

APPENDIX C

The Plains - area-wide suburb
technical land information

Factsheet 3 - Spencerville to Brooklands

3.1 Ground conditions and groundwater

Regional geology maps show this area is underlain by stabilised beach sand dunes or river sand (and back dune deposits) of Holocene age.

Table C3.1 summarises the area-wide subsurface ground investigations undertaken by EQC in this area following the 4 September 2010 and 22 February 2011 earthquakes. These investigations indicate that the near-surface soil profile in the area generally comprises very loose to dense sand and silts.

Table C3.2 summarises typical ground elevation and groundwater depths in the area (the values listed correspond to the 10th and 90th percentiles and the median). This was derived from LiDAR ground elevation survey commissioned by EQC in February 2012, and a groundwater surface developed from recent EQC groundwater monitoring in conjunction with historic Environment Canterbury groundwater data. This area is generally moderately low-lying with shallow groundwater.

The ground conditions and groundwater in this area are generally similar to most of the eastern suburbs of Christchurch and Waimakariri District.

While ground surface disturbance has occurred in some areas (e.g. settlement, cracking and ejection of material), the underlying ground which liquefied appears to have now returned to its pre-earthquake strength.

3.2 Post-earthquake observations

Rapid mapping of liquefaction and lateral spreading observations was undertaken following the 4 September 2010 earthquake, first on a regional and street-by-street level in the days immediately after the earthquake, and

then on a property-by-property level over the following weeks. This mapping was supported by additional air-photo, regional or street-level mapping for the subsequent main earthquakes. This additional mapping indicated that the pattern of liquefaction and lateral spreading in this area for the subsequent earthquakes was generally similar to that observed in the first main earthquake, but usually less extensive and severe.

Figure C3.1 and Table C3.3 present a summary of the property-by-property rapid mapping of liquefaction and lateral spread observations in this area. These observed liquefaction and lateral spread mapping colours have completely different meaning to the colour codes used by the Canterbury Earthquake Recovery Authority (Cera) for residential land zoning and the Department of Building and Housing (DBH) for technical categories.

Table C3.4 summarises the change in ground elevation inferred from the LiDAR survey. The total change in ground elevation which has occurred is a combination of regional uplift or subsidence due to fault movements (tectonics) and local ground subsidence due to liquefaction and related effects. The LiDAR is of limited accuracy (about $\pm 100\text{mm}$). This means that the LiDAR is more suitable for measuring large changes in ground elevation (greater than about 100 to 200mm), and may not accurately represent areas where only minor changes in ground elevation have occurred.

Table C3.5 summarises the extent and severity of observed liquefaction and lateral spread.

Table C3.1 - Area-wide geotechnical investigations undertaken by EQC (December 2011)

Suburb	Number of cone penetration tests	Number of boreholes	Number of groundwater standpipes	Length of MASW geophysical testing (m)
Brooklands (incl. Kainga)	19	-	12	-
Spencerville	21	2	5	320

Brooklands (includes Kainga) and Spencerville

Table C3.2 - Summary of ground elevation and groundwater depth (February 2012)

Suburb	Ground elevation above sea level	Groundwater depth
Brooklands (incl. Kainga)	Typically 1.2m to 2.1m (Avg 1.6m)	Typically 0.7m to 1.5m (Avg 1.0m)
Spencerville	Typically 1.8m to 2.4m (Avg 2.2m)	Typically 0.9m to 1.5m (Avg 1.2m)

Table C3.3 - Summary of liquefaction and lateral spread observations for residential land, aggregated from mapping undertaken by EQC following earthquake of 4 September 2010

Suburb	Total residential property count	Not mapped	No observed ground cracking or ejected liquefied material	Minor ground cracking, but no observed ejected liquefied material	No lateral spreading, but minor to moderate quantities of ejected material	Moderate to major lateral spreading or large quantities of ejected material	Severe lateral spreading, ejected material often observed
Brooklands (incl. Kainga)	765	4%	25%	11%	51%	9%	0%
Spencerville	228	4%	0%	33%	60%	<1%	2%

Table C3.4 - Changes in ground elevation inferred from LiDAR survey

Suburb	Change in ground elevation from July 2003 to February 2012 (positive values are uplift, negative values are subsidence)
Brooklands (incl. Kainga)	Typically -400mm to -100mm (Average -300mm)
Spencerville	Typically -400mm to -100mm (Average -250mm)



Factsheet 3 - Spencerville to Brooklands

Table C3.5 - Liquefaction and lateral spread observations

Suburb	Observations
Brooklands (incl. Kainga)	<p>Widespread moderate liquefaction in the main residential area, causing sand ejection and settlement.</p> <p>Widespread major lateral spreading in the west of the main residential area, towards the Styx River. Localised moderate lateral spreading in Stewarts Gully (near Kainga) associated with movement of the stopbank towards the Waimakariri River.</p> <p>Settlement and minor ground cracking in several areas without any obvious surface evidence of liquefaction, likely due to minor liquefaction occurring at depth below the surface but not being ejected.</p> <p>For the residential properties to the west of the main Brooklands township (including most of Kainga), there was no surface evidence of liquefaction, but minor ground cracking in some areas.</p>
Spencerville	<p>Widespread moderate liquefaction across most of the residential area, causing sand ejection and settlement.</p> <p>Major to severe lateral spreading towards the Styx River, but localised to the properties immediately adjacent.</p> <p>Settlement and minor ground cracking in several areas without any obvious surface evidence of liquefaction, likely due to minor liquefaction occurring at depth below the surface but not being ejected.</p>

For further area-wide geotechnical information, refer to the technical data reports on the EQC website, at <http://canterbury.eqc.govt.nz/news/reports>

Brooklands (includes Kainga) and Spencerville

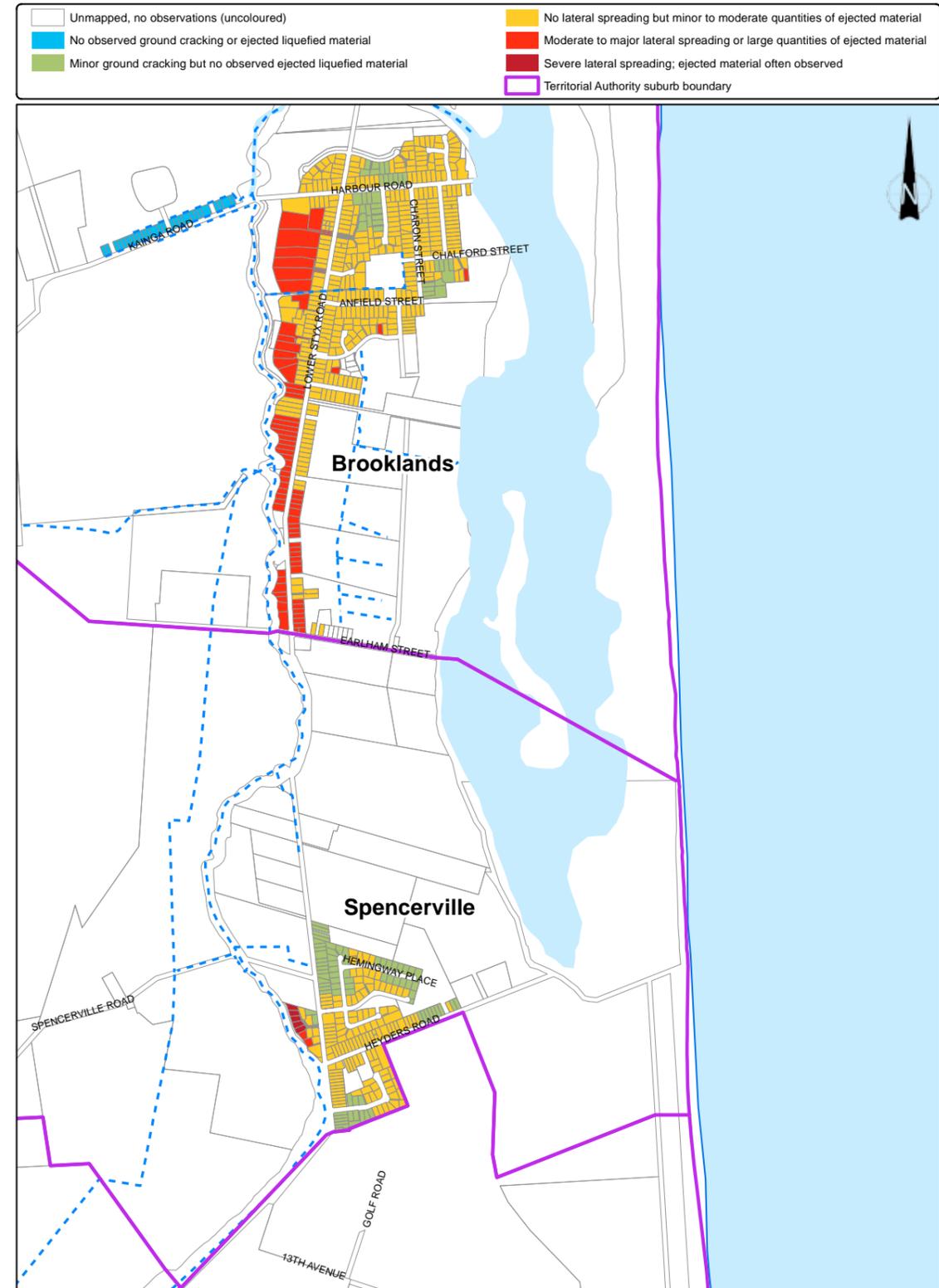


Figure C3.1 - Overview of liquefaction and lateral spreading observations, from mapping undertaken following the earthquake of 4 September 2010

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