

# ESI Groundwater Flooding Note

Technical review

December 2016

## Background

ESI have produced a [note](#) suggesting that the annual damages associated with groundwater flooding are £530 million. They argue that around 75% of these costs are due to the influence of groundwater on other sources of flooding. As a result, they suggest that groundwater should be considered as an integrated catchment management issue rather than a local flood risk issue.

## Who else has estimated groundwater impacts?

The Committee for Climate Change (CCC) has previously [estimated the cost](#) of groundwater flooding as £156 million.

BGS has estimated the [number of properties](#) at risk from groundwater alone to be between 122,000 and 289,000. They also suggested that up to 960,000 properties could be at risk from a combination of groundwater and rivers or sea.

## Do we agree with ESI's estimate of groundwater annual damages?

The approach ESI have used is logical. The result of their calculation is within the range of possible results. However, that range is so large that any single figure given should be treated with caution.

We reproduced the ESI calculation, replacing the most uncertain data inputs with upper and lower estimates to understand the range of possible results. This method produced results between £70 million and £10 billion.

This result is important because of three reasons

1. The size of the range spans three orders of magnitude. This highlights a clear knowledge gap.
2. Even the bottom end of the range is significant in terms of overall flood risk (5% of total damages). This shows that we need to understand groundwater flood risk to be able to understand overall flood risk.
3. The top end of the range is clearly unrealistic. This demonstrates the need to balance theoretical estimates with empirical data in any future work.

## Do we agree with the estimate of properties at risk?

ESI state that there are 1.05 million properties at risk from at least one source of flooding with a 1% annual chance of flooding. We would estimate this as between 1.49 million and 1.66 million. Of this total, we estimate that around 30% of properties are affected by groundwater to some degree. About half of these (15% of the total) are affected by groundwater and at least one other source.

## Is there anything else missing?

The analysis by ESI focusses on direct damages to properties, this makes it a fair comparison with other sources. However, it doesn't value two factors that could change the relative importance of groundwater:

- **Missing receptors.** Groundwater often affects underground infrastructure such as sewers and the London underground. It can affect these receptors even when groundwater is near, but still below, the surface.

- **Indirect damages.** These damages include economic loss through closure of businesses or roads. Indirect damages tend to accrue over time, therefore they are likely to be much higher for long duration groundwater flooding than other sources.

### How does this relate to claims that we overstate annual damages?

Edmund Penning-RowSELL has written a paper suggesting that [economic damages from flooding are overstated](#). This note from ESI appears to contradict that work, suggesting that damages should be inflated further.

However, the focus of ESI's note is on the relative importance of groundwater compared to other sources of flooding. If damages from rivers and the sea really are overstated then all of the other numbers in ESI's note would decrease by a proportional amount. This would leave the relative importance of groundwater unchanged.

To help avoid confusion between these two papers it may be helpful to focus the discussion on groundwater's contribution to overall flood risk. ESI estimate this as 30%.

### How does the ESI estimate differ to the Committee for Climate Change estimate?

The ESI estimate was created to show the relative significance of groundwater to other sources of flooding. The Committee for Climate Change (CCC) estimate was created to use as baseline to see how flood risk could change in the future.

The ESI estimate is the higher of the two, both in absolute terms (ESI: £530 million, CCC: £156 million) and as a proportion of overall risk (ESI: 30%, CCC: 16%). However, both estimates focus on a very similar number of properties (ESI: 260,000, CCC: 250,000).

The main reason for the differences between the two estimates is the different uplift factors used to estimate the cost of groundwater flooding compared to river flooding:

- ESI used an uplift factor of 2.5. They argue that because groundwater is long duration flooding it causes more damage to the property.
- The CCC report follows a similar approach but argues that much of groundwater flooding is clear water flooding and less damaging than muddy floods associated with fluvial flooding. So they use a smaller uplift factor of 1.2.

Another difference between the reports is that ESI assume groundwater flooding can happen independently of flooding from other sources. So they add the damages from each source of flooding. The CCC analysis assumes that groundwater flooding in the fluvial or surface water floodplain is always occurs at the same time as groundwater flooding. So they only count the damage once when groundwater interacts with other sources.

Overall, both estimates are relatively similar and within the possible range we would expect.

### Who has contributed to this note?

The note was created in discussion with experts from the Environment Agency, the British Geological Survey and the Flood Forecasting Centre.