Generating flow forecasts with uncertainty limits from rain gauge inputs in sewer systems require simple models with identifiable parameters that can adequately describe the stochastic phenomena of the system. In this paper, a simple grey-box model is proposed that is attractive for both forecasting and control purposes. The grey-box model is based on stochastic differential equations and a key feature is the separation of the total noise into process and measurement noise. The grey-box approach is properly introduced and hypothesis regarding the noise terms are formulated. Three different hypotheses for the diffusion term are investigated and compared: one that assumes additive diffusion; one that assumes state proportional diffusion; and one that assumes state exponentiated diffusion. To implement the state dependent diffusion terms Itô's formula and the Lamperti transform are applied. It is shown that an additive diffusion noise term description leads to a violation of the physical constraints of the system, whereas a state dependent diffusion noise avoids this problem and should be favoured. It is also shown that a logarithmic transformation of the flow measurements secures positive lower flow prediction limits, because the observation noise is proportionally scaled with the modelled output. Finally it is concluded that a state proportional diffusion term best and adequately describes the one-step flow prediction uncertainty, and a proper description of the system noise is important for ascertaining the physical parameters in question.