RECOMMENDATIONS ON RISK ASSESSMENT OF IMPACTS ON GROUNDWATER QUANTITY AND QUALITY

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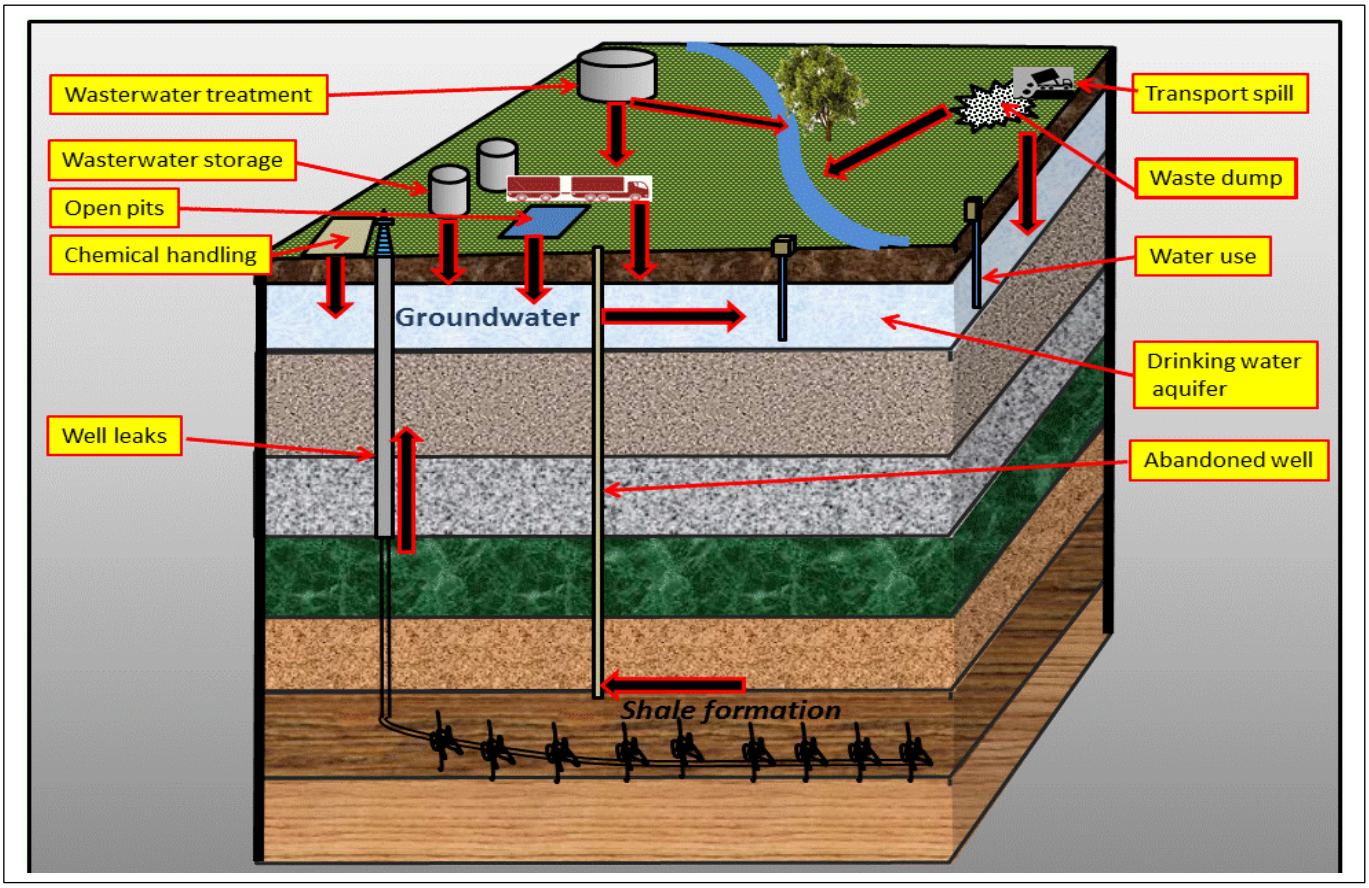

Background

The main objective of the M4ShaleGas project was to summarize the existing knowledge related to the surface, subsurface, atmospheric and social impacts of shale gas exploration and production. One of the topics addresses the environmental impacts related to groundwater and surface water contamination. Topics include relevant methodologies, geological models, and impacts on groundwater quality and finally the potential toxic contaminants. The research activities summarize the knowledge gap relevant for a European assessment of application related to hydraulic fracturing on-shore.

Study

This study assessed the available data and existing best practices from North America of the environmental problems related to groundwater and surface water contamination. The study includes a review of scientific literature, including the reports and scientific papers from the research and information, to assess knowledge and experience of the potential for hydraulic fracturing to change the quality or quantity of surface and groundwater resources. Drinking water is defined in this study as any groundwater or surface water that may serve as a source of drinking water for public or private use. The study has compiled the reviews with emphasis placed on the problems and solutions that can be attributed to hydraulic fracturing and only minor attention to general pollution risks of on shore drilling has been given.

Results

The main results shows that groundwater may be potentially contaminated by extraction of shale gas both from the constituents of shale gas itself, from the fracking liquid injection used for hydraulic fracturing or from flowback and produced water released during gas extraction, which may have a high content of saline formation water. The large volumes of water required may reduce groundwater resources, which influence other uses as drinking water, industry and agriculture and also ecosystems dependent on groundwater influx. On-site spills or leaks could potentially occur during mixing and preparation or during transport to the site. The large amounts of solid waste and cuttings present a particular risk due to the content of environmentally harmful substances and, in some cases, radioactive substances.

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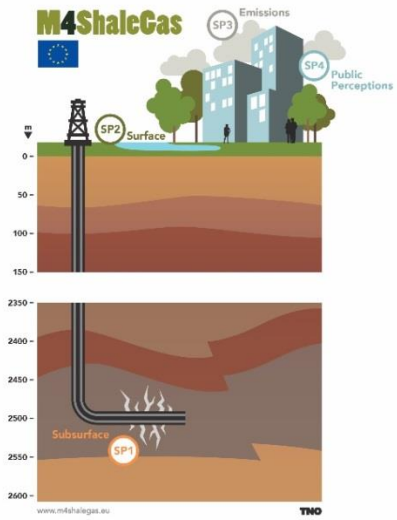
Science-based Recommendations

It is recommended that decision-makers when dealing with hydraulic fracturing activities should be focused on:

- Water acquisitions for hydraulic fracturing over time and in areas of low water availability. The baseline study should as a minimum include groundwater flow properties and its chemical composition. Monitoring design must be based on a priori local characterization of the hydrological and hydrogeological conditions. Characterization and monitoring must be organized according to: 1) Improve knowledge and understanding of the local area. 2) Documenting this understanding by observations. 3) Be able to conduct remediation of inappropriate influences.
- Spills during handling of hydraulic fracturing liquids and additives. Spills of produced water during the handling stage have reached groundwater and surface water resources in some cases. The lack of information of the composition of chemicals in fracturing fluids, and the fate and transport of spilled fluids greatly limits the ability to evaluate the potential impacts to surface water and groundwater resources. Spill prevention plans and response activities might prevent spilled fluids from reaching groundwater or surface water and minimize impacts from spilled fluids.
- Correct management of flowback and produced water that result in large volumes of wastewater with high concentrations of chemicals that might reach groundwater. In order to predict impact from spills or accidents baseline monitoring data and field studies of hydrogeological properties of the areas in question are needed. However, knowledge on the chemical composition of fracturing fluid is equally important and a full disclosure of additives is needed.
- Avoid injection of hydraulic fracturing fluids which could leak directly into ground water aquifers. Migration via leaks in old or abandoned deep wells is the most likely pathway that could permit injected chemicals and dissolved compounds from the shales from depth to contaminate shallower aquifers. Only minor possibilities exist for hydraulic fracturing to create subsurface pathways that could permit contamination of shallower aquifers from injected chemicals and dissolved compounds from the deep shales.
- Discharge of inadequately treated hydraulic fracturing wastewater to surface water should be avoided in any case. Disposal or storage of hydraulic fracturing wastewater in unlined pits, resulting in contamination of ground-water must not take place. For a safe development, a number of environmental projects should be initiated, e.g. analyses of existing cases of the environmental problems with wastewater handling. Further, a potential classification of liquid wastes as industrial or hazardous, thereby subjecting them to additional testing and disposal requirements. Finally, a number of controlled experiments to understand processes that are responsible for or may result in groundwater contamination from surface spills.
- The large amounts of solid waste and cuttings present a particular risk due to the content of environmentally harmful substances and, in some cases, radioactive substances. Storage must be carried out with greatest control by testing solid waste and clear risk-based classification indicating the NORM level in waste would prompt more stringent waste management practices.

The Project

M4ShaleGas examines the potential environmental impacts and risks related to **shale gas** exploration and exploitation in Europe with the goal to build a technical and social knowledge base on best practices and innovative approaches for **m**easuring, **m**onitoring, **m**itigating, and **m**anaging these impacts.



4 sub-programs:

- SP1-subsurface
- SP2-surface
- SP3-air emissions
- SP4-public perceptions

Funding:
The project that has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement number 640715.

Horizon 2020 Topic LCE-16-2014:
Understanding, preventing and mitigating the potential environmental impacts and risks of shale gas exploration and exploitation.

Project duration:
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Coordination:
TNO

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