Memorandum 19 December 2014

To: John Duguid

From: Nick Brown

Subject: Non-Statutory Layers - Flooding

Introduction

1. This memorandum has been prepared in response to a memorandum on behalf of the Independent Hearings Panel (IHP) dated 4 December 2014 concerning the legality and use of the non-statutory GIS map layers within the PAUP. The second part of the IHPs memo included the following statement and request:

   "It is also noted that there are a number of submissions questioning the accuracy of the non-statutory layers. Therefore, ***Council is also requested to provide a detailed outline of the methodology, research, studies, analysis and mapping work undertaken, to establish the need for and accuracy of all of the non-statutory layers in the GIS maps."***

2. This memorandum addresses the Flood Hazards layers in the Non-Statutory layers in the Proposed Auckland Unitary Plan maps, these being the:

   (a) Flood Prone Areas.
   (b) Flood Plains.
   (c) Flood Sensitive Areas.

3. Some of the information included in this memorandum has already been presented to the IHP in the evidence of Mr Nick Brown and Ms Jane Olsen.

4. The Council generates and holds detailed information in order to manage flooding effects in accordance with its functions and powers under various statutes including the Resource Management Act 1991 and the Building Act 2004.

Base of Flood Hazard Mapping

5. The Flood Hazard layers displayed in the non-statutory layers have been generated over a long period of time. All new flood hazard analysis uses a ground surface as surveyed by Aerial Laser Survey (also referred to as LiDAR). The majority of the flood hazards in the Auckland Region have been mapped post LiDAR information becoming available (2005/2006).

6. The LiDAR survey generated spot heights at a spacing of 1 spot height every 1.5m^2. The accuracy of this survey, was required to be plus or minus 100mm on the vertical axis and plus or minus 300mm in the horizontal axes. The raw LiDAR data was then processed to remove artificial high points such as buildings or trees to produce a digital terrain model. The resulting digital terrain model was then used as the basis for the mapping used as a basis for the flood hazard layers. This terrain data used in the flood hazard analysis includes all of the surface features or infrastructure (whether designed to convey surface water or not) captured by the LiDAR survey.

7. Subsequent more detailed survey is carried out to support the various modelling studies in particular to confirm: floor levels; pipe or culvert levels; stream channel cross-sections and areas under trees with limited LiDAR coverage.

Flood Prone Areas

8. Flood prone areas are defined as:

   "The extent of land within a topographical depression that water will pond on in a 1 percent flood event, assuming any outlet to the depression is blocked."

9. Topographical depressions can occur either naturally or as a result of man-made features which act as dams when stormwater outlets are blocked. Flood prone areas typically include depressions formed by road/railway/motorway embankments which were built across natural gullies, some of the depressions in the Auckland region are also from volcanic activity or sand dune depressions in coastal areas.

10. The flood prone areas shown on the Flood Hazards Layer were generated using the ground surface as surveyed by Aerial Laser Survey (also referred to as LiDAR).

11. The flood prone areas were created by taking the LiDAR data and using GIS techniques the depressions in the terrain were identified. The outlet elevation for overland flows from these depressions (that is the low point of the high point) was then similarly identified and the area of land below this outlet level was then identified as a flood prone area. The outlet elevation wasn't used as the maximum level where the 1% flood event does not contain enough volume to fill the depression. Where the volume of rainfall is insufficient to fill the depression the flood prone area is mapped up to the level the volume of the 1% AEP flood event would reach if the outlet were blocked.

12. Being a GIS based analysis technique the flood prone area analysis does not include:

    (a) A risk assessment of the likelihood of the outlet to the depression becoming blocked.
    (b) The extent of ponding required for flows to build up and flow out of a depressions.
    (c) The frequency or likelihood of a depression filling up.

13. Analysis of the risks posed by flood prone areas is being undertaken by council to check risk is being managed. As part of the analysis flood prone areas are being remapped where the risk of blockage has been adequately dealt with such that the risk of ponding in the flood prone area is low.

Flood Plains

14. Flood Plains are defined as:

    "*The area of land that is inundated by water during a specific flood event."*

15. Unlike flood prone areas the level of analysis needed to define a flood plain requires more than simple GIS analysis techniques. It includes the hydrological and hydraulic modelling of a catchment taking into account such things as:

    (a) Rainfall.
    (b) Climate change effects.
    (c) Runoff from various surfaces.
    (d) Catchment soil types.
    (e) Catchment area.
    (f) Catchment impervious coverage.
    (g) Catchment and flood plain topography.
    (h) Drainage path types (channel, pipe, culvert or overland flowpath).
    (i) Times of travel thorough various flow paths.
    (j) Obstructions to the flowpath.

16. Inputs to the definition of flood plains, includes (amongst other things):

(a) Rainfall statistics.
(b) Climate Change predictions.
(c) Catchment and subcatchment area definition.
(d) LiDAR data
(e) Specific on-site survey data.
(f) Aerial photographs.
(g) District Plan information – land use current and future.
(h) Soil maps.
(i) Soakage information.
(j) Pipe size, level and location information.
(k) Stream cross-sections, including bridges and culverts.
(l) Roughness coefficients for the various flowpaths.
(m) Building types and floor elevations.

17. The complexity of drainage systems (in particular the urban ones) mean that they need to be analysed using computer based numerical analysis or modelling techniques. To achieve this analysis computer based models have been constructed for various catchments within the Auckland Region since the mid 1990's. Since that time modelling methodologies have evolved as knowledge has increased and computing power, memory, speed and analytical techniques have improved.

18. The Auckland Council has developed and uses a Flood Modelling Specification (2011) to obtain flood modelling results base on consistent modelling methodologies and results. This specification has been developed to address the historical variations in approach across the region, and removes the consequential uncertainty in reliability or consistency of the outputs. All new modelling is required to be carried out to this specification, however, to date, not all catchments have been modelled using this specification. Currently the most extreme event modelled is the 1%AEP event. We have noted these specifications have been adopted as a basis for modelling by a number of Council's around the country.

19. The flood plains mapped have been derived from a series of sources and assessments ranging from the coarse to the detailed. The coarse assessments provide useful information for development assessments whereas the detailed ones identify existing issues and can be used for optioneering studies to refine options to mitigate existing or anticipate future flooding issues. Generally, the more coarse models are more common in the rural areas. These rural areas typically have more limited drivers for detailed modelling as there would usually be free of buildings within the flood plain or not subject to growth pressures.

20. Whatever the model source or detail it does need to be noted that the flood plains are mapped on a catchment wide basis. That is, there can still be some uncertainty of the information, particularly around the fringes of the mapping. While every effort is made to inspect individual properties there can still be some questions raised about individual properties. When a potential issue is identified the Council carries out site specific assessments and where necessary the flood plains are modified to suit the results of the site specific assessment.

21. There are 233 catchments within the Auckland region, 103 urban and 133 rural. Of the urban catchments 47 currently have detailed models completed for them and a further 36 are currently being modelled. The remaining 20 urban catchments are scheduled to be started over the next two years. The priority for commissioning the detailed models is for those with the most buildings in the flood plains or those in areas subject to imminent growth drivers to be targeted first.

22. In the urban areas where there is not detailed modelling available the available modelling has been used to map the flood plain areas. In some cases this includes models that have detail on the main stem or channel of the system but not in the upper reticulated areas. Some catchments have flood plain information based on Rapid Flood Hazard Assessments (RFHA). These RFHA are carried out using a system that is based on the surface features of a catchment and the reticulation is not considered in the modelling. The RFHA technique would normally be expected to yield results with slightly more extensive floodplains than would be modelled by the more detailed techniques and are useful for the initial appraisal of a catchment to determine the likely location and approximate magnitude of issues but they are not appropriate for detailed analysis and options assessment. The RFHA information provides is useful to show where likely flooding issues are and where further analysis is required.

Flood Sensitive Areas

23. Flood sensitive areas are defined as:

> *"The area bordering the 1 percent AEP floodplain which is within 500mm in elevation of the predicted 100 year flood level."*

24. This area is typically only included within the old North Shore City Council area and is not shown on the non-Statutory layers in the other legacy council jurisdictions. It is plotted as a GIS function by using the LiDAR data and determining the area which lies within 500mm elevation of the defined flood plain area and then determining the aerial extent of that and plotting it.

25. Accuracy of this data is as accurate as the underlying flood plain maps and the LiDAR data or local survey from which it is plotted.

Updating Flood Hazard Information

26. Updating of the flood hazard information is a continuous process. The need for it comes from:

(a) The production of new computer model information either by the Council or by developers.
(b) The result of land modification during development processes.
(c) Revised information from site specific investigations.
(d) Undertaking flood mitigation works results in a need to change the hazard information such that the benefits of undertaking the work can be realised for the land owner.