



Hatfield
CONSULTANTS

Regional Capacity Building Program for Health Risk Management of Persistent Organic Pollutants (POPs) in South East Asia



Final Risk Assessment Report for
Case Study Site in Samut Prakan, Thailand

March 2009



Canadian International
Development Agency

Agence canadienne de
développement international





Canadian International
Development Agency

Agence canadienne de
développement international



**REGIONAL CAPACITY BUILDING PROGRAM
FOR HEALTH RISK MANAGEMENT
OF PERSISTENT ORGANIC POLLUTANTS (POPs)
IN SOUTH EAST ASIA**

**FINAL RISK ASSESSMENT REPORT FOR
CASE STUDY SITE IN SAMUT PRAKAN, THAILAND**

Prepared for:

THE WORLD BANK GROUP
1818 H STREET, NW, WASHINGTON DC,
20433, USA

Prepared by:

HATFIELD CONSULTANTS
SUITE 201 - 1571 BELLEVUE AVENUE
WEST VANCOUVER, BC
V7V 1A6

MARCH 2009

POP1406



TABLE OF CONTENTS

LIST OF TABLES	iii
LIST OF FIGURES.....	iv
LIST OF APPENDICES	v
LIST OF ACRONYMS.....	vi
ACKNOWLEDGEMENTS.....	viii
DISTRIBUTION LIST	ix
1.0 INTRODUCTION.....	1
1.1 SELECTED SITE	1
1.1.1 Operation and Ownership.....	5
1.1.2 Surrounding Property and Land Use	5
1.1.3 Climate	8
1.1.4 Suspected Contaminants.....	8
1.2 RISK ASSESSMENT OBJECTIVES.....	8
1.3 APPROACH.....	9
2.0 PRELIMINARY DATA COLLECTION	11
2.1 SAMPLING PLAN CONSIDERATIONS	11
2.2 ANCILLARY DATA NEEDS FOR EXPOSURE ASSESSMENT	11
2.3 SAMPLING QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC).....	12
2.4 TYPES OF SAMPLES COLLECTED	13
2.5 SAMPLING SITES	14
2.6 LABORATORY ANALYSIS OF ENVIRONMENTAL SAMPLES.....	16
2.6.1 CALUX Analysis	16
2.6.2 High Resolution Analysis	16
3.0 PROBLEM FORMULATION	18
3.1 COMPONENTS OF A PROBLEM FORMULATION	18
3.2 IDENTIFICATION OF CHEMICAL HAZARD	19
3.2.1 Characteristics of POPs	19
3.2.2 Screening contaminant levels against guidelines.....	19
3.3 IDENTIFICATION OF RECEPTORS.....	23
3.4 IDENTIFICATION OF PATHWAYS.....	26
3.5 CONCEPTUAL EXPOSURE MODEL.....	26
4.0 EXPOSURE ASSESSMENT.....	29
4.1 IDENTIFICATION OF DATA NEEDS	31
4.2 VARIABLE ENTRY INTO MODELING.....	35
5.0 HAZARD ASSESSMENT AND RISK CHARACTERIZATION	36

5.1	SELECTING A TOXICITY REFERENCE VALUE (TRV).....	36
5.2	MODELING RESULT	36
5.3	RISK CHARACTERIZATION FOR CARCINOGENS.....	37
5.4	DISCUSSION	39
5.5	UNCERTAINTIES AND ASSUMPTIONS.....	40
6.0	PATH FORWARD TO RISK MANAGEMENT	42
6.1	EXISTING MANAGEMENT PLAN.....	42
6.2	SETTING RISK REDUCTION GOALS FOR THE SITE	43
6.2.1	Goals	43
6.2.2	Sub-goals and Indicators	44
6.2.3	Proposed Indicators.....	44
6.3	PROPOSED MANAGEMENT MEASURES.....	45
6.4	RECOMMENDED RISK MANAGEMENT ALTERNATIVES	46
6.5	IMPLEMENTATION PLANNING	47
6.6	RISK COMMUNICATION	48
7.0	SUMMARY	50
8.0	REFERENCES	53
9.0	CLOSURE.....	55

LIST OF TABLES

Table 1.1	Major land use classes within 1 km radius from the MEA Facility, Samut Prakan, Thailand.	6
Table 1.2	Risk Assessment Design	9
Table 2.1	List of Samples Collected, MEA Facility, Samut Prakan, Thailand.....	13
Table 3.1	Concentrations of PCDDs/PCDFs & PCBs in soil and sediments using CALUX, MEA Facility, Samut Prakan, Thailand (based on WHO-TEF2005* and NATO I-TEF).	21
Table 3.2	Concentrations of organo-chlorine pesticides in soil and sediments using HR-GCMS, MEA Facility, Samut Prakan, Thailand.	22
Table 3.3	Potential Human receptors related to the MEA Facility Case Study site (within 1km radius).	23
Table 3.4	Key Demographic Characteristics of Thailand.....	24
Table 4.1	Contaminant concentration data needs for each exposure scenario.	32
Table 4.2	HR-GCMS analysis results for PCBs and PCDD/F.	32
Table 4.3	Contaminant concentrations to be used in the exposure model.	33
Table 4.4	Risk Characterization Tool Input Table.....	34
Table 5.1	Results of Risk Characterization for Non-Carcinogens, MEA facility, Samut Prakan, Thailand.	37
Table 5.2	Results of Risk Characterization for Carcinogens, MEA facility, Samut Prakan, Thailand.	38
Table 6.1	Examples of Goals, sub-goals and indicators for the MEA Facility, Samut Prakan, Thailand.	45

LIST OF FIGURES

Figure 1.1	Location of MEA Facility, Samut Prakan, Thailand.....	3
Figure 1.2	Location of the MEA Facility and adjacent properties, Samut Prakan, Thailand.....	4
Figure 1.3	MEA Facility, Samut Prakan, Thailand.	4
Figure 1.4	Management structure of the MEA Facility, Samut Prakan, Thailand.....	5
Figure 1.5	Land Use Map of the Case Study Site of the MEA Facility, Samut Prakan, Thailand.....	7
Figure 2.1	Sampling locations at the MEA Facility, Samut Prakan, Thailand.....	15
Figure 3.1	Three components required for risk.....	18
Figure 3.2	Vulnerability Map of the MEA Facility, Samut Prakan, Thailand.....	24
Figure 3.3	Potential receptors associated with the MEA Facility, Samut Prakan, Thailand.....	25
Figure 3.4	Conceptual Exposure Model for Storage Facility Employees.....	27
Figure 3.5	Conceptual Exposure Model for Local residents.	27
Figure 3.6	Conceptual Exposure Model for Aquatic Receptors.	28
Figure 4.1	Equations used in the Exposure Assessment.	29
Figure 4.2	Data entry into the Exposure Assessment component of the Risk Assessment tool.	35
Figure 6.1	Potential Risk and its major components.....	43

LIST OF APPENDICES

- Appendix A1 List of Samples Collected and Analyzed
- Appendix A2 List of Samples and Lab Analytical Parameters
- Appendix A3 Raw Chemical Data
- Appendix A4 Parameterization of Risk Assessment Model

LIST OF ACRONYMS

CALUX	Chemically Activated Luciferase Gene Expression
CCME	Canadian Council of Ministers for the Environment
CIDA	Canadian International Development Agency
COC	Chain of Custody (form)
COPC	Contaminants of Potential Concern
EIA	Environmental Impact Assessment
GCMS	Gas Chromatography Mass Spectroscopy
GIS	Geographic Information System
HCH	Hexachloro Cyclo Hexane
HHRA	Human Health Risk Assessment
HPT	Hatfield POPs Project Team
HQ	Hazard Quotient
HR GCMS	High Resolution Gas Chromatography – Mass Spectrometry
ILCR	Incremental Lifetime Cancer Risk
IR	Intake Rate
LE	Years Of Exposure
MEA	Metropolitan Energy Authority
MONRE	Ministry of Natural Resources and Environment
NC	National Consultant
NFP	National Focal Point for POPs
NIP	National Implementation Plan
PCBs	Polychlorinated Biphenyls
PCD	Pollution Control Department
PCDDs	Polychlorinated dibenzodioxins or Dioxins
PCDFs	Polychlorinated dibenzofurans or Furans
PF	Problem Formulation
PIP	Project Implementation Plan
POPs	Persistent Organic Pollutants
POPs Project	Regional Capacity Development Program for Management of Health Risks of Persistent Organic Pollutants in South East Asia
PTS	Persistent Toxic Substances

QA/QC	Quality Assurance / Quality Control
RA/RM	Risk Assessment/Risk Management
RBCs	Risk Based Concentration
SF	Cancer Slope Factor
SOPs	Standard Operation Procedures
TCDD	Tetrachlorodibenzo-P-Dioxin
TCDF	Tetrachlorodibenzofuran
TDI	Tolerable Daily Intake
TEF	Toxic Equivalence Factor
TEQ	Toxic Equivalence Quotient (equivalence to 2,3,7,8 TCDD)
TRV	Toxicity Reference Value
USEPA	United States Environmental Protection Agency
XDS	Xenobiotic Detection Systems Inc.

ACKNOWLEDGEMENTS

Hatfield Consultants and the POPs Project Team express our sincere thanks to the many individuals who have played significant roles to date in the *Regional Capacity Development Program for Management of Health Risks of Persistent Organic Pollutants (POPs) in South East Asia* (hereafter referred to as the POPs Project).

Special thanks are due to Dr. Supat Wangwongwatana, Director General of Pollution Control Department (PCD), and the World Bank Project Task Team, including Dr. Jitendra (Jitu) Shah, Dr. Catalina Marulanda and Mr. Manuel Cocco, for their support and assistance with all aspects of project implementation. We would also especially like to thank the Canadian International Development Agency's (CIDA) POPs Fund, for their financial support for the POPs Project.

We would also like to thank Khun Pornpimon Chareonsong, Pollution Control Department and her staff for their assistance with all aspects of this project. We especially thank Dr. Jarupong Boon-Long, Senior POPs Advisor and the MEA Facility in Samut Prakan for their technical contributions and positive collaboration that ultimately led to the success in the case study development and other project activities.

Our sincere thanks also go to all relevant national agencies for their active support and invaluable contributions to the POPs Project. We especially thank the participants of the National Training Workshop which took place in Hue Hin, Thailand, from 26-27 January 2009 for their valuable comments and suggestions for finalizing the present Risk Assessment for the MEA Samut Prakan facility site.

DISTRIBUTION LIST

The following individuals/firms have received this final document:

Name	Firm	Hardcopies	CDs	FTP
Jitendra Shah	World Bank	√	√	√
Catalina Marulanda	World Bank	√	√	√
Manuel Cocco	World Bank	√	√	√
Pornpimon Chareonsong	PCD, NFP for Thailand	√	√	√