

## ***Interactive comment on “I-WARP: individual water main renewal planner” by Y. Kleiner and B. Rajani***

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The authors would like to thank Mr. Beuken for his interest and useful comments.

Comment # 1: I-WARP is general enough to be used in any circumstances. Pipe-dependent covariates can be accommodated by simply creating a relevant homogeneous group. For example, if a utility has asbestos cement (AC) and cast iron (CI) pipes, with diameters of 6” and 8”, ideally, 4 homogeneous groups could be formed (AC-6”, AC-8”, CI-6”, and CI-8”) and I-WARP applied to each group separately. In situations where too few data exist for fine grouping, groups could be combined for analysis (some engineering judgment would be useful for deciding on which groups to combine). Readers should note that in situations where too few data exist for one or more classes of inventory the accuracy of the results will likely be compromised regardless of the type of model or whether or not covariates are considered explicitly or

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implicitly through grouping.

As for time-dependent covariates, here again the underlying model is flexible enough to consider any such covariate, provided data are available to support such an analysis. In its current form I-WARP supports 3 climate related covariates (freezing index, rain deficit-cumulative and rain-deficit-snapshot), two types of cathodic protection covariates and two user-defined time series. As is explicitly written in the last paragraph of section 3.2 of the manuscript, I-WARP can accommodate as a time-dependent covariate any time series (e.g., pressure regime changes, leak detection campaigns, etc.) that is thought to have an impact on observed historical breakage patterns.

Comment #2: Mr. Saegrov’s comments about the homogeneity of the data were addressed in an earlier response. It is hard to prescribe quality requirements of data, without discouraging water utilities from at least trying to apply any kind of model for their planning efforts. The authors’ experience in the field shows that no water utility has a perfect dataset and there are huge differences in data quality between water utilities. Even advanced water utilities with sophisticated GIS can have severe deficiencies in the quality of data that pertain sometimes to pipes laid more than 100 years ago. Data cleansing is always encouraged and the I-WARP program application has some (limited) built-in tools to filter out inconsistencies.

The authors’ sense is that it is prudent to have at least 5 years worth of failure data in order to obtain meaningful results, but of course a longer dataset is expected to increase accuracy and significance of results. Pipe-dependent data (material, diameter, vintage, service connections, etc.) is used as grouping criteria and the more data there are available the more refined the grouping, likely yielding more refined and accurate results.

The authors would like to re-iterate that the example given in the manuscript is just a small example selected for illustration and demonstration only. A full research report will soon be available from the Water Research Foundation (formerly known as

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AwwaRF), including a disk with the program. In this report there are descriptions of many other trial and case studies that may be of interest to readers.

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Interactive comment on Drink. Water Eng. Sci. Discuss., 3, 25, 2010.