

SV-210**High resolution monitoring**

Title	: High resolution monitoring as a basis for integral groundwater (quality)management in urban areas
Theme	: Water systems
Estimated project costs	: NLG 631,600.00

CONSORTIUM

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SUMMARY**- Objective**

- Make an inventory of the questions that municipalities and perhaps even provinces have in the field of urban groundwater (quality) management, which can be answered with high resolution monitoring in space and in time.
- Uncover the knowledge, methods and techniques available in the literature, at knowledge institutions and at universities and to indicate how these can be used to solve a number of the problems the municipalities are facing.

- Bottlenecks

- To fill up the lack of knowledge at the practical and end user levels regarding the possibilities of high resolution monitoring in space and in time to resolve problems regarding urban groundwater (quality) management.
- Apply and make accessible the methods and techniques that are available at universities and knowledge institutions but which have not yet found their way to the consultancy agencies, municipalities and provinces.

- **Approach**

Phase 1

During the initial phase an inventory was conducted in close cooperation with the end users (municipalities and provinces) regarding the current questions in the field of urban groundwater management that can be tackled by high resolution monitoring. At the same time, during Phase 1, the methods and techniques were reviewed that are available in the literature and at knowledge institutions and are suitable for tackling the questions of the end users.

Phase 2

Between Phase 1 and Phase 2 a go/no go decision was taken. Depending on the number and the nature of the questions that emerged from the workshops in Phase 1, a decision was made regarding whether or not Phase 2 would be started. In the end there were enough questions that appeared to be answerable using techniques for the interpretation of large amounts of data, thus Phase 2 will be conducted. The SKB test committee was involved in this go/no go decision.

Subsequently a number of questions were selected on the basis of two cases and translated into hypotheses that will be used for the elaboration during Phase 2. As a follow-up to the literature study some promising methods and techniques have been tested using the measured data. The application of the methods to the data obtained was designed to gain experience with the processing of the large data streams as well as to find an answer to the following questions: Which calculation methods are essential? How do these measurements provide information?

Subsequently the most suitable data interpretation methods and techniques for the selected hypotheses were selected and elaborated. This does not primarily involve the development of new methods or techniques, but rather the selection and combination of existing techniques. Finally the methods and techniques were tested on the available data series. During the data analysis, the amounts of data and insights appear to lead to new questions. It is possible to select methods and techniques that can be used to (1) answer the questions and support or counter the hypotheses and (2) process the large amounts of data that will be collected over the next few years in the scope of 'Waterstad 2000'.

- **Results**

Phase 1:

1. A measurement net;
2. Report from a workshop on an initial inventory of questions posed to (policy) functionaries at municipalities regarding soil and groundwater quality management that may possibly be solved by the insights provided by high resolution monitoring;
3. Report from a second workshop in which the questions from the internal workshop are prioritised, tested and elaborated/supplemented;
4. Poster presentation for the World Water Forum;
5. Demo for the World Water Forum;
6. Final report Phase 1, including the questions that will be elaborated in Phase 2 plus a general indication of the possible solutions;
7. Detailed basic project plan for Phase 2

Phase 2:

8. A data set consisting of the measurements of all the divers used in the Waterstad 2000 project. We expect measurement results on hydraulic heads, electrical conductivity and temperature. The measurement frequencies will vary between 1 to 2 measurements per hour.
9. A database in which the above-mentioned data set will be stored in such a way that it is easily accessible.
10. A report on methods for obtaining relevant information on the monitoring of the groundwater system with the help of the data sets.
11. To be able to answer two or three of the municipalities' questions, a method or technology will be elaborated per question in a concrete (monitoring) application based on a specific case. This will result in two or three methods or technologies to answer two or three questions.
12. A (probably digital) final report with a description of the applied and developed methods plus recommendations on the implementation of concrete (monitoring) applications.
13. Poster presentation at Aquatech 2000
14. An application demonstration, to be used at Aquatech 2000

15. A publication in a journal for specialists, such as H₂O. It may be possible to compile a special issue of Waterstad 2000 in which the various work groups (including the work group Soil) can present their results.
16. (Optional) An external workshop, can be added to the project as an option for distributing and testing of the results among a wider audience. This may also be combined with an SKB symposium.

- **Keywords**

Measurement sensors, measurement data, high resolution monitoring, monitoring, data files, statistical analysis, geographical information system, groundwater, surface water, groundwater contamination, (ground)water systems, cities, municipalities, Delft.