

PETRONAS TECHNICAL STANDARDS

HEALTH, SAFETY AND ENVIRONMENT

GUIDELINE

INTEGRATED ENVIRONMENTAL SITE MANAGEMENT

PTS 60.3008

MARCH 2009



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PTS Circular 2009



PTS No:	60.3008
PTS Title:	Integrated Environmental Site Management

This new PTS **60.3008 - Integrated Environmental Site Management (March 2009, Revision 0)** has been developed to provide an updated and integrated user friendly land management guideline.

This PTS also includes PETRONAS Lessons Learnt and PETRONAS Best Practice for the subject matter **Integrated Environmental Site Management**.

This PTS has incorporated and combined the relevant information and requirements from 4 other related PTS documents as listed below. Hence these PTS documents will no longer be available as standalone PTS documents:

- i. 60.3103 (June06) - Environmental Quality Standards – Soil and Groundwater
- ii. 60.3205 (June 06) - Managing Potentially Contaminated Land
- iii. 60.3303 (June 06) - Soil and Groundwater Monitoring
- iv. 60.3401 (June 06) - Decommissioning, Remediation and Reclamation of On-shore and E&P Sites

Note that although the above documents are no longer listed as PTS documents, the documents are retained as resource material with GHSED.

The custodian of this PTS is: Manager - HSE MS, Standards & Regulations, GHSED.

Please direct any questions regarding this PTS to the above-mentioned.

Document Approval

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PREFACE

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Acknowledgement

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1.0 INTRODUCTION

This section provides an overview introduction of this document.

1.1 Objectives

This document is developed to provide PETRONAS requirements on the conduct of environmental risk assessment for land-based sites including guidelines on how to systematically manage land based sites with the objective to:

1. Avoid, minimize and control the risk of contamination of:
 - land surface of the site, and
 - The groundwater resources underneath.
2. Restore sites to As Low As Reasonably Practicable (ALARP) level, in the event the sites are contaminated.

1.2 The Need

In line with PETRONAS Group HSE Policy Statement, the conduct of environmental site risk assessment is required:

- 1 To safeguard the environment (soil, surface water, groundwater and ecosystem)
- 2 To safeguard human health & safety (workers and community)
- 3 To safeguard safety of operations & asset
- 4 To avoid legal liability
- 5 To minimise commercial risk
- 6 To safeguard Group's reputation

The Group recognises that management of historic contamination is expensive and recommends that in all cases it is preferable to avoid contamination in the first place. Wherever possible, preventive engineering techniques and technologies should be adopted to eliminate or reduce the occurrence of contamination.

For new projects and/or facility upgrades, minimum standards of preventative engineering should be incorporated into the design. For existing operations, work practices and housekeeping arrangements should be applied to prevent spillages, a Risk-Based Maintenance and Inspection (R-BM&I) programme should be introduced to avoid leakages, and modifications should be made to achieve containment in susceptible areas.

2.0 SCOPE

This guideline is applicable to PETRONAS land-based sites (domestic & international), which manufacture, store, use, handle & dispose hydrocarbon products, chemicals and hazardous wastes. This shall include crude oil / gas terminals, petrochemical plants, refineries, depots, service stations, buildings and supply bases.

It is applicable for new asset acquisition, existing operations, site decommissioning and handover of operatorship.

3.0 DEFINITIONS

Contaminated site: A site at which substances occur at concentrations:

1. Above natural occurring metal concentrations and pose or are likely to pose an immediate or long term hazard to human health or the environment; and/or
2. Exceed concentration specified in the Site Screening Levels.

Contaminated site can also be described as site containing substances present in concentration levels that are significantly high, which result in harm towards humans, animals and the environment.

4.0 REFERENCE

- i. Environmental Quality Standards – Soil & Groundwater (Guideline), June 2006, PTS 60.3103, Rev.1
- ii. Managing Potentially Contaminated Land (Guideline), June 2006, PTS 60.3205, Rev.1
- iii. Soil And Groundwater Monitoring (Guideline), June 2006, PTS 60.3303, Rev. 1
- iv. Decommissioning, Remediation And Reclamation Of On-Shore E & P Sites (Guideline), June 2006, PTS 60.3401
- v. ASTM E 1527-00 “Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process”
- vi. ASTM E 1903-97 “Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process”
- vii. [*Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites. Final Guidance \(EPA, 1996\).*](#) EPA Document No. 540-R-96-023.
- viii. [*User Guide to the VOCs in Soils. Presumptive Remedy \(EPA, 1996\).*](#) EPA Document No. 540-F-96-008.
- ix. [*Presumptive Remedy - CERCLA Landfill Caps RI/FS Data Collection Guide \(EPA, 1995\).*](#) EPA Document No. 540-F-95-009.
- x. [*Presumptive Remedy for Soils, Sediments, and Sludges at Wood Treater Sites \(EPA, 1995\).*](#) EPA Document No. 540-R-95-128.
- xi. [*Presumptive Remedies: Policies and Procedures \(EPA, 1993\).*](#) EPA Document No. 540-F-93-047.
- xii. [*Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils \(EPA, 1993\).*](#) EPA Document No. 540-F-93-048.
- xiii. [*Presumptive Remedy for CERCLA Municipal Landfill Sites \(EPA, 1993\).*](#) EPA Document No. 540-F-93-035.
- xiv. http://www.frtr.gov/matrix2/appd_a/appd_a.html

5.0 ENVIRONMENTAL SITE RISK ASSESSMENT

Environmental Site Risk Assessment is a management tool to evaluate risks to the environment with regards to land contamination issues, which translates to potential liability to the company. The environmental site assessment forms the basis for evaluating the risks involved with respect to potential land contamination. In addition, other means of managing the contamination risk include the risk assessment modeling and if the risk assessed is deemed unacceptable, remediation action may be included as part of the overall risk management.

The overall integrated environmental site risk management flow chart land based sites are shown in **Figure 1**.

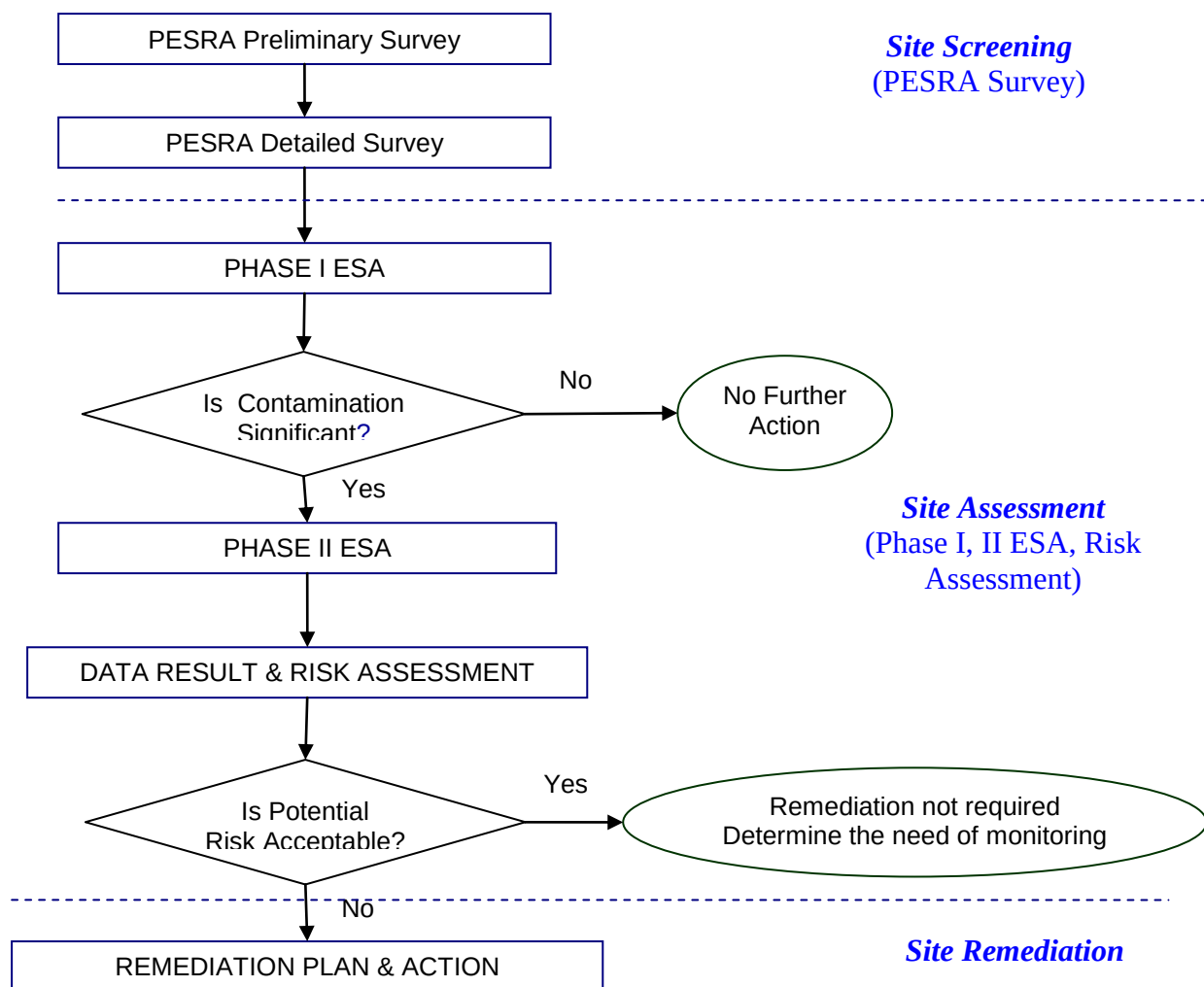


Figure 5.1: Overall Integrated Environmental Site Management

The screening concept of the site assessment for the environmental site risk based management is illustrated in **Figure 5.2** below.

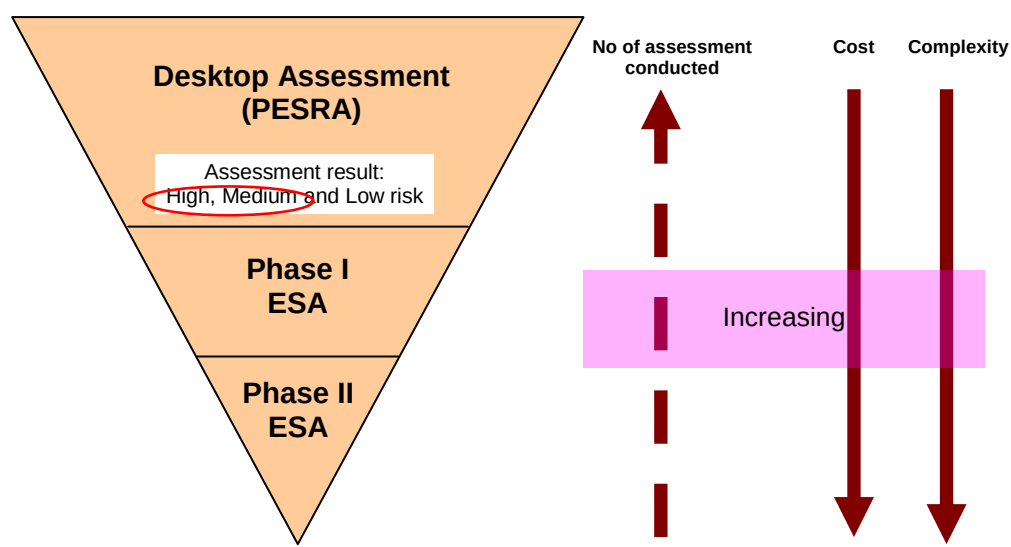


Figure 5.2: Screening Concept for Environmental Site Risk based Management

5.1 Environmental Site Risk Assessment Requirements

This section describes the environmental risk assessment requirements for land-based sites of PETRONAS.

Environmental Site Risk Assessment shall be conducted when:

1. Acquiring an existing site (brownfield), or
2. Developing a site (greenfield/ brownfield), or
3. During operation – e.g. meeting MEMS requirements, after a loss of containment event, suspected contamination, regulatory requirement, or
4. Leasing PETRONAS owned site, or
5. Decommissioning / exiting a site, or
6. Prior to transfer of ownership / operatorship (PSC)

The various aspects of managing Environmental Site Risk Assessment requirements are summarized in **Table 5.1**. This includes the various business activities and the parties responsible to manage and conduct the risk assessment.

Site / Land Type	Environmental Site Risk Assessment	Who's responsible?
New Development (Green field)	At EIA stage: Obtain Site Environmental baseline data (equivalent to Phase I ESA)	Project Manager
Merger / Acquisition (Brown field)	Conduct Environmental Site Assessment (Phase I ESA*; Phase II ESA*) as part of HSE Due Diligence. A Phase 2 (intrusive) investigation may also be carried out, pending findings of the ESA Phase 1.	Group Business Unit, Business Unit in OPU
Existing Sites - Normal	Conduct PETRONAS Environmental Site Risk Assessment (PESRA)	Asset Manager (the highest position responsible for the site), e.g. Regional Manager at PDB, Plant Manager at Plant
Existing Sites – With known contamination	Conduct Phase I and Phase II ESA, or as per regulatory requirements	Asset Manager (the highest position responsible for the site), e.g. Regional Manager at PDB, Plant Manager at Plant.
Divestures- Leasing out a site/ Leasing in a site/ Decommissioning / Exiting site / transfer of site ownership	Conduct Phase I Environmental Site Assessment (ESA) as part of HSE Due Diligence. A Phase 2 (intrusive) investigation may also be carried out, pending findings of the ESA Phase 1.	Head of Handover team for divestures or Project Manager for others

* as and when required

Table 5.1: Management of Environmental Site Risk Assessment

5.1.1 Who Conducts the Site Risk Assessment?

While the above identifies parties responsible to initiate and manage risk assessments, the environmental site risk assessment itself can be conducted in –house or by engaging external consultant, depending on the complexity of the assessment and local requirements, as per the guide below:

- Preliminary PESRA : by Operations
- Detailed PESRA : led by Environment TP or equivalent
- Phase I ESA : in house (led by EM TP or equivalent) or 3rd party external consultant
- Phase II ESA : by 3rd party external consultant

5.1.2 Site Risk Assessment Team Composition

An environmental site risk assessment team shall be formed according to the composition (at the minimum) as summarized in **Table 5.2**.

Team member	Competency level	Main roles & responsibility
Team Leader	• Technical background with managerial skill • Knowledge of site assessment procedures and requirements	• Assessment project team leader • Assemble team members with necessary skills and competency • Assign members to conduct parts of assessment • Selection, appointment and management of consultant* • Endorsement of report • Ensure timeliness of the assessment
Members	• Familiar with site background, historical operation and surrounding areas. Familiar with HSE aspects of the site	• resource person • Provide site information
Environmental Management Technical Professional (EM TP) or equivalent.	• Staff EM TP and above	• Technical advisor • Prepare / Review scope of work • Review result analysis / interpretation • Review technical aspects of the report

* In the event an independent external consultant is required

Table 5.2: Environmental Site Risk Assessment team composition

5.2 Environmental Site Risk Management Process

Following the environmental site risk assessment, depending on the outcome, the environmental site risk management shall follow actions illustrated in charts below.

The chart highlights the steps involved at various phases of the assessments i.e. ESA Phase 1 and Phase 2 against a nominated Site Screening Levels. It also highlights the next stage, which involve the tiered approach of the risk evaluation, in the event the Site Screening Levels (SSL) is exceeded. **Figure 5.3** highlights the steps involved for a new

site and **Figure 5.4** for an existing site. The details of the PESRA and Phase 1 and 2 ESA are in Section 3 and Section 6 of this document, respectively.

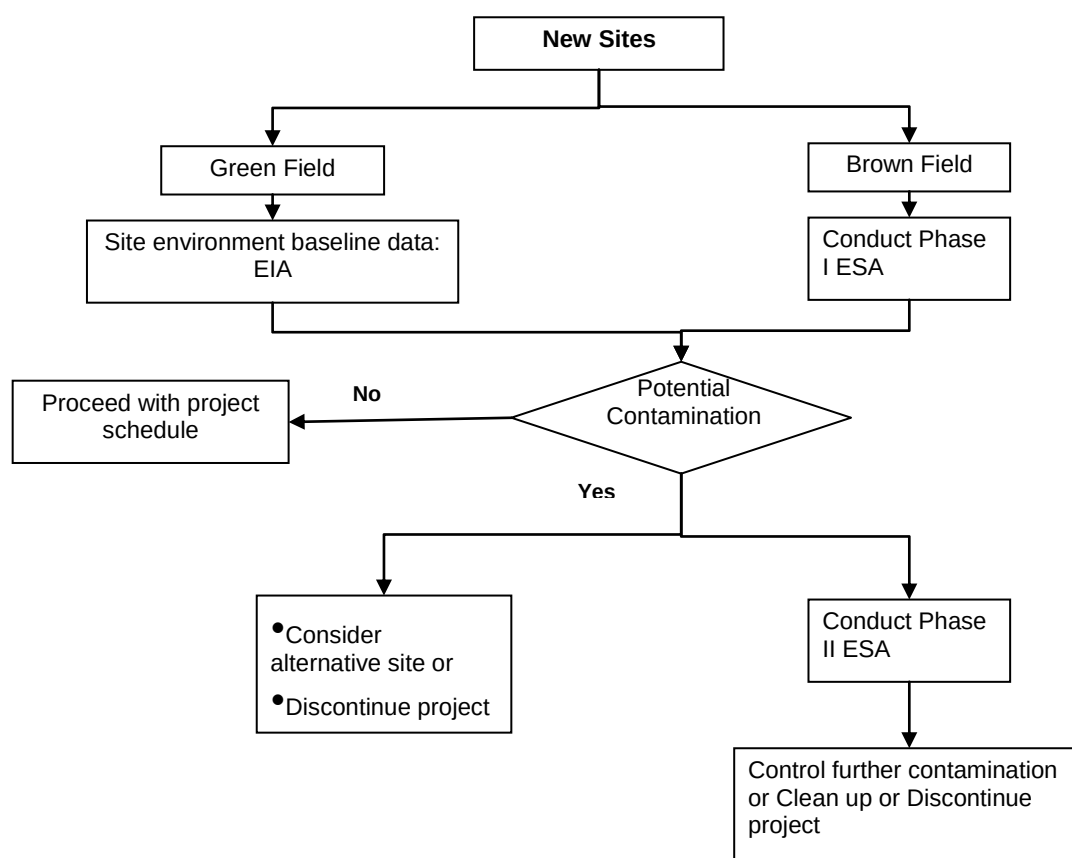


Figure 5.3: Environmental Site Risk Management Process for New Sites

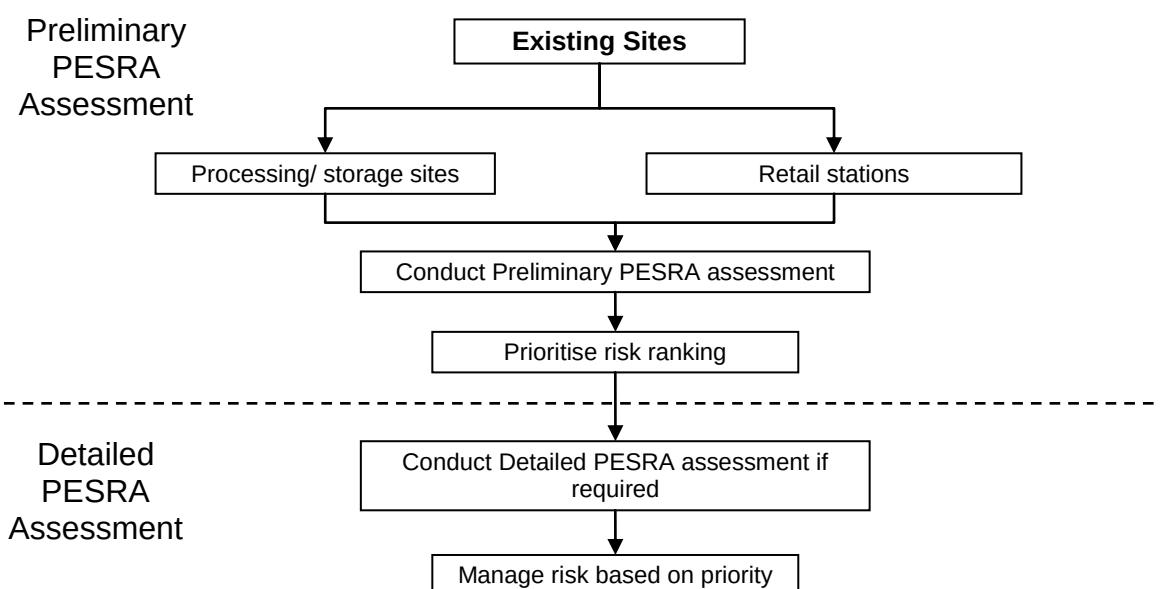


Figure 5.4: Environmental Site Risk Management Process for Existing Sites

Below is the summary table of the key elements of the PESRA; Phase I ESA and Phase II ESA. The subsequent sections will provide details of all the elements highlighted.

Table 5.3: Summary of PESRA, Phase I ESA, Phase II ESA

	PESRA	PHASE I ESA	PHASE II ESA
Objective / purpose	To facilitate proactive decision making regarding the management of environmental and associated business risks at the site	To determine the possible presence of contamination at site	To evaluate the REC/COC identified in Phase I Note: Work scope may consist of several iterations and may be terminated at any point, once the objectives are satisfied
When is it required?	For existing site / during normal operation	- When acquiring an existing site / Farm-in; or - Leasing out a site/ Decommissioning / Exiting site / Transfer of site ownership	- For existing site / during operation – in the event of loss of containment, suspected contamination, to comply with regulatory requirements, or to satisfy MEMS requirements; or - When outcome of environmental site risk assessment show potential contamination for these sites/land type: - new development - farm-in - lease out - decommissioning - transfer of site ownership
Party responsible for the conduct of environmental site risk assessment	Site Manager (highest position responsible for the site)	- Acquiring an existing site / Farm-in: GBU, Business Unit in OPU - Leasing out a site / Decommissioning / exiting site: Project Manager - Prior to transfer: Head of transfer team	Follows the same parties responsible for the Phase 1 study
Process / components	STEP 1 – Risk screening STEP 2 – Data gathering STEP 3 – Generate scores and ranking STEP 4 – Interpret results STEP 5 – Proactive management decisions	- Records / data review - Scope of Review & Boundary - Documentation of Records Reviewed - Site Reconnaissance - Documentation - Limitations - Frequency - Prior Assessment Usage	- Developing the scope of work - Identify Site Limitations - Review Existing Information - Potential Distributions of Contaminants - Sampling - Health and Safety - Chemical Testing - Quality Assurance/Quality Control Procedures - Assessment activities - Field Screening and Field Analytical Techniques - Environmental Media

		• Uses and Conditions • General Site Setting 3. Limited Measurement, Sampling and Analysis 4. Interviews With Past and Present Owners and Occupants 5. Assessment 6. Report Preparation	• Sampling Handling 3. Evaluation and presentation of data • Verification of Assumptions • Verification of Data 4. Interpretation of results • Elimination of Recognized Environmental Conditions • Confirmation of Recognized Environmental Conditions 5. Report preparation (presentation of findings and conclusions) • Purpose • Characteristics • Format of Report
Methodology	By applying Site Index (SI) and Environmental Index (EI) to obtain Relative Site Environmental Risk (RSER)	N/A	N/A
Report format / Related documents	Refer to Appendix 1 for the sample Questionnaire / Survey form and Appendix 2 for the preliminary risk ranking table.	Refer to Appendix 4 for report format	Refer to Appendix 12 for report format

6.0 ENVIRONMENTAL SITE RISK ASSESSMENT FOR EXISTING LAND-BASED ASSET: PESRA

This section explains on the process adopted by PETRONAS to determine the environmental risk ranking for PETRONAS land-based assets with regards to the potential for and possible consequences of, soil and groundwater contamination.

6.1 PESRA Process

6.1.1 What is PESRA ?

PESRA stands for PETRONAS Environmental Site Risk Assessment. PESRA is a process to rank and prioritise PETRONAS operated land-based sites, according to the defined environmental risks.

The purpose of PESRA is to facilitate pro-active decision making regarding the management of environmental and associated business risks at the site.

In determining the potential risk of a site, PESRA looks into the information on the source (i.e. equipment, presence of contamination, potential source of contamination, facilities condition, etc), the receptor (land use, groundwater use, etc.) and their interaction pathway (or exposure pathway).

6.1.2 How does the process work?

PESRA process consists of five basic steps:

STEP 1 – Risk Screening: Preliminary PESRA survey form to be answered by Plant Operation. The result from the survey which ranks High High, High Medium and Medium is required to carry out Detailed PESRA assessment as stated in the following steps. For the result which ranks Low Medium or Low Low should continue to have good housekeeping and maintenance programme at plant.

STEP 2 – Data Gathering: Detailed PESRA assessment requires gathering specific data on individual sites to assess the risks. Data quality is very important to ensure an accurate assessment result. Sets of questionnaires have been developed in gathering the data required (refer to **Appendix 1** for sample Preliminary PESRA and Detailed PESRA survey form for bulk storage and service station, and **Appendix 2** for PESRA risk matrix). Environment TPs and personnel with site specific knowledge may complete the questionnaire.

STEP 3 – Generate scores and rankings: After the completion of site information in the questionnaires, each answer should be given scores and weightings. The site specific risk score will be calculated from these entries.

STEP 4 – Interpret results: The results from STEP 2 are relative only. They do not give a measurement of absolute risks, nor do they predict probabilities of actual problems occurring at the site.

STEP 5 – Proactive Management Decisions: The results interpretation may guide the Management in making business decisions e.g. remediation programmes, further investigation of contamination, capital investment strategies, acquisition or divestment.

6.2 PESRA Methodology

6.2.1 Site Index (SI)

SI indicates the relative risk of a loss occurring of one site to another site. It assesses the 'likelihood' of a loss to occur and the 'severity' of the loss should it occur. It does not predict the occurrence of an actual loss. SI is based on the information about equipment and product. Example of SI is shown in the following table.

Table 6.1: Site Index for PESRA

Site Index (SI) relative risk of loss occurring	
Likelihood / probability of a loss i.e. what factors could contribute to a loss occurring, causing contamination which would be a source.	Potential severity of loss i.e. if there is a loss, would it be small or large volume, would it be detected quickly and would it tend to migrate quickly
- Existing contamination - Equipment type, condition, age, failure history - Containment (primary / secondary) at fill points and dispensers	- Type of product - Number of equipment - Throughput - Storage capacity - Existing control (e.g. detectors, level control)

6.2.2 Environmental Index (EI)

EI indicates the relative potential risk of impacting a receptor if contamination was present at one site to another site. It assesses the likelihood of impacting a receptor and the potential severity of the impact. EI is based on information about receptor types and sensitivities, distances and hydro-geology. Example of EI is shown in the following table.

Table 6.2: Environmental Index for PESRA

Environmental Index (EI) – relative potential risk of impacting a receptor	
Likelihood / probability of impacting a receptor i.e. what factors could contribute to contamination reaching the receptor	Potential severity of impact i.e. if the contamination did reach the receptor, how serious would the impact be
• Soil types • Depth to groundwater • Distance to various receptors (e.g. surface water, groundwater wells, residential etc)	• Number of people affected • Presence of basements • Current and intended use of various receptors

6.2.3 Relative Site Environmental Risk (RSER)

RSER is defined as a function of the EI & SI. It is an expression of the risk that a source and receptor may be present together, resulting in potential environmental impact.

The framework below shows in **Figure 6.1** is the relationship between SI, EI & RSER

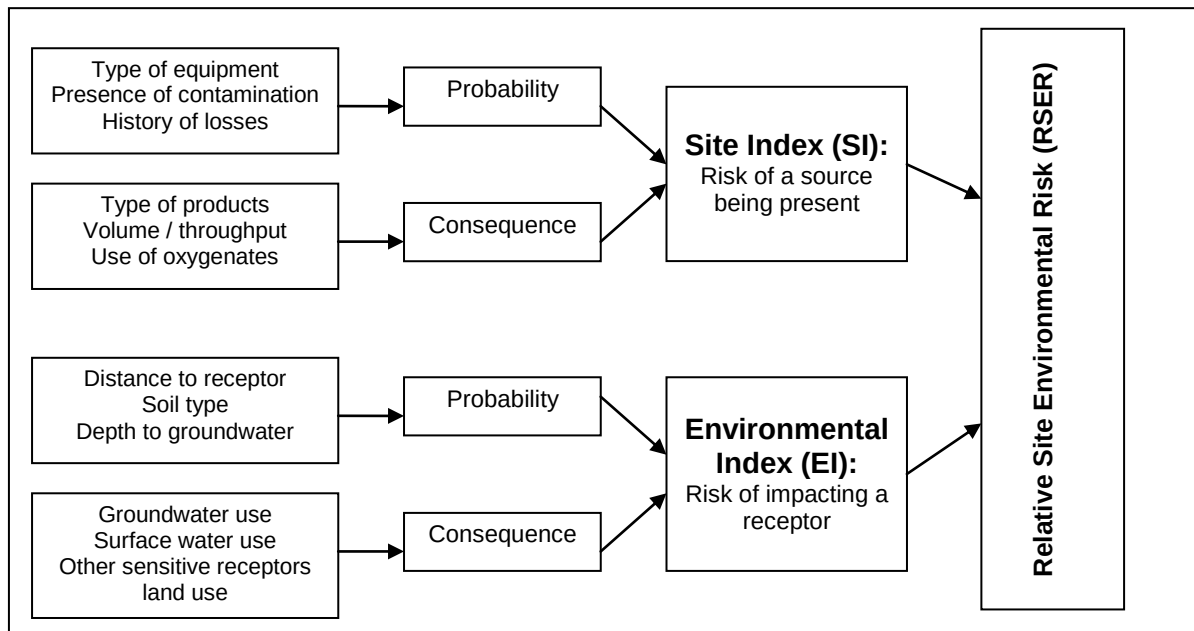


Figure 6.1: The relationship between SI, EI & RSER

6.2.4 Potential Receptors and Pathways Associated with Contaminated Land to facilitate PESRA

Table 6.3: Potential Receptors and Pathways

Receptors	Pathways
Humans - health and safety	Ingestion of soil, sediments, groundwater or surface water
i. current site workers	Dermal contact with soil, sediments, groundwater or surface water
ii. future users	Inhalation of particulates
iii. construction/maintenance workers	Inhalation of vapours/asphyxiating atmospheres
iv. site neighbours	Ingestion of crops/produce grown on site
	Build up and ignition of explosive levels of vapours
Groundwater ⁽¹⁾	Downward infiltration of free phase liquids in unsaturated zone
	Downward infiltration of leachate in unsaturated zone
	Creation of preferential migration pathway
Surface water ⁽¹⁾	Lateral migration of free phase liquids
	Lateral migration of solute in saturated zone
	Surface run off
Ecological	Direct contact with soil, sediments, groundwater or surface water
	Through the food chain
Building materials piping & other infrastructure	Direct contact - leading to impairment of structural properties
Commercial risk	Poor understanding of risk
	Poor communication of risk associated with site
Group reputation	Poor understanding of risk
	Poor communication of risk associated with site

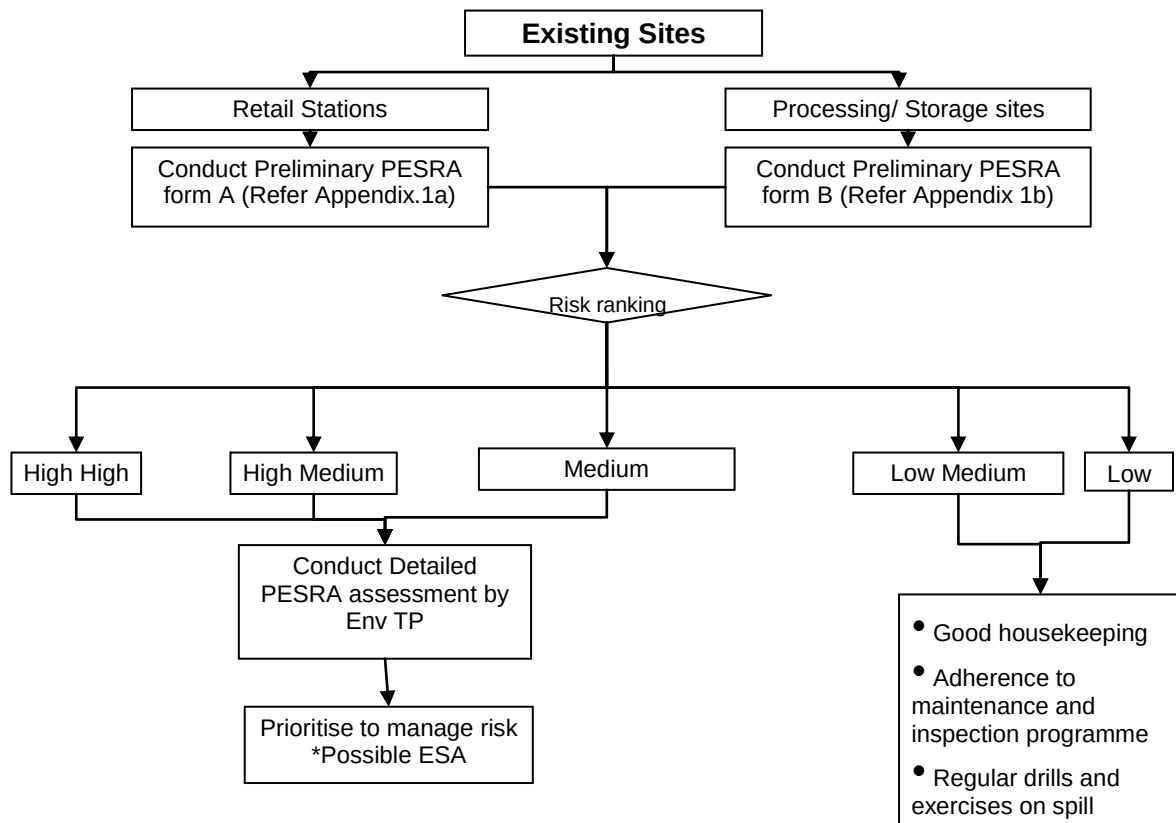
(1) It is important to note that groundwater and surface water may in some regulatory environments be considered as receptors as well as pathways. This is normally adopted in an effort to prevent degradation of groundwater resources. Such policies can lead to expenditures of energy and capital for no environmental benefit. In general groundwater and surface water should not be considered as receptors unless driven by local regulations. Where directly used as a resource (e.g. domestic water, recreational use) the threat to the resource should be evaluated based on the potential receptors of the water (e.g., human consumption, aquatic ecosystem, process usage). Otherwise it should be treated as a pathway with the receptor being the user/use of the groundwater at the point of abstraction or exposure.

6.2.5 Scoring Algorithm

Table 6.4: Scoring Algorithmn for Detailed PESRA Assessment

Slp Total of (score for answer to eachQ * weight for eachQ) Total of (max possible score for eachQ * weight for eachQ)	Elp Total of (score for answer to each Q * weight for each Q) Total of (max possible score for each Q * weight for each Q)
Slc Total of (score for answer to each Q * weight for each Q) Total of (max possible score for each Q * weight for each Q)	Elc Total of (score for answer to each Q * weight for each Q) Total of (max possible score for each Q * weight for each Q)
SI = Slp * Slc	EI = Elp * Elc
RSER = (SI + EI)/2	

6.3 PESRA Management of Risk



*Possible ESA – based on TP assessment of Detailed PESRA Assessment

Figure 6.2: PESRA Management of Risk

6.4 Task and Responsibilities

Table 6.5: Task and Responsibilities of PESRA

Task	Who
Ensure PESRA is conducted	Highest person in-charge (PIC) of the site e.g. Terminal superintendent is responsible for terminals
Conduct Preliminary PESRA Assessment	Operation personnel
Conduct Detailed PESRA Assessment	HSE and PESRA Team Members to include personnel from operations, maintenance & technical services
PESRA Peer review	Staff EM TP and above

7.0 PHASE I ENVIRONMENTAL SITE ASSESSMENT (PHASE I ESA) AND BASELINE ENVIRONMENTAL SITE ASSESSMENT (BESA): PROCESS, CRITERIA METHODOLOGY

7.1 Introduction

Phase I Environmental Site Assessment (Phase I ESA) is conducted to determine the possible presence of contamination at site and is usually non intrusive. However, a Baseline Environmental Site Assessment (BESA) may also be carried out for land properties which are not identified with any potential subsurface contamination during the initial assessment (ESA Phase 1) to establish the background level of subsurface soil and groundwater quality for future reference. This is especially applicable for land properties that will be used for activities of polluting industries, prior to the commencement of the development.

BESA may be integrated as part of the ESA Phase I. The methodology for field work of BESA follows closely to that of a Phase II ESA of the following Section 5.

In projects involving Merger & Acquisition or Divestures, the ESA Phase I is also known as Environmental Due Diligence.

A Phase I ESA shall / should have the following components, as described below:

1. **Records Review**—Review of records e.g. Maintenance Record, Spill Record, Facility Design, Environmental Baseline records (EBS), Hydro-geological data, regulatory requirements, etc.;
2. **Site Reconnaissance**—A visit to the property to observe any indication of contamination such as oil stained on soil / pavement, affected grass, oily sheen in the drain, etc;
3. **Limited measurement, sample collection / analysis** – if sign of contamination is observed, a limited number of samples should be taken for analysis to determine the presence of contamination;
4. **Interviews**—Interviews with present and past owners, operators, occupants of the property, neighbouring property and public;
5. **Assessment** – assessment of data gathered; and
6. **Report** — report preparation;

7.2 Process and Methodology of Assessment

This section discusses the practical issues for implementing the recommended steps of the assessments.. The responsible parties may also wish to consult two publications prepared by the American Society for Testing and Materials (ASTM) and one from Singapore's Jurong Town Corporation (JTC) for further information:

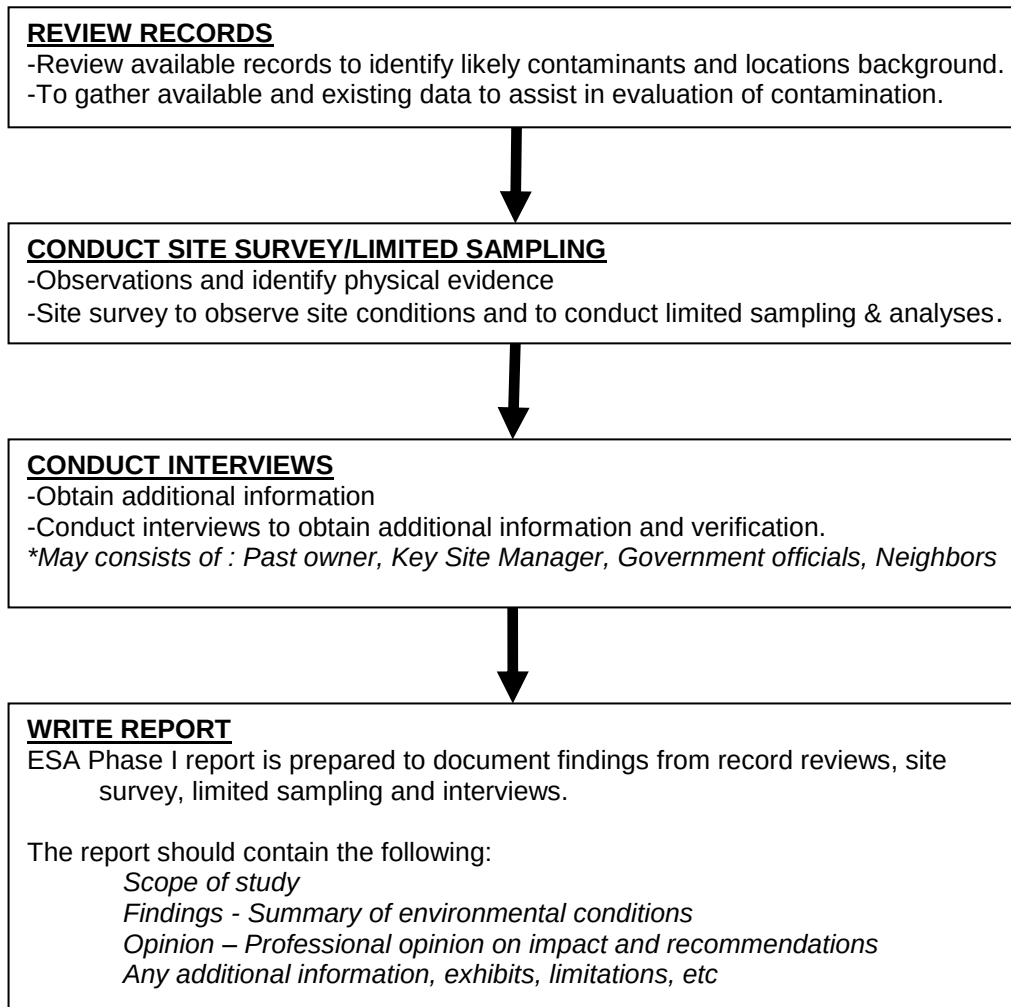
- ASTM E 1527-00 “Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process” or its latest edition
- ASTM E 1903-97 “Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process” or its latest edition
- Singapore’s Jurong Town Corporation, “Guideline on Environmental Baseline Study (2003)”, or its latest edition

These environmental documents were created to help with the resolution of some of the competing interests that may arise during a real estate transaction but can also be used to conduct ESAs including the Baseline ESAs for the purposes stated within this PTS. In addition, there are many other relevant reference and guideline specific to the oil and gas sector’s site risk management which are highlighted throughout the PTS.

7.3 Phase I ESA Process & Methodology

7.3.1 The key steps involved in carrying out a Phase I ESA

Figure 7.1: Key Steps Involved In Phase I ESA



During the actual visit, it is common to include an ‘opening meeting’ in order to present the overview of the assessment plan; highlight the list of data/information/documents required for the review; introducing the assessors and the

key personnel of the facility/ owner; and understand or obtain an overview of the facility/site.

Similarly, at the end of the assessment, usually a closing meeting is held for discussion of the key findings mainly to ensure accuracy, completeness of the findings

7.3.2 Methodology

7.3.2.1 Records / Data Review

The purpose of the records review is to obtain and review records that will help identify recognized environmental conditions/concern (REC) or contaminants of concern (COC) in connection with the property. Refer to **Appendix 3** for typical lists of COC related to oil and gas industry.

7.3.2.2 Scope of Review & Boundary

The scope of the review of a particular record may be adjusted in the discretion of the user.

Factors to consider in adjusting the scope of the review include:

- i. The population density of the area which the property is located (for example, urban, rural, or suburban);
- ii. The distance that the hazardous substances or petroleum products are likely to migrate based on local geologic or hydro-geologic conditions;
- iii. The property type / land use;
- iv. Existing or past uses of surrounding properties, and
- v. Other reasonable factors.

Any adjustment on the scope of review must be justified and explained in the report.

7.3.2.3 Documentation of Records Reviewed

The report shall document all records that were reviewed, even if a record revealed no findings. Supporting documentation shall be included in the report or adequately referenced.

7.3.2.4 Site Reconnaissance

The objective of the site reconnaissance is to obtain information indicating the likelihood of identifying REC/COC in connection with the property.

During the site visit, the following aspects shall be observed:

- i. Physical condition of the structure (e.g. corrosion, damage, cracks, leaks, stain, etc)
- ii. Condition of drainage system
- iii. Condition of hazardous materials / wastes storage area
- iv. Signs of contamination (e.g. affected grass / soil)
- v. Presence and quality of water bodies
- vi. Adjacent buildings or public areas

7.3.2.4.1 Documentation

The report shall document method used to observe the property (for example, grid patterns or other systematic approaches used for large properties, which spaces for owner or occupants were observed).

7.3.2.4.2 Limitations

The user shall document, in the report, general limitations and basis of review, including limitations imposed by physical obstructions such as adjacent buildings, bodies of water, asphalt, or other paved areas, and limiting conditions (for example, snow, rain).

7.3.2.4.3 Frequency

It is not expected that more than one visit to the property shall be made in connection with a Phase I ESA. The one visit constituting part of the Phase I ESA may be referred to as the site visit.

7.3.2.4.4 Prior Assessment Usage

The information supplied in connection with the site reconnaissance portion of a prior environmental site assessment may be used for guidance but shall not be relied upon without determining through a new site reconnaissance whether any conditions that are material to recognized environmental conditions in connection with the property have changed since the prior environmental site assessment.

7.3.2.4.5 Uses and Conditions

The user(s) performing the Phase I ESA are obligated to identify uses and conditions only to the extent that they may be visually and/or physically observed on a site visit, as described in this practice, or to the extent that they are identified by the interviews or record review processes described in this practice.

Table 7.1 below provides a general list of areas to be covered in an assessment.

Table 7.1: General Site Setting

No.	Site Aspects	Description
1	Current and Past Use(s) of the Property	The current and past use(s) of the property that likely to involve the use, treatment, storage, disposal, or generation of hazardous substances or petroleum products shall be identified in the report. Unoccupied occupant spaces should be noted. (For example, there may be signs indicating a past use or a structure indicating a past use.)
2	Current and Past Uses of Adjoining Properties	The current and past uses of adjoining properties shall be described in the if they are likely to indicate an REC/COC in connection with the adjoining properties.
3	Current or Past Uses in the Surrounding Area	The current or past uses of properties surrounding the area (e.g. residential, commercial, industrial) shall be noted if they are likely to indicate an REC/COC in connection with the property.
4	Geologic, Hydrogeologic, Hydrologic, and Topographic Conditions	The topographic conditions of the property, as well as the general topography of the area surrounding the property that is visually and/or physically observed from the periphery of the property. These may be used to evaluate whether hazardous substances or petroleum products are likely to migrate to the property, or within or from the property, into ground water or soil.
5	General Description of Structures	The report shall generally describe the structures or other improvements on the property, for example: number of buildings, number of stories each, approximate age of buildings, ancillary structures (if any), etc

No.	Site Aspects	Description
6	Roads	Public thoroughfares adjoining the property shall be identified in the report including roads, streets, and parking facilities on the property.
7	Potable Water Supply	The source of potable water for the property shall be identified in the report.
8	Interior and Exterior Observations	<u>Hazardous Substances and Petroleum</u> Past and present uses of hazardous substances and petroleum products – to approximate quantities involved, types of containers (if any) and storage conditions shall be described in the report. <u>Storage Tanks</u> Above ground storage tanks, or underground storage tanks or vent pipes, fill pipes or access ways indicating underground storage tanks shall be identified (its content, capacity, and age) <u>Odors</u> Strong, pungent, or noxious odors shall be described and their sources shall be identified, where possible. <u>Pools of Liquid</u> Standing surface water, pools or sumps containing liquids likely to be hazardous substances or petroleum products shall be described. <u>Drums</u> Drums and containers, whether or not they are leaking, unless it is known that their contents are not hazardous substances or petroleum products <u>Hazardous Substance and Petroleum Products Containers (Not Necessarily in Connection With Identified Uses)</u> Containers containing hazardous substances or petroleum products that are or might be an REC/COC - the hazardous substances or petroleum products shall be identified or indicated in the report, and the approximate quantities involved, types of containers, and storage conditions shall be described in the report. <u>Unidentified Substance Containers</u> Open or damaged containers containing unidentified substances suspected of being hazardous substances or petroleum products - the approximate quantities involved, types of containers, and storage conditions shall be described in the report <u>Heating/Cooling</u> The means of heating and cooling the buildings on the property, including the fuel source for heating and cooling, shall be identified in the report (for example, heating oil, gas, electric, radiators from steam boiler fueled by gas). <u>Stains or Corrosion</u> Stains or corrosion on floors, walls, or ceilings shall be

No.	Site Aspects	Description
		described in the report, except for staining from water.
		<u>Drains and Sumps</u> Floor drains and sumps shall be described in the report.
		<u>Pits, Ponds, or Lagoons</u> pits, ponds, or lagoons on the property, particularly if they have been used in connection with waste disposal or waste treatment.
		<u>Stained Soil or Pavement</u> Areas of stained soil or pavement shall be described in the report.
		<u>Stressed Vegetation</u> Areas of stressed vegetation (from something other than insufficient water) shall be described in the report.
		<u>Solid Waste</u> Areas that are apparently filled or graded by non-natural causes (or filled by fill of unknown origin) suggesting trash construction debris, demolition debris, or other solid waste disposal, or mounds or depressions suggesting trash or other solid waste disposal
		<u>Waste Water</u> Waste water or other liquid (including storm water) or any discharge into a drain, ditch, underground injection system, or stream on or adjacent to the property
		<u>Wells</u> All wells including dry wells, irrigation wells, injection wells, abandoned wells, or other wells. Any groundwater abstraction well located in the vicinity should also be included.
		<u>Septic Systems</u> Indications of on-site septic systems or cesspools should be described in the report

Note that the above list is not an exhaustive and areas to be covered may vary from site to site.

7.3.2.5 Limited Measurement, Sampling and Analysis

If sign of contamination is observed, a limited field measurement and/or a limited number of samples should be taken for analysis to determine the presence of contamination.

If potential contaminant are easily vaporized or contain VOC, such as petroleum hydrocarbon, the presence of contaminant can be detected by soil vapour analysis using photo ionization detector (PID) or Drager tube.

For non-vaporised contaminant such as metals, samples should be taken, e.g. stained soil, groundwater sample, etc. Refer to the following Section 5 for detailed methodology of soil and groundwater investigation of the Phase II ESA.

Other samples that may be taken are flora and fauna within the site, drainage water, paint samples, etc, if necessary.

** Note that typically, a Phase I ESA scope does not include scope for sampling and analysis. However a limited sampling and analysis, for sites where indication of a likely contamination, may be warranted and in the case of a BESA, the sampling work for a baseline record is one of the main purpose of the assessment.*

7.3.2.6 Interviews with Past and Present Owners and Occupants

The objectives of the interview are:

1. to verify the information obtained from the record review
2. to obtain missing information
3. to obtain undocumented / additional information

Interviews with past and present owners, operators, and occupants of the property, consist of questions to be asked in the manner and of persons as described in this section. The content of questions to be asked shall attempt to obtain information about uses and conditions.

Who should be interviewed?

1. Key Site Personnel: e.g. property manager, the chief physical plant supervisor, or head maintenance person. It is important for the personnel assigned to be experienced and familiar with the site/facility and with a good knowledge of the current and past operational and maintenance matters.
2. Past Owners, Operators, and Occupants (if possible/allowed)
3. Owners or occupants of neighbouring properties (if possible/allowed)

7.3.2.7 Assessment

The data shall be assessed against its baseline data and/or the national / local authorities' requirements / standards. In the absence of such a standard, the USEPA Regional Screening Level, 2008 standard (or its' latest version) shall be used which is also the proposed Site Screening Level (SSL) criteria adopted by the Malaysian DOE. . Alternatively, in the case where no specific requirements mentioned, the latest Risk Based Levels of the Australian Oil Industry Environmental Guideline (AOIEG) is recommended for petroleum sites. However, whichever criteria adopted is still subject to acceptance by the relevant authorities.

7.3.2.8 Report Preparation

7.3.2.8.1 Report Format

The report for the Phase I ESA should generally follow the recommended report format attached in **Appendix 4** unless other-wise required.

7.3.2.8.2 Documentation

The findings, opinions and conclusions in the Phase I ESA report shall be supported by documentation. Supporting documentation shall be included in the report or adequately referenced to facilitate reconstruction of the assessment. Sources that revealed no findings also shall be documented. Certain document may be excluded from the report due to confidentiality agreement.

7.4 Quality assurance

Quality assurance (QA) is a critical element of environmental site assessment. The objectives are to ensure that results are meaningful, complete and accurate.

Key points are that:

1. accurate, comprehensive and auditable records must be kept for all activities;
2. all personnel must be trained to the required levels of competency. These should be defined and training should be documented; and
3. all equipment must be properly maintained and, if appropriate, calibrated. Maintenance and calibration records should be documented.

Operational records should be kept in log books, recording both field and laboratory observations, equipment used, procedures followed, dates and times and personnel involved, including responsibilities. Documentation should be designed to facilitate clear audit trails. For example, sample handling can use 'chain-of-custody' forms embracing collection, storage, transport, analysis and disposal. A detail on the above aspects relating to Quality Assurance is further elaborated in the *Section 5* on Phase II ESA.

8.0 ENVIRONMENTAL SITE ASSESSMENT PHASE II: PROCESS, CRITERIA, METHODOLOGY

8.1 Introduction

Phase II ESA is conducted to evaluate the REC/COC identified in the Phase I ESA /Environmental Due Diligence. Typically, the purposes of a Phase II ESA are to:

- a) Develop sufficient information to confirm the findings of ESA Phase I and to determine the extent of contamination (REC/COC); or
- b) Develop sufficient information about the presence of an REC/COC at a site and the surrounding areas to meet the business objectives and to provide sufficient data in making informed business decisions, or both.

Note that a Baseline ESA (BESA) follows closely the methodologies/protocols of the Phase II ESA with a limited Phase I ESA. This is in line with its purpose of mainly establishing the baseline conditions of the site especially with respect to the soil and groundwater quality. Hence, it is only beneficial to carry out a BESA before the start of any development and operation of the site, by the new occupier/owner.

The Phase II work scope may consist of several iterations and may be terminated at any point, once the objectives are satisfied.

The components of a Phase II ESA are as follows:

- Developing the scope of work,
- Assessment activities,
- Evaluation and presentation of data, and
- Report preparation (presentation of findings and conclusions).

8.2 Developing the Scope of Work

A work scope and methodology shall be established to achieve the Phase II objectives. The description should provide the rationale for planned sampling locations and testing parameters along with identification of selected methodologies and appropriate QA/QC measures.

The description may provide for minor field modification where appropriate. The description should be organized to facilitate the orderly, objective focused implementation of the plan in the field.

In general, there are seven main tasks in developing a description of the work, as described in section 8.2.1 to 8.2.7

8.2.1 Identify Site Limitations

The ESA Phase II Project Proponent is responsible for anticipating foreseeable physical and logistical impediments which interfere with, or limit the ability to conduct explorations, analyses and sampling, for example, low ceilings, narrow alleyways, soft ground, steep slopes, known subsurface structures, such as utilities, etc.

8.2.2 Review Existing Information

The following available existing information should be reviewed to identify or establish site characteristics and its vicinity:

1. Information on Potential REC/COC(s) to be assessed;
2. Affect the potential distribution and mobility of hazardous substances or petroleum products in structures, on the ground, in ground water, in soils, or in surface water and environs at the site; and
3. Affect the manner in which the presence of hazardous substances or petroleum products may be assessed.
4. The review of readily available existing information should serve as the basis for evaluating the likely distribution of hazardous substances or petroleum products at the site, identifying appropriate sampling locations, and selecting appropriate sampling and analytical methodologies. Readily available information may be gained in review of Phase I ESAs conducted. Other ESAs or reports may be used where the information, in the judgment of the user, can be reasonably relied upon.
5. The user may review additional sources of information as is appropriate to the property, or as required by the judgment of the user. Information developed at this stage of the assessment may eliminate recognized environmental conditions identified in a Phase I ESA or transaction screen from further Phase II assessment where, in the judgment of the user, the additional information adequately demonstrates that hazardous substances or petroleum products associated with a previously identified recognized environmental condition.

8.2.3 Potential Distributions of Contaminants

The user should consider the likely distribution of potential contaminants. This requires that the user consider the properties, behaviors, and fate and transport characteristics of the contaminant in a setting like that being assessed.

The above is effectively a working hypothesis presented in a graphical or pictorial form via the Conceptual Site Model (CSM). It is used to present identified potential nature and sources of contamination, their likely spatial distribution in soil (or other environmental media), routes of exposure (pathways), and the potential effects of the contaminants on the site and on adjacent sites and other receptors. See **Appendix 5** for examples of CSM. Note that a preliminary CSM may also be developed at the Phase I ESA stage for an identified contaminated site. Then, during the Phase II, the CSM may be revised, if and where necessary.

8.2.4 Sampling

A sampling program should be designed to provide collection of potentially contaminated environmental media, if they occur, at locations and depths where the highest concentrations are likely to occur, as determined pursuant to the provisions of this section.

The above sampling and analysis plan is part of the site investigation plan where it may also be tentatively designed at the Phase 1 ESA stage but usually firmed up at the start of a Phase II ESA.

8.2.5 Health and Safety

The work description should include personnel health and safety precautions to be followed in accordance with applicable PETRONAS or state or local equivalents and any requirements imposed.

8.2.6 Chemical Testing

The chemical testing program should be designed to detect the contaminants suspected to be present in the samples collected. . Refer to **Appendix 3** for typical lists of COCs related to oil and gas industry. The chemical tests should be appropriate for detecting the indicator constituents of the hazardous substances and petroleum products. The chemical testing program should include tests which provide quality assurance (QA) and techniques that provide quality control (QC) over the chemical analyses. QA/QC, including detection limits of the chemical testing plan, should be consistent with the intended use of the data. The chemical testing program may include both field analytical and laboratory analytical techniques.

The user should specify in advance the analytical methods to be used as well as the requirements for data deliverables (for example, tabulated results, individual analysis sheets, chromatograms, spike recoveries, instrument calibration data, etc.) and quality control information (that is, project-specific or only laboratory batch-specific QC sample analysis).

An extensive body of methods is available for the analysis of environmental samples gathered in the course of a Phase II ESA. Several distinct compilations of methods for the analysis of environmental samples have been developed, principally by EPA and ASTM, for different purposes, primarily for hazardous waste management, industrial and municipal waste-water monitoring, assessment and cleanup.

For each specific medium and target analyte, a variety of methods may be appropriate, depending upon the particular circumstances. The user should select methods for the analysis of samples giving consideration to the intended end use of the resulting data, the user's data quality objectives, the statutory, regulatory, or policy framework applicable to the sample in question, and any limitations or allowances associated with the level of effort as understood by the user. The selected analytical method should be appropriate for the sample medium, target analyte, and detection limits. The choice of analytical methods will influence conclusions regarding recognized environmental conditions.

8.2.7 Quality Assurance/Quality Control Procedures

Appropriate quality assurance/quality control (QA/ QC) procedures should be included in the Phase II ESA to allow for assessment of the quality of the data collected. The QA/QC measures may include, for example, written field sampling protocol, decontamination procedures, instrument calibration, the preparation and analysis of trip blanks, equipment blanks, duplicate samples, and holding times for sample analysis. The data quality objectives of the user will influence the decision whether to include QA/QC samples and the selection of particular QA/QC procedures.

8.3 Assessment Activities

The assessment activities to be conducted under the Phase II ESA may range from field screening methods to intrusive multi-media sampling and laboratory analysis. This section references an overview of recognized intrusive and non-intrusive site assessment methodologies and common field screening activities and analytical protocols. The selection of one or a combination of these methods will be based on the stated objectives of the user and the judgment of the user. Appropriate QA/QC measures should be implemented according to the work plan.

8.3.1 Field Screening and Field Analytical Techniques

Field methods may be used for the purpose of characterizing certain physical attributes of a site and for the assessment of the presence and distribution of specific chemical or chemical classes at a sampling location. Field screening and field analytical techniques include methods of data gathering which may result in real-time acquisition of data. Field screening and field analytical techniques generally allow rapid, multiple measurements at relatively low cost. Because the accuracy and reliability of data produced by field instruments varies, the selection of particular field instruments and methods is influenced by the data quality objectives of the assessment. The quality of the data generated should be consistent with the intent of the assessment.

Some common field screening instruments, such as portable flame and photoionization detectors (PID), have higher detection limits and lower precision and accuracy compared to field or laboratory analytical instruments and are most suited to general qualitative analyses and health and safety monitoring. A sample PID data of a post oil spill project is attached in **Appendix 6** for reference.

Field analytical methods include all chemical analysis methods capable of providing chemical specific quantitative data in the field or non-laboratory setting. More reliable data than obtained through field screening may be obtained in the field or laboratory through the use of portable gas chromatographs or mobile field laboratories. The highest degree of data accuracy can generally be obtained by use of EPA and ASTM analytical methods.

Field screening and field analytical techniques may be used in Phase II ESAs for: qualitative and quantitative confirmation of the presence of contaminants constituting a recognized environmental condition, preliminary mapping of the area and vertical distribution of contaminants, guiding the collection of samples for more rigorous analysis, and guiding the placement of monitoring wells (Refer to typical well designs in **Appendix 7**). The user should establish standard procedures and protocols prior to the implementation of field screening and field analytical efforts. A set of an internationally accepted protocol for well installation; soil boring; groundwater sampling; soil sampling; and water level gauging are attached in **Appendix 8**. Note that the protocols were developed incorporating many QA/QC elements.

Common field methods may assess soil, soil gas, surface water and ground water. Field screening and field analytical methods include use of ion-selective electrodes, detection of volatile compounds using field gas chromatographs, and detection of inorganic constituents and semi-volatile organic chemicals using colorimetric wet chemistry methods, including enzyme immunoassay tests.

8.3.2 Environmental Media Sampling

Phase II ESAs generally require environmental sampling and field or laboratory analysis, or both, to determine whether hazardous substances or petroleum products are present on a property. The selection of sampling locations and analytical parameters should be consistent with the work description developed at the onset of the project. Deviations from the description of work to be performed should be noted and justified in the final report. Sampling locations should be documented to allow the sampling event to be reproduced later. The need for surveyed locations is subject to the agreement.

The Phase II sampling activities should be conducted to avoid the introduction of contaminants into the sample from the sampling equipment, and from environmental factors and to avoid, if feasible, and minimize the spread of contaminants in the environment. Sampling methods should be selected based on requirements of the local jurisdiction, where applicable.

8.3.3 Sampling Handling

Sample handling includes sample collection and containerization, filtration, and preservation. Sample handling procedures should be selected based on requirements of local jurisdictions, where applicable. Sample handling methods approved or recommended in the applicable analytical protocol should be used. A completed chain of custody record should accompany each shipment of samples to the analytical laboratory, and should be included in the written report of the assessment. Chain of custody records provide written documentation regarding sample collection and handling and identify the persons involved in the chain of sample possession (a sample Chain of Custody form attached in **Appendix 9**). Chain of custody records also provide a written record of requested analytical parameters.

The environmental professional should take appropriate measures to deliver the samples such that the analysis can be completed within the appropriate sample holding times.

8.4 Evaluation of Data

The implementation of the work planned will generate information and data on environmental conditions at the property that must be evaluated. To complete the Phase II ESA, this information and data must be analyzed to qualify the adequacy of the work performed, and evaluate whether a release or disposal of hazardous substances or petroleum products has occurred.

8.4.1 Verification of Assumptions

The first step in analysis of data is to consider whether the assumptions upon which the in some jurisdictions, the evaluation and analysis of the subsurface conditions may require a licensed individual (for example, registered geologist, professional engineer) work description was based were valid. That is, one asks whether samples were collected of the appropriate media (for example, soil, ground water) at the right location and depth (that is, where the highest concentrations of contaminants should be, if the potential release had actually occurred).

A work description is typically based upon assumptions as to subsurface physical conditions, for example, relative soil or aquifer permeabilities, depth to the water table, ground water flow direction and characteristics of potential contaminants. Actual information on these conditions is usually gained through the explorations, sampling, and observations completed under the work description (at least for those studies where subsurface conditions are of concern). The environmental professional should evaluate whether the assumptions were valid, in light of the actual conditions encountered. If an assumption was not valid, then the work performed may not have verified the recognized environmental conditions and additional iterations may be appropriate.

For example, the work description may have called for the installation of a number of observation wells, some of which were intended to be down gradient of areas where releases may have occurred. However, the water levels measured in the wells might have indicated that ground water flowed in a different direction than that inferred for development of the description of work to be performed. Hence the wells were not down gradient of the potential release areas and their purpose was not met. This would indicate that additional site work would have to be done to successfully complete the Phase II ESA. On the other hand, water levels may have confirmed that the wells were down gradient, as intended. They are then qualified as meeting their purpose, and the analysis and interpretation of data relating to them can proceed. Refer to sample borelogs produced during a well installation/boring (**Appendix 10**). In addition, the relevant field data forms such as the Field Groundwater Quality; Groundwater Well Development; Level Survey forms are appended (**Appendix 11**) for reference.

8.4.2 Verification of Data

The second step is to evaluate whether any target analytes detected in the samples are in fact attributable to the site. This requires the user to determine whether the analytical results should be questioned based on the QA/QC procedures. When data quality is determined to be acceptable, test results should be interpreted.

8.5 Interpretation of Results

The results of the Phase II explorations, sampling and testing should be interpreted to determine the significance of the data as they relate to the user's objectives. The data should also be evaluated to determine if other sources of contamination or more highly contaminated media may exist at the site but were not assessed in accordance with this guide. If chemicals that occur in nature are detected, the data must be interpreted to determine whether they are naturally occurring or are present as a result of human activity. For example, lead occurs naturally in soils and waters, at a range of concentrations. Mere detection of lead does not necessarily reflect lead disposal or release. The user must judge the likelihood that the lead level detected exceeded the naturally occurring lead level in the site vicinity and must evaluate potential sources (for example, fill materials present on the property in an area where use of mine tailings as fill was prevalent) to determine whether disposal or a release has occurred.

8.5.1 Elimination of Recognized Environmental Conditions

If hazardous substances or petroleum products were not detected, and the Phase II ESA information and data has been evaluated and found by the user to provide sufficient information from which the user can render a professional opinion that there is no reasonable basis for suspecting the disposal or release of hazardous substances at the site, then no further work is necessary to satisfy the "all appropriate inquiry" element with respect to the recognized environmental conditions assessed.

Where fewer than all recognized environmental conditions identified in a Phase I ESA or transaction screen are assessed in the Phase II ESA, the conclusion that no further inquiry is warranted applies only to the recognized environmental conditions assessed. However, this guide should not be construed to require Phase II assessment of all recognized environmental conditions identified in a Phase I ESA or a transaction screen. Where the user's objectives may be other-wise satisfied, a recognized environmental condition identified in a Phase I ESA may be eliminated from further assessment in the Phase II ESA.

A recognized environmental condition identified in a Phase I ESA may also be eliminated from the full scope of Phase II ESA procedures by developing further information not included in the Phase I or transaction screen. For example, the user may obtain a tank closure report not included in the Phase I report that confirms there were no releases from the tank that was identified as a recognized environmental condition in the Phase I or transaction screen. This new information may eliminate the need for additional Phase II tasks with respect to that recognized environmental condition. Similarly, a recognized environmental condition identified in the Phase I due to off-site conditions may be eliminated from a Phase II ESA if the records associated with such sites confirm that hazardous substances or petroleum products have not migrated or are not likely to migrate onto the property.

8.5.2 Confirmation of Recognized Environmental Conditions

If the Phase II ESA was conducted in accordance with this guide and the presence of hazardous substances or petroleum products at the property is confirmed under conditions that indicate disposal or a release, the user defense may not be supportable with respect to these confirmed substances. If hazardous substances or petroleum products were detected, and if requested by the user, the Phase II information and data may be interpreted to determine what further work is required or desirable to assess the