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A summary report on the disposal and destruction of POP pesticide contaminated soil in Nghe An and Ha Tinh

15 December 2014

Prepared by Tauw for the GEF-UNDP-MONRE project: “Building capacity to eliminate POP pesticide stockpiles in Viet Nam”.

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Contents

1 Sustainable management of contaminated sites

This chapter provides information on the Global Environment Facility, UN Development Programme and Ministry of Natural Resources and Environment project, of which the disposal and destruction of around 700 tonnes of POP pesticides is one of the main deliverables. This chapter also explains the short-term risk reduction measures in the context of the sustainable management of the contaminated sites.

1 Sustainable management of contaminated sites

Viet Nam is facing serious pollution from obsolete and Persistent Organic Pollutants (POPs). A large number of sites contaminated with POP pesticides and large quantities of POP pesticide stockpiles are scattered throughout the country. As part of a GEF (Global Environment Facility) and UNDP (UN Development Programme) funded project on "Building capacity to eliminate POP pesticide stockpiles in Viet Nam", four sites were selected to go through a phased process of sustainable management of the contamination.

1.1 General

This is a GEF-funded project with UNDP as the implementing agency. The project beneficiary is the Ministry of Natural Resources and Environment (MONRE) of the Socialist Republic of Viet Nam. A Project Management Unit (PMU) takes care of the day-to-day project activities. Tauw bv, a Dutch international consulting firm, is assisting the PMU with the implementation of the project.

This report evaluates the part of the project related to the destruction of POP pesticides – one of the main project deliverables. The target at the time of the project design was 1,000 tonnes. This amount was lowered to 700-880 tonnes to be collected from seven sites, following a review of inventory data by Rick Cooke international expert contracted by UNDP. The volume was also reduced because of the high unit price for combustion treatment in Viet Nam (about 2,700-3,000 USD per one tonne of contaminated soil). The exact amount collected at the seven sites was 691.6 tonnes, of which 591.6 tonnes were destroyed as 100 tonnes turned out to not be strongly contaminated. These 100 tonnes were taken by the contractor carrying out the on-site soil remediation. At a later phase of the project the Chien Thang site was added as the eighth site, with a total quantity of excavated and destroyed contaminated soil totalling 59.5 tonnes.

The total quantity of soil destroyed has now reached 651.8 tonnes and these total volumes are discussed in the following chapters.

The information in this report comes from the different site-specific environmental management plans and various technical reports that are listed on the last page of this evaluation report.

The phases for sustainable management of contaminated sites that need to be followed are discussed below and illustrated in Figure 1.1. This procedure is also described in detail in the guidelines for the sustainable management of POP pesticide contaminated sites, written as part of the UNDP project.

Phase 1 - Preliminary site assessment
As a first step, 11 sites where POP pesticides have been handled, were visited and preliminarily assessed. The result of this assessment is a site-specific Phase 1 report describing the initial conceptual site model and all the identified potential and preliminarily assessed environmental risks.

Phase 2 - Site assessment
The preliminary site assessment was followed by a site assessment where potential environmental risks were identified. The site assessment focused on an inventory of the leftover POP pesticides and contaminated soil and groundwater. A POP pesticides inventory was made and samples taken from the soil and groundwater for analysis in a laboratory. Phase 2 was closed with an environmental risk assessment. Several site assessments confirmed the environmental risks identified in Phase 1. These sites generally have a high environmental risk profile. All results are reported in a site-specific Phase 2 report.

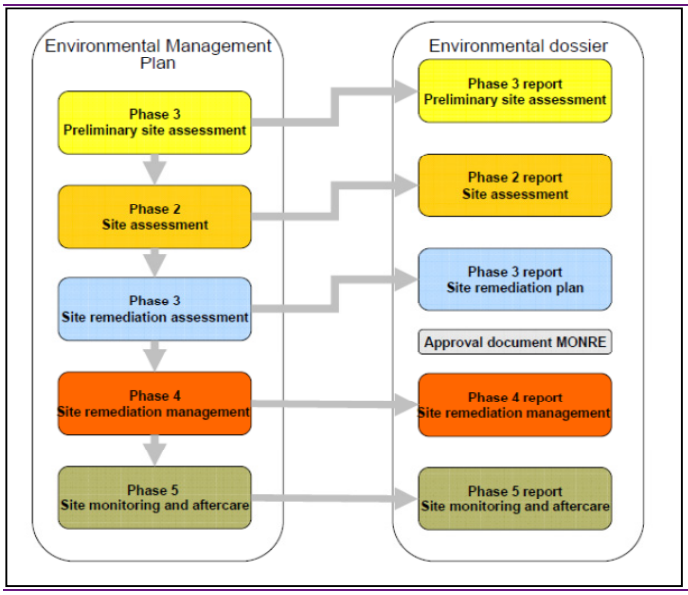

Figure 1.1 The phases of sustainable management of contaminated sites as part of the Environmental Management Plan and Environmental Dossier

Phase 3 - The remediation assessment and plan
Because the identified environmental risks in Phase 2 have to be remediated or contained, short-, mid- and long-term risk reduction measures were selected and drafted for those sites where unacceptable environmental risks were present. These risk reduction measures are reported in a site-specific Phase 3 report. Short-term risk reduction measures are measures that should be implemented as soon as possible to eliminate the direct environmental risks.

Mid-term risk reduction measures should be implemented in the coming one to two years and should last maximum five years, reducing or mitigating the potential environmental risks. Long-term risk reduction measures should also be implemented in the coming one to two years but will last for a longer period and will help to contain the latent environmental risks.

Phase 4 - The site management/remediation

From the initial 11 sites assessed in the scope of this project, the Nui Cang, Vuc Rong, Thạch Luu and Hon Tro sites were selected for site clean-up. There was an immediate implementation of short-term risk reduction measures, such as the collection, excavation, packaging and destruction of POP pesticides, and mid- and long-term risk reduction measures such as remediation and/or containment of contaminated soil. Through various tender procedures different contractors for the different works were selected. The evaluation of the short-, mid- and long-term risk reduction measures is reported in the site-specific Phase 4 reports.

The Chien Thang site was added to the programme for a number of reasons, including a strong suspicion about the health impact on people living in the five family houses nearby. These households were therefore moved. The site could be added to the programme because the project had remaining budget after the seven initial sites were treated (four major sites and three small sites) and because the project was extended to the end of 2015.

Phase 5 - Site monitoring and aftercare

After the remediation of POP pesticide contaminated sites has been completed and residual contamination is left, the period of monitoring and aftercare begins. At sites where residual contamination is left, monitoring and aftercare needs to be implemented to ensure that the remediation end-results, i.e. the mitigation and/or containment of the human health, ecological and the risks for off-site migration of contaminants, are contained. The monitoring and aftercare measures are reported in the site-specific Phase 5 report.

The site-specific Environmental Plan and Environmental Dossier

The different site-specific plans to carry out the five phases for sustainable management of contaminated sites are collectively known as the site-specific Environmental Plan. The reports on the phases carried out plus the approval documents from MONRE to proceed from Phase 3 to Phase 4, as well as other relevant documents, form the site-specific Environmental Dossier. The four sites selected by the project are exemplary of a large number of sites in Viet Nam. These Environmental Dossiers therefore function as templates for many future site clean-ups.

1.2 Contents of this report

In this summary report on the disposal and destruction of POP pesticides, the work related to the destruction of 700-880 tonnes of POP pesticides is evaluated. This work is part of Phase 4 of the sustainable management of contaminated sites. To give a more complete overview of the phases that preceded this phase and some other important aspects, we will briefly discuss the site assessment (Phases 1 and 2) in Chapter 2. Chapter 3 provides some technical details on the remediation assessment and conceptual design, Phase 3 of the sustainable site management. The remediation management, Phase 4, which includes selecting the contractor, stakeholder involvement and the short-term risk reduction measures to remove the POP pesticides, is elaborated in Chapter 4. Chapter 5 gives a summary of the lessons learned in relation to the disposal. Chapter 6 gives a table with all relevant project documents used to write this summary report.

The site assessment

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This chapter explains the selection of the four sites for the removal and final destruction of POP pesticides.

2 The site assessment

For detailed information on Phase 1, the preliminary site assessment, and Phase 2, the assessment of the sites that have been remediated, reference is made to the site-specific reports that are included in the site-specific Environmental Dossiers.

2.1 General

After a review of the site inventory made by the Vietnamese authorities, 11 sites were selected for Phase 1 of the sustainable management of contaminated sites. This preliminary site assessment consists of a site visit, background and historical site review and limited soil and groundwater sampling to establish if POP pesticides have impacted the area. The results are all presented in a Phase 1 report containing an initial conceptual site model and a preliminary or Tier 1 risk assessment.

The preliminary site assessment is the first step in reviewing the environmental status. POP pesticide contaminated sites with the highest potential environmental risks need further detailed site assessment to see if remediation within the framework of sustainable management of contaminated sites is necessary.

Sites where potential environmental risks are present are further investigated in Phase 2, the site assessment. The site assessment comprises comprehensive drilling and sampling, followed by the construction of a conceptual site model. A full conceptual site model describes the sources of contamination, the receptor pathways and the receptors. With the information from the full conceptual site model the site risks are quantitatively assessed, the Tier 2 risk assessment.

2.2 The sites to be remediated

Based on the environmental risks the following sites were chosen for Phase 3:

- Nui Cang, Diem Thuy, Thai Nguyen province
- Vuc Rong, Tan Ky, Nghe An province
- Thạch Luu, Thach Ha, Ha Tinh province
- Hon Tro, Dien Yen, Dien Chau, Nghe An province
- Chien Thang, Vinh Loc, Can Loc, Ha Tinh province

The approximate site locations are shown in Figure 2.1.

Figure 2.1 The site locations

The remediation assessment

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This chapter provides a brief overview for each site of the aspects that are of importance for the implementation of the short-term risk reduction measures[1].

[1] Short-term risk reduction measures are measures that should be implemented as soon as possible to eliminate the direct environmental risks.

3 The remediation assessment

The full conceptual site model and the environmental risks assessed in Phase 2 provide input for Phase 3 and the design of the short-, medium- and long-term risk reduction measures. Short-term risk reduction measures are focused on the removal of any direct environmental risks, such as the risk related to pure POP pesticides, heavily contaminated soil and contaminated drinking water. Medium-term risk reduction measures are focused on the reduction and containment of potential environmental risks, whereas the long-term risk reduction measures aim to contain any latent risks.

3.1 General

The short-term risk reduction measures at all the four sites encompass the excavation, repacking and removal of pure POP pesticides and heavily contaminated soil to an off-site location for destruction. The mid- and long-term risk reduction measures are mainly enforcement of site-use restrictions, phytoremediation and/or containment of the contaminated soil. The groundwater is contained by run-off interception trenches and permeable reactive barriers. See Figure 3.3 as an example of the risk reduction measures for the Hon Tro site.

3.2 Nui Cang

At the Nui Cang site several tonnes of soil contaminated with DDT and Lindane were originally deposited on the ground surface on a raised embankment beside a rice paddy field.

Figure 3.1 The bunker at Nui Cang

Subsequently the contaminated soil was placed in nine purpose-built cells in a concrete bunker located on the site (see Figure 3.1). The most contaminated soils were placed in cell 2 of this bunker. The initial project was designed to recover the material that was placed in cell 2, drum the material and then transport it for disposal.

3.3 Hon Tro

Close to the National Highway No 1 and next to the QL48 main road, the Hon Tro site was ideally situated as a regional agrochemical distribution centre. The site is on the foot slope of a hill and overlooks the surrounding rice fields to the east.

Operations at the site started in 1967 in a small storage building. This building was replaced by the current storage building later in the 1970s. The site was in operation until 1994. Minor quantities of POP pesticides were still present inside the storage building in 2010. The main issue at the site, however, is the contaminated soil in the direct surroundings caused by the outdoor storage of POP pesticides and other agrochemicals. It was also mentioned that there is suspicion of a health impact on the village downstream and it was therefore a high priority to remediate this site.

Figure 3.2 The Hon Tro storage building during the site assessment

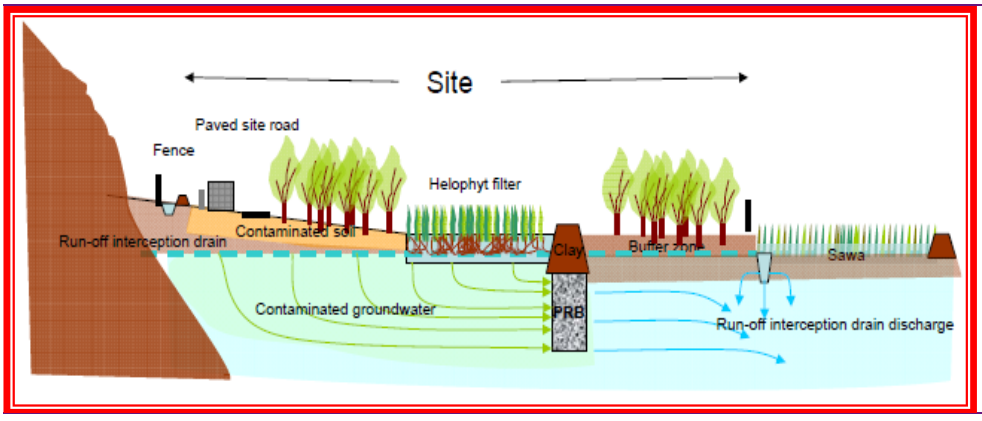

Figure 3.3 Long- and mid-term risk reduction measures in Hon Tro

3.4 Vuc Rong

The Vuc Rong site is situated in the inland area of Nghe An province towards the border with Laos. Surrounding the site is the floodplain of the Song Con River. The floodplain is intensively used for the growth of sugarcane and the clay is used to make bricks. A steep hill of limestone formation, covered in rainforest, is directly west of the site.

Figure 3.4 The bunker (overgrown) at Vuc Rong

At the edge of the village there is a former pesticide storage, which was in use until 1977. In 2005 the residual pesticides and contaminated soil were transferred to an underground bunker (see Figure 3.4). The bunker is built on the foundation of the former pesticide storage. Since then, the area has overgrown. An estimated 280 tonnes of POP pesticides and contaminated soil are still inside the bunker.

3.5 Thach Luu

In the greater Ha Tinh city area is the Thach Luu site. Access to the site is through a narrow road with shops and a market. Located between three households and right next to a primary school this site is in the most urban setting. Vegetable gardens and a cattle shack in use are located at the very edge of the bunker (see Figure 3.5).

Figure 3.5 The bunker at Thach Luu

The site used to be a DDT storage facility made out of wood and owned by the Public Health Department. In 2003 the DDT left at the site, together with contaminated soil, was transferred to a partially underground bunker. After filling the original bunker, heavy rain flooded the area and the southern and northern walls of the bunker broke, spilling the contaminated soil into the surrounding yards and fields.

3.6 Chien Thang

The Chien Thang site is a small former POP pesticide storage site located on a hillock with views over the surrounding agricultural land. The entire area is strongly overgrown and fairly uneven. At the bottom of the hillock water collects in small ponds. A canal is present across the road (see Figure 3.6). In addition to the bunker, the foundations of most likely a former store as well as a house can be seen. The foundations are concrete and in reasonable shape. Two former hand-dug wells are also present on the site. These wells have been filled up with waste and soil from the surrounding area. In the area around the bunker two households are living at a distance of about 50-100 meters. Around the bunker is a graveyard.

Figure 3.6 The bunker at Chien Thang

Initial drilling indicated POP pesticide contaminated waste inside the bunker at a depth of 1.25 to 3 meters minus top of the bunker. The quantity of materials inside the bunker has been estimated at around 50 m^3, equalling 50-70 tonnes.

The remediation management

4

This chapter elaborates on the most important aspects of the remediation management and summarizes the results of the short-term risk reduction measures by providing the quantities and concentration of the removed contaminated materials and people who were affected.

4 The remediation management

The remediation plan containing the preliminary design of the short-, medium- and long-term risk reduction measures is input for Phase 4. Phase 4 is the actual remediation and starts by informing stakeholders of the upcoming site remediation. Parallel to this process the tendering for the short-term risk reduction measures starts.

4.1 Stakeholder involvement

For each site an analysis was made of the relevant stakeholders. This includes both national and international organisations, local and provincial bodies as well as the people living in the direct vicinity of the site. Each stakeholder was assigned a specific task and role in the project, varying from funder to the control of fences during the absence of the project implementation unit.

Figure 4.1 Stakeholder involvement training

Consultation with stakeholders has to take place continuously and not only during the site assessment and implementation phases. One of the key goals of the project was to inform and train Vietnamese government staff on the assessment and implementation of measures, including stakeholder involvement, when dealing with POP pesticide contaminated sites (see Figure 4.1).

Example of stakeholder involvement in Thach Luu

In the village of Thach Luu a bunker with POP pesticides and contaminated waste is present. This bunker was originally constructed in 2003. During heavy rain the bunker broke and all the POP pesticides and contaminated soil spilled into the surrounding gardens. Since then, the bunker has been restored but the area is still affected by POP pesticides.

Figure 4.2 Primary consulting as part of the stakeholder involvement planning

The local people intially resented remediation of the bunker. Trust in the authorities was lacking after the earlier incident. The people living around the site refused to cooperate and were treathening to prevent excavation of the bunker. Primary consultations showed that the local commune had failed to inform the people living at the site adequately about the planned remediation (see Figure 4.2).

Figure 4.3 Informal consultation with people directly living around the sites

What followed was a very important series of (informal) consultations directly with the people living around the site (see Figure 4.3). From this it became clear that they reacted emotionally to the bunker. They had bad experiences with the POP pesticides, and previous (non)actions from the authorities had only made it worse.

A stakeholder strategy was drafted, based on regaining the trust of the local people. To achieve this, intense consultations were held with the people living next to the site, listening to their grievances and past experiences. Where possible the team tried to alleviate these grievances and bad experiences during the excavation and repacking process. Overall the company was keen to keep their word and to continously inform the stakeholders of any changes and

adjustments to the plan. In the end the project was completed within schedule and budget, and most importantly with the approval of the people living around the site.

4.2 Tender procedure

For the execution of the short-term risk reduction measures multiple contractors were selected. The selection was done by following a public international tendering procedure, according to GEF/UNDP and MONRE requirements.

By the deadline of 22 April 2013, the UNDP procurement unit received 15 submissions for the tender to dispose of 700-880 metric tonnes of POP pesticides. The UNDP procurement unit carried out a pre-qualification exercise and based on this 12 bidders meeting the requirements were invited to proceed with the qualification.

The Request For Proposal (RFP) was sent to the pre-qualified bidders. By the deadline of 4 September 2013, the UNDP procurement unit received seven proposals from the 12 invited bidders. The unit screened against the Al-Qaida List and UN Suspended Vendor List. None of the seven bidders were on these lists.

The technical proposals were sent by UNDP to the members of the evaluation panel for their review and assessment, following the criteria and scoring weights included in the RFP documentation. The financial proposal remained sealed with the UNDP procurement office. The evaluation panel reviewed the seven proposals against the mandatory requirements and all seven met the requirements for detailed technical evaluation. All bidders were then ranked according to their technical rating.

Based on these results, the evaluation panel recommended that four proposals, which met the minimum scoring requirement of 700 points, were considered for the next stage of the procurement process, the financial evaluation.

The evaluation panel checked the cost breakdown of the four bidders for consistency, omissions and mistakes. When needed, clarification from the bidders was sought. Based on the information provided by the bidders on the lump sum cost and unit prices, the bidders were ranked based on their lump sum price.

The last step of the selection procedure was ranking based on the total technical and financial score. As Holcim Viet Nam Co. Ltd had the highest score they were invited to enter the last stage of the tendering, which is the contracting.

This resulted in a disposal contract between UNDP and Holcim Viet Nam Co. Ltd. This contract made Holcim Viet Nam Co. Ltd responsible for the transport to and final destruction by co-

processing of the POP pesticide waste. The co-processing took place in a cement kiln in the Hon Chong cement plant.

Viet Nam Natural Resources & Environmental Technology & Investment JSC was selected as the contractor responsible for the excavation and repacking of the POP pesticides and contaminated soil on the four sites.

UNDP led the procurement process. The PMU staff, including the Visting Senior Technical Expert of Tauw and relevant MONRE staff, including the focal point of the Stockholm Convention, were involved in all technical aspects and were members of the evaluation panel.

4.3 Preparation of short-term risk reduction measures

At the four selected sites the direct risks associated with the POP pesticides were eliminated by the excavation of the POP pesticides and contaminated soil from the bunkers (Nui Cang, Vuc Rong and Thach Luu sites) and the POP pesticides from the storage facility and buried contaminated soil (Hon Tro site).

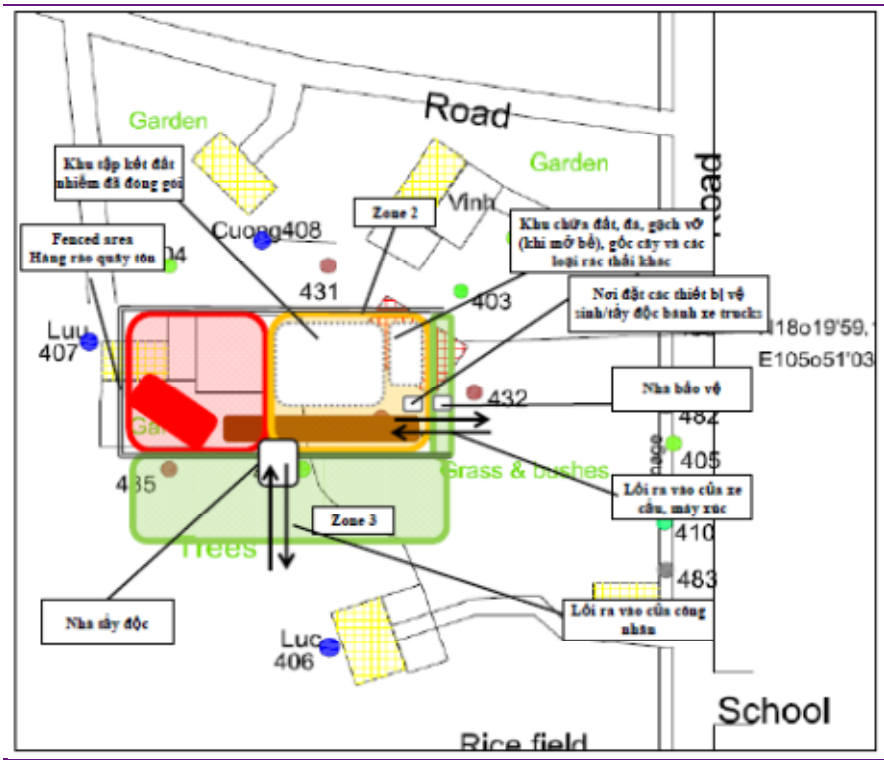

Figure 4.4 Zoning at the Thach Luu sites

Prior to the start of the work the entire area was zoned according to the UN Food and Agriculture Organization's (FAO) health and safety prescriptions. This effectively means that each site was divided into the following three zones:

- **Zone 1** or contaminated zone (red). This is where the contaminated soil and POP pesticides were excavated and repacked.
- **Zone 2** or intermediate zone (orange). This is where the repacked pesticides were stored prior to transport. In this area the loading of the packed POP pesticides and contaminated soil to the trucks took place. This zone was also the zone to prepare for entering zone 1 and leaving for zone 3.
- **Zone 3** or clean zone (green). This is where the clean materials were stored. It was also a buffer to zone 2.

The zoning for all four sites differed slightly. This was mostly due to the characteristics of the area and the space available for the work. Entrance to zone 1 was always through a sluice made in zone 2 that allowed staff to change into the protective clothing used in the works. Figure 4.4 shows the zoning at the Thach Luu site.

Following the zoning all staff were instructed during a task-based risk analysis of the risks of working with the POP pesticides and machinery on the site. This risk analysis was done at the start of the work. Every following working day started with a much shorter job safety analysis that described what would be done for that day and what to look out for from a health and safety perspective. A set of infographics (see Figure 4.5) was used for the task-based risk analysis.

Figure 4.5 The daily job safety analysis using a set of infographics

The excavation was done inside zone 1 by a small backhoe. The operator dug the contaminated soil from the bunker or the ground according to the information given by the site supervisor. Three staff members in Tyvek coveralls held open a lined big bag and the contaminated soil was moved directly into the big bags. The maximum weight of the bags was around 1,200 kg. Using a crane truck or the backhoe the big bags were moved onto pallets in zone 2, where they waited to be transferred onto the trucks (see Figure 4.6).

The bags were labelled, weighed and registered. For every 20 bags a composite sample was taken for further laboratory analysis. After the last soil was removed from the bunkers, the bunker walls were checked for contamination and any contaminated plaster and brickwork was removed and collected in big bags. Where contaminated soil was present, samples were taken from the excavation pit walls and bottom to verify the quality of the remaining soil.

Figure 4.6 Using a crane truck or the backhoe the big bags were moved onto pallets in zone 2

Bunker walls and construction materials left behind were sprayed with hydrogen peroxide multiple times to desintegrate any POP pesticide dust left behind. The area was covered and given to the contractor responsible for further medium- to long-term measures to deal with any residual contamination.

To verify the concentration of the contaminated soil the bags were all sampled and analyzed. Soil coloured by pesticides and containing lumps of pure pesticides were not sampled for analysis because these samples will inevitablly have high concentrations of pesticides (see Figure 4.7).

Figure 4.7 Soil coloured by pesticides and containing lumps of pure pesticides

4.4 Short-term risk reduction measures

Nui Cang short-term risk reduction measures

The short-term risk reduction measures are focused on the elimination of direct risks. For this site no direct risks were identified during the update of the conceptual site model. The necessary mitigation measures were already implemented. These measures included excavation of hotspot material (soil mixed with lumps of pure pesticides) and contaminated soil and storage in a newly constructed bunker. The hotspot material and contaminated soil were stored separately. The removal of the hotspot material from cell 2 for final disposal was the last stage of the short-term risk reduction measures, eliminating the direct risk related to the former hotspot at this site.

Figure 4.8 Nui Cang short-term risk reduction measures

The objectives of this last stage were to carry out a remediation pilot and repack around 20-30 tonnes of hotspot material for final disposal, in order to reduce the risks related to the storage of hotspot material in the bunker (see Figure 4.8). The total quantity repacked and shipped to the Holcim plant for co-processing was 25.5 tonnes (see Table 4.6). The strongly contaminated soil also contained large lumps of Lindane and DDT. The percentage was not further specified.

Tables 4.1 gives a summary of the beneficiaries of the short-term risk reduction measures.

Table 4.1 Environmental benefits of the Thai Nguyen short-term risk reduction measures

Risk reduction measures	Quantity	Beneficiaries
Diem Thuy commune total population	6,400	Inhabitants (1999)
Affected households of Diem Thuy village	900	Family members living in houses near the site
Affected household very close to the site	30	Family members living in the six houses just around the site

Hon Tro short-term risk reduction measures

In addition to the one to two tonnes of pure POP pesticides from the store (which were repacked and destroyed by the Plan Protection Institute), contaminated sediment from the fish ponds and contaminated soil in front of the store was collected and repacked. The old Hon Tro POP pesticide store was ideal as a temporary storage while waiting for transportation off-site (see Figure 4.9).

Figure 4.9 The POP pesticides were temporarily stored in the renovated on-site storage facility

Hon Tro is the only site where no bunker is present. Most contamination was either because of pure POP pesticides left inside the old storage or contaminated soil and sediments in the area around the old storage. Excavation of the contaminated soil was done in the summer of 2013. A total of 216 tonnes of strongly contaminated soil were excavated and repacked (see Table 4.6).

The average concentration of the 216 tonnes of contaminated materials was 1,055.54 ppm. The concentrations varied between 46.65 ppm and 4,754.83 ppm. The 216 tonnes also contained an unspecified quantity of pure pesticide lumps.

Tables 4.2 gives a summary of the beneficiaries of the short-term risk reduction measures.

Table 4.2 Environmental benefits of the Hon Tro short- and mid-term risk reduction measures

Risk reduction measures	Quantity	Beneficiaries
Dien Yen district total population	14,500	Inhabitants (1999)
Affected households of Village 15	300	Family members living in houses near the site
Affected households at the site	5	Family members living in houses at the site

Vuc Rong short-term risk reduction measures

Excavation and repacking in Vuc Rong was done during the summer of 2013. Over a period of eight days a total of 306.3 tonnes of contaminated soil were excavated from a large underground bunker (see Table 4.6). After laboratory analysis of the composite samples of excavated soil, 100 tonnes with an average concentration of organchlorine pesticides below 50 ppm were returned for on-site treatment by a third party. The bunker itself did not have a bottom so part of the soil underneath the bunker was also removed.

Figure 4.10 The big bags were stored in a neighbouring warehouse

The remaining excavated soil (206.3 tonnes) was stored in big bags in a neighbouring empty warehouse (see Figure 4.10). The warehouse was upgraded with a new roof and doors to allow for more secure storage while waiting for the pick-up of the materials in the spring of 2014. The area in the vicinity of the excavated bunker was also contaminated. This contaminated soil was treated with in-situ techniques by a third party as a mid-term risk reduction measure.

Each big bag was sampled for chemical analyses. The main contaminant was HCH with concentrations as high as 5,979 ppm (γ-HCH and isomers). DDT was found only in relatively low concentrations. The maximum DDT (and isomers) found were approximately 30 ppm. The average organochlorine pesticide concentration of the 206 tonnes of contaminated materials was 1,268 ppm. The concentrations varied between 73 ppm and 5,994 ppm. The 206 tonnes also contained an unspecified quantity of pure pesticide lumps.

Tables 4.3 gives a summary of the beneficiaries of the short-term risk reductions measures.

Table 4.3 Environmental benefits of the Vuc Rong short-term risk reduction measures

Disposal of strongly contaminated soil mixed with lumps of pure pesticides	Quantity	Beneficiaries
Tan Long commune	9,700	Inhabitants (1999)
Affected households around the store of Vuc Rong farm	200	Family members living in houses near the site

Thach Luu short-term risk reduction measures

Because space was limited, Thach Luu was the only site where the excavation of the soil and the transportation to the final place of destruction was done in parallel (see Figure 4.11). Intensive contact between the excavation contractor, the transport company and the company responsible for the final destruction allowed for smooth operations.

Figure 4.11 The excavation of the contaminated soil from the bunker

Although Thach Luu was the smallest site of the four, the limited space for manoeuvring and the proximity of the households required the longest preparation. A total of 134.8 tonnes (see Table 4.6) of contaminated soil with lumps of POP pesticides were removed from the small bunker in the summer of 2014. After removal of the content, the bunker walls were cleared of their plaster and checked for the presence of any residual contamination. After that the bunker was demolished and the excavation backfilled with contaminated soil from the direct surroundings of the former bunker.

The concentrations of POP pesticides in the soil inside the bunker ranged from 60 to 4,000 ppm of total organochlorine pesticides in dry soil, mostly DDT, DDE, DDD and Lindane (gamma BHC). The total quantity of POP pesticide contaminated soil with lumps of pure pesticides was 144

tonnes, including 700 kg of POP pesticide waste collected from a number of small sites in Ha Tinh province. The average organochlorine pesticide concentration of the 143.8 tonnes of contaminated materials was 35.9 ppm. This concentration excludes any pure POP pesticides.

Tables 4.4 gives a summary of the beneficiaries of the short-term risk reduction measures.

Table 4.4 Environmental benefits of the Thach Luu short-term risk reduction measures

Disposal of strongly contaminated soil mixed with lumps of pure pesticides	Quantity	Beneficiaries
Thach Luu commune	3,150	Inhabitants (1999)
Affected Village 4 of Thach Luu commune	350	Family members living in the commune
Affected Thach Huong 1 Kindergarten just opposite the site	200	School kids and staff attending and working at the kindergarten
Affected Thach Huong 2 Provincial People's Committee (PPC) office and households around the site	100	PPC staff working at the office and family members living in the nearby houses
Affected Son Tho households around the site	50	Family members living in the nearby houses

Chien Thang short-term risk reduction measures

The bunker at Chien Thang was opened and excavated in December 2014. The contaminated soil and POP pesticides were loaded in big bags and directly transported to the final place of destruction (see Figure 4.12).

Figure 4.12 The excavation of the contaminated soil from the bunker

A total of 59.5 tonnes (see Table 4.6) of contaminated soil with lumps of POP pesticides were removed from the bunker. After removal of the content, the bunker walls were cleared of their plaster and checked for the presence of any residual contamination. After that the bunker was demolished and the excavation backfilled with contaminated soil from the direct surroundings of the former bunker.

The soil inside the bunker was strongly contaminated with organochlorine pesticides such as DDT, DDE, DDD and Lindane (gamma BHC).

Tables 4.5 gives a summary of the beneficiaries of the short-term risk reduction measures.

Table 4.5 Environmental benefits of the Chien Thang short-term risk reduction measures

Disposal of strongly contaminated soil mixed with lumps of pure pesticides	Quantity	Beneficiaries
Vinh Loc commune where site is located	3,400	Inhabitants (1999)
Affected Village 4 of Chien Tang commune	500	Family members living in the commune
Affected households close to the site	100	PPC staff working at the office and family members living in the houses (2013)
Affected households around the site	250	Family members living in the houses. Five households were relocated.

4.5 Loading, transportion and destruction

A total of 751.1 tonnes (see Table 4.6) of contaminated materials were collected from the five large sites as discussed above, and 0.7 tonnes were collected from three smaller sites. A total of 651.8 tonnes of contaminated materials were either packed in drums or big bags, with a weight between 250 kg and 1,250 kg. Using a crane truck the materials were loaded onto the hazardous waste trucks. All trucks were inspected prior to departure in convoy for the Holcim plant in the south of Viet Nam. Drivers were instructed on passive driving and an escort car with trained workers and safety materials followed the convoy to assist in case of an emergency.

At the Holcim processing facility the materials were first sieved and bricks, rocks and other waste were separated from the contaminated soil. The soil was then transferred to a ball mill before adding water to turn it into sludge (see Figure 4.13).

Figure 4.13 Soil was then transferred to a ball mill before adding water to turn it into sludge.

Course bricks and rocks were transferred to a crusher, before following the same treatment as the soil. Plastics, wood and packaging materials were shredded. The sludge and shredded materials were fed to the cement kiln, effectively destroying the POP pesticides at high temperature. The emissions of HCL, SO_2, NOx and dust at the stalk from the cement kiln were

monitored continuously in the period from 5 June till 28 August 2015. The emmison were all below the limit values. The emissions of dioxins and furan were measured on Friday 3rd October 2014. During operation, all emission measurements did not exceed the QCVN limits, in fact all emissions were significantly below these required limits. For more information reference is made to the Holcim reports mentioned in section 6 of this report.

In total 651.8 tonnes of POP pesticides and contaminated soil were destroyed in the summer of 2014. Around 1,600 local people living close to eight contaminated sites and 200 children and teachers of a nearby kindergarten are considered as direct beneficiaries of the project.

Table 4.6 Total tonnage of POP pesticides destroyed and long-term risk reduction measures implemented

TT	Sites	Tonnes excavated and packaged	Tonnes destroyed	Long-term risk reduction measures
1	Nui Cang	25.5	25.5	Implemented by DONRE
2	Vuc Rong	306.3	206.3	Implemented by DONRE including remediation of 100 tonnes soil with low POP content
3	Hon Tro	216	216	Implemented by this project
4	Thach Luu	143.8	143.8	Implemented by this project
5	Son Tho 1	0.32	0.32	None
6	Thach Huong 1	0.27	0.27	None
7	Thach Huong 2	0.119	0.119	None
8	Chien Thang	59.5	59.5	Implemented by DONRE
9	Mau 2	0	0	Implemented by this project
	Total	**751.8**	**651.8**	

Lessons learned

5

This chapter elaborates on the achievements and lessons learned and can be seen as recommendations for the further implementation of risk reduction measures in the context of the sustainable management of contaminated soil and POP pesticides.

5 Lessons learned

The excavation, repacking and transportation of the POP pesticide contaminated materials from the sites to the processing plant for destruction was an excellent project component for capacity building of the PMU, MONRE, provincial departments of natural resources and environment (DONRE) and contractor staff in dealing with contaminated soil and POP pesticides.

The project involved almost all relevant aspects of handling POP pesticides, as well as general issues on the excavation of contaminated soil and dealing with stakeholders. Intensive contact with the international supervisors allowed for rigorous training of all staff on the job.

Figure 5.1 Contractor staff involved in loading

Not just the staff of MONRE benefited but also DONRE environmental staff and contractor staff involved in the loading and destruction of the materials. All in all 651.8 tonnes of heavily contaminated soil and pure POP pesticides have been safely excavated, repacked, transported and destroyed. The immediate risks that POP pesticides posed at these sites have been eliminated.

In all projects there is room for improvement, also in this project. The most important lessons to learn are:

- A more thorough preparation will limit the on-the-spot adjustments to be made. Early involvement of the people living directly next to the site will prepare them for the upcoming work and will increase their support.
- A consistent administration prevents future double work and gives planners a better oversight of what has already been done and what needs additional attention.

- The sampling and analysis of POP pesticides is a delicate procedure that needs constant attention. More precise sampling, labelling and analysis is necessary to provide the accuracy needed to establish the remediation measures for contaminated soil and groundwater.
- Allthough the preparation of the remediation (Phase 4) is a step-wise approach (including Phase 1, 2 and 3) the project management will always be confronted with unexpected events during the site remediation (Phase 4). Therefore it is advised to allocate upfront before the project starts:
  - Extra time in case the project is confronted with a time overrun
  - Budget contingencies in case the project is confronted with unexpected costs
- Unexpected events can be better managed if the decision makers and responsible parties allow the project management to work with a flexible work plan concerning time and budget. The margins of time and budget should be clearly divided by the responsible party and communicated to the project management.
- And last but not least, sustainable management of contaminated sites goes hand in hand with environmentally sound operations and a strict enforcement of health and safety rules. For each remediation project, the saftey meetings like the toolbox meetings and daily job safety analysis or ‘start work analyses’ play a crucial role in the health and safety awareness raising of the workers. The message is that working with POP pesticides can be done safely through all the five phases of sustainable management of contaminated soil and POP pesticides.

6 References

6 References

This evaluation report is a summary of two years of planning, preparation and work releated to the destruction of 650 tonnes of POP pesticides – one of the main deliverables of this UNDP project. The information presented in this summary comes from the documents mentioned in the table below.

Technical Reports	Training Manuals
Phase 4 report Remediation of Vực Rồng - Tân Kỳ - Nghệ An - Vietnam. Tauw, reference R107-4788415GMC-V01-NL, 16 April 2014	Supervision Manual, POP pesticides loading and transport, Viet Nam. Tauw, reference R105-4788415GMC-beb-V01-NL, 4 April 2014
Phase 4 report Remediation of Thạch Lưu - Thạch Hà - Hà Tĩnh - Vietnam. Tauw, reference R108-4788415GMC-V01-NL	Review Holcim Facilities, Tauw, reference N009-4788415GMC-los-V01-NL, 2 April 2014
Phase 4 report Remediation of Hòn Trơ - Dien Yen, Dien Chau, Nghệ An Vietnam. Tauw, reference R109-4788415GMC-V01-NL	Volume 1 EMP Guidelines for Sustainable Management of POP pesticides contaminated sites Tauw, Reference R109-4788415GMC-beb-V04-NL
Emission report, Destruction of soils contaminated POP Pesticides Hon Chong Plant 5th June to 30th August 2014	Volume 2 EMP Guidelines for Sustainable Management of POP pesticides contaminated sites Tauw, Reference R109-4788415GMC-beb-V04-NL
Midterm Report of Holcim contract for POP pesticide waste project, 11 September 2014	Volume 3 EMP Guidelines for Sustainable Management of POP pesticides contaminated sites Tauw, Reference R109-4788415GMC-beb-V04-NL
Photo Report Thạch Lưu, Tauw, reference N012-4788415GMC-los-V01-NL, 15 August 2014.	Volume 4 EMP Guidelines for Sustainable Management of POP pesticides contaminated sites Tauw, Reference R109-4788415GMC-beb-V04-NL
FAO Site remediation plan Bunker Cell 2NUI CANG, DIEM THUY, THAI NGUYEN DATE: 20 September 2011	Volume 5 EMP Guidelines for Sustainable Management of POP pesticides contaminated sites Tauw, Reference R109-4788415GMC-beb-V04-NL
EMP Thai Nguyen, Viet Nam R109-4788415GMC-beb-V04-NL Final Draft, 11 January 2012	
EMP Vực Rồng - Tân Kỳ - Nghệ An - Vietnam, Tauw, reference R109-4788415GMC-beb-V04-NL Final 16 October 2012	
EMP Thạch Lưu - Thạch Hà - Hà Tĩnh - Vietnam, Tauw, reference R109-4788415GMC-beb-V04-NL Second version, 15 July 2013	
EMP Hòn Trơ - Dien Yen, Dien Chau, Nghệ An - Vietnam, Tauw, reference R001-4788415BKT-beb-V01, 5 March 2012	

Technical Reports	Training Manuals
Emission measurement on the cement kiln of the Holcim cement plant in Hon Chong, Vietnam – POP report, 22nd January 2015	

Appendix

Holcim Emission Report

The Vietnamese government, UNDP and FAO have developed the POP pesticides project 'Building capacity to eliminate pesticides stockpiles in Viet Nam' (project ID 00060927). The project has been developed to remove capacity barriers to the sustainable elimination of POP pesticides in Viet Nam. The project document was formulated during the Project Development Facility - block B (PDF-B) in 2007. This project has a turn-around of four years and the total project budget is USD 10,900,909 (USD 4,390,800 from GEF with the rest being co-funding and counterpart funding by UNDP, FAO and the Ministry of Natural Resources and Environment).

UNDP, FAO as the implementing agency for GEF, and the Ministry of Natural Resources and Environment signed the project document on 1 October 2009. The Ministry of Natural Resources and Environment is the line agency. The Viet Nam Environment Administration is the implementing partner, which has delegated the project to the Waste Management and Environmental Promotion Agency. Day-to-day operation of the project is managed by a Project Management Unit. UNDP contracted the Dutch consultancy company Tauw to assist the Project Management Unit implementing the project.

Around 1,153 POP sites were identified during a country-wide inventory between 2007 and 2010. A lot of these sites have buried pesticides that mixed with soil. This is significantly different from the situation in 2007, where 120 storage sites and only a few pesticide burial sites had been identified. The conditions at these POP sites require measures eliminating the direct risks to humans in the short term. The Government already started the clean-up of POP sites by removing and destroying 200 tonnes of POP. The objective of the project is to come up with guidelines for environmentally sound site management. These guidelines can then be used for country-wide environmentally sound POP contamination site management.