

REGISTRATION OF CONTAMINATED SITES IN VIETNAM

PART 2: METHODS OF RECORDING CONTAMINATED SITES USING THE EXAMPLE OF BAC NINH PROVINCE



Registration of Contaminated Sites in Vietnam
Part 2: Methods of Recording Contaminated Sites
Using the Example of Bắc Ninh Province

Imprint

Text and content

Dr. Harald Mark
Dr. Mark, Dr. Schewe & Partner GmbH,
Hasenwinkeler Str. 139, 44879 Bochum

Editors

Patrick Konopatzki & Sarah Kovac
Independent Institute of Environmental Issues (UfU e.V.)
Greifswalder Straße 4, 10405 Berlin

Layout & Illustrations

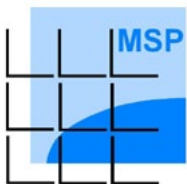
Lorenzo Zimmermann (mail@lorenzozimmermann.de)

Picture credits

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Cover image

Thuy Thi Nguyen



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ABBREVIATIONS

ALKIS	Amtliches Liegenschaftskatasterinformationssystem
Al ₂ O ₃	Aluminium oxide
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
BTNMT	Decision or Circular of the Ministry of Natural Resources and Environment Vietnam
CO	Carbonoxide
CO ₂	Carbondioxide
Cr	Chromium
Cr ₆₊	Hexavalent chromium
DONRE	Department of Natural Resources and Environment
ESRI	Environmental Systems Research Institute
Fe	Iron
FDI	Foreign direct investment
GDLA	General Department of Land Administration
GIS	Geographic Information System
Hg	Mercury
ID	Identification number
IGN	Photothèque Nationale in Saint-Mandé Cedex
MONRE	Ministry of Natural Resources and Environment
MT	Land parcel/unit code
MX	Code for the communal administrative unit
Ni	Nickel
NO _x	Nitrogen oxides
Pb	Lead
PbO	Lead oxide
PCB	Polychlorinated biphenyl
SB	Ordinal of the sheet of the cadastral map
SO ₂	Sulfur dioxide
ST	Number of the land parcel on the respective sheet of the cadastral map
TCVN	Technical Standards in Vietnam
UfU	Unabhängiges Institut für Umweltfragen
USD	US-Dollar
Zn	Zinc
ZnO	Zinc oxide



1. INTRODUCTION

In October 2018, a first manual for managing contaminated areas with the title „Registration of Contaminated Sites in Vietnam: Part 1: Basic information“ has been presented to circles of specialists in Vietnam. It contains indispensable basic information for a proper, methodically founded and as a result replicable approach for the handling of contaminated areas.

This second manual focuses on the recording of sites suspected to be contaminated, therefore, giving more detailed information related to this part of the registration process presented in the first manual. By presenting experiences gained in the development of a cadaster of contaminated sites in the province of Bắc Ninh, the authors show which information sources for the recording process are available in Vietnam and how findings of the investigation may and should be translated into a cadaster. In Vietnam, country-specific conditions for the investigation of sites suspected to be contaminated are in place. The application of methods for the recording of those areas may differ from other countries.

The present manual aims to provide a guideline for Vietnamese authorities and external experts, which allows to record contaminated areas in Vietnam

- on a high, task-oriented quality level and
- according to a uniform standard.

Since October 2016, the new regulation 30/2016/TT-BTNMT issued by the government specifies how to treat contaminated sites. The registration of sites suspected to be contaminated is the first step in the systematic treatment process of contaminated sites (see Fig.1) and an essential step to implement the regulation 30/2016/TT-BTNMT.

The cadaster gives an overview of (potential) risks related to contaminated areas in Vietnamese provinces. It is therefore an essential tool to prevent subsequent uses of contaminated sites, which might lead to negative health impacts for the affected population.

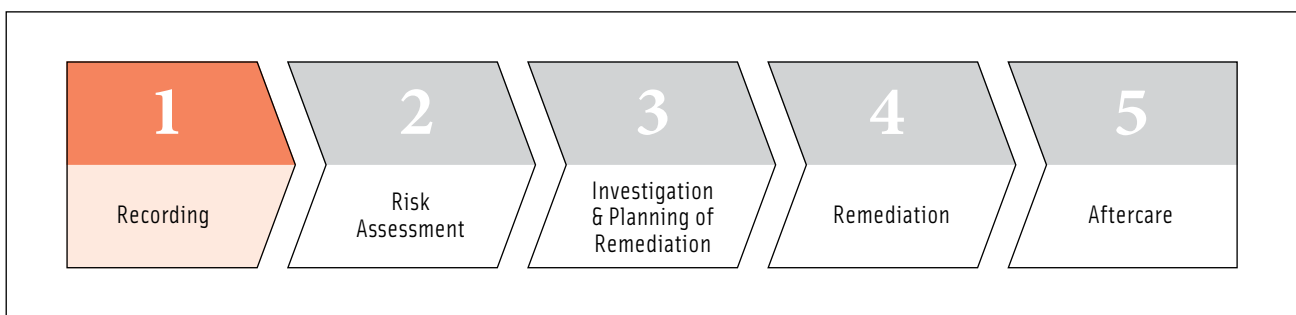


Fig. 1: The registration of contaminated sites is the first step of its treatment process.

2. PREREQUISITES

The results of the investigation and surveying of (potentially) contaminated areas may have far-reaching consequences for competent authorities, guardians of order, residents and other persons concerned. The gained information is the basis for the management of subsequent uses in order to prevent hazards through gradual intoxication via different pathways. Thus, special demands have to be made on the quality of work, the technical equipment and data basis used, as well as the professional background of the personnel involved.

2.1 PERSONNEL AND TECHNICAL PREREQUISITES

For a successful expert assessment with suitable and high-quality investigation results, specific personnel and technical prerequisites have to be given.

Persons carrying out investigations and processing cadastral data should have special knowledge of recording. Thus, they have to be in a position to properly choose and apply methods of archive research and evaluation of documents and records. They shall have experience in the multi-temporal evaluation of maps and aerial photos as well as in the questioning of contemporary witnesses. They also shall be familiar with site inspections relevant to the (site-related or area-wide) investigation of areas suspected of being contaminated.

The personnel involved has to evaluate the facts and findings gained and to present them in such a way that they provide a well-founded basis for the planning and decision-making on further steps.

The persons responsible for the assessment also have to be equipped with suitable equipment and facilities to carry out their tasks. This refers to hard- and software for the evaluation of aerial photos as well as to a proper office and computer equipment including Geographical Information System (GIS) software.

— spatial recording (position, extension) of all sites (plants shut down or operating, waste disposal sites) relevant to environment and representation on the basis of the actual topography

2.2 DATA BASIS

As described in the first manual, the basic structure of the cadaster of contaminated sites shall be build up in such a way that the following information is contained or may be retrieved:

- data regarding the owners, address etc.

The required basic structure shall be developed by using a computerized Geographical Information System and data bank program:

- The space-related data are stored and managed in the Geographical Information System. When using ESRI software, each site is reflected as a polygon within a shape file (= layer data). An attribute table with the respective data bank reference exists for each shape file.
- The data stock required to register contaminated areas is very comprehensive and would exceed the “capacity” of the attribute table. Therefore, all data is stored in a relational data bank. Each site is marked with the same identification number (ID) in the GIS and the data bank whereby communication between the data bank and the GIS is established (Fig. 2).

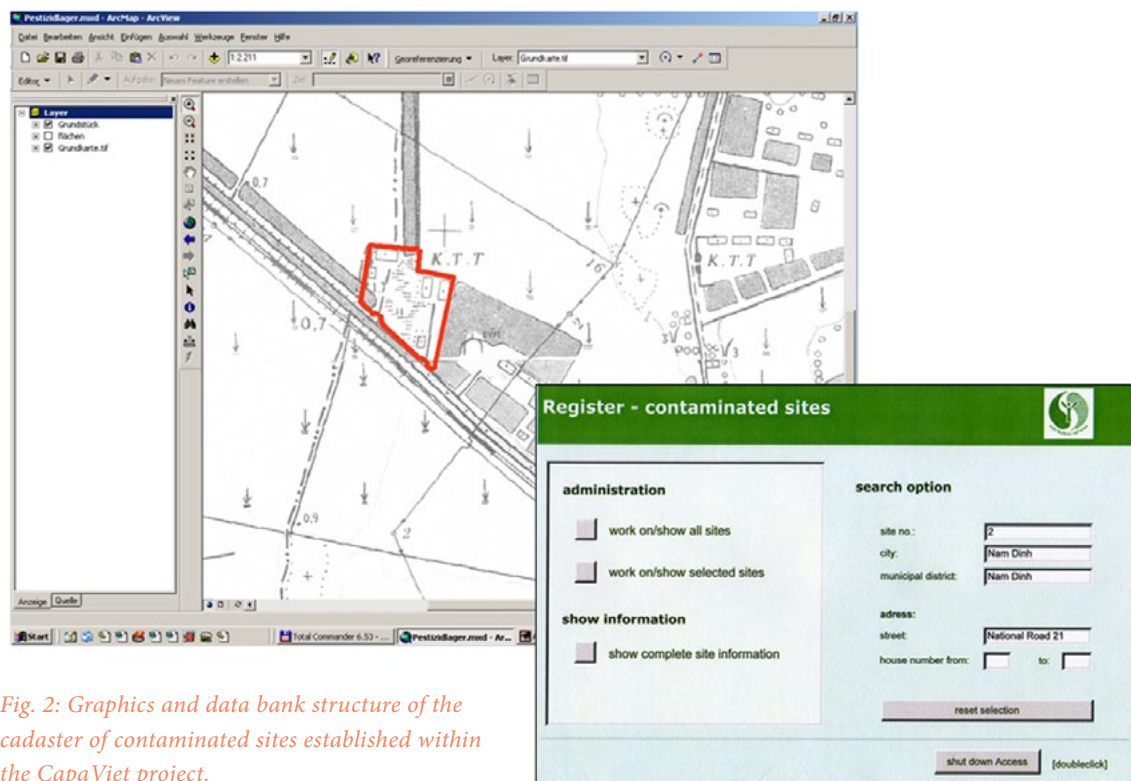


Fig. 2: Graphics and data bank structure of the cadaster of contaminated sites established within the CapaViet project.

The market offers a multitude of data bank products and Geographical Information Systems – but in general the principle represented above is everywhere the same.

One of the most important preconditions for a functional register of contaminated sites are spatial data of the current topographical situation (see chapter 2.2.1).

2.2.1 PROPERTY DATA

Data relevant for the detection of contaminations is recorded in a Geographic Information System (GIS) by using property data as a basis. Therefore, accurate basic geographical data must be provided. The geographical data shall at least reproduce the outlines/contours of properties and buildings within a regional authority.

Once the recording of uses that may lead to contamination takes place, the basic geographical data gets interlinked with the obtained data or data to be collected.

In Vietnam, the registration of property data is regulated by law. Responsible for it is the General Department of Land Administration (GDLA), a department subordinated to the

Ministry of Natural Resources and Environment (MONRE). Land administration falls under the responsibility of the Agency of Natural Resources and Environment.¹ Its administration system extends throughout Vietnam. Especially after the 2003 Land Law² came into effect, the management of cadastral documents and land registration activities are mainly carried out at the Offices of Land Use Right Registration.³

According to the Land Law from 2003, parcels/units of land are portions of land with a determined boundary, which are formed when the State gives land use rights to users. A land parcel/unit code (in Vietnamese signed as “MT”) defines each parcel/unit. It consists of three numbers that are separated by a dot. The first number (signed as “MX”) is the code for the communal administrative unit, the second is the ordinal of the sheet of the cadastral map (“SB”). SB shows the land parcels/units of the communal administrative unit and is numbered from one uninterruptedly up. Hereby, it follows the principles for cadastral maps of the same scale: (a) from small scale to larger scale; (b) from left to right; and (c) from top to bottom. The third number (signed as “ST”) is the number of the land parcel/unit on the respective sheet of the cadastral map.⁴ According to the following two principles, ST is numbe-

red uninterruptedly from 01 up: (a) from left to right; and (b) from top to bottom. When a new parcel is formed, its ordinal number will be the natural number one above the highest ST number currently being used on the sheet of the cadastral map in which the new land parcel/unit is registered.

The registration, recording and numbering of a change or formation of a land parcel/unit has to follow the rules above (signed as “MT=MX.SB.ST”), which mainly derive from the 2003 Land Law and related provisions of the Government and the Ministry of Natural Resources and Environment.⁵ Figure 3 shows an example of the data structure.

¹ Quan (2011)

³ Ibid.

² Government of Vietnam (2003)

⁴ Ibid.

⁵ Ibid.



Fig. 3: Example of digital property data

2.2.2 DATA STOCK

As a rule, a comprehensive data stock is required if sites are assessed regarding to their relevance to contamination. This is even more necessary if this data stock shall be used for a reliable and target-oriented planning of further measures. If all data would be stored in one sheet, its continuous use and updating would be confusing and complicated. That is why data of the cadaster is distributed onto various tables.

The site as such (factory site or waste disposal site/waste dump) forms the superior data unit in the cadaster. Properties of this site („attributes“) are e.g. the site name, the address and the branch, yet also the phases of development (history of use) or environmental protection measures already carried out. All of this site-related data is inserted into specially designed data fields.

The data of a site can be accessed by means of various search options. A data entry form allows a targeted search of a site via its site number or address. A further search option is the determination of sites within a specific region, i.e. all sites within a province or a city may be indicated.

By using the search function, the first data sheet of the site gets visible. It contains primarily data relating to the exact location, area size and a survey-like representation of the history of use located at the site. The next data sheet (company details) contains respective entries with addresses and contacts to obtain further details on the history of the company.

Further data sheets complete the picture of the site's history of use by supplying information on the following aspects:

- history of use
- planned measures
- measures carried out
- sources of investigation
- state of updating

2.2.3 GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Geographical Information Systems combine spatial data with subject data. This means that e.g. the information „storage building“ contained in the GIS data bank is visualized as an area (polygon) that outlines its exact position and contours. The storage building – equally as all other (partial) uses recorded – is represented in the GIS with its contours on a topographical basic map (or if not available: an aerial photo) and thus can exactly be located in the terrain (see Fig.2, Chapter 2.2).

This graphical information together with the data bank entries provide an important basis for planning and carrying out further measures for areas showing a high risk of contamination due to their actual and/or historical use.

The GIS-project, being part of the project to record soil contaminations in Bắc Ninh, was developed by using the Geographic Information System ArcView, version 10.5 (operating system Microsoft Windows 10; language: English with Vietnamese character encoding).

Geographical basic data are official cadaster information of the responsible land registry office (similar to ALKIS in Germany). Reference frame is DGN_1995_UTM_Zone_48N. Additionally to the cadaster data, serial mapping photographs of various years have been implemented into the GIS-project. These aerial photographs have been radiometrically improved and geo-referenced. Figure 4 shows the serial mapping photograph 1031 for the central part of Vân Môn with GIS-integration, referenced on the basis of current cadaster information.

Firstly, a layer that shows the contours of all craft villages and contains basic information (spatial allocation, location, name etc.) has been developed.

During the research progress, this layer was gradually supplemented with further areas of operation. For the recording of detailed information about individual businesses and business clusters, a thematic layer with 26 information columns was created. Figure 5 shows two extracts from the attribute list of this layer. Among others, the following information has been given or recorded:

- name of the village (of the zone)
- company number
- municipality
- district
- address
- operations, activities
- name of the establishment
- operator
- interview partner
- start and end of operation
- status
- further information, e.g. waste
- link to a photograph
- contamination-relevant uses/processes
- geographical information (size of the area)

The localization and marking of individual locations takes place based on the cadaster data of Bắc Ninh Province (Fig. 6).



Fig. 4: Aerial photograph from 18.10.2003 Nr. F1-03-5-1031, central area of Vân Môn.
(Source: Information Center for Measurement and Maps Data, Hanoi)

SiteNo	OBJECTID	VillageNo	Province	District	Municipali	Village	Business	Remarks	Source	Beginn	End	Site Statu
56001	93	56	Bac Ninh	Bac Ninh	Tam Giang	Vong Nguyet	silkworm rearing, selling pupae, other	Mr Mich	site visit, Mr Mich information			In operation
56002	94	56	Bac Ninh	Bac Ninh	Tam Giang	Vong Nguyet	domestic waste, others	Mr Mich	site visit, Mr Mich information			In operation
27001	96	27	Bac Ninh	Yen Phong	Dong Tho	Trung Ban	Wood furniture, others		site visit			In operation
28001	97	28	Bac Ninh	Yen Phong	Dong Tho	Dong Xuat	Wood furniture, others		site visit			In operation
27002	98	27	Bac Ninh	Yen Phong	Dong Tho	Trung Ban	domestic waste		site visit			In operation
28002	99	28	Bac Ninh	Yen Phong	Dong Tho	Dong Xuat	domestic waste		site visit			In operation
10101	100	101	Bac Ninh	Tu Son	Huong Mac	Vinh Tho	Wood furniture	Mr Truong	site visit, Mr Truong information			In operation
10102	101	101	Bac Ninh	Tu Son	Huong Mac	Vinh Tho	domestic waste	Mr Truong	site visit, Mr Truong information			In operation
17001	102	17	Bac Ninh	Tu Son	Huong Mac	Huong Mac	Wood furniture	Mr Truong	site visit, Mr Truong information			In operation
17002	103	17	Bac Ninh	Tu Son	Huong Mac	Huong Mac	domestic waste	Mr Truong	site visit, Mr Truong information			In operation
19001	104	19	Bac Ninh	Tu Son	Huong Mac	Kim Thieu	Wood furniture	Mr Truong	site visit, Mr Truong information			In operation
19002	105	19	Bac Ninh	Tu Son	Huong Mac	Kim Thieu	domestic waste	Mr Truong	site visit, Mr Truong information			In operation
18001	106	18	Bac Ninh	Tu Son	Huong Mac	Mai Dong	Wood furniture	Mr Truong	site visit, Mr Truong information			In operation
18002	107	18	Bac Ninh	Tu Son	Huong Mac	Mai Dong	domestic waste	Mr Truong	site visit, Mr Truong information			In operation
10201	108	102	Bac Ninh	Tu Son	Huong Mac	Dong Huong	Wood furniture	Mr Truong	site visit, Mr Truong information			In operation
10202	109	102	Bac Ninh	Tu Son	Huong Mac	Dong Huong	domestic waste	Mr Truong	site visit, Mr Truong information			In operation
20001	110	20	Bac Ninh	Tu Son	Huong Mac	Kim Bang	Wood furniture	Mr Truong	site visit, Mr Truong information			In operation
20002	111	20	Bac Ninh	Tu Son	Huong Mac	Kim Bang	domestic waste	Mr Truong	site visit, Mr Truong information			In operation
23001	113	23	Bac Ninh	Tu Son	Tam Son	Duong Son	Wood furniture	Mr Thanh	site visit, Mr Thanh information			In operation
23002	115	23	Bac Ninh	Tu Son	Tam Son	Duong Son	domestic waste	Mr Thanh	site visit, Mr Thanh information			In operation
45001	118	45	Bac Ninh	Tien Du	Tuong Giang	Hoi Quan	mosquito-net, scarf		site visit			In operation
45002	119	45	Bac Ninh	Tien Du	Tuong Giang	Hoi Quan	domestic waste		site visit			In operation
46001	120	46	Bac Ninh	Tien Du	Tuong Giang	Tieu Long	mosquito-net, scarf		site visit			In operation
46002	121	46	Bac Ninh	Tien Du	Tuong Giang	Tieu Long	domestic waste		site visit			In operation
15001	130	15	Bac Ninh	Luong Tai	Tan Lang	Tu Ne	domestic waste	Mr Chien	site visit, Mr Chien information			In operation
15002	131	15	Bac Ninh	Luong Tai	Tan Lang	Tu Ne	Noodles	Mr Chien	site visit, Mr Chien information			In operation
31001	132	31	Bac Ninh	Gia Binh	Lang Ngam	Ngam Mac	has left the bamboo rattan,	Mrs Huong	site visit, Mrs Huong information			In operation
31002	133	31	Bac Ninh	Gia Binh	Lang Ngam	Ngam Mac	domestic waste	Mrs Huong	site visit, Mrs Huong information			In operation

Fig. 5: Extracts from the layer <Site_Register> (1/2)

Adresses	Companies	Owners	Further In	Related Do	Photo Link	Editor	Actualsat	Activity
			Wastewater, solid waste	Photo	E:\Vietnam\anh\Wongguyet_Tamlang\IMG_0883.jpg	Dai	24-08-2018	silkworm rearing
A few			domestic waste	Photo	E:\Vietnam\anh\Wongguyet_Tamlang\IMG_0887.jpg	Dai	24-08-2018	domestic waste
			Wood furniture	Photo	E:\Vietnam\anh\Trungban_Dongtho\IMG_0889.jpg	Dai	24-08-2018	Wood furniture
A few			Wood furniture	Photo	E:\Vietnam\anh\Trungban_Dongtho\IMG_0896.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh\Trungban_Dongtho\IMG_0893.jpg	Dai	24-08-2018	domestic waste
			domestic waste	Photo	E:\Vietnam\anh\Trungban_Dongtho\IMG_0895.jpg	Dai	24-08-2018	domestic waste
various			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0930.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0935.jpg	Dai	24-08-2018	domestic waste
			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0930.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0945.jpg	Dai	24-08-2018	domestic waste
			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0945.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0929.jpg	Dai	24-08-2018	domestic waste
			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0951.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0940.jpg	Dai	24-08-2018	domestic waste
			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0956.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0946.jpg	Dai	24-08-2018	domestic waste
			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0951.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0954.jpg	Dai	24-08-2018	domestic waste
			Dust, exhaust emission	Photo	E:\Vietnam\anh24-8\IMG_0973.jpg	Dai	24-08-2018	Wood furniture
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0971.jpg	Dai	24-08-2018	domestic waste
			solid waste	Photo	E:\Vietnam\anh24-8\IMG_0975.jpg	Dai	24-08-2018	solid waste
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0976.jpg	Dai	24-08-2018	domestic waste
			solid waste	Photo	E:\Vietnam\anh24-8\IMG_0979.jpg	Dai	24-08-2018	solid waste
			domestic waste	Photo	E:\Vietnam\anh24-8\IMG_0978.jpg	Dai	24-08-2018	domestic waste
			domestic waste	Photo	E:\Vietnam\Làng nghề Nhóm Tuyên Hiền\Tu Ne\IMG_20180823_092353.jpg	Tuyen	25-08-2018	domestic waste
			Wastewater	Photo	E:\Vietnam\Làng nghề Nhóm Tuyên Hiền\Tu Ne\IMG_20180823_091723.jpg	Tuyen	25-08-2018	
			Work in agriculture	Photo		Tuyen	25-08-2018	
			domestic waste	Photo	E:\Vietnam\Làng nghề Nhóm Tuyên Hiền\Tu Ne\IMG_20180823_092353.jpg	Tuyen	25-08-2018	domestic waste
			Piece of bamboo and rattan	Photo	E:\Vietnam\Làng nghề Nhóm Tuyên Hiền\Mon Quang\IMG_20180824_145955_HDR.jpg	Tuyen	25-08-2018	Piece of bamboo and rattan
			domestic waste	Photo	E:\Vietnam\Làng nghề Nhóm Tuyên Hiền\Mon Quang\IMG_20180824_150947_HDR.jpg	Tuyen	25-08-2018	domestic waste
			Piece of bamboo and rattan	Photo	E:\Vietnam\Làng nghề Nhóm Tuyên Hiền\Lap A\IMG_20180824_090046.jpg	Tuyen	25-08-2018	Piece of bamboo and rattan

Fig. 5: Extracts from the layer <Site_Register> (2/2)

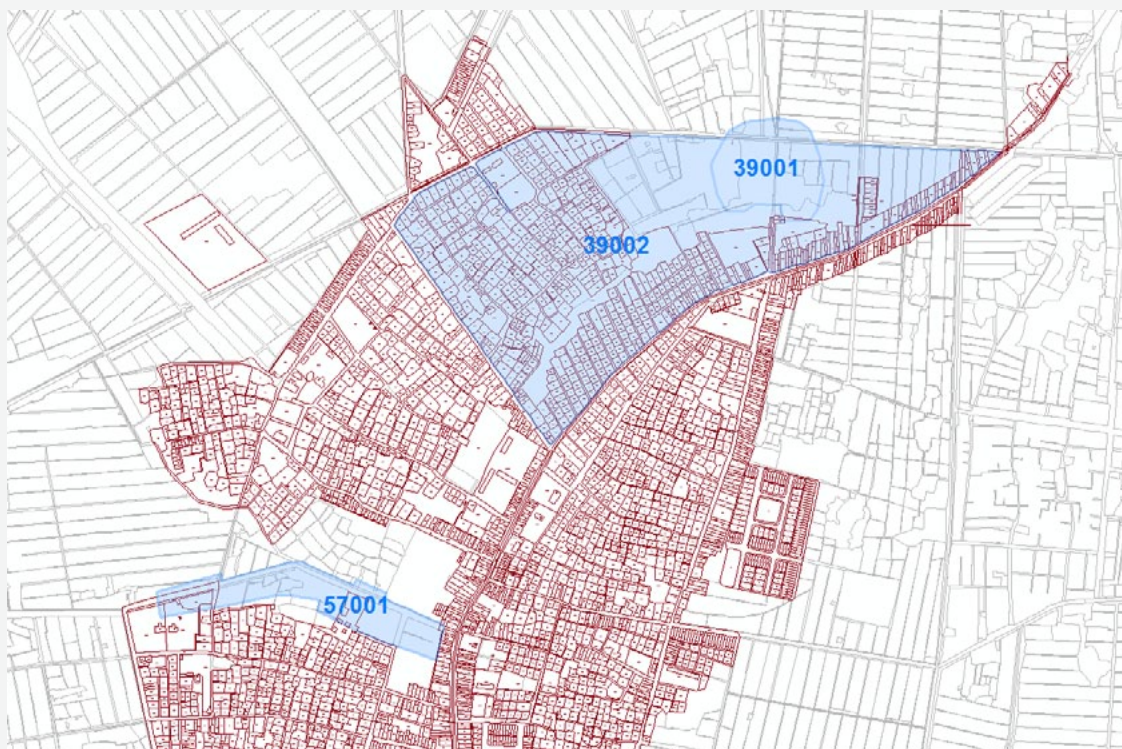


Fig. 6: Marking of sites based on current cadaster basics

3. RECORDING OF USES THAT MIGHT LEAD TO CONTAMINATION IN BAC NINH

Bắc Ninh is located to the East of Hanoi with a total area of 822.7 km² and belongs to the smaller provinces in Vietnam. However, the population density - 1477 inhabitants/km² - is very high.⁶ Bắc Ninh has a rather even and flat terrain, with a slope from North to South and West to East. The large river systems of Đuống river, Cầu river and Thái Bình river form together with many inland rivers and canals the dense river network of Bắc Ninh province.⁷ Plain areas lay around 3 to 7 meters above sea level, hill and mountain areas around 300 - 400 meters above sea level. Hills and mountains make up only 0.53% of the natural area of Bắc Ninh, mainly in the two districts of Quế Võ and Tiên Du.⁸

Agricultural land, forestry land, specially used land and homestead land accounts for 43.5%, 0.6%, 17.1% and 10.2% of the area of the province respectively.⁹ The province's mineral reserves are limited: they consist mainly of construction materials such as clay in Quế Võ and Tiên Du, sandstone in Thị Cầu, Vũ Ninh, Bắc Ninh town and peat in Yên Phong.¹⁰

Bắc Ninh province lies on the major traffic artery linking Vietnam and China – which is a strongly growing market. It also lies on the Nanning - Lạng Sơn - Hanoi - Hải Phòng and Nanning - Singapore economic corridors, the Hanoi capital city planning area and the busy Hanoi - Hải Phòng - Quảng Ninh economic development triangle.¹¹

With its rapid industrialization and modernization, Bắc Ninh Province is known as a showcase for industrial development. In Bắc Ninh are 15 industrial parks. Until 2017, Bắc Ninh province attracted 810 foreign direct investment (FDI) projects worth over 14.8 billion USD, including investments by Canon, Samsung, P&T, Sumitomo, Foxconn, ABB, Orion, PepsiCo and Nokia.¹²

In Bắc Ninh exist more than 100 handicraft-producing villages, of which 62 villages are involved in the production of traditional products such as copper casting (Đại Bái in Gia Bình), iron and steel (Đa Hối in Từ Sơn) and wooden products (Đồng Kỵ in Từ Sơn).^{13,14} They have a high potential to contribute significantly to Bắc Ninh's economic development.

Branches of the economy of Bắc Ninh are agro-forestry-fishery (5.3%), industry and construction (75.6%) and services (19.1%).¹⁵ The value of industrial production was estimated USD 26.2 billion, while the total export turnover of goods was estimated at USD 23.2 billion and the total state budget revenue in the province was estimated at USD 638 million.¹⁶

The strong dominance of industry and craft production in Bắc Ninh Province is associated with a related high potential for the release of harmful substances, which can pollute soils and ground water, but also surface waters.

For hazard prevention and the planning of remediation and protection measures on contaminated sites, it is crucial that the responsible authority works with a reliable database in the form of a cadaster of contaminated sites.

In the next chapters, it is outlined how the recording and technical and data-based processing of information about sites suspected to be contaminated can be carried out. The recent work in the province Bắc Ninh will serve as an example.

Due to the industrial-commercial development of Bắc Ninh, the methodical approach used distinguishes between three functional and spatial focus points:

1. Recording of contamination-relevant uses in craft villages,
2. Recording of contamination-relevant uses in industrial zones and parks,
3. Recording of other contamination-relevant uses.



Fig. 7: Aluminum casting in Vân Môn (Photo: MSP 2017)

3.1 SURVEYING CONTAMINATED SITES IN CRAFT VILLAGES

The inhabitants of craft villages, a special feature of rural Vietnam, develop skillful and sophisticated handicraft works. The Vietnamese government has recognized around 1400 handicraft villages, of which 220 are traditional handicraft villages.¹⁷ Certain production processes in handicraft villages can lead to water, air and soil pollution.

3.1.1 RELEVANCE OF CONTAMINATIONS IN CRAFT VILLAGES

Despite hundreds of years of history, craft villages have remained small-scale. In addition, production processes at craft villages have always employed manually operated equipment and antiquated technologies. Craft villages have also been characterized by low material and fuel efficiency, limited manufacturing space and an insufficient awareness on environment and health protection among its inhabitants. Because of this, a number of activities carried out in craft villages have imposed pressure on their respective environments.¹⁸

Some of the craft villages of Bắc Ninh have a very long tradition. For example, the Dai Bai copper casting village can

look back of 900 years of history.¹⁹ In recent years, craft villages have changed rapidly due to the economic transition towards a market-oriented economy and the encouragement of craft production in joint living and working areas for domestic use and export. The industrialization trend and the promulgation of policies that create a favorable environment for the development of home craft production have provided jobs for permanent and seasonal workers and increased incomes of rural households.²⁰

Along with positive aspects, the development of craft villages has led to a number of shortcomings, especially in terms of environmental issues. Unaware of the long-term impacts of pollution and focusing on quick profits, enterprises at craft villages usually apply manual production procedures and employ unskilled workers. Furthermore, in order to reduce production prices and improve competitiveness, enterprises have used cheap fuel and toxic chemicals including prohibited chemicals. Together with a lack of investment in safe equipment, this antiquated technology leads to material and fuel over-consumption and to an increased pollutant emission to water, air and soil that as a result affects product prices, environmental quality and people's health (Fig. 7).²¹

Although craft villages have invested in production techniques and technologies, there has been a lack of investment on environmental protection. Therefore, pollutant treatment systems such as infrastructure for wastewater collection and treatment as well as landfill and toxic waste collection systems are inefficient or non-existent in many Vietnamese craft villages.²²

Depending on the production processes in craft villages, typical characteristics regarding the types and pathways of environmentally relevant pollutants can be identified. Craft villages focusing on food production, husbandry and slaughtering may discharge high volumes of wastewater polluted with organic substances. The same applies to dyeing, weaving and leather craft villages with the addition of chemicals like bleach as well as chromium (VI) (from leathercraft). These wastewaters pose various risks primarily to surface water and ground water.²³

Other crafts such as recycling, mechanical processing, copper casting, plating and metal fine art production pose the risk of potential soil contaminations, but also pollution of air and water due to the discharge of a variety of substances in the process. The wastewater discharge of these crafts might be small in volume, but high in concentrations of toxic

substances such as heavy metals (Zn, Fe, Cr, Ni, etc). Silver plating and battery recycling also discharge Hg and cyanide as well as Pb, respectively. Wastewater of some craft villages show contents of heavy metals such as Cr⁶⁺, Zn²⁺, Pb²⁺ up to 1.5 to 10 times higher than permitted by regulation QCVN 03:2015/BTNMT.²⁴ In addition to that, gases containing acids, alkalis and metal oxides (PbO, ZnO, Al₂O₃) are emitted into the air in the production processes.²⁵

In general, the combustion of poor quality coal in craft villages across branches of production causes air pollution by dust, CO₂, CO, SO₂, and NO_x. For the most part, solid waste is neither collected nor treated in craft villages and discharged directly into the environment posing the risk of certain contaminations according to the line of production.²⁶

In Bắc Ninh province, many typical branches of craft villages can be found, also the primarily environmentally relevant recycling villages (Table 1).

⁶ General Statistics Office of Viet Nam (2017)

⁷ Government of Bắc Ninh (2016a)

⁸ Ibid.

⁹ General Statistics Office of Viet Nam (2016)

¹⁰ Government of Bắc Ninh (2016a)

¹¹ Government of Bắc Ninh (2016b)

¹² Ministry of Planning and Investment of Viet Nam (2019)

¹³ Government of Bắc Ninh (2016c)

¹⁴ Government of Bắc Ninh (2017)

¹⁵ Government of Bắc Ninh (2015)

¹⁶ Ibid.

¹⁷ Government of Korea / World Bank

¹⁸ Monre (2008)

¹⁹ Government of Bắc Ninh (2016d)

²⁰ Monre (2008)

²¹ Government of Korea / World Bank

²² Ibid.

²³ Monre (2008)

²⁴ Government of the Socialist Republic of Vietnam (2015)

²⁵ Monre (2008)

²⁶ Ibid.

TABLE 1: BRANCHES OF CRAFT VILLAGES IN BAC NINH

BRANCH	MAIN PRODUCT	NAME OF VILLAGES (EXEMPLARY)
FOOD PROCESSING	Rice wine	Quan Đình, Đại Lâm, Cẩm Giang, Xuân Thụ, My Xuyên
	Tofu	Trà Lâm
	Noodles	Cầu Giữa, An Ninh, Cầu Gạo, Đức Lân, An Tập, Thôn Đoài, Tiễn Trong, Tiễn Ngoài, Tử Nê
	Fish breed	Mão Điền
WOODWORK	Wood furniture	Đồng Kỵ, Hương Mạc, Mai Động, Kim Thiều, Kim Bảng, Phù Khê Đông, Phù Khê Thượng, Dương Sơn, Khúc Toại, Kênh Phố, Cao Thọ, Trung Bạ, Đông Xuất, Tuyên Bá
	Bamboo and rattan products	Làng Cỏ, Ngâm Mạc, Lập ái, Xuân Lai, Xuân Hội, Đức Tái, Môn Quảng
WASTE RECYCLING	Aluminium casting	Đại Bái, Quảng Bồ, Mẫn Xá (Xã Văn Môn)
	Iron	Việt Vân, Đa Hội, Trịnh Xá
	Scrap	Quan Độ (Xã Văn Môn)
	Paper	Dương Ổ, Đào Xá
ART HANDICRAFT	Pottery, jars	Phấn Trung, Thủ Công (Xã Phù Lãng)
TEXTILE	Mosquito-net, scarf	Hối Quan, Tiêu Long, Lai Tề, Triện Quang
	unspecific	Đại Mão
	Silk	Vọng Nguyệt
CONSTRUCTION MATERIAL PRODUCTION	unspecific	Đình Cả, Duệ Đông, Vĩnh Kiều, Tiêu Sơn

THE FOLLOWING FIGURES GIVE EXAMPLES FOR ENVIRONMENTAL IMPACTS THROUGH CRAFT VILLAGES IN BAC NINH.





Fig. 8: Examples for environmental impacts through craft villages in Bắc Ninh (Photos: MSP 2017/2018)

- 1 – Risk of soil contamination through the dismantling of transformers in a recycling village (Vân Môn)
- 2 – Waste deposits (ashes and slags, among others) on the brink of rice fields in Vân Môn
- 3 – Risk of soil and ground water contamination in an operation of surface refinement in Da Hoi
- 4 – Pollutant emissions through unfiltered fumes in Duong Ô (recycling of paper)
- 5 – Discharge of untreated wastewater of plating into the canalization in Da Hoi (see arrow)
- 6 – Exposure of surface waters through direct discharge of polluted wastewater and washing processes at the shore area (Duong Ô)



Fig. 9: Locations of aluminium recycling and residential uses in an aerial photograph from 2018. (Source: Google Earth)



Fig. 10: Dust emitting facilities and deposits in Vân Môn in an aerial photograph from 2018 (Source: Google Earth)

3.1.2 DELINEATION AND CHARACTERIZATION OF SUSPECTED CONTAMINATED SITES IN CRAFT VILLAGES

It is typical for Vietnamese craft villages that many land parcels are used in similar or identical ways. Sites of coherent use should therefore be aggregated. Thereby it has to be distinguished between production sites and deposits.

It is fundamental that uses with the potential to cause contaminations are recorded regardless if soil, groundwater, surface waters or air are actually affected. The focus of the soil contamination cadaster is (primarily) on (potential) causes of pollution. All other measures of further investigation or hazard prevention take place in the next step based on information recorded and described in the cadaster.

Besides production sites, most craft villages possess also areas primarily used for housing and administration. Usually, these areas do not cause relevant contaminations. A first step is therefore to delineate sites suspected to be contaminated from non-relevant areas by evaluating different sources. Aerial photographs are, among others, important recording tools.

AERIAL PHOTOGRAPHS

The evaluation of aerial photographs is recommended as a first step to identify those areas within a handcraft village, which are suspected to be contaminated due to their use. The craft village Vân Môn, for example, is depicted in aerial photographs in Google Earth in such a high-resolution that an adequate data basis is available for first definition issues, but also for the recording of uses, which might entail contamination (Fig. 9).

Sometimes, a simple look at the rooftops may be enough to distinguish residential uses from units of use that are thought to pollute the environment. Rooftops being colored grey from dust emissions can be clearly distinguished from other uses (as shown in Fig.9)

Also chimneys and deposits in the range of production sites which can be seen on aerial photographs are safe indications for usages which might entail contaminations (Fig. 10).

HISTORICAL AERIAL PHOTOGRAPHS

Craft villages often possess long traditions, so that production sites may have changed spatially throughout the history of their use. If production sites in the village have been relocated or individual operations closed, sensitive after uses such as housing or agriculture might lead to hazardous situations.

Example: *At a parcel in a craft village, transformers have been dismantled and recycled between 1985 and 1995. Through this operation, the soil has been contaminated significantly with transformer oils that contained PCB. The operation has been relocated to another site in 1995.*

Subsequently, a residential building with a small kitchen garden has been built at the area. Here exists a high health risk because playing children always come into contact with the contaminated soil and might also consume small quantities. Also crop plants can be contaminated with pollutants due to absorption and adhesions so that an additional health risk exists. Not at least because of the previous use, the groundwater might be contaminated, which could enter the nutrition cycle as drinking water causing considerable health risks due to relevant contamination with PCB.

IT IS ONE OF THE MOST IMPORTANT PERFORMANCE CHARACTERISTICS OF A SOIL CONTAMINATION CADASTER TO RECOGNIZE SUCH HAZARDOUS SITUATIONS OR TO PREVENT THEM THROUGH PLANNING MEASURES.

One of the most important sources for the acquisition of historical usages are aerial photographs of past years (see Manual part 1, pages 26 - 27). An important procurement source for historical aerial photographs is the Center of Survey and Mapping Data in Hanoi.²⁷ At the webpage of this organization (www.bandovn.vn), current, as well as historical aerial photographs can be researched and digital copies can be obtained. The recordings date back until the fifties and are of French origin. (IGN - Photothèque Nationale in Saint-Mandé Cedex).

In general, it is not necessary to look back so far into the past for the investigation of spatial changes in craft villages, as significant changes in the production structure of craft villages took place mainly in the 1980s. Therefore, aerial photographs from this decade to the present are sufficient in most cases.

Besides the Center of Survey and Mapping Data, Google Earth can be mentioned as another important source for aerial photographs regarding the last 10 to 15 years. It also allows the evaluation of historical images (Fig. 11).

Using the example of the craft village Vân Môn, it shall be demonstrated which findings can be gained through the evaluation of historical aerial photographs.

Figure 12 shows the development of deposits in the East of the craft village Vân Môn within 10 years. It can be recognized that the previous use consists of a hollow form filled with water, which was gradually filled up with ashes and slags from the aluminium recycling businesses.

²⁷ The Center of Survey and Mapping Data is a business unit under the Department of Survey and Mapping of Vietnam and the MONRE. It assist the Department of State Management in the field of survey and mapping of information; implementation of public services for storage, integration, updating, providing survey and mapping data as prescribed by law.

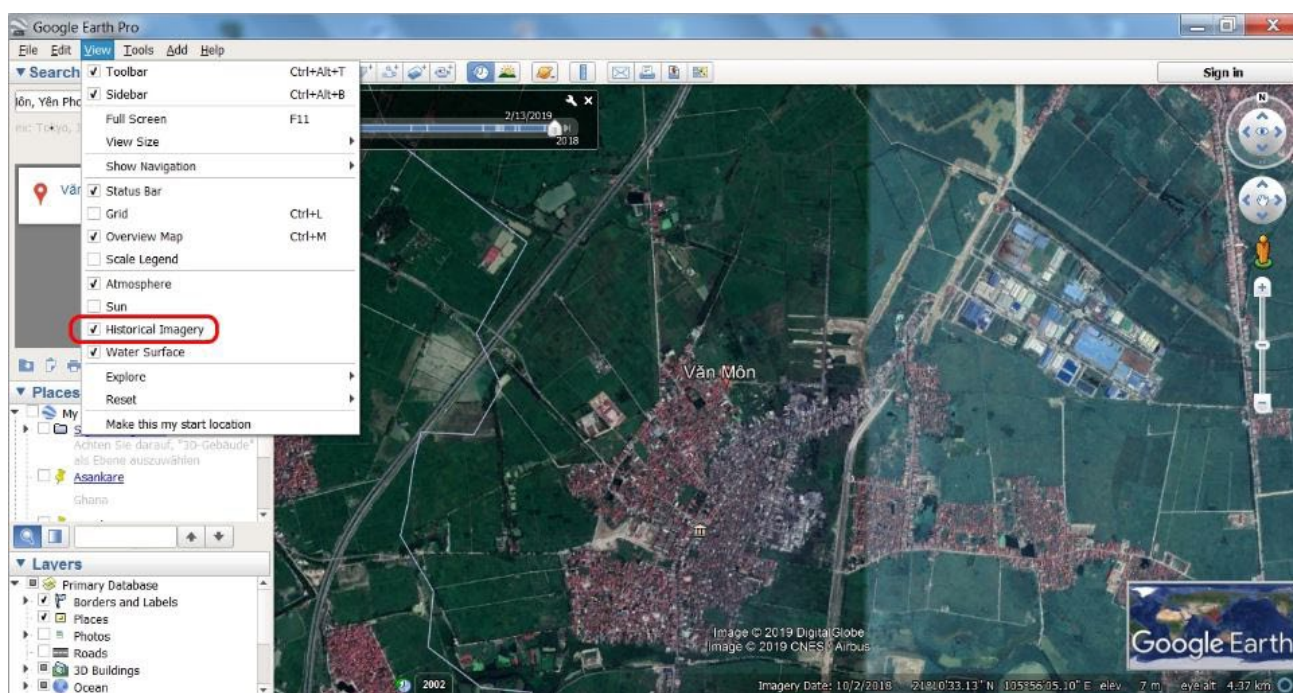


Fig. 11: Function of historical images in Google Earth (Source: Google Earth)



Fig. 12: The chronological and spatial development of facilities and deposits of aluminum recycling in the East of Văn Môn (Source: Google Earth)



Fig. 13: Excavations in an area of present ash deposits from aluminium recycling in an aerial photograph from 1992 (Source: Center of Survey and Mapping Data)



Fig. 14: Settlement structure in the East of Vân Môn in an aerial photograph from 1992 (Source: Center of Survey and Mapping Data)

Even older images show deposits of prior use, which might have served for the production of clay bricks (Fig.13).

The evaluation of historical aerial photographs is especially useful if

- Past uses that might have caused contaminations are currently not more recognizable at the area, but have to be captured;
- the duration and therewith the relevance of a use which might entail contaminations shall be determined.

Even if a use with contamination potential has taken place a long time ago, it must be assumed that increased pollutant inputs in the soil have occurred.

In Bắc Ninh – but also in other provinces with craft villages – it can be seen that despite the long tradition of commercial activities, massive environmental impacts have only taken place since the 1990s.

In Vân Môn for example, aerial photographs show that sites used for aluminium recycling in nowadays, still have been rice fields back in the 1990s. In 1992, straw bales from rice can be identified in the backyards of the buildings, with no melting furnaces to be found (Fig.14).

Due to the comparatively short period in which uses that might cause contamination have taken place, the risk of sensitive subsequent uses appears to be moderately low. It occurs rather seldom that operations causing contaminations are abandoned and replaced by residential and agricultural uses.



Fig. 15: „On spot“- demarcation of utilization units with the environmental protection officer of the district Yên Phong (Photo: Thuy Thi Nguyen/MSP Bochum)

However, it can be observed that, especially in the recycling sector, a high fluctuation of land use can be recorded in those areas where machine and plant components are dismantled. Machines are stored and dismantled mostly in property areas near to the street, while the same sites are already being used for other purposes after a short time.

As a rule, these changes in use are difficult to comprehend through the evaluation of aerial photographs due to their short operating time. In these cases – but also to delineate these areas from areas already recorded by the analysis of aerial photographs – local experts are an important source of information.

ENVIRONMENTAL PROTECTION OFFICERS AT THE DISTRICT LEVEL

In a further step, the potentially contaminated areas already being recorded through the evaluation of photographs must be clearer defined and further information has to be filed in. An early consideration of environmental experts from the district level is recommended, because information in the form of official files are only seldom available about craft villages.

During the development of the cadaster in the province Bắc Ninh it became clear that the environmental experts at the provincial level possess good regional knowledge. They have been able to concretize the preliminary only rough demarcations units of use in the craft villages and could add further environmentally relevant data to the individual uses (Fig. 15).

3.2 SURVEYING CONTAMINATED SITES IN INDUSTRIAL ZONES

The number of industrial zones and parks in Vietnam continues to rise as foreign investment pours in. In 2016, there were 325 industrial zones set up nationwide, with 220 already in operation on a total of 60900 ha.²⁸ The parks occupy a natural land area of almost 85000 hectares, with about 66% of the total land area designated as industrial land for leasing. Occupancy reached 51.5% overall, and 73% at operating industrial parks.²⁹ The risks of contaminations from industrial zones vary widely according to environmental standards in the industrial parks, the type of production processes carried out in the individual branches and other factors.

3.2.1 COMMON RELEVANCE OF CONTAMINATIONS IN INDUSTRIAL ZONES

Presently, there are 15 bigger industrial zones in Bắc Ninh province (Fig. 16), which are coordinated by the Bắc Ninh Industrial Zones Authority at Ly Thai To N°10 in Bắc Ninh city. The Bắc Ninh Industrial Zones Authority is an important source to acquire information for the cadaster.

The majority of the industrial zones of Bắc Ninh developed in the 2000s, so their usage history is manageable. In all known cases, previous types of land use were always agriculture (Fig.17).

²⁸ Vietnam Briefing (2017)

²⁹ Ibid.



Fig. 16: Industrial zone on the district level at Bắc Ninh province
(Source: Bắc Ninh Industrial Zones)



2002



2018

Fig. 17: Previous use (2002) and current situation (2018) in the industrial zone Tuan Than 3 (300 ha) (Source: Google Earth)



*Fig. 18: Central wastewater treatment plant in the industrial zone Que Vo 1
(Photo: MSP 2018)*

All industrial zones possess local administrations which are normally represented by operator organizations. The local administrations are, among others, also responsible for central services such as waste disposal and the operating of wastewater treatment plants. Operators of the industrial zones are solely Vietnamese, as well as foreign organizations (mostly with Vietnamese share).

A number of production operations possess their own wastewater treatment plants, which treat the wastewater in such a way that the chemical prerequisites for the final treatment through the central wastewater treatment plant are met (Fig. 18).

The environmental standards in the industrial zones vary considerably and often correlate with external conditions:

- As a rule, the operating organization is also responsible for the infrastructure of the respective industrial zone. Here it can be observed that the compliance to environmental standards varies. Wastewater treatment plants were partly undersized or in a poor technical state (Fig. 19).

- The environmental relevance of production sites within industrial zones always correlates with the contamination risk potential of individual branches. These are environmental exposures that are typically linked with the operation of a facility. A company which operates for example in beverage production has a lower risk potential than a company that deals with surface refinement of metals (see chapter 3.2.2).
- Some companies have already implemented extensive environmental protection measures, such as switching from oil to electricity as an energy source. So far, however, formerly induced soil contaminations have rarely been recorded, evaluated and, if needed, remediated. These businesses also need to consider a historical component in the assessment of their risk potential regarding contaminations.
- Besides the risk potential of the branch itself, the origin of the plant operator plays a significant role regarding the plant's compliance with environmental standards. It is often observed that especially those operators pay close attention to environmental standards in whose countries of origin (e.g. USA, South Korea, Japan) environmental standards are high.



Fig. 19: Examples from industrial zones in Bắc Ninh (Photos: MSP 2018)

- 1 – Extraction of sludge in a central wastewater treatment station with apparent leakages.
- 2 – Open basin with chemicals for the production of molybdenum. Production of a Chinese operator.
- 3 – Oil tanks from previous uses of a glass producing business.
- 4 – Open storage of oil barrels and construction machinery on an unsealed area
- 5 – Positive example for „cleaner production“: The company Van Loi moved in 2017 from Vân Môn to Dong To Industrial Complex to operate in aluminium recycling.

TABLE 2: DEFINITIONS OF COLLECTION CLASSES

FIRST COLLECTION CLASS	Branches whose production sites typically show contamination caused by the regular (technological) processes.
SECOND COLLECTION CLASS	Branches whose production sites show contamination only in individual cases and/or under special operational conditions.

3.2.2 CONTAMINATION RISK POTENTIAL OF INDIVIDUAL BRANCHES

The experience in dealing with contaminated areas shows that sites of specific industrial branches show certain pollution loads, whereas in other industrial branches, such pollution loads are only to be expected in some subordinated businesses or under specific conditions.³⁰

Therefore, it has proven successful to apply a two-stage system for the classification of the contamination risks of sites.

The First Collection Class covers branches of industry whose production sites typically show contamination caused by the regular (technological) processes and/or the substances handled or produced on site (e.g. galvanic enterprises).

The Second Collection Class covers branches of industry whose production sites show contamination only in individual cases and/or under special operational conditions, but the suspicion of contaminations due to former land use cannot be excluded. A compilation of the most important branches relevant to contamination is contained in the Annex of this manual.³¹ Collection Classes shall not be put on the same level with the potential hazard of the sites of a branch. In individual cases, a site of a branch of the Second Collection Class may have in absolute terms a higher risk potential than a site of a branch being classified in the First Collection Class due to specific technological processes or previous environmentally harmful productions on site. This classification is practiced in Germany – especially in the Federal State North Rhine-Westphalia. It is based on knowledge gathered in recording areas suspected of being contaminated and on experiences gained in the further treatment process.³²

The list of branches in the Annex of the manual is a tool that assists in the broad recording of all sites relevant to contamination. The classification is based on the branch classification system of the Federal Statistical Office in Germany. It has to be taken into consideration that this system reflects the

branch spectrum of Germany as such. However, as most of the branches are also represented in Vietnam, this system will also be appropriate for the development of cadasters for Vietnamese provinces.

The branch list also serves as a basis to develop an individual list of branches. For example, the branch list may be adapted to the respective conditions existing in a province. Therefore, the special industrial history of the province shall also be considered apart from the general historical or actual development of the branches. The branch list used for recording may be extended by branches typical to the province. In addition, the DONRE of a province has the possibility not to record specific branches if they are not regarded relevant for the respective province.

3.2.3 SOURCES FOR THE RECORDING OF SITES IN INDUSTRIAL ZONES SUSPECTED TO BE CONTAMINATED

In contrast to the recording of uses in craft villages, the recording of sites in industrial zones is significantly easier. To get an overview over the usages in industrial zones, the responsible authority at the province level shall be contacted. In Bắc Ninh, this is the Bắc Ninh Industrial Zones Authority in Bắc Ninh city (chapter 3.2.1).

A further source to gain data about branches, operators, utilization period, etc. are operating organizations of the industrial zones and parks. As a rule, digital data can be found which can easily be integrated into the existing GIS of the cadaster of contaminated sites.

Site visits shall be organized to gain further information. If possible, photos of uses that might have an impact on the environment should be taken and included into the GIS.

To record uses that might have an impact on the environment at the sites within industrial zones, the following considerations are relevant:

TABLE 2: DEFINITIONS OF COLLECTION CLASSES

GENERAL ASSUMPTIONS RELATED TO THE BRANCH	Handling loss when refilling soil or water-hazardous substances into other tanks, barrels or other containers, or while cleaning containers and equipment units
	Leakage, loss of pipelines
	Corrosion of storage tanks and pipelines
	Seepage of pollutant-containing waste water into pits and sinks; defective sewer lines
	Shutdown and demolition of production plants
INDICATIONS TO SPECIAL INCIDENTS	Dumping of production waste and faulty charges on the factory ground
	Failures, accidents

In principle, when handling substances relevant to the environment, there may arise the risk to release these substances into the environment due to handling loss, carelessness or by normal cleaning processes. Table 3 gives an overview of possible ways to release pollutants.

If these processes take place in buildings or parts of them, a respective contamination of the structural substance (“building pollution”) or of the soil and groundwater under the building is possible. Concrete floors provide, in principle, a barrier to

spreading. However, a remarkable input into soil and groundwater is possible due to leakage of concrete joints or fissures in the floor covering. There are also substance groups – such as e.g. hydrocarbons – which may penetrate even „dense“ concrete floors and cause a respective contamination of soil and groundwater.

THIS IS WHY THE TYPE OF BUILDINGS USED CORRELATES OFTEN DIRECTLY WITH SPECIFIC CONTAMINATION RISKS.

Accordingly, the buildings, plants and waste disposal sites recorded are classified into respective risk categories (if the type of the dumped material is known or may be at least limited). As contamination will (mostly) not only remain on the building surface, a certain seam or buffer of transmission has to be considered which may be easily implemented by using GIS technology.



Fig. 20: Dong Tho Industrial Complex. Data sources are the administration units in the individual operating corporations in the industrial zones. (Photo: MSP 2018)

30 Mark, Harald & Dodt, Jürgen (2013)

31 Ibid.

32 Ibid.

3.3 SURVEYING CONTAMINATED SITES IN OTHER PLACES

Besides the described sites in craft villages and industrial zones, also other sites can be categorized as a risk of contamination due to the uses taking place at these areas.

Examples for this category are e.g. petrol stations. There is a risk of contamination of soil and groundwater through petroleum-derived hydrocarbons. This category includes industrial companies that are not located in industrial areas and may already have a longer history of use. In general, it can also be applied here that environmentally relevant uses on a larger scale were only made since the 1990s.

For the recording of these sites, all sources that have already been mentioned are eligible. Sites that are already closed down completely and are taken into consideration to further sensitive uses (e.g. housing at the location of a former factory) are rare, though.

Therefore, in particular those sources reflecting the current state, e.g. up-to-date aerial photographs (Fig. 21) and classified directories (“yellow pages”) are here useful. The link <http://yellowpagesvn.com> can be used to research a large part of the industrial enterprises located in Bắc Ninh province by using selection criteria such as the search for specific branches.

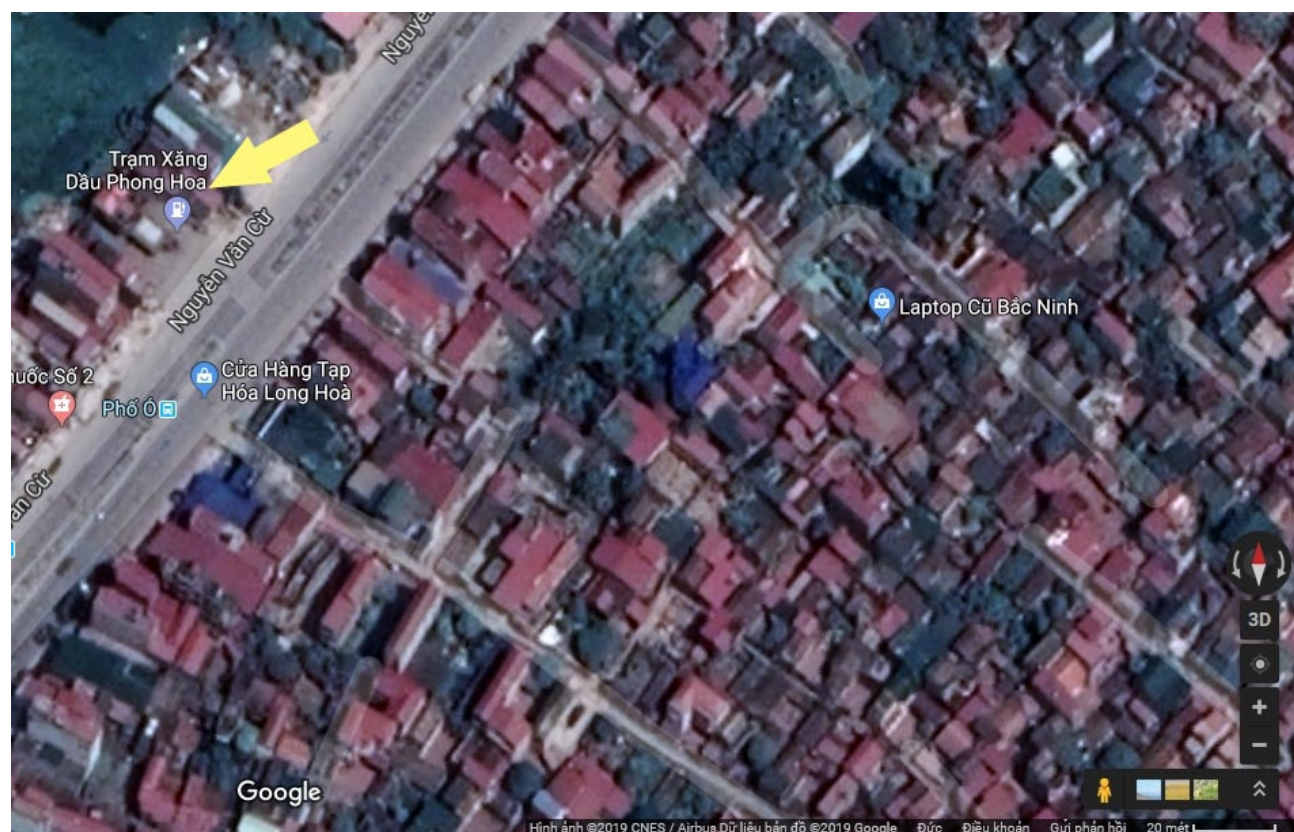


Fig. 21: Industrial zone on the district level at Bắc Ninh province
(Source: Bắc Ninh Industrial Zones)

4 SUMMARY AND OUTLOOK

In this manual, the process of recording sites suspected to be contaminated is presented.

By using experiences gained at the development of a cadaster in Bắc Ninh province, a deeper insight into data collection, data processing and data presentation for the development of a cadaster of contaminated sites is given.

The data collection in Bắc Ninh province has been organized with regard to craft villages, industrial zones and other contamination-relevant uses as functional and spatial focus points.

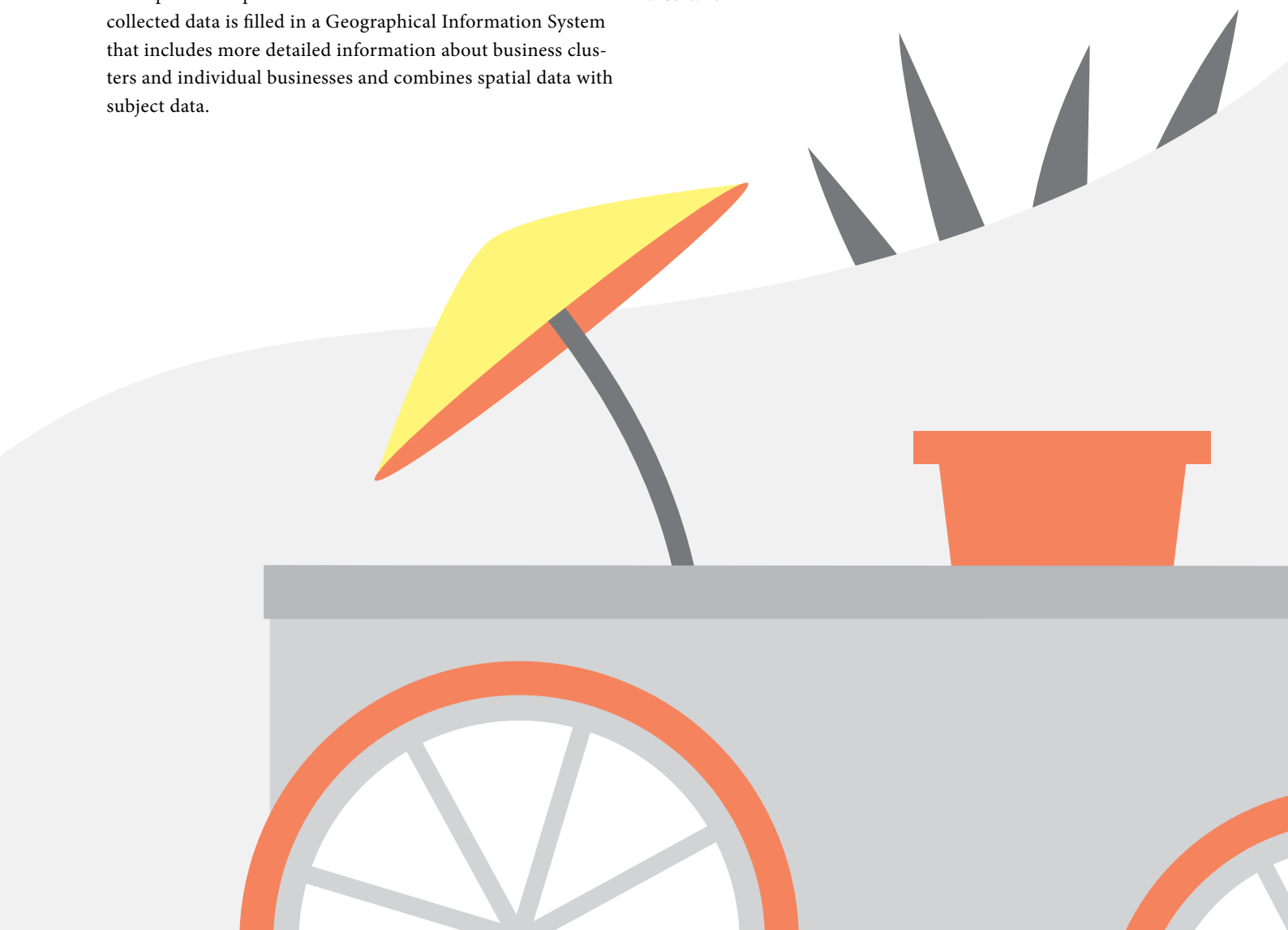
The data processing includes the classification of a sites' relevance to contamination. A branch list that categorizes sites of province-specific branches serves here as a basis. The collected data is filled in a Geographical Information System that includes more detailed information about business clusters and individual businesses and combines spatial data with subject data.

The development of a cadaster is the first step in the systematic treatment of contaminated sites.

By giving an overview to (potential) risks related to contaminated areas, a cadaster is an essential tool to prevent subsequent uses, which might lead to negative health impacts due to various pollutant pathways.

The use of a cadaster for the reporting of environmental damages in the provinces, for the identification of safety measures in individual branches and in municipal and regional planning helps to avoid harm among the population.

Therefore, the authors highly suggest the development of a cadaster of contaminated sites also for other provinces of Vietnam.



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ANNEX

At the following pages, an example for a branch list as described in chapter 3.2.2 is presented. With its two-stage system to determine a sites' relevance to contamination (see chapter 3.2.2), the branch list serves as a basis for a province-specific classification of sites of branches. This specialized branch list can be developed by including and excluding province-specific branches.

BRANCH GROUPS

The branches are assigned to 15 branch groups marked by numbers:

BRANCH GROUP	NUMBER
Mining and energy	1
Chemistry and mineral oil	2
Metal production and processing	3
Wood and paper	4
Leather and textiles	5
Other services (other industries)	6
Other producing industries	7
Glass and ceramics	8
Electrical engineering, precision engineering	9
Car construction, repair, filling station	10
Food industry (big industry)	11
Trade and storage	12
Building industry	13
Recycling and disposal	14
Military facilities	15

The sites detected in the framework of data collection or listed in the Annex of Vietnamese laws/decrees have to be classified into the following branch classification system. An assignment can be made by using company name and potential additional information. The succession of branches is built up hierarchically (superior branches and subordinate branches). As far as consistent and appropriate to their content, only the respective superior branches were included.

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
BRANCH GROUP 1: MINING AND ENERGY		
I	Hard coal mining and briquetting	
I	Hard coal mining	
I	Production of hard coal briquettes	
I	Lignite mining and briquetting	
II	Electricity supply	Thermal power, water power
I	Gas generation with and without purchase for distribution	
II	Gas distribution without generation and production	
ORE MINING		
I	Iron ore mining	Extraction and processing/ dressing and pelleting of iron ores
I	Non-iron metal mining	
QUARRYING, OTHER MINING		
II	Ashlar quarrying	
II	Asphalt mixing plants	
II	Quarrying of gravel, sand, clay and kaoline	
I	Mining of chemical and fertilizer minerals	
II	Salt extraction	
BRANCH GROUP 2: CHEMISTRY AND MINERAL OIL		
I	Mineral oil processing	
I	Hydrogenation plants CHEMICAL INDUSTRY	
CHEMISTRY AND MINERAL OIL		
I	Production of basic chemical materials	
I	Production of industrial gases	
I	Production of dyes and pigments	
I	Production of other inorganic basic chemical materials and chemicals	
I	Production of distilled tars	
I	Production of other organic basic chemical materials and chemicals	
I	Production of fertilizers and nitrogen compounds	

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
I	Production of synthetic materials in primary forms	
I	Production of synthetic rubber in primary forms	
I	Production of fertilizers and plant protectives	
I	Production of paints, printing dyes and luting	
I	Production of pharmaceutical products	
I	Production of soap, detergents, cleansing and personal hygiene products	
I	Production of other chemical products	
I	Production of pyrotechnical products	
I	Production of adhesives and gelatine	
I	Production of ethereal oils	
I	Production of photochemical products	
I	Production of blank sound, picture and data carriers	
I	Production of chemical fibres	
PRODUCTION OF RUBBER AND PLASTIC PRODUCTS		
I	Production of rubber products	
I	Production of tires	
I	Retreading of tires	
I	Production of other rubber products	a. o. vulcanization works
I	Production of plastic products	
BRANCH GROUP 3: METAL PRODUCTION AND PROCESSING		
METAL PRODUCTION AND PROCESSING		
I	Production of iron, steel and ferro-alloys	
II	Production of pipes	(of iron and steel)
II	Other first treatment of iron and steel, production of ferro-alloys	
I	Production of drawn wire	
I	Production and first treatment of non-iron metals	
I	Production and first treatment of aluminium	
I	Production and first treatment of lead, zinc and tin	

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
I	Production and first treatment of copper	
I	Foundry	
I	Iron foundry	
I	Steel foundry	
I	Light metal foundry	
I	Non-ferrous metal foundry	
PRODUCTION OF METAL PRODUCTS		
II	Steel and light metal construction	
II	Boiler and tank construction	incl. production of boiler
I	Production of forged pieces, pressed, drawn components, stampings, rolled rings and powder metallurgical products	
I	Surface finishing and thermal treatment	electroplating, paint, hardening shop,
II	Machine shop	Locksmith's, welding, grinding shops, turnery
I	Production of cutlery, tools, locks and small iron work	
II	Production of iron, tinware and metal products	(e.g. screws, springs etc.)
II	Mechanical engineering	
I	Production of weapons and ammunition	
II	Production of household appliances	(electrical and non-electrical) e.g. refrigerators
BRANCH GROUP 4: WOOD AND PAPER		
WOOD INDUSTRY		
I	Wood impregnating plants	
I	Veneering, plywood, wood fibre slab and particle board producing shops	
II	Production of construction units, prefabricated units, lining elements and prefabricated wood units	
II	Production of packaging material and storage tanks consisting of wood	
I	Finishing of wood and related products	Without production of wood products, only finishing
PAPER INDUSTRY		
I	Production of mechanical wood pulp, cellulose, cardboard and paper board	
I	Production of mechanical wood pulp, cellulose	

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
I	Production of paper, cardboard and paper board	
I	Paper, cardboard and paper board processing	a.o. production of wallpaper
I	Printing industry	Big plants: printing plant and newspaper printing plant
II	Typesetting and reproduction	
BRANCH GROUP 5: LEATHER AND TEXTILES		
TEXTILE TISSUE		
II	Web tissue processing and spinning mill	
II	Weaving shop	
I	Textile finishing	
II	Textile processing	
II	Production of ropes and cords	
II	Production of leather cloths	
I	Preparation and dyeing of fells	
LEATHER TISSUE		
I	Leather production	Tannery, leather dyeworks etc.
II	Leather processing (without production of leather cloths and shoes)	Only big plants and factories
II	Production of shoes	
BRANCH GROUP 6: OTHER SERVICES (OTHER INDUSTRIES)		
I	Railway	Goods stations (closed down), repair shops, railway tracks shops
I	Airport workshops	
II	Technical, physical and chemical investigations	chem. laboratory
II	Cleaning of machinery	
II	Disinfection and pest control	
II	Photographical laboratories	Only big plants
II	Filling and packaging industry	
II	Shooting ranges	Not military
II	Laundry	
I	Chemical cleaning and clothing dyeworks	

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
BRANCH GROUP 7: OTHER PRODUCING INDUSTRIES		
PRODUCTION OF FURNITURE, JEWELLERY, MUSICAL INSTRUMENTS, SPORT APPARATUSES, TOYS AND OTHER PRODUCTS		Only large plants and factories
II	Production of furniture	
II	Production of mattresses	
II	Production of jewellery and similar products	
II	Production of musical instruments	
II	Production of sport equipment	
II	Production of toys	
II	Production of other products	Other products: e.g. buttons, candles and similar wax products, zips, matches, baby carriages, Christmas decoration
BRANCH GROUPS 8: GLASS AND POTTERY		
I	Production and processing of glass	
II	Pottery (without glazing)	Production of pottery products incl. production of pottery wall and floor tiles and plates, production of other construction pottery; Only big plants
I	Pottery (with glazing)	
II	Production of fireproof pottery materials	
II	Brickyards	No field burning brickyards
II	Production of cement, lime and burnt gypsum	
II	Production of concrete, cement and gypsum products	
II	Production of fibre cement products	e.g. asbestos cement
II	Production of other mineral products	e.g. millstones, burnishing stones
II	Production of mineral products	a. o. processing of asbestos and production of asphalt products and bituminous mixtures
BRANCH GROUP 9: ELECTRICAL ENGINEERING, PRECISION ENGINEERING		
II	Production of office machinery, data processing appliances and equipment	
PRODUCTION OF EQUIPMENT OF ELECTRICITY GENERATION AND DISTRIBUTION ETC.		
I	Production of electric motors, generators and transformers	
I	Production of isolated electric cables, lines and wires	

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
I	Production of accumulators and batteries	
II	Production of electric lamps and lighting units	
II	Production of electrical equipment	
II	Broadcasting, TV and telecommunications	
II	Medical engineering, process instrumentation and control, optics	(a.o. precision engineering)
BRANCH GROUP 10: CONSTRUCTION OF CARS, REPAIR, FILLING STATION		
II	Production of motorcars and motorcar parts	
CONSTRUCTION OF OTHER VEHICLES		
I	Ship building	
I	Breaking up and scrapping of ships	
I	Construction of rail vehicles	
I	Engine building	
I	Wagon, railcar and railbus building	
I	Repair of rail vehicles	
II	Production of immobile track material	
II	Production of motorcycles, cycles and vehicles of disabled persons	
II	Maintenance and repair of motorcars	
I	Varnishing of motorcars	
II	Vehicle-washing facilities	
I	Filling stations	
BRANCH GROUP 11: FOOD INDUSTRY (BIG INDUSTRY)		
FOOD INDUSTRY		Only big plants and factories
II	Slaughtering and meat processing	
II	Fish processing	
II	Fruit and vegetable processing	
II	Production of plant and animal oils and fats	
II	Milk processing	
II	Flour mills and hulling mills, production of starch and starch products	

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
II	Production of fodder	
I	Carcass disposal	
II	Other food industries	(without production of drinks)
II	Processing of coffee and tea	a. o. coffee roasting houses
II	Production of drinks	
II	Alcohol distillery	
II	Production of beer	
II	Tobacco processing	Only big plants and factories
BRANCH GROUP 12: TRADE AND STORAGE		
II	Wholesale trade with motorcars	
II	Wholesale trade with motorcycles, parts and accessories	
II	Wholesale trade with detergents, cleaners	
II	Wholesale with pharmaceutical products	
I	Wholesale with solid fuel and mineral oil products	
II	Wholesale with ores, iron, steel, non-iron metals and semi-finished products	Only relevant in the case of storage similar to scrapyards
II	Wholesale with building material and elements consisting of mineral substances	
I	Wholesale with paints, varnishes and similar materials	
I	Wholesale with chemical products	e.g. fertilizers, pesticides, raw technical fats and oils
I	Wholesale with scrap	
I	Wholesale with other waste materials and recycling	(e.g. waste oils, waste tires)
II	Freight handling and storage	incl. freight handling in inland navigation
II	Cold stores	
II	Logistics	In particular transport of dangerous goods incl. goods transport in road traffic
BRANCH GROUP 13: BUILDING INDUSTRY		
II	Demolition, blasting and freeing from ruins	
II	Building, bridge and tunnel construction etc.	Big plants with storage grounds
II	Sealing against water and humidity	Without „wood and building protection“
II	Timbering and civil engineering in timber	Big plants and storage grounds

COLLECTION CLASS	NAME OF BRANCH	COMMENTS
II	Road and permanent way construction	
II	Facade cleaning	
BRANCH GROUP 14: RECYCLING AND DISPOSAL		
RECYCLING		
I	Recycling of scrap	
I	Recycling of non-metal waste materials and residual products	
I	Recycling of textile waste materials and residual products	
I	Recycling of waste materials and residual products of paper, cardboard and paperboard	
I	Recycling of waste materials and residual products of glass	
I	Recycling of waste materials and residual products of plastic	
I	Recycling of other waste materials and residual products	Chemicals, waste tires, demolition material
II	Sewage plants	
I	Collection, transport and intermediate storage of waste	
II	Composting plants	
II	Waste incineration plants	
II	Other waste treatment plants	
II	City cleaning and other disposal institutions	
BRANCH GROUP 15: MILITARY FACILITIES		
I	Fuel stores	Tanks, pipelines
I	Airfields, airports	Refuelling stations, hangars
I	Barracks, troop accommodation	Supply, disposal, laundry, chem. cleaning
I	Storage, depot	Chemical store, petrol station, ammunition depots
II	Signalling equipment	Transformer boxes and engineering area
II	Missile and anti-aircraft bases	Launching areas
I	Repair/maintenance	Disposal, storage, repair area
I	Shooting range	
I	Military training areas	Assignment area/refuelling station, storage depot training area

THIS MANUAL WAS DEVELOPED WITHIN THE GERMAN-VIETNAMESE PROJECT CAPAVIET

The cooperative project “CapaViet – Capacity and infrastructure development for the establishment of a soil contamination cadaster in Vietnam by the example of Bắc Ninh Province” wants to strengthen Vietnamese authorities at the provincial level in the independent registration and assessment of contaminated sites.

Together with MSP - Dr. Mark, Dr. Schewe & Partner GmbH and the regional environmental agency (DONRE), a cadaster of contaminated sites will be developed in Bắc Ninh Province. Potentially polluted locations will be recorded in a data bank and in GIS by German and Vietnamese experts. Like this, the involved employees of DONRE Bắc Ninh will learn in practice the necessary know-how for the development of a cadaster of contaminated soils. As flagship project, the cadaster for Bắc Ninh can serve as a transferable example for other provinces in Vietnam.

Training courses in cadaster development and in the use of mobile analytical methods for the assessment of heavy metals in soils strengthens the employees of Vietnamese authorities at the provincial and national level.

To support the autonomous development of soil contamination cadasters, experts in Vietnam will be provided with technical tools for the mobile analysis of heavy metals and cadaster development, which will be drafted and disseminated during the project. UfU will further develop a draft for a legal regulation defining the registration of soil contaminations.

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Fig. 22: Photos: KOVAC



