CB(1)458/13-14(01)

To: k
From: Kevin Laurie
Date: 11/29/2013 02:53PM
Subject: Important information on motion to exclude Tai Long Sai Wan from Country Park
(See attached file: British Geological Survey - Groundwater Flood Susceptibility Mapping.pdf)

Dear LegCo Panel Secretary,

Can you please circulate this message to your panels members for their information on the forthcoming debate on the motion to exclude Tai Long Sai Wan from Country Park.

Septic tanks and soakaway pits (STS) systems for Village Houses will not work in country park enclaves, including **Tai Long Sai Wan**.

As a trained geologist, I've conducted a review of the use of on-septic tanks and soakaway pits (STS) systems to dispose of sewage and wastewater in Hoi Ha, Pak Lap, So Lo Pun and **Tai Long Sai Wan.**

Because of the local geology they won't work, which means any Small House development in these enclaves will have to consider different means to dispose of sewage. **This is a major problem**, which has not been considered by the government or LegCo. Full details of this issue in relation to Hoi Ha, Pak Lap and So Lo Pun can be found in the attached blog post:

http://hongkongcountrysidewatch.blogspot.hk/2013/11/septic-tanks-and-soakaway-pits-sts_27.html

Details of this issue in relation to **Tai Long Sai Wan** can be found in the following post:

http://hongkongcountrysidewatch.blogspot.hk/2013/11/underlying-geology-at-tai-long-sai-wan.html

The keys points on this issue in relation to Small House development in these enclaves are listed below:

Key points

1. On-septic tanks and soakaway pits (STS) systems will not work in Hoi Ha, Pak Lap, So Lo Pun or **Tai Long Sai Wan** because the underlying geology will not support their use;

2. Any proposed development areas in these enclaves is susceptible to alluvial flooding because of the underlying geology, which even according to the governments own guidelines means STS systems cannot be used in such areas;

3. Buffer zones will not separate the discharges from STS systems from the streams, no matter how great the distance, because the groundwater in the alluvial deposits are hydraulically connected to the water in the stream, which means they are not separate, but are part of the same interconnected system;

4. The use of STS systems in these enclaves also poses an unacceptable health risk. One of the strategies for preventing the spread of a global pandemic from Hong Kong is environmental hygiene, something which using STS systems in these enclaves threatens. On this matter, understanding the implications of the following information is critically important - ***H7N9 bird flu may be spreading through human faeces and this has important implications on the infection control strategies for the virus, as the influenza virus in stools may contaminate the surrounding environment***;

5. The use of STS systems in these enclaves also poses an unacceptable risk to the environment, as wastewater will neither be filtered nor buffered as proposed in the government guidelines, with potentially devastating environmental consequences.

It should be noted, these issues are not confined to these enclaves. Similar issues are likely to be evident in the majority of coastal enclaves under threat of development. This is not selective criticism, it is a straight forward question of geography and the siting of human habitation.

In short, the government needs to find an alternative solution to the use of on-septic tanks and soakaway pits (STS) systems in Hoi Ha, Pak Lap, So Lo Pun, **Tai Long Sai Wan** and any other enclaves which are situated in similar circumstances.

To understand the issues at **Tai Long Sai Wan** can I suggest that you get copies of the relevant Hong Kong Geological Survey map (Sheets 8 – Sai Kung), overlay any proposed Land Uses diagrams on the geology of Tai Long Sai Wan, then get a sedimentary geologist to explain the implications to you, with specific reference to the British Geological Survey paper on *Confidence and Groundwater Flood Susceptibility Mapping*. I've attached a copy of this paper for your reference – see the section on Alluvial Flooding.

This is **Basic Geology**. Hong Kong has an amazing Geological Survey which was undertaken so that policy makers and developers could make informed decisions in cases such as this. **I am stunned** that no one in government or LegCo is aware of this. From **the perspective of public health, I am deeply concerned** by both the lack of government knowledge on this and more importantly, of the implications if something goes catastrophically wrong.

In making these comments, you should be aware that I trained as a geologist, I have extensive experience of working as an archaeologist conducting excavations in alluvial deposits and have spent over 45 years collecting fossils from alluvial deposits, so I am intimately aware of their characteristics. Of equal importance, as a Senior Superintendent of Police I was in charge of the operation to track the initial batch of defaulters from Amoy Gardens during SARS, I initiated the tracking procedures which eventually led to SARS being brought under control globally and I was responsible for conducting the enquiries on behalf of The Coroner into the tragic deaths of the six frontline medical professionals who died trying to protect Hong Kong, so I am committed to ensuring that such a disease outbreak never occurs again.

Your co-operation on this matter is most appreciated.

Regards Kevin Laurie, PMSM,
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Confidence and Groundwater Flood Susceptibility Mapping

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1. Background

Groundwater flooding is increasingly being recognised as a hazard (Bloomfield and McKenzie 2005, Jacobs 2004). Local knowledge of historic groundwater flooding events has generally been the only guide to an area's vulnerability to flooding. Unfortunately, local knowledge of groundwater flooding is patchy and can be unreliable, and often groundwater flooding is not recognised as a distinct event, being masked by surface water floods. (Marsh, and Dale 2002) There is clearly a need to assess areas susceptible to groundwater flooding.

Work was undertaken to produce a national map of groundwater flooding susceptibility for the UK (ver.1.0). Two main types of flooding were considered:

> "Alluvial (or permeable superficial deposits – PSD) flooding" associated with rivers hydraulically connected to alluvial material). In PSD groundwater flooding the conceptual model is a cross-section through a river valley filled with permeable deposits overlying impermeable rocks. Water moves through the permeable deposits from the river and floods the low-lying land either side of the river (Figure 1).

> "Clearwater flooding" resulting from groundwater rising and outcropping at the surface. The clearwater flooding conceptual model, considers a permeable aquifer with a groundwater-supported river flowing down a valley. As the regional groundwater level rises groundwater emerges either side of the river in the valley. The higher the groundwater level rises, the larger the area that is inundated by groundwater (Figure 2).

Based primarily on geological criteria (geological controls), the map identifies areas where groundwater is close to the surface and where geological conditions suggest that an area is susceptible to groundwater flooding. This work has concentrated on the geological 'vulnerability' or susceptibility to groundwater flooding rather than mapping the risk of groundwater flooding events.

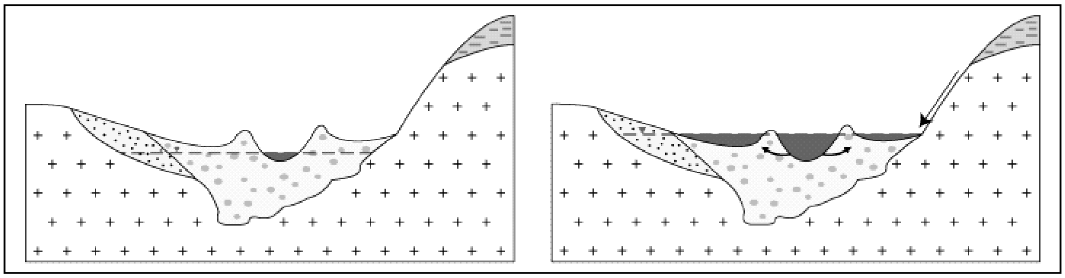


Figure 1. Illustration of the PSD groundwater flooding conceptual model, showing a cross-section through a river valley filled with permeable deposits overlying impermeable rocks. Water moves through the permeable deposits from the river and floods the low-lying land either side of the river.

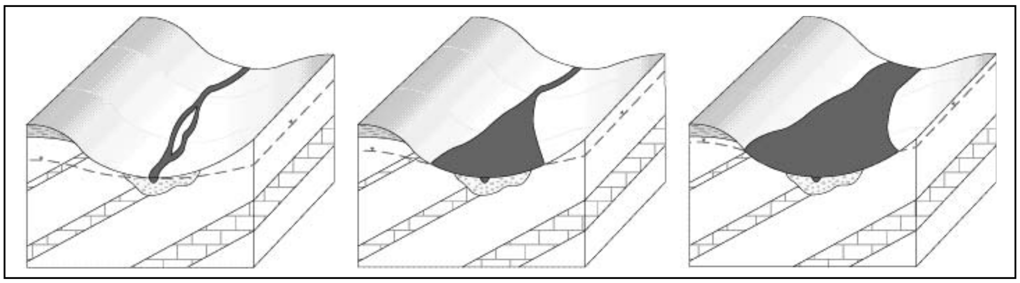


Figure 2. Illustration of the clearwater flooding conceptual model, showing a permeable aquifer with a groundwater-supported river flowing down a valley. As the regional groundwater level rises groundwater emerges either side of the river in the valley. The higher the groundwater level rises, the larger the area that is inundated by groundwater.

As there are a considerable number of factors associated with the development of the dataset, it was necessary also to consider the issue of uncertainty, or confidence. This paper focuses on the development of a confidence map for use with this dataset. A description of the principal factors controlling confidence is described for both conceptual models of flooding, and is discussed in more detail for the clearwater flooding scenario. It was recognised that many aspects of geological and hydrogeological modelling are subject to expert opinion, and confidence can be difficult to quantify.

2. Methodology

Production of the confidence map was a three-stage process:

> Stage 1 – identification of areas of confidence (and uncertainty) in the preparation of the flood susceptibility map. This was carried out using a semi-formal process to produce a cause and effect or 'fish diagram' (Cave and Wood, 2002) that relates primary areas of confidence with underlying factors, then describing each of these factors.
>
> Stage 2 – translation of the 'fish' diagram into semi-quantitative estimates of relative confidence using a simple rule-based scoring process
>
> Stage 3 – using the rule-based scoring process in step 2 in a GIS to produce a map of confidence in the flood susceptibility map

Throughout the three-stage process the procedure adopted combined estimates of uncertainty in the input datasets with a review of available ‘ground truth’ observations.

This three-stage process was undertaken separately for each of the two groundwater flooding scenarios and then the resulting confidence maps were combined.

For both the scenarios five principal contributing factors to the confidence model were identified as follows;

- confidence in the permeability index
- confidence in the conceptual model
- confidence in the digital elevation model (DEM)
- confidence in the rest water level
- availability on information to validate the susceptibility classification

These factors were developed by the preparation of a cause and effect or ‘fish’ diagram for each conceptual model. The diagram was used within a collaborative team discussion to ensure that all aspects of the confidence model had been considered.

1.1 Confidence estimates for PSD flood susceptbility

Figure 3 shows the fish diagram for the PSD confidence model and illustrates the relationship between these primary and secondary factors that influence confidence in estimates of PSD flood susceptibility. It was possible to quantify to some extent some, but not all, of these factors and sub-factors.

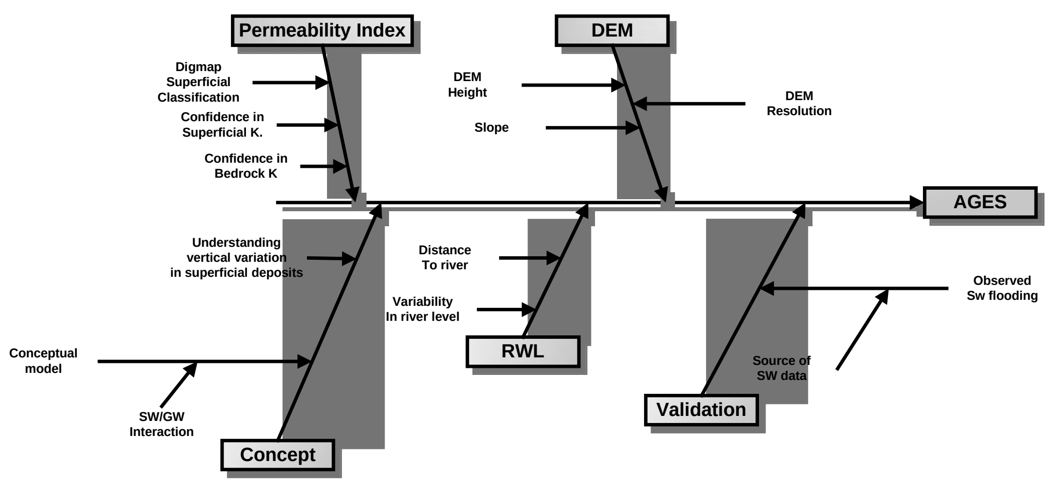


Figure 3. ‘Fish’ diagram used as the basis of the estimation of confidence for PSD flooding (where ‘AGES’ is the total confidence score for PSD flooding).

1.2 Confidence estimates for Clearwater flood susceptibility

Figure 4 shows the fish diagram for the clearwater flooding confidence model, and illustrates the relationship between these primary and secondary factors that influence confidence in estimates of clearwater flood susceptibility. Table 1 is used as an example to briefly describe each of the factors and sub-factors in the ‘fish’ diagram and whether they are quantifiable.

Using Table 1, each of the factors that effect confidence was then used to produce rule-based numerical scores that could be implemented within a GIS.

A combined confidence map was produced by combining the PSD and clearwater flooding confidence files in the GIS. Where there was overlap between the two datasets, the approach was to take the lowest confidence.

Figure 4. 'Fish' diagram used as the basis of the estimation of confidence for clearwater flooding (where 'CGES' is the total confidence score for clearwater flooding).

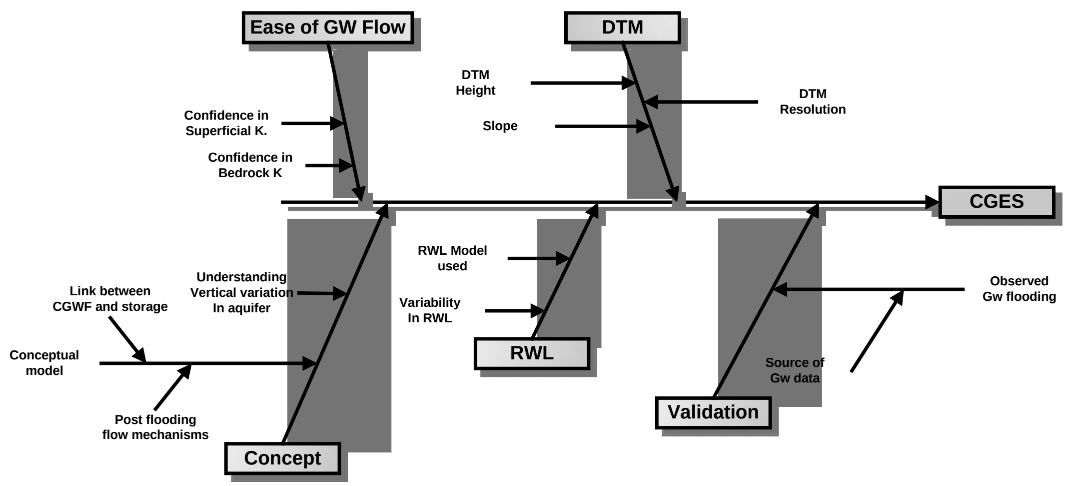


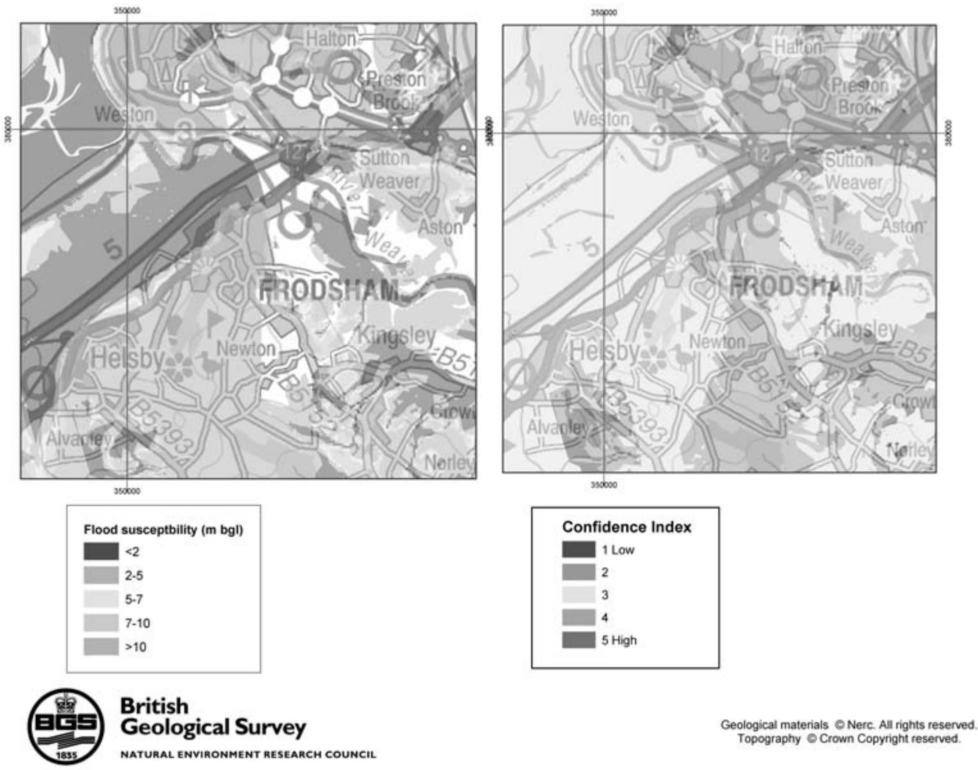
Table 1 Description of confidence factors for clearwater flooding

Factor	**Sub factor**	**Quantification**	**Notes**
Permeability Index	PI of superficial deposits	Available as part of the PI dataset.	Simplified PI confidence used
	PI of bedrock deposits	Available as part of the PI dataset.	Simplified PI confidence used
Concept	Conceptual model	Not quantifiable	Concept of clearwater used is assumed to be valid
	Post flooding flow mechanisms	Not possible with current information	Once flooding occurs water flows away from the flooded area down surface water courses, consequently zones of emergence may not be zones where floods cause economic impact

	Vertical variation in aquifer	Consistent over all units	DigMap only records deposits at surface, and these may not be an accurate representation of the full thickness of saturated deposits
	Link between flooding and aquifer storage	Not quantifiable	The rate at which water level will vary in response to recharge will depend on aquifer storage. PI data is a poor surrogate for storage
DEM	DEM Height	Fixed for a particular DEM	The better the elevation model, the better the accuracy of depth to groundwater estimates, although in practice as relative heights between river and groundwater are used the influence of this factor will be limited.
	DEM Resolution	Fixed for a particular DEM	As for DEM Height
	Slope	Derived from DEM	Flooding from groundwater is assumed to be less likely on steep slopes for the alluvial flooding conceptual model
RWL	RWL Model used	Derived from RWL dataset	Three water level models, with differing degrees of accuracy have been used.
	Variability in river level	Not possible with current information	River level variability, while an important driver for groundwater surface water interaction has not been quantified, and is assumed constant in this release of the dataset.
Validation	Observed groundwater flooding	Comparison with observations	Observed flooding in areas of high or moderate risk validates map in that area
	Source of GW data	Not used	The validation dataset is based on limited observations only

3. Results

A sample of the resulting clearwater flooding and associated confidence map are shown in Figure 5.



4. Discussion

For any point on the groundwater flooding susceptibility map a 'confidence' value can be read off the accompanying confidence map. The confidence value is based on a number of different factors, and may vary across a polygon that has a single susceptibility value. For example, a polygon may be highly susceptible to flooding, but as one of the inputs to the confidence value may be the confidence of water levels, which is highest in close proximity to rivers, part of the polygon near a river havea different confidence value from those parts further away from the river.

Where only point values are required these variations within a polygon are not an issue. However where prognoses are made on the basis of values within a radius of a given point then it is harder to select an appropriate value for confidence. Generally the highest value of susceptibility within the search radius will be chosen. The options for confidence are then (in order of complexity) to:

a. take the lowest value of confidence within the search area;
b. take the lowest value of confidence within the search area that relates to the susceptibility value selected;
c. take an average or area weighted average value of confidence within the search area that relates to the susceptibility value selected.

In all of these cases, as a precautionary approach, the lowest value of confidence should be used, even if this means that an area shown as having high susceptibility and generally high confidence is reported as high susceptibility low confidence. An indication of low confidence is an indication that further investigation may be warranted.

5. Conclusions

The confidence maps provide a valuable resource in guiding the user as to the level of uncertainty in the groundwater flood susceptibility datasets. One of the main limitations in the approach is that its accuracy depends to a large extent on estimations of the accuracy of the contributing datasets. In some cases, these datasets are themselves provided without confidence data. Thus the estimates made suggest a degree of certainty in the resulting confidence estimate that is not, in reality, justified. Not withstanding the limitations, the confidence maps provide a valuable resource in guiding the user as to the level of uncertainty in the groundwater flooding datasets.

References

Cave, M R and Wood, B. 2002. Approaches to the Measurement of Uncertainty in Geoscience Data Modelling. *British Geological Survey Internal Report*, IR/02/068. 42pp.

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