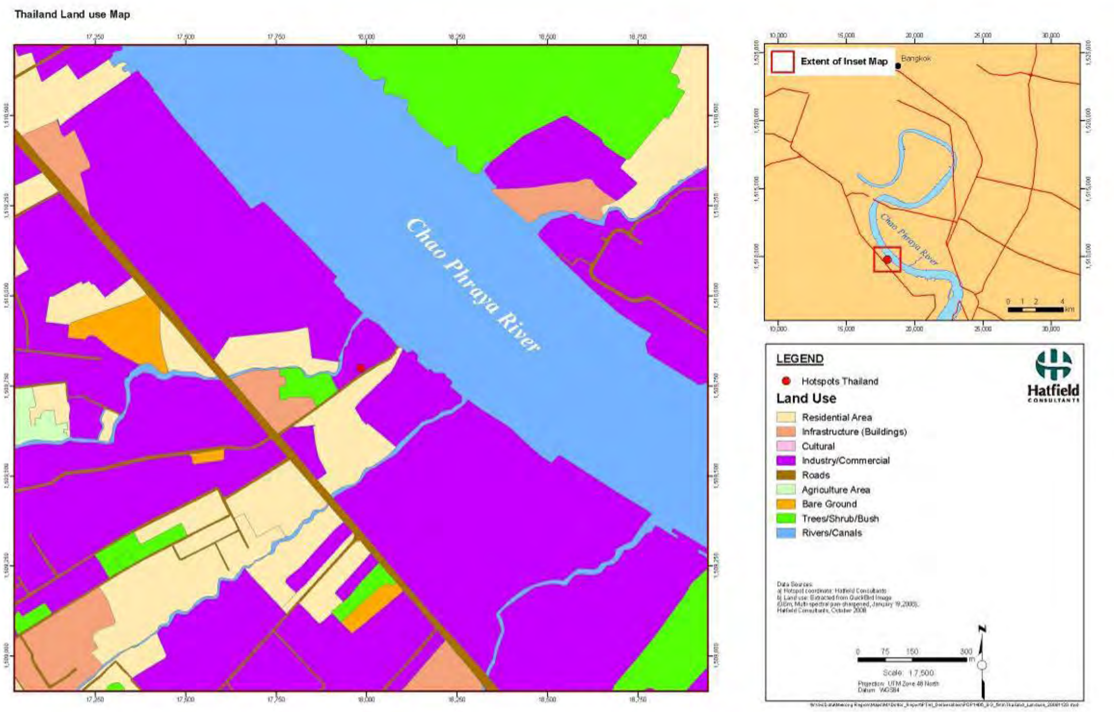
Table 1.1 Major land use classes[1] within 1 km radius from the MEA Facility, Samut Prakan, Thailand.

Land Use	Area (Ha)	Area (Percentage)
Agriculture Area	2.0	0.6%
Bare Ground	4.2	1.3%
Industry/Commercial	150.1	47.8%
Roads	8.4	2.7%
Infrastructure (Buildings)	9.2	2.9%
Residential Area	32.5	10.4%
Trees/Shrub/Bush	22.6	7.2%
River/Canals	85.2	27.1%
TOTAL	314.2	100%

The major land use classes within 3 km^2 are predominantly industrial/commercial (48%); river/stream/water body (27%); and residential area (10%). The land use is not expected to change significantly in the next 10 years.

[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.

Figure 1.5 Land Use Map of the Case Study Site of the MEA Facility, Samut Prakan, Thailand.



1.1.3 Climate

The climate in the study site is tropical. The average daytime temperature in May, the peak summer season, is 35°C (89°F).

1.1.4 Suspected Contaminants

The primary POPs of concern at the site are PCBs (from storing and handling of old transformers and capacitors). Accordingly, PCBs, associated coplanar dioxin-like PCBs, and chlorinated diobenzo-p-dioxins (TCDD/TCDF) are contaminants of concern.

Organochlorine pesticides were considered a secondary concern, most likely attributable to off-site sources. No evaluation was made of non-POPs contaminants such as metals, hydrocarbons, or solvents.

1.2 RISK ASSESSMENT OBJECTIVES

The objectives of the present study are:

1. To illustrate, using the MEA Facility Case Study Site at Samut Prakan, 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 MEA 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 MEA Facility 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 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 team reviewed available site information collected through site reconnaissance visits and report submitted by the Senior POPs Advisor, Thailand to: i) determine basic site characteristics; ii) initially identify potential exposure pathways and exposure points; and iii) help determine data needs (including modeling needs). The site information were also obtained through: i) scoping information in NIPs, POPs Inventory reports, National Profile for POPs Management, and other official literature; ii) listing site inspection data (formally 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 assist in evaluating the possible impacts of releases from the site by POPs of concern on human health and the environment, a preliminary site investigation and modeling were carried out. The field program was designed to gather enough information to assess risks the human health evaluation within the time and budget constraints. The Study design covers four main stages as shown in Table 1.2.

Table 1.2 Risk Assessment Design

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 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 and Characterization	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

After assessment of data gaps, the project team and national stakeholders collected additional data required to complete the risk assessment of the selected case study site. The Project Team worked closely with the key national stakeholders in the risk assessment process – sampling design, sample collections and analysis, and quality control and use of the results for developing case study. The collected data was 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.