

Interactive comment on “Domestic wells have high probability of pumping septic tank leachate” by J. E. Horn and T. Harter

Anonymous Referee #1

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The authors present a framework for estimating the probability of a domestic well pumping septic tank leakage as a function of aquifer properties, lot and drain field size. The research is interesting and appears to have made a significant contribution. I say “appears” because the presentation of the paper is not clear to understand well either what the authors have done, or some of the results that they claim. I would thus recommend that the paper is sent back to the authors for major revision, after which it should be sent out for re-review to assess the contribution of the paper. I have provided below some specific comments (both major and minor) at places where things were unclear. 1. Methods: My major comment regarding the methods is that the authors go into specifics without first giving a clear idea on what they are setting out to do which makes the paper very difficult to follow. I would suggest enhancing this section

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(both text and figures) prior to resubmission. a. An example is the first paragraph in Section 4. I had to go back to read the 2009 paper to understand that statement. While I am not asking that the authors go into full details on Methods and repeat the 2009 paper, it would be helpful to state a little bit more (maybe a Figure) so that this paper stands on its own. b. The same comments hold true for the entire section 4. At times there were too much details given (for example the function name in Matlab), but overall the explanation was not adequate to get a good understanding of what the authors have done. c. Figure 1: If the authors are not showing the capture zone here, what is the point of showing details on capture zone? Makes the figure confusing d. Figures 1 and 2 would benefit if the main capture zone and the elongated capture zones can be shown e. Description of the well capture zone is based on a numerical groundwater flow model. I am struggling to see then how the flow direction α is a probabilistic value? If we are focusing on the capture zone of a well, the flow direction is towards the well, no? What am I missing here? Can the authors please clarify? f. The capture zone of a pumping well is circular – how do the authors make the polygon assumption? 2. Results and Discussion: The results section should be enhanced with more figures and more quantitative analysis. Currently there are too many claims, but not enough figures or tables to substantiate them. In addition some figures are mislabeled. Following are some specific suggestions on improving this section: a. “Figure 3 shows results for all lot-drainfield” configurations” – this is not correct. Figure 3 shows pT for different values of K_h and K_g . It is not clear what lot-drainfield configuration this is for. b. The caption on Figure 3 also does not correspond to what is shown in the Figure. I think Fig 3 and Fig 4a have been switched. c. Since this is a parametric study, it is important to state in the figure caption the magnitude of the parameters that are held constant (lot size, drainfield size and K_g). This has not been done which makes it difficult to assess the results. d. Pg 5714, line 10: “For the half acre lots pT is above 50%”. This does not correspond to what is shown in the figures e. Pg 5714, third and fourth paragraphs: Instead of statements like “An increase of K_h causes an enlargement of the capture zone which results in an eightfold increase in pT. The smallest increase due to K_h is

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observed for the smallest lots, for which p_T is already very high at small K_h ; the largest lot and drainfield sizes are most sensitive to K_h ”, the authors should consider stating that the relationships are non-linear, and if possible fit a relationship to demonstrate the non-linearity f. The authors state in page 5715 “Generally, the larger the lots are, the lower the sensitivity to the gravel pack hydraulic conductivity, i.e., absolute variations of the intersection probability due to K_g decrease with increasing lot size. For the largest lots (L6) and the smallest drainfield (D1), the probability increase 5 between lowest and highest K_g is only 0.1%. Here, the variation of the size of the capture zone has only a marginal effect on the intersection probability”. Is this shown in a Figure somewhere? g. The authors should consider presenting one or more additional figures that help substantiate their claims better. Instead of making statements like parameter A has a greater effect than parameter B, the authors can think of presenting contour plots of change in p_T with changes in the two parameters along the two axes. Other options might be fitting the variations to equations and comparing the parameters of the equations h. Pg 5716 first para: Is there a figure showing this? i. Pg 5717: The authors have made statements made regarding the mass balance estimates being insufficient without adequate proof in the form of figures etc. Suggest adding a figure that states how Q_P/Q_r ratio provides an incorrect estimate of the probability of risk. j. Same comment holds true regarding the Q_s/Q_r estimation. Figures and more text are necessary to understand specifics. It is often unclear when the authors are switching between the mass balance estimations that they seem to be doing in the discussion section versus limitations of their probabilistic approach. k. Pg 5717: line 20 reference missing.

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