

## Concept soil map

### Small investigation – A lot of information

by Jürgen SCHNEIDER, State authority for Mining, Energy and Geology,  
Stilleweg 2, 30655 Hannover E-mail: [juergen.schneider@lbeg.niedersachsen.de](mailto:juergen.schneider@lbeg.niedersachsen.de),  
Tel: +49-511-643-3593

**Keywords:** concept soil map, input data, soil mapping

#### Abstract

Over the last several years, there have been increasing requests for soil information from local governments for managing urban areas. A method of data acquisition has therefore been developed for describing the environment and evaluating pedologically relevant data as a basis for measures affecting the environment. In this data acquisition method, a factor analysis is realized to determine which factors affect the soils in the urban area. This method has been applied in various research programs (HAMMERSCHMIDT & SCHNEIDER 1995, SCHNEIDER 1994, BARTSCH et al 1997, ARBEITSKREIS STADTBÖDEN 1997). Pedologically relevant data was selected and subjected to a factor analysis in order to determine the initial geogenic situation and the anthropogenic changes. The initial data was stored in various thematic layers for map overlays for intersection in a geoinformation system. The concept soil map prepared in this way reveals the combination of factors affecting the environment. The information can be used to predict soil distribution and soil properties and can be interpreted for the user's purposes. The concept soil map is also an effective basis for field work. The use of previously acquired pedologically relevant data shortens the time for a field survey and consequently it lowers the costs of pedological mapping and evaluating soil data.

#### Introduction

In order to meet the increasing demand for information on soils, methods are needed for making this information available in suitable form to the user. In the selection of the appropriate method, not only the required hardware need to be taken into consideration, but also how data acquisition, representation, and interpretation are implemented.

In this context soil mapping is a important aspect because they provide previously acquired information as well as field data. The results of soil mapping are stored in computer databases as point, profile, and areal data. In the past, soils in urban areas were not included on soil maps. Owing to the increased need for soil data for urban ecological problems, a deficit of information on soils in urban, industrial, and mining areas has become increasingly apparent. As the demand for such information has increased, research has conducted to alleviate this deficit (cf. AK STADTBÖDEN 1997).

The concept for mapping urban soils in Lower Saxony envisages making all pedologically relevant information available on a Concept Soil Map. This map would then be used as a

basis for soil mapping in urban areas, as routinely done in nonurban areas of Lower Saxony and in a similar form in test studies in urban areas.

The pedologically relevant information needed for urban soil mapping is not necessarily the same as that needed for nonurban areas. In order for mapping procedures to be uniform throughout the state, pedologically relevant data available for all parts of the state must be used and supplemented where necessary.

### **Input Data**

Information relevant for the soil mapping of urban, industrial, and mining areas can be divided into geogenic factors and anthropogenic factors. Geogenic factors

A) Information level: Soil Assessment As shown by test studies (CORDSEN 1990, SCHNEIDER 1994), soil assessment data provides valuable information for soil mapping in urban areas. This data is especially detailed in the case of areas that have been settled for the first time in the last sixty years.

B) Information level: Geological Map The geological map provides important information about the parent material of the soils. The petrographic and geogenetic information on the geological map also aid identification and localization of anthropogenically changed areas. C) Information level: Soil Map A 1 : 50 000 soil map covering all of Lower Saxony is available. The scale of this map is normally too small to be useful for urban studies, but it does provide valuable information about the natural soil conditions. D) Information level: Relief Relief data provides information about erosion and accumulation areas in the planned survey area. Elevation data is more important for surveys in southern Lower Saxony than in relatively flat northern Lower Saxony.

### Anthropogenic factors

A) Information level: Land use (past and present)

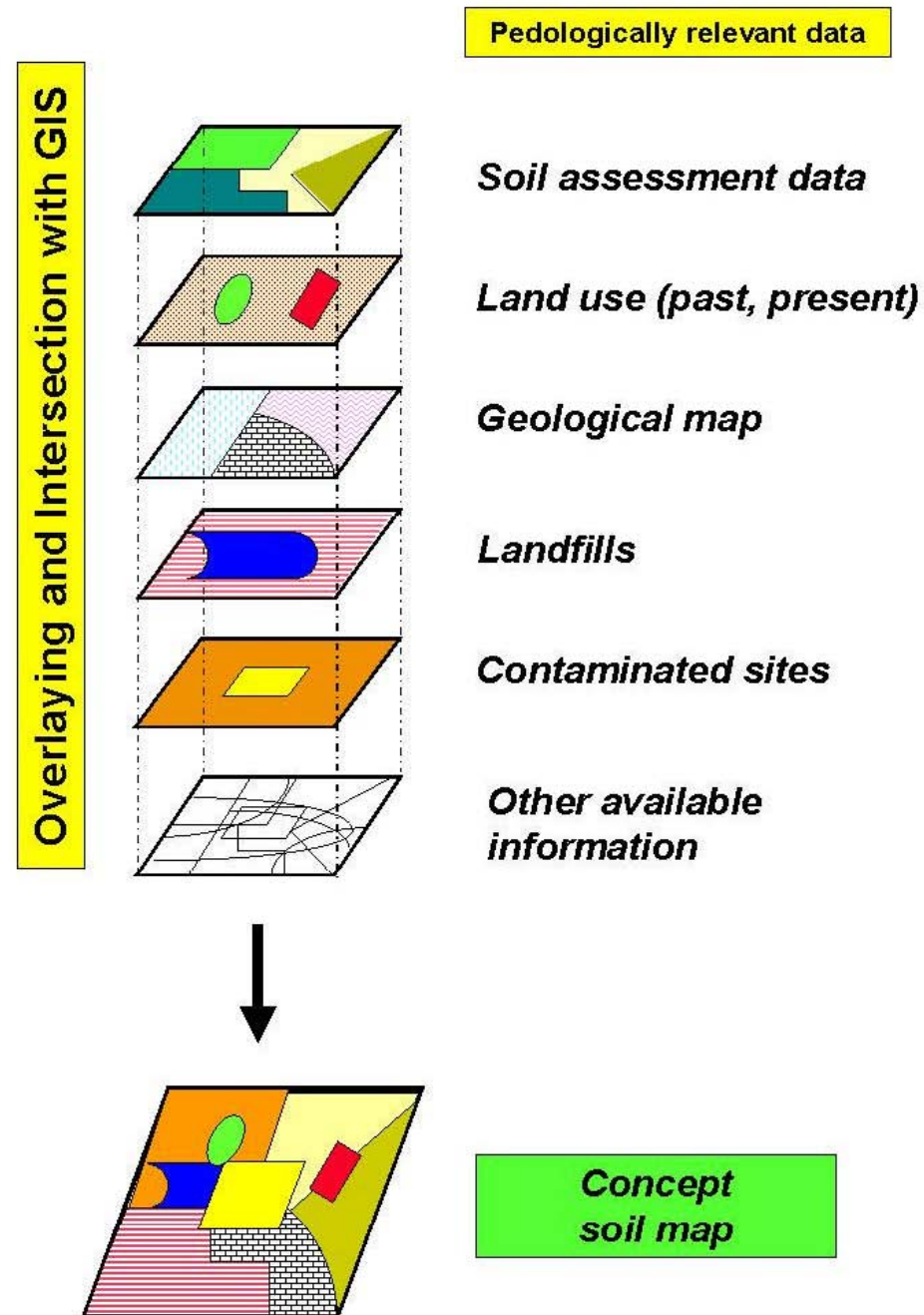
Land use is a major factor for soil conditions in an urban area. Current land use can be obtained from the ATKIS databases. Land use in the past can be derived from old maps.

B) Information level: Current and Abandoned Landfills Information on current and abandoned landfills proved to be very useful in test soil surveys in urban areas. Such areas could be targeted for pedological analyses. Such data is available for all of Lower Saxony.

C) Information level: Foundation Soil Map Foundation soil maps also contain information about landfills. Like the information of current and abandoned landfills, this data can be used to target specific areas for pedological analyses.

D) Information level: Contaminated sites Information on contaminated sites makes it possible to target such areas for chemical analyses.

Fig 1. Flow chart Concept Soil Map



## Interpretation

The Concept Soil Map is prepared by linking pedologically relevant data in overlays and intersection of the geogenic and anthropogenic factors. New areas with new combinations of factors are formed by this procedure. On the basis of this new combination of data, hypotheses about the pedological properties of the soils in these areas are possible.

Experience has shown that factor combinations resulting from intersection should be aggregated before Concept Soil Map can be used as a basis for a soil survey. For example, the stratigraphic data could be aggregated on the basis of the petrography. In general, areas should be combined that have different factor combinations that point to the same pedological properties. This reduces the number of factor combinations that need to be investigated in the field.

Test studies in the field, evaluated using the hypothesis that "the same land use and the same initial geogenic conditions lead to the development of the same soil properties", have demonstrated that the information on the Concept Soil Map is relevant for urban soil surveys. For example, in a pedological field survey the hypotheses made on the basis of the Concept Soil Map were verified. With investigation of 2 % (70 of 4000 factor combinations) results for about 25 % of the area (50 of 200 km<sup>2</sup>) are elaborated (BARTSCH et al. 1997).

## Results

The Concept Soil Map is important as a means of making pedological information available, as well as for preparation for field work.

- Areas are marked in which the same pedologically relevant data point to the same pedological properties.
  - The user can select areas that are of interest for his/her field work.
- These two aspects make it possible to target areas for soil mapping and sampling, reducing survey cost.

Data on the physical, chemical, and biological properties of a soil obtained in Lower Saxony by any governmental agency are required by law to be given to the Lower Saxony Geological Survey (NLfB), where it is to be entered into the Lower Saxony soil information System NIBIS. This data base will be used to develop guidelines for characterization of urban soils.

## References

- Arbeitskreis Stadtböden der Deutschen Bodenkundlichen Gesellschaft (1997): Empfehlungen des Arbeitskreises Stadtböden der Deutschen Bodenkundlichen Gesellschaft für die bodenkundliche Kartierung urban, gewerblich, industriell und montan überformter Flächen (Stadtböden), 2. Auflage, 111 S., 61 Tab., 9 Abb.
- Bartsch,H.U, Kues,J., Sbresny,J & SCHNEIDER,J. (1997): Soil information system as part of a municipal environmental information system, Environmental Geology, Vol. 30, Number 3/4, p. 189–197, 9 Fig., Springer Verlag
- Cordsen,E. (1990): Möglichkeiten des Einsatzes von Daten der Reichsbodenschätzung bei Stadtbodeninventuren, Mitt. Dtsch. Bodenkundl. Gesellsch., 61, S. 73–76
- Hammerschmidt,U. & Schneider,J. (1995): Ermittlung und Bewertung der flächenhaften Schwermetallbelastung im Boden in einem durch industrielle Immissionen geprägten Raum (Stadt Nordenham), Mitteilgn. Dtsch. Bodenkdl. Gesellschaft, Bd. 76/II, S. 1053–1057
- Schneider,J. (1994): Eignung DV-gestützter Verfahren zur bodenkundlichen Datenerhebung in urbanen Räumen, Dissertation, Univ. Essen, 138 S. 45 Abb., 19 Tab.