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# Foreword

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*Wolfgang Rauch and Zizzimos Vergos*

Sewer systems are among the most valuable and cost-intensive structures in the urban environment representing a considerable national capital asset for most countries. Typically these sewer pipes are designed with a life expectancy of approximately 50 years but some of them have already lasted for more than 100 years. Thus it is clear that the majority of the existing pipe network has been constructed with rules, guidelines and principles which differ from the ones generally applied today. Most notably, until three decades ago, the tightness of joints between pipes was not considered to be an issue and sewer infiltration has been seen as unavoidable (and sometimes even as a desired feature for drainage). A second aspect of the rather long life expectancy of sewers is their proneness to degradation, defects and subsequent leakage. This has led to increasing local flooding, groundwater pollution and reductions in sewage treatment plant performance.

Following the above, a typical sewer system has to be considered as being an inherently leaky system that does not comply with the EU Standard EN 752 which requires a “watertight” system. The water industry is now beginning to realise that even small exfiltration losses (<2%) can be potentially prejudicial to long term environmental quality and sustainable urban water resource management. Wastewater can also exfiltrate from the sewer network, thus contributing to groundwater pollution in the urban environment. In cases where the groundwater table is above the sewer, water can infiltrate which leads to huge amounts of parasitic water and unnecessary costs to the treatment plant. Such infiltration has long been recognized by water authorities, but the APUSS project has also highlighted the potential problems that might be associated with exfiltration leakage.

Following early awareness and publications in the 1990’s, a group of universities, consultants, companies and municipalities applied for funding under the 5<sup>th</sup> Framework programme of the EU to assess this problem of sewer infiltration and exfiltration. This book summarizes the achievements made during the course of the project APUSS. A significant effort of the group has been devoted towards the development of innovative tracer measurements in sewers to assess the amount of exfiltration and infiltration given the inherent difficulties and high costs associated with traditional pressure testing and CCTV survey. Although not a simple and straightforward technique, the APUSS tracer methodology has contributed significantly to scientific innovation in the field. The methodology and its field application are described in several chapters and illustrate the difficulties of identifying and quantifying losses from sewer defects by applying conventional techniques. Following major achievements towards a better understanding of the role of sewer sediments and the colmation layer to the exfiltration process, the book depicts conceptual modelling of the phenomena on both catchment and sewer reach scale. The final chapters deal with performance indicators and economic issues. The development of cost-structure approaches for typical sewer systems also provides a basis for benchmark sewer asset surveys.

Overall, the APUSS project has led to significant new insights to the problem of leaky sewer systems and drawn attention to the urgent need to safeguard the capacity and efficiency of both existing and future sewer infrastructure. It has promoted a better scientific understanding of sewer processes under conditions of sediment deposition, with proposals for new definitions for the growth of “blocking” zones in open sewer joints and fractures. The role of sediment in achieving quasi-sealing conditions in sewers is now much better understood as well as the circumstances

under which equilibrium breakthrough can occur to cause disruption of the sealed joint or opening. This book is a most valuable source of information for scientists and practitioners interested in the phenomena.

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