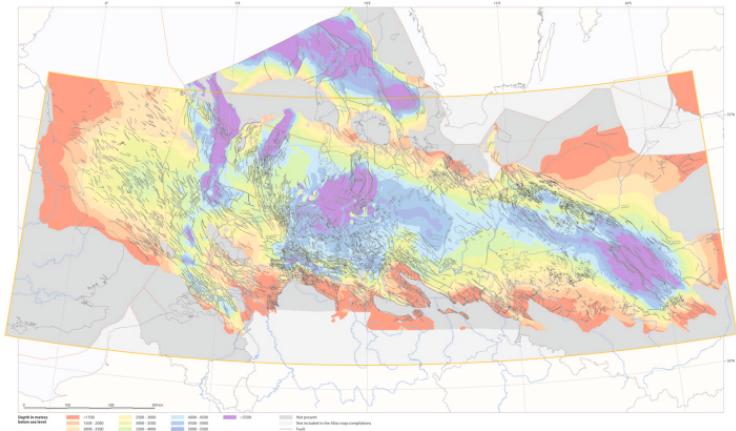
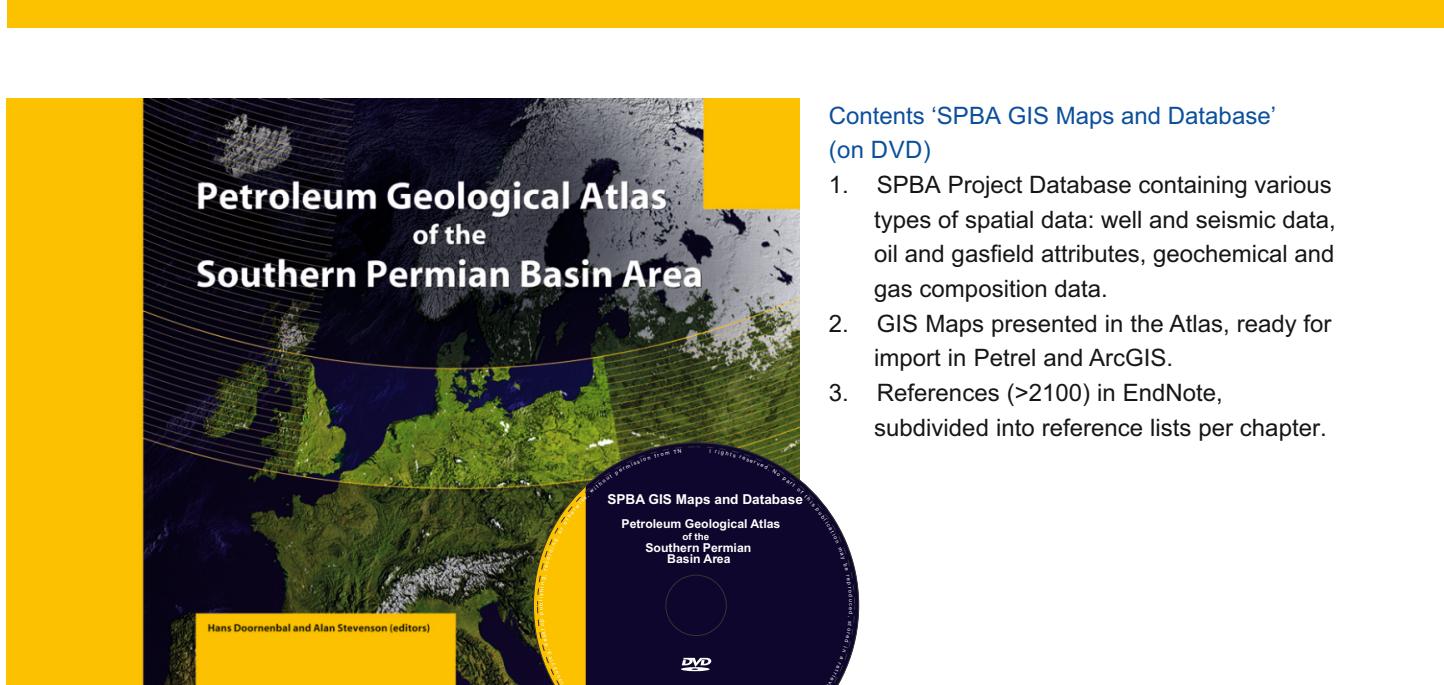


# SPBA GIS MAPS AND DATABASE

The Southern Permian Basin Atlas (SPBA) presents a comprehensive and systematic overview of the results of over 150 years of petroleum exploration and research in the Southern Permian Basin area. The Atlas aims to stimulate the petroleum E&P industry to continue their activities in this mature basin. The subsurface characterisation provided in the Atlas will also be of great value to governments, researchers and other individuals interested in the deep subsurface. The Atlas is available in print (A2 format) and in PDF format (ordering information: [www.eage.org/bookshop](http://www.eage.org/bookshop)). The enclosed GIS Maps and the SPBA Project Database are also available now as a separate digital product on DVD and could be ordered by filling the form at the end of this document.



Depth to the base of the Zechstein.



## Contents 'SPBA GIS Maps and Database' (on DVD)

1. SPBA Project Database containing various types of spatial data: well and seismic data, oil and gasfield attributes, geochemical and gas composition data.
2. GIS Maps presented in the Atlas, ready for import in Petrel and ArcGIS.
3. References (>2100) in EndNote, subdivided into reference lists per chapter.

# SPBA Project Database

The SPBA Project Database contains various types of spatial data: well and seismic data, oil and gasfield attributes, geochemical and gas composition data. Each type is described in the following section and their attributes are presented in Tables 1 to 6.

## Well and seismic data

Databases of exploration wells, 2D-seismic lines and 3D-seismic surveys were compiled from input provided by the participating countries. They are provided as standard ESRI GIS format. Tables 1, 2 and 3 list the attributes of these data.

Table 1. Metadata for exploration wells.

Name	Description
ID	Unique number for each entry
Country	Name of the country where the well is situated
Well/location name	Name of the well or well location (geographic)
Well short name	Short name, number or code of the well
Co-ordinates (x, y)	Co-ordinates of the well surface location
Spud date	Start date (drilling of the well)
Completion date	End date (drilling of the well)
Owner/operator	Name or ID of the owner or operator of the well
End depth (MD, TVD)	End depth of the well (measured depth, total vertical depth)
Stratigraphy at TD (general, details)	Stratigraphic level at the end depth of the well (general period, formation or group)
Target stratigraphy (general, details)	Target stratigraphic level (general period, formation or group)
Result	Result with respect to hydrocarbon exploration (e.g. gas, oil, dry hole)

Table 2. Metadata for 2D-seismic lines.

Name	Description
ID	Unique number for each entry
Country	Name of the country supplying the data / where the 2D seismic line was recorded
Survey	Name of the 2D-seismic survey
Line	Name of the 2D-seismic line
Additional information	Optional additional information on the survey or survey operator
Completion date	Year (or a more specific date) when the seismic line was recorded

Table 3. Metadata for 3D-seismic surveys.

Name	Description
ID	Unique number for each entry
Country	Name of the country supplying the data / where the 3D-seismic survey was recorded
Survey	Name of the 3D-seismic survey
Additional information	Optional information about the survey or survey operator
Completion date	Year (or a more specific date) when the seismic survey was recorded

## Oil and gasfield attributes

A dataset of oil and gasfields in the SPBA area has been compiled with input mainly from the participating organisations (Table 4). In some cases, regulatory or commercial confidentiality, or lack of data, did not allow the datasets to be completed. Where possible, the data gaps were filled by data provided by IHS Energy.

Table 4. Oil and gasfield attribute data in the SPBA Project Database.

Name	Description
ID	Unique number for each entry
Country	Name of the country where the field is located
Field name	Name of the field
Discovery year	Year in which the discovery well was drilled
Discovery well	Well that discovered the field
Reservoir age	Age of the reservoir rock
Reservoir lithology	Lithology of the reservoir
Fluid type	Gas, oil or oil and gas
Source rock	Name of the rock that sourced the reservoir
Depth	Approximate depth of the top of the structure
Initial pressure	Initial pressure of the reservoir
Temperature	Temperature of the reservoir
Field size	Gas or stock tank oil initially in place (HClIP)
Recoverable volume	The quantity of oil or gas to be recovered
Cumulative production	Amount of gas/oil produced until present
Development status	Status of the development
Year start of production	Year of production start
Year end of production	Year of production end
Petroleum province number	Number of petroleum province used in Appendix 3 and Chapter 15

## Source-rock geochemistry

The geochemical properties of the source rocks in the SPBA area are described in Chapter 13. The diagrams and graphs in the chapter are based on the data held in the SPBA Project Database (Table 5). This database was compiled from contributions by the participating countries with additional information from published sources. The geochemical data show the source-rock organic-matter quality and quantity, as well as its maturity. Rock-Eval pyrolysis and vitrinite reflectance (VR) data make up most of the geochemical data in the SPBA Project Database, although it also holds molecular and isotope data. All data are categorised by area (basin) and unit (stratigraphy).

Table 5. Approximate numbers of datasets in the SPBA Project Database – source-rock geochemistry.

Country	OM quantity (TOC)	OM quality (S <sub>2</sub> , HI)	Maturity	Other (%Ro, T <sub>max</sub> )	Main data suppliers
Entire database	9750	9950	13 450	720	All participating countries
United Kingdom	900	850	900	180	TNO, CCGS, IGI Ltd.
Belgium	200	200	250	0	GSB, TNO
The Netherlands	4500	4500	8650	200	TNO
Denmark	1200	1200	1350	40	GEUS
Germany	1100	1100	750	250	BGR
Poland	1600	1550	1250	30	POGC, PGI
Lithuania/Russia	250	550	300	20	IGI Ltd.

## Gas composition

In addition to source-rock data, the SPBA Project Database includes a gas database and selected molecular data on oils. The gas database consists of gas composition and isotope data from more than a thousand locations (Table 6). The database contains contributions from the participating countries combined with data from the Northwest European Gas Atlas Project (Lokhorst et al., 1998).

Table 6. Number of datasets in the SPBA Project Database – gas composition.

Country	Gas composition	Gas isotopes	Main data suppliers
Entire database	2309	130	All participating countries
United Kingdom	26	0	NW European Gas Atlas Project
The Netherlands	1416	130	TNO
Denmark	14	0	NW European Gas Atlas Project
Germany	258	0	NW European Gas Atlas Project
Poland	595	0	POGC, PGI

## GIS Maps presented in the Atlas

All grid and vector data presented in the SPBA are available on DVD in ESRI shape file or (ASCII) grid format. The DVD also includes all GIS maps listed below as ESRI Arc Map Document (MXD) and Adobe Portable Document Format (PDF).

Figure number	Map title	Scale		
		3M	6M	other
1.2	Topography and bathymetry			
1.3	Pre-Quaternary subcrop			
1.4	The distribution of about 1240 oil and gasfields in the Southern Permian Basin Atlas area including the 35 hydrocarbon field examples			
1.6	Locations of well and seismic data used to produce the 1 : 3 million scale lithostratigraphic depth maps			
2.1	Crustal structure of the Southern Permian Basin area and its surroundings			
2.2	Depth to the Moho Discontinuity			
2.19	Gravity. Bouguer (onshore) and free-air (offshore) anomaly			
2.20	Gravity. Free-air anomalous			
2.21	Gravity. Residual 1 (upward 2 km – upward 10 km)			
2.22	Gravity. Residual 2 (upward 5 km – upward 40 km)			
2.23	Magnetics. Total field			
2.24	Magnetics. Total field reduced to the North Pole			
2.25	Magnetics. Total field – pseudogravity			
2.26	Geothermal. Heat-flow density (uncorrected)			
2.27	Geothermal. Temperature level - 1000 m			
2.28	Geothermal. Temperature level - 2000 m			
2.29	Geothermal. Temperature level - 3000 m			
3.3	Terranes amalgamated to form Laurussia			
3.5	Terranes amalgamated to form Pangea			
3.9	Early Permian (lower Rotliegend) tectonic evolution: Artinskian (280 Ma)			
3.11	Late Permian (Zechstein Z2) tectonic evolution: Wuchiapingian (255 Ma)			
3.13a	Early Triassic tectonic evolution: Olenekian (248 Ma)			
3.13b	Mid-Triassic tectonic evolution: Ladinian (237 Ma)			
3.15	Late Triassic tectonic evolution: Norian (216 Ma)			
3.17	Early Jurassic tectonic evolution: Sinemurian (195 Ma)			
3.19a	Late Jurassic tectonic evolution: Kimmeridgian (152 Ma)			
3.19b	Early Cretaceous tectonic evolution: Hauterivian (132 Ma)			
3.21	Late Cretaceous tectonic evolution: Santonian (85 Ma)			
3.25	Late Paleocene tectonic evolution: Selandian (59 Ma)			
3.26	Early Miocene tectonic evolution: Aquitanian (23 Ma)			
3.30	Salt tectonics			
3.31	Locations of regional seismic lines shown in Figures 3.32 to 3.43			
4.2	Locations of boreholes and pre-Devonian outcrops (with geology and chronostratigraphy)			
4.3	Depth to the top of the pre-Devonian basement			
4.18	Possible maximum extent of the Upper Cambrian 'Upper Alum Shale'. Fields with pre-Devonian reservoir			
5.2	Devonian rocks in deep boreholes			
6.2	Carboniferous structural elements			
6.4	Permian subcrop in the SPBA area			
6.18	Namurian and partly Dinantian black shales in the Northwest European Carboniferous Basin			
6.19	Maturity at the top of the Carboniferous			
6.20	Carboniferous reservoirs in the SPBA. Fields with Carboniferous reservoir			
7.2	Depth to the base of the upper Rotliegend clastics			
7.3	Thickness of the upper Rotliegend clastics			
7.20	Reservoir facies distribution of the lower part of the Slochteren Formation and its equivalents. Fields with Rotliegend reservoir			

Figure number	Map title	Scale		
		3M	6M	other
7.21	Reservoir facies distribution of the upper part of the Slochteren Formation and its equivalents. Fields with Rotliegend reservoir	■		
8.2	Depth to the base of the Zechstein	■		
8.3	Thickness of the Zechstein	■		
8.6	Thickness of Zechstein 1 deposits	■		
8.7	Thickness and palaeogeography of the Zechstein Limestone	■		
8.18a	Facies distribution of the Stassfurt Carbonates and equivalents. Fields with Zechstein reservoir	■		
8.18b	Thickness of the Stassfurt Carbonates and equivalents	■		
8.19	Thickness and palaeogeography of the Platy Dolomite Limestone deposits	■		
8.22	Distribution of the youngest Zechstein salts	■		
9.2	Depth to near base of the Lower Triassic (base of the Buntsandstein)	■		
9.3	Thickness of the Lower Triassic	■		
9.4	Depth to near base of the Middle Triassic (base of the Röt evaporites)	■		
9.5	Thickness of the Middle Triassic	■		
9.6	Depth to near base of the Upper Triassic	■		
9.7	Thickness of the Upper Triassic	■		
9.11	Present-day distribution and facies of the Middle Buntsandstein Subgroup and equivalents. Fields with Triassic reservoir	■		
10.2	Depth to near base of the Lower Jurassic (base of the Lias Group)	■		
10.3	Thickness of the Lower Jurassic	■		
10.4	Depth to near base of the Middle Jurassic (top of the Lias Group)	■		
10.5	Thickness of the Middle Jurassic	■		
10.6	Depth to near base of the Upper Jurassic	■		
10.7	Thickness of the Upper Jurassic	■		
10.8	Paleogeographical evolution in the Southern Permian Basin area during the Jurassic			■
10.11	Distribution of Jurassic hydrocarbon reservoirs. Fields with Jurassic reservoir	■		
10.12	Lower Jurassic source rocks	■		
10.13	Upper Jurassic/Lower Cretaceous source rocks	■		
11.2	Depth to near base of the Lower Cretaceous (approximately near base Ryazanian)	■		
11.3	Depth to the base of the Upper Cretaceous (base of the Chalk Group, base Cenomanian)	■		
11.4	Thickness of the Lower Cretaceous	■		
11.5	Subcrop at the base of the Lower Cretaceous	■		
11.6	Thickness of the Upper Cretaceous	■		
11.7	Subcrop at the base of the post-Chalk Group (near the base of the Tertiary)	■		
11.22	Fluid overpressure at top Chalk level in the central North Sea			■
11.24	Distribution of Cretaceous hydrocarbon reservoirs. Fields with Cretaceous reservoir	■		
12.1	Depth to near base of the Tertiary (top of the Chalk Group, top Danian)	■		
12.14	Depth to the base of the Quaternary	■		
13.1a	The petroleum provinces and districts in the Southern Permian Basin area. Fields related to Paleozoic source rocks	■		
13.1b	The petroleum provinces and districts in the Southern Permian Basin area. Fields related to Mesozoic source rocks	■		
13.4	The Baltic Basin petroleum province with fields and accumulations charged by pre-Devonian source rocks	■		
13.7	The western area of the Northwest European Carboniferous Basin with fields and accumulations charged by Namurian source rocks	■		
13.10	The East Midlands petroleum province with fields and accumulations charged by Namurian source rocks	■		
13.14	The Cleveland Basin petroleum province with fields and accumulations charged by Namurian source rocks	■		
13.18	The Pomeranian petroleum province with fields and accumulations charged by Early Carboniferous and/or Namurian black shales	■		
13.22	The Fore-Sudetic Monocline petroleum province with fields and accumulations charged by Early Carboniferous and/or Namurian black shales	■		
13.26	The Lublin Basin petroleum province with fields and accumulations charged by Early Carboniferous and/or Namurian black shales	■		

Figure number	Map title	Scale		
		3M	6M	other
13.30	The Anglo-Dutch and North German basins petroleum province with fields and accumulations charged by Westphalian Coal Measures			■
13.33	The Pomeranian petroleum province with fields and accumulations charged by Zechstein source rocks			■
13.36	The Fore-Sudetic Monocline and Brandenburg petroleum province with fields and accumulations charged by Zechstein source rocks			■
13.40	The Weald Basin petroleum province with fields and accumulations charged by Lower Jurassic source rocks			■
13.44	The Dutch Central Graben petroleum province with fields and accumulations charged by the Posidonia Shale Formation			■
13.50	The West Netherlands and Broad Fourteens basins petroleum province with fields and accumulations charged by the Posidonia Shale Formation			■
13.54	The Lower Saxony Basin and Dogger Troughs petroleum province with fields and accumulations charged by the Posidonia Shale Formation			■
13.58	The Tail End Graben petroleum province with fields and accumulations charged by Jurassic source rocks			■
13.63	The Lower Saxony Basin petroleum province with fields and accumulations charged by Wealden source rocks			■
13.67	Distribution of bright spots and amplitude anomalies in the southern North Sea			■
14.2a-h	Licensed acreage awarded over time by decade			■
14.3	Licensed acreage at 1 January 2006			■
14.6a-e	2D seismic-data coverage by decade			■
14.7a-c	3D-seismic data coverage by decade			■
14.9	Exploration wells drilled showing results			■
14.10	Exploration well bottom-hole stratigraphy			■
14.11	Exploration well targets			■
14.12a-e	Exploration wells drilled by decade			■
14.13a-e	Exploration wells drilled by decade showing results			■
15.1	Overview of petroleum provinces related to Paleozoic source rocks			■
15.2	Overview of petroleum provinces related to Mesozoic and Cenozoic source rocks			■
15.3	The Baltic Basin petroleum province. Fields charged by pre-Devonian source rocks. Main reservoir: Cambrian			■
15.5	The Anglo-Dutch and North German basins petroleum province. Fields charged by Westphalian Coal Measures. Main reservoirs: Rotliegend, Zechstein, Triassic, Cretaceous			■
15.7	The East Midlands and Cleveland Basin petroleum province. Fields charged by Namurian source rocks. Main reservoirs: Carboniferous, Zechstein			■
15.9	The Thüringian and Sub-Hercynian basins petroleum province. Fields charged by Zechstein source rocks. Main reservoir: Zechstein			■
15.11a	The Pomeranian petroleum province. Fields charged by Early Carboniferous source rocks / Namurian black shales. Main reservoir: Rotliegend			■
15.11b	The Pomeranian petroleum province. Fields charged by Zechstein source rocks. Main reservoirs: Carboniferous, Zechstein			■
15.13a	The Fore-Sudetic Monocline and Brandenburg petroleum province. Fields charged by Early Carboniferous source rocks / Namurian black shales. Main reservoir: Rotliegend			■
15.13b	The Fore-Sudetic Monocline and Brandenburg petroleum province. Fields charged by Zechstein source rocks. Main reservoir: Zechstein			■
15.15	The Lublin Basin petroleum province. Fields charged by Early Carboniferous source rocks / Namurian black shales. Main reservoir: Carboniferous			■
15.17	The Weald Basin petroleum province. Fields charged by Lower Jurassic source rocks. Main reservoir: Jurassic			■
15.19	The Tail End Graben petroleum province. Fields charged by Jurassic source rocks. Main reservoir: Cretaceous			■
15.21	The Dutch Central Graben petroleum province. Fields charged by the Posidonia Shale Formation. Main reservoir: Jurassic			■
15.23	The West Netherlands and Broad Fourteens basins petroleum province. Fields charged by the Posidonia Shale Formation. Main reservoirs: Jurassic, Cretaceous			■
15.25	The Lower Saxony Basin and Dogger Troughs petroleum province. Fields charged by the Posidonia Shale Formation and the Wealden. Main reservoirs: Jurassic, Cretaceous			■
15.27	The shallow gas petroleum province (Netherlands offshore). Main reservoir: Cenozoic. Fields with Cenozoic reservoir			■

# Order form ‘SPBA GIS Maps and Database’

Date [REDACTED]

P.O. number [REDACTED]  
(if applicable)



TNO Geological Survey  
of the Netherlands  
Princetonlaan 6  
P.O. Box 80015  
3508 TA Utrecht  
The Netherlands

## How to order

Complete this form, undersign, scan it and return it as pdf file to Hans Doornenbal  
by email: [hans.doornenbal@tno.nl](mailto:hans.doornenbal@tno.nl) or by fax: +31 88 866 46 05

## Buyer

Name [REDACTED]

Position [REDACTED]

Company [REDACTED]

Invoice address [REDACTED]

Zipcode [REDACTED]

Country [REDACTED]

Telephone [REDACTED]

Fax [REDACTED]

Email: [REDACTED]

VAT number [REDACTED]

## SPBA GIS Maps and Database

### Petroleum Geological Atlas of the Southern Permian Basin Area

DVD

While every precaution has been taken in the preparation and production  
of this publication, TNO Geological Survey of the Netherlands is  
not liable for possible damage that could result from any error  
(in content or execution) in this publication.

ISBN 978-90-9026-349-1

© 2010 TNO and contribution  
of individual authors

VAT number

NL002875718B01

## Wants to order

SPBA GIS MAPS AND DATABASE SOFTWARE VERSION 2010-1.0 and as  
further described in the product description “SPBA GIS Maps and Database”  
attached to this Order Form

Chamber of Commerce

27376655

## Email

[hans.doornenbal@tno.nl](mailto:hans.doornenbal@tno.nl)

First-site license. Fee € 10,000 excl. VAT

Second-site license. Fee € 10,000 excl. VAT

Multi-site license. Fee € 25,000 excl. VAT

Multi-site academic license.

Fee € 1,000 excl. VAT

Direct dialing

+31 88 866 46 19 or

+31 6 12 74 96 86

By countersigning this form, USER hereby acknowledges having received the TNO License Conditions - SPBA GIS Maps and Database  
and confirms its acceptance thereof.

Date

Signature buyer

## TNO LICENSE CONDITIONS – SPBA GIS MAPS AND DATABASE

### DEFINITIONS:

In these conditions and in the "Order form ' SPBA GIS Maps and Database" (the "Order Form"):	
"TNO" shall mean:	Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO (Netherlands Organisation for Applied Scientific Research TNO), having its registered office and principal place of business in The Hague, The Netherlands.
"SOFTWARE" shall mean	the computer programs including map data and databases in the version specified in the Order Form and as far as ordered via the Order Form, including - if applicable - the database(s) and any records or data elements contained therein, and protection key(s).
"USER" shall mean	the client of TNO mentioned in the Order Form.
"SITE" shall mean	a specified geographic location residing in a single building or contiguous set of buildings sharing the same physical address and under common management.

### Article 1

Subject to the terms herein set forth, TNO hereby grants to the USER a non-exclusive, non-transferable license to install and use SOFTWARE on one or more computers for use by USER personnel under the license type specified in the Order Form (First-Site License; Second-Site License; Multi-Site License or Multi-Site academic license) for internal research or academic purposes only (the "Purpose"). Such license shall not be assigned or sublicensed by the USER. USER hereby acknowledges and agrees that SOFTWARE constitutes proprietary and trade secrets and/or copyrighted material of TNO. The protection key, if part of SOFTWARE, represents the ownership of the license and will only be replaced by TNO if proven defective. In case of loss or theft of the key, replacement is the sole responsibility of USER. No rights or licenses are granted to USER, except as explicitly set out in this Article 1. USER may not use the SOFTWARE and/or any parts thereof and/or any intellectual property rights embodied therein for any purposes other than the Purpose explicitly stated in this Article 1. Any other use require the prior written consent of TNO, which may be subject to further conditions.

### Article 2

In consideration for the rights granted hereunder, USER shall pay a non-refundable license fee as determined in the Order Form for each package of SOFTWARE ordered by USER for the license type specified in the Order Form. Payment of the license fee does not transfer the rights, title or interest in SOFTWARE to the USER. All payments due to TNO hereunder shall be paid on a net base by USER, making reference to "**SPBA GIS MAPS AND DATABASE**" (Version 2010-1.0) within thirty (30) days from the invoice date, unless otherwise stated in the Order Form. USER shall pay statutory interest as well as any and all costs of collection if USER exceeds any term of payment hereunder.

### Article 3

USER is not allowed (and shall not allow others) to copy in whole or in part, modify, reverse compile or reverse assemble all or any part of SOFTWARE, or rent, lease, distribute, sell or create derivative works of SOFTWARE or any parts thereof. Unless otherwise explicitly stated in the Order Form, USER shall not publish SOFTWARE or parts thereof or disclose, provide, deliver or otherwise make available SOFTWARE in any form (including transfer in bulk of individual records of SOFTWARE or databases) to third parties, such including parties belonging to the same group of companies. USER acknowledges and agrees that TNO may from time to time remove one or more data elements from the database(s) and TNO shall have no obligation either to continue to supply any data element removed from said database(s) or to provide a substitute data element. Installation and implementation of SOFTWARE on the equipment of USER is the sole responsibility of the USER.

### Article 4

The material and information made available hereunder are for the use of client or USER in conducting its own development and production programs. TNO assumes no responsibilities whatsoever with respect to the use, or the results of the use of the SOFTWARE, the database(s) or parts thereof by USER. SOFTWARE is provided to the USER "as is". Neither TNO nor its suppliers make any representation or warranty of any kind including but not limited to warranties of fitness for a particular purpose, completeness, satisfactory quality, accuracy, non-infringement or merchantability, nor are any such warranties to be implied with respect to the SOFTWARE or any parts thereof, any TNO materials or any services furnished or any information, data element, software, or algorithms

provided or any results thereof. TNO shall not have any obligation to furnish data feeds, updates, assistance, information or documentation with respect to the SOFTWARE, except as provided for herein.

#### **Article 5**

TNO is not liable in any way whatsoever for damage sustained by the USER by the use of SOFTWARE or any parts or results thereof. Moreover, TNO will in no event be liable for damages sustained by third parties, arising out of the use of SOFTWARE by the USER and the USER indemnifies and holds TNO harmless against all claims and liabilities resulting from the use of SOFTWARE by the USER.

#### **Article 6**

In case the USER neglects or fails to perform or observe any of these conditions, the USER is liable for all damage emanating from such act. In that case the right to use SOFTWARE expires immediately while all the obligations of USER remain in full force.

#### **Article 7**

TNO is willing to offer USER helpdesk support for a limited period to such level of assistance as TNO may deem reasonable to effectively use SOFTWARE. Such support will be provided via e-mail and/or TNO web-services on a time and material basis to be specified in a separate agreement, at TNO's then current standard rates.

#### **Article 8**

USER shall not make any use of the name of TNO or of any other trademarks of TNO in connection with the use of the SOFTWARE by USER in any advertising, promotional or sales literature without the prior written consent of TNO. TNO shall not unduly restrict or prevent the use of the name of TNO by USER whenever or wherever required by applicable law or regulation, either domestically or internationally.

#### **Article 9**

The competent court in The Hague, The Netherlands, shall determine all disputes arising from or in connection with the present conditions, or from any further agreements relating thereto. Dutch Law is applicable.