



Canterbury Fact Finding Project

Consideration of liquefaction and lateral spreading hazards in the zoning and development of:

Part A: The eastern suburbs of Christchurch from 1977 to 22 Feb 2011

Part B: Brooklands, Kaiapoi and Kairaki/The Pines from 1977 to 4 Sept 2010

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FOREWARD

This report is a combination of two studies. The first study is presented here as:

Part A: Consideration of liquefaction and lateral spreading hazards in the zoning and development of the eastern suburbs of Christchurch from 1977 to 22 Feb 2011

The second is presented as:

Part B: Consideration of liquefaction and lateral spreading hazards in the zoning and development of Brooklands, Kaiapoi and Kairaki /The Pines from 1977 to 4 Sept 2010.

The Executive Summary covers both studies.

Part A was conducted in Jun/Jul 2011 and on review by the Ministry, the decision was made to expand the study area to include Brooklands, Kaiapoi and Kairaki /The Pines.

Executive Summary

Project Brief and Principal Finding

The Ministry for the Environment commissioned this fact-finding study into the extent to which information on liquefaction and lateral spreading hazards were known, available and factored into planning and development processes, initially for the residential component of the eastern suburbs of Christchurch in the period from 1977 to the present. The study area was later expanded to Brooklands, Kaiapoi, and Kairaki/The Pines.

Based on the information sources available to the study team during the course of the research, it has become apparent that information on liquefaction and lateral spreading hazards was non-existent in the zoning and consenting decision-making processes associated with the zoning and development consenting in the eastern suburbs, as well as, Brooklands, Kaiapoi, and Kairaki/The Pines.

The main themes to arise from this Study, including the reasons for the lack of consideration of liquefaction and lateral spreading hazards, are:

Findings on Zoning - Part A Eastern Suburbs

- (a) With the exception of one area of land (Bexley South), all residential zoning in the Study Area (i.e. the eastern suburbs of Christchurch affected by severe liquefaction and severe lateral spreading) was established well before the commencement of the Study Period in 1977 (i.e. most of the current residential zoning was introduced at the time of the 1968-1972 District Scheme planning period and in many instances as early as 1962 when the first District Scheme for Christchurch was produced);
- (b) The exception – the Bexley South area - was zoned as a mix of residential and recreation/conservation in 1991 (having been previously zoned “employment” (a form of industrial zoning) between 1979 and 1986 and prior to that having a designation for “Filling Purposes” with an underlying residential zoning between 1972 and 1979. However there is no documented evidence of information on liquefaction and lateral spreading hazards being produced or considered in that decision-making exercise for Bexley South. Rather, the emphasis on that zoning exercise was predominantly on conservation values of the block and specifically where the boundary between recreation/conservation and residential should be drawn;
- (c) In 2001, Variation 48 to the Christchurch City Plan was promulgated. It established flood management areas over much of the study area and required resource consent to be obtained for the filling of sites and the erection of buildings. It provided the Christchurch City Council (CCC) with discretion over the floor level of new buildings and adverse flood management related effects.
- (d) Information on liquefaction and lateral spreading does not appear to have been available in any documented form in the Christchurch planning context until 1977 when the Regional

Planning Authority produced a generic Technical Report on the influence of natural hazards (including seismic) on the direction and extent of new urban growth in Greater Christchurch as a forerunner to their 1979 Christchurch Regional Planning Scheme. It is not clear what direct influence that Regional Scheme had on zoning in the CCC proposed District Scheme that was publicly notified later that year;

- (e) Other publications on liquefaction in the Canterbury and Christchurch context did not appear until the early 1990s (after the Bexley South zoning) but even then such studies were not specifically directed at the Christchurch zoning pattern. The first practical application of this information in a planning context was the 1997 Lifelines Project however the focus of that was on the effect of seismic activity (including liquefaction) on major utilities and communications infrastructure. The first known District Plan to specifically incorporate mitigation measures to counter potential liquefaction appears to have been a private plan change promulgated to the Waimakariri District Plan for the Pegasus New Town in 2000;

Findings on Zoning - Part B Brooklands, Kaiapoi and Kairaki/The Pines

- (f) Most of the residential zoning in Brooklands was established before the commencement of the Study Period in 1977. In 1995 the first District Plan under the RMA rezoned Brooklands as Living RS (Rural Settlement), and this zone identifies drainage and flooding as issues for the area but not any other natural hazard;
- (g) Four small areas (northern Brooklands, north-eastern Brooklands, west Brooklands and central Brooklands) were rezoned from non-residential to residential in 1995, and at the same time some allotments were rezoned from residential to conservation. There is no evidence that hazard issues other than flood risk were considered in the analysis for the rezonings. A variation to the district plan classified the entire township of Brooklands as a Flood Management Area, which did not come into force until January 2011 and was directed towards flooding and servicing limitations as opposed to seismic hazards;
- (h) Kairaki and The Pines settlements were zoned as 'urban' in 1975, and the subsequent 1998 District Plan maintained the same zoning pattern. Overall, there is no indication in the provisions of any of the district planning instruments (both pre and post 1977) that seismic issues were considered in the land use zoning pattern;
- (i) With one exception (Courtney Downs), the entire township of Kaiapoi within the Study Area, was already zoned for residential purposes by 1977, however some of these residentially-zoned areas were not yet developed at this time. The residential zoning pattern was continued into the subsequent 1985 and 1998 plans;
- (j) The Courtney Downs area (a former freezing works) was rezoned from non-residential to residential under a plan change notified in 1991. The documentation associated with the plan change indicates that there was no consideration of potential liquefaction or potential lateral spreading issues. The only natural hazard to be considered was the potential for flooding;
- (k) The information on liquefaction in Canterbury mentioned in (d) above which became available in the early 1990s did not include the areas of Brooklands, Kaiapoi and Kairaki/The Pines.

The first major publications relating to liquefaction risk in these areas appear to be from 2000 – 2005;

Findings on Development Consenting – Part A Eastern Suburbs

- (l) Despite the existence of residential zoning before 1977, many parts of these residential zones in the Study Area were not developed until after 1977 and quite often not until after 1986 and in some instance in the 2000s. This was due to a range of factors including the low lying nature of the land, the alternative uses it was being put to (e.g. market gardening), fragmented landownership and the absence of services. When the land was proposed for development the principle technique was land subdivision consenting (either as a scheme plan of subdivision under Part 20 of the Local Government Act 1974 or as a subdivision consent under the RMA 1991). From the records made available and consulted, there was no evidence found of the consideration of liquefaction or lateral spreading in the subdivision consenting process, either in the documents sourced or the interviews undertaken. The main development issues were:
- a) Flooding - from the Avon River and tidal influences – and ensuring minimum ground levels and floor heights;
 - b) Services – ensuring that there was sufficient fall for the provision of sanitary sewers and that any proposed development area was serviced by mains sewer and water;
 - c) Foundations – that land was suitable for the construction of light framed dwellings.
- (m) The majority of land within the overall study area was zoned for residential purposes prior to 1977. Therefore, there was an expectation that the land was suitable for development to the permitted density and lot sizes specified in the district scheme/plan and that subdivision consenting requirements were largely an administrative process. All of the subdivision consents of the individual study areas viewed contained a range of conditions and information memorandum to address issues around drainage and stability;
- (n) The use of LIMs as a mechanism by which a potential purchaser or developer of a property can find out the known land characteristics from a territorial local authority to highlight the potential effect of liquefaction has developed since the mid-2000s. At that time the CCC received from Environment Canterbury as a series of studies from approximately 2003 to a final report in 2005 (Beca Carter Hollings & Ferner Ltd. (2005). Christchurch Liquefaction Study- Stage IV (Addendum Report), Environment Canterbury). Prior to then, LIM information did not cover liquefaction. After that time, the CCC LIMs contained a broad/generic statement as to whether or not a property was within a Liquefaction Study Area. Since September 2010, the CCC LIMS include specific information for those properties affected by liquefaction and lateral spreading from the 4 September earthquake as identified by Tonkin and Taylor in late 2010.

Findings on Development Consenting – Part B Brooklands, Kaiapoi and Kairaki/The Pines

- (o) Despite the existence of residential zoning before 1977, many residential zones were not developed until after 1977. Residential subdivisions occurred in Brooklands between 1996-2008 and Kaiapoi between 1994-2001. The later primarily being in the Courtenay Downs

area. There was no apparent subdivision in Kairaki/The Pines during the Study Period. As described in (k) and (l) above, there was no evidence found of the consideration of liquefaction or lateral spreading in the consideration of subdivision consents or in the setting of consent conditions, either in the documents sourced or the interviews undertaken. The main development issues considered were flooding, services and foundations/stability. The existing residential zoning over much of these areas created an expectation that the land was suitable for development to the plan specifications;

- (p) It is understood that since 2000-01, for Kaiapoi and Kairaki/The Pines, Waimakariri District Council (WDC) has included supplementary information on liquefaction risk in LIMs. Since May 2011, the WDC LIMs include specific supplementary information on requirements for building consents for those properties affected by liquefaction and lateral spreading from the 4 September earthquake as identified by Tonkin and Taylor in late 2010. The same as mentioned in (m) above for the CCC area applies to LIMs issued for Brooklands.

Part A: Consideration of liquefaction and lateral spreading hazards in the zoning and development of the eastern suburbs of Christchurch from 1977 to 22 Feb 2011

1 Introduction

1.1 The Brief

1.1.1 Overview

This fact finding study was commissioned by the Ministry for the Environment. A copy of the brief for the project is attached in Appendix 1.

The principle purpose of the project was defined as:

The Ministry wishes to commission a fact-finding exercise concerning the extent to which information on liquefaction and lateral spreading hazards were known, available and factored into planning and development processes for the eastern suburbs of Christchurch in the period from 1977 to the present.

Essentially, the purpose of the study is to determine in a purely factual context, what information on the risks of liquefaction and lateral spreading in respect of Christchurch's eastern suburbs was available when decisions were taken on developing district schemes/district plans or plan/scheme changes along with land subdivision/development consents for the relevant suburbs.

In particular, the brief suggested that particular attention should be paid to:

- the type and nature of the information (geotechnical or other);
- the source of the information (professional reports, observations, or anecdotal);
- How extensive the information was; and
- Any findings and conclusions reached in the information.

1.1.2 Scope of Project

It is not intended to repeat the content of the brief here but rather to note that the brief covered and summarised three key parameters; namely geographical extent of the proposal, the scope of the hazard being investigated and scope of the information being provided. The instructions on the brief on these matters were as follows:

Geographic extent of study area:

Those parts of the eastern suburbs of Christchurch along the Avon River that have been impacted more severely by liquefaction and lateral spread following the 4 September 2010 and 22 February 2011 earthquakes.

Scope of hazard information to be investigated:

Information should only relate to liquefaction and lateral spreading hazards in the agreed eastern suburbs (or part thereof) of Christchurch. The Ministry is not seeking information on any other residential development in Christchurch or elsewhere, nor on liquefaction hazards more generally.

Scope of information to be provided:

The report should focus on factual information only. The Ministry is not seeking conclusions or any evaluation of the performance of any party, or the quality of processes. The Ministry is not seeking recommendations for further action. The consultants should ensure that this approach is also understood by any individuals who discussions are had with in relation to this project.

The brief also spelt out matters such as the focus of the investigation and information sources. The specific details of these are contained in the brief in Appendix 1.

1.2 The Approach

The methodology employed in undertaking this study was essentially divided into three distinct components as follows:

- Stage 1: Scoping the study area
- Stage 2: Information collection and collation
- Stage 3: Information review (thematic commentary)

A fuller description of the methodology for each stage is discussed in Sections 2-4 of this report along with a précis of the results obtained from each of the three stages.

2 Scoping the study area

2.1 Methodology

The first stage of the project was to identify the spatial extent of the eastern suburbs of Christchurch to be researched.

The key spatial areas listed in the brief included:

- Eastern suburbs of Christchurch – including but not limited to Avonside, Bexley, Avondale, Aranui, Dallington, and Westhaven;
- Those areas affected by severe liquefaction;
- Those areas affected by severe lateral spread;
- Those areas zoned for residential development post 1977; and
- Those areas developed as residential post 1977.

The brief commented further on the geographic extent of study area stating that a general indication of these areas is illustrated by the liquefaction and lateral spreading mapping provided from Tonkin and Taylor (EQC Engineers) 2011. It was recorded that in some instances the study area will only need to cover part of some suburbs as other parts of the suburb may be outside the temporal scope of the investigation or will not have suffered extensive damage in recent earthquakes.

The brief concluded that:

The consultants should confirm with the Ministry the geographical focus of this fact finding exercise at the completion of the scoping meeting to be held early in the project.

The methodology of how this was undertaken is set out as follows:

As the brief required consideration of the zoning decisions and the development of land decisions within the eastern suburbs, the initial scoping exercise was divided into two.

Step 1: Ascertaining zoning changes pre and post 1977

The first exercise was to establish a residential zoning baseline prior to 1977 and then identify the changes to that baseline for the residential areas in the eastern suburbs. This involved reviewing the Christchurch City Council district scheme and district plan maps, as well as the Waimairi County (later Waimairi District) district scheme maps.

The District Scheme and District Plan Maps used for this exercise were as follows:

- Christchurch City District Scheme – Operative 1962;
- Christchurch City District Scheme – Operative 1972;
- Christchurch City District Scheme – Proposed 1979;

- Christchurch City District Scheme – Operative 1986;
- Christchurch City District Plan – Proposed 1995;
- Christchurch City District Plan – Decisions Version 1999;
- Christchurch City District Plan – Operative 2005;
- Waimairi County District Scheme – Operative 1965; and
- Waimairi County District Scheme – Operative 1974.

Copies of these schemes and plans were kindly provided by current and former staff of Christchurch City Council. The changes to the residential zoning from these documents were compiled onto *Scoping Map 1: Residential zone changes by planning period* (Appendix 2).

Step 2: Overlaying Tonkin and Taylor maps of severe lateral spreading and liquefaction

The next source documents to be used related to the identification of the areas affected by severe liquefaction and lateral spreading. The source maps used for this task are from the Canterbury Recovery Project Orbit website. Orbit Map 06 – Liquefaction Property v1.0 (22 February 2011), prepared by Tonkin and Taylor, was used as the reference to identify those areas subject to moderate to severe liquefaction and severe lateral spreading. It is these areas that were used as the base for this aspect of the study.

The information from this two-step methodology provided the baseline to examine the decision-making process for zoning and consenting in the Study Area for the period 1977 to present.

2.2 Results - The study area

A comparison was then made of the areas of intersection of “new zoning” and areas affected by “moderate to severe liquefaction” and “severe lateral spreading”. As part of the same exercise, those areas where there had been a change in the cadasta, that were affected by severe liquefaction and severe lateral spreading were also identified. The resulting areas were used to create *Scoping Map 2: Individual study areas 1-15* (Appendix 3).

These 15 areas then had targeted research undertaken into the decisions on zoning or development for residential purposes; and how liquefaction and lateral spreading hazards were factored into those decisions.

3 Information collection and collation

3.1 Methodology

Scoping Map 2: Individual study areas 1-15 (Appendix 3) was used in discussions with the professionals involved in the development of areas in the eastern suburbs to assist in the identification of the chronological order of development and to identify where consideration was given to liquefaction and lateral spreading in zoning and development decisions.

A range of people were interviewed to assist in identifying relevant information, including:

- current and former local authority staff (Environment Canterbury (ECAN), Christchurch City Council (CCC), Waimairi County Council (WCC) and Canterbury Drainage Board (CBD) involved in zoning and consenting decision making;
- current and retired surveying, engineering and planning practitioners;
- staff from the New Zealand Centre for Advanced Engineering (CAENZ); and
- staff from the Canterbury Earthquake Recovery Authority (CERA).

Original source material was also reviewed. This included:

- a full set of district plan maps from 1962 to 2005;
- district schemes and plans;
- Bexley Plan Change 57 documentation;
- technical reports; and
- examples of subdivision consent decisions and memoranda of information.

A full list of original source material is set out in Appendix 4.

It should be noted that not all of the information sought was available due to circumstances affecting its retrieval as a result of the earthquakes, including the further earthquakes of June 13, and the short timeframe involved.

3.2 Results

The information obtained from the above sources is presented in tabular and map form as follows:

- **Table 1 - History of zoning and development for individual study areas 1-15 (1962-2011) (Appendix 5);**

Table 1 is a composite table that summarises for each of the 15 identified individual study areas the zoning and development history. Part A of the table covers the zoning sequence for the various planning documents 1962-2011. Part B of the table summarises the development sequence (where known) for the 15 individual study areas from 1977-2011. In both parts, the table indicates for each individual study area the extent to which information on liquefaction and lateral spreading were taken into account in the zoning and consenting decision making process. The information in Table 1 is elaborated on in the thematic commentary which makes up Section 4.

- **Table 2 - Comparative zoning of regional planning schemes and district schemes/plans for individual study areas 1, 4, 5 and 15 (1951-1985) (Appendix 6);**

Table 2 is a snap shot comparison of the status of areas 1, 4, 5, and 15 under both the Canterbury regional planning schemes and the Christchurch district scheme/plans for the periods 1951, 1971, 1979 and 1985. Although outside the period 1977-2011, the comparative zoning of these areas under the regional and district schemes/plans provides a useful context for understanding the evolution for the zoning framework for the eastern suburbs up until the beginning of the study period in 1977 and its early years.

4. Thematic Commentary

4.1 Context

As outlined in the introductory section of this report, this exercise involved a fact finding exercise concerning the extent to which information on liquefaction and lateral spreading hazards were known, available and factored into planning and development processes for the eastern suburbs of Christchurch from the period of 1977 to the present. In undertaking Stage 1 (Scoping) and Stage 2 (Information collection and collation) of this exercise, a number of factual themes have emerged. This final stage (Stage 3: Information Review) endeavours to present a précis of those themes in terms of undisputed fact and informed professional opinion of interviewees.

The following presentation groups these factual themes into the following two categories:

- a) District plan zoning; and
- b) Consenting for subdivision development.

In presenting the themes under the above headings, the discussion, whilst focussing on the 1977 to present period, has included, for contextual purposes, a discussion on the zoning and development baseline that existed prior to 1977. By necessity, this involves a brief synopsis of the zoning pattern between 1962 and 1977. As will become apparent in the following commentary, there is very little residential zoning post 1977 to comment on because the current zoning pattern was largely in place well before then. As such, the pre 1977 zoning process and decision-making takes on more significance than originally anticipated in the brief.

The scoping maps (Maps 1 and 2) and tables (Tables 1 and 2) developed in sections 2 and 3 of this report, and included in the appendices, are the key references for this commentary.

In addition, detailed mapping for each of the 15 individual study areas (identified on Scoping Map 2) was carried out in relation to the subdivision consent process. The individual area maps show, where available, the Deposited Plan (DP) numbers, and the stages and dates of subdivision within each area.

The maps of the individual study areas are set out in Appendix 7. The maps are from the CCC Web Map System.

4.2 District plan zoning

4.2.1 Zoning Overview 1962 - 2011

The principle theme regarding zoning is that, with the exception of four¹ of the 15 individual study areas, the residential zoning pattern that existed for the eastern suburbs in 2011 prior to the earthquake was largely in place by 1962 when the first district scheme was produced under the Town and Country Planning Act 1953.

The four areas not part of the residential zoning pattern were zoned rural in the prevailing 1962 District Scheme. As Table 2 (Appendix 6) illustrates, this was consistent with the prevailing 1951 Christchurch Regional Planning Scheme which classified those four areas as rural, thus excluding them from being included in the prescribed settlement for the Greater Christchurch Metropolitan Area.

By 1968, when the second District Scheme was notified (Operative 1972), two of the four aforementioned areas² were re-zoned from rural to residential and the remaining two³ were zoned a mixture of rural and residential.

For completeness, it is recorded that Area 1 (Bexley South) had a rural zoning in the 1968 publicly notified proposed District Scheme, which was changed to a residential zoning in the subsequent 1972 operative District Scheme, albeit that in both cases it was an underlying zoning associated with a CCC public works designation for "*Filling Purposes*". The designation of Bexley South appears to have been uplifted in 1977 and replaced with an Employment 1 zone (a form of industrial style commercial zoning).

On the above basis, the zoning baseline that was in place in the eastern suburbs at the inception of the study period in 1977, was such that all of the overall study area - with the exception of Area 1 (Bexley South), the majority of Area 5 (Burwood) and a small pocket of Area 4 (Kate Sheppard) were zoned for residential development. However, within two years (i.e. by 1979), Area 5 (Burwood) and Area 4 (Kate Sheppard) were also fully zoned for residential purposes⁴. In the 1979 District Scheme (Operative 1986), the Residential 1 zone (an outer suburban low to medium density zone) was the prevalent residential zone.

Again for completeness (and as will be apparent from the later thematic commentary relating to consenting of subdivision and land developments), large pockets of many of the 15 individual study areas were not developed until after 1977 despite a permissive residential zoning regime being in place prior to then. The delay in development in these areas was a reflection of a number of factors including the low lying nature of the land, alternative uses (e.g. market gardening), unavailable services (e.g. sewer) and multiple/fragmented ownership.

¹ Individual study Areas 1 (Bexley South), 4 - partial (Kate Sheppard), 5 - partial (Burwood) and 15 (Avondale North)

² Areas 1 (Bexley South) and 15 (Avondale North)

³ Area 4 (Kate Sheppard) was predominantly rural with some Residential 1A while Area 5 (Burwood) was predominantly Residential 1A with a small pocket of Rural zoning.

⁴ Residential 1 zone in the 1979 publicly notified 2nd Review of the District Scheme (Operative 1986)

In 1991-1992, Area 1 (Bexley South) was rezoned from Employment 1 to Residential 1 and Recreation 5 by way of CCC Plan Change 57.⁵ As this was prior to the RMA coming into force, the Plan Change was processed under the provisions of the Town and Country Planning Act 1977.

In 1995 the current District Plan was publicly notified (Decisions Version 1999/ partially Operative 2005⁶). This was the first statutory plan for Christchurch City produced under the RMA 1991. All 15 of the individual study areas were zoned for residential purposes. The zoning descriptor was "Living 1", which, like the Residential 1 zone, is a low-medium density suburban zone.

Since 2005 there have been no new residential zonings in the overall study area.

4.2.2 Pre 1977: Situation regarding zoning and liquefaction/lateral spreading

Evidence of the extent to which liquefaction and lateral spreading factors influenced the zoning framework that existed prior to 1977 was not sought as part of this study because that timeframe is outside the study period. Nonetheless, a number of themes emerged during the interviews with current and former staff at the CCC and ECan.

The principle theme was that prior to 1977 there was no specific mention of liquefaction or lateral spreading in any specific residential zoning decision.

The reasons given by the interviewees for the absence of any reliance on or acknowledgement of, liquefaction or lateral spreading risks in zoning decisions prior to 1977 included:

- a) The first District Scheme (Operative 1962) was principally a straight recognition of the existing land use pattern in place at the time. Accordingly, many older residential suburbs such as Bexley Central (Area 2) and Bexley North (Area 3) had housing stock already established during the post-World War 2 period and the zoning in 1962 was merely a reflection of that without any consideration of potential environmental constraints/limitations. Associated with this, Areas 1 (Bexley South), 4 (Kate Sheppard) and 5 (Burwood) and 15 (Avondale North) which were all zoned rural in the first District Scheme were outside the settlement area and all classified *Rural* in the 1959 Christchurch Regional Planning Scheme. This meant that they were areas deemed not to be suitable for any form of urban statement and there was an obligation for district schemes to conform to regional plans⁷;

⁵ Plan Change 57 was notified on 6 August 1991 and became operative on 1 September 1992.

⁶ Operative 21 November 2005

⁷ The 1959 Christchurch Regional Planning Scheme contained a section entitled Obligation to Conform to Regional Scheme which stated that "*Subject to the provisions of Section 4 of the Town and Country Planning Act 1953, every public body and local authority having jurisdiction within the Region shall in the performance of its public duties and functions adhere to the provisions of this Scheme*".

- b) The second District Scheme (notified 1968 and Operative 1972), although including several planning innovations, continued to re-zone previously residential land to residential purposes without any reference to environmental constraints. In addition, it zoned some previously rural land to residential. Those newly zoned areas (such as Areas 1 (South Bexley), 4 (Kate Sheppard) (partial), 5 (Burwood) (partial) and 15 (North Avondale) were known low-lying areas with drainage/flooding problems. This is borne out by the District Scheme zone statement for the proceeding 'deferred' residential and rural zones of these four areas (and also incidentally for the zoning for Areas 2 and 3 during the 1962-1968 period). That 'deferred' residential zone was known as the Residential 1A zone. The zone statement made reference to this land being "*situated generally in the eastern section of the District*" and that these areas "*may generally be described as Ferrymead, Ferry Road-Linwood Avenue, Bexley and Travis Swamp area*". The statement recorded that "*development of the land in the zone has been neglected to date largely because of its low lying nature and technical difficulties of development, particularly in respect of drainage*". It continued to record that "*the land has limited agricultural value, but subject to solution of the technical problems is well suited to urban uses*". It concluded that "*most uses within the zone are conditional uses, in order to ensure that each area within the zone is developed as a comprehensive whole and also to ensure that development is staged to follow the provision of sewer, and stormwater and other services*"⁸;
- c) In addition to the above, and still in the 1968-72 periods, individual study areas 4 and 5 were both classified "*Special Rural Area*" in the 1971 Christchurch Regional Planning Scheme. That classification⁹ meant that were deemed not to be suitable for any form of urban development and (as with the 1959 Regional Planning Scheme), the 1971 Regional Planning Scheme contained a similarly worded obligation for District Schemes to conform to Regional Schemes¹⁰; and
- d) Between 1972 and 1979 (i.e. between the first review of the District Scheme becoming operative and the notification of the second review of the District Scheme) there is no

⁸ Page 42 1972 District Scheme

⁹ "*Special Rural Area*" was defined on page 2 of the 1971 Christchurch Regional Planning Scheme as including *.....Land where the soils have a high potential for agricultural production.*

¹⁰ The 1971 Christchurch Regional Planning Scheme contained a section entitled Obligations to Conform to Regional Scheme which stated that : *Subject to the provisions of Section 4 of the Town and Country Planning Act 1953, every public body and local authority having jurisdiction within the Region shall in the performance of its public duties and functions in respect of matters of regional significance adhere to the provisions of this Scheme; and every District Scheme shall make it clear that its interpretation and application are subject to the provisions of Ordinances 4, 5, 6, 7 and 11 hereof.*

record of any additional zoning alterations (by way of variation or plan change) associated with residential zoning in the eastern suburbs of the overall study area.

4.2.3 1977-2011: Situation regarding zoning and liquefaction/lateral spreading

During this period there was a minimal amount of new residential zoning in Christchurch City. Moreover, only three of the 15 individual study areas were associated with new residential zoning¹¹. They are:

- (a) Area 4: Kate Sheppard;
- (b) Area 5: Burwood; and
- (c) Area 1: Bexley South.

Areas 4 and 5 – Kate Sheppard and Burwood

Between 1977 and 1979 those parts of Areas 4 and 5 not zoned residential (i.e. they were partially residential and partially rural)¹² were completely zoned residential in the 1979 District Scheme (Operative 1986).

Evidence of the extent to which liquefaction and lateral spreading factors influenced the zoning of Areas 4 and 5 was not evident in the sources consulted. What is apparent however is that whereas in 1972 the Christchurch Regional Planning Scheme provided an impediment to urban zoning of these areas that impediment appears to have been removed in the 1979 Regional Planning Scheme when Areas 4 and 5 were re-classified from “Rural” (i.e. non settlement) to “Special Development Area”.

The extent to which the Canterbury Regional Planning Authority Report from 1977 (*Regional Policy No. 6: Restraints on Urbanisation (Physical Constraints – climate, flooding, soil stability and earthquake considerations)*) influenced the content of the 1979 Regional Planning Scheme classifications and the extent to which that classification in turn influenced the residential zoning in the 1979 District Scheme is unknown.

For the record, the 1985 Proposed Regional Planning Scheme¹³ and the 1986 Operative CCC District Scheme classified Areas 4 and 5 as “*Settlement*” and “*Residential 1*” respectively.

¹¹ Refer to Tables 1 and 2 for zoning sequence for Areas 1, 4 and 5.

¹² The majority of Area 5 was already residential in 1977 however only a small pocket of Area 4 was residential at that date. The non-residential land in both areas had a rural zoning in 1977.

¹³ Canterbury Region Regional Planning Scheme (Second Review) Section 1: Settlement Distribution. Prepared by Canterbury United Council under the Town and Country Planning Act 1977

Area 1 – Bexley South

In 1977 this area was designated for “*Filling Purposes*”. The Requiring Authority responsible for the designation was the CCC. Although designated, the land had an underlying zoning. In this instance the zoning was a mixture of Residential 1A and Rural 5.

In the 1979 proposed District Scheme (Operative 1986), the designation was removed and the entire area was zoned Employment 1.

In 1991, prior to the RMA coming into force (i.e. under the jurisdiction of the Town and Country Planning Act 1977), the CCC promulgated a Plan Change to the zoning over this area (Plan Change 57). That zone change, which became operative in 1992, rezoned the land from Employment 1 to a mixture of Residential 1 and Recreation 5.

In 1995 under the RMA, the zoning in the Proposed City Plan (Operative 2005) was a mixture of Living 1 and Conservation 1. The records for the zoning changes between 1977 and 1991, excluding Plan Change 57, were not available. However, the records associated with Plan Change 57 were reasonably comprehensive and included some background to the zoning history. From these records the following themes have been discerned:

1962 (Operative District Scheme) -1968 (Proposed District Scheme – First Review)

The site was zoned Rural. It is not clear what use was undertaken at that time.

1968 (Proposed District Scheme – First Review) - 1979 (Proposed District Scheme – Second Review)

A CCC designation for “filling purposes” (for a future landfill with an underlying zoning of Rural 5) over the site was introduced into the publicly notified District Scheme in 1968. The designation became operative in 1972 with an underlying zoning of Residential 1A/Rural 5. There is no record of why the underlying zoning changed. The records available do show that the land covered by the designation was purchased by CCC in 1973. While no documentation regarding the reasons for the purchase was sighted, the consensus of the interviewees was that it was for the future landfill or for a future employment zone; the later which duly occurred in 1977 (assumed by a Scheme Change). However, before it could be developed the land was required to be filled. This occurred over a number of years although it was limited to the area north of the then Anthony Street (later closed).

1979 (Proposed District Scheme – Second Review) – 1989 (Local Government Amalgamation)

The 1979 proposed District Scheme (Operative 1986) retained the zoning of the entire site as Employment 1. That zone existed solely at Bexley and “*its general purpose was to provide increased employment opportunities for the residents of the eastern suburbs.*”¹⁴ The zone permitted a wide range of uses including offices, retailing and industrial but not residential. Development in the zone was to be undertaken in conjunction with a layout plan contained in Appendix M of the District Scheme which set out the general

¹⁴ The City of Christchurch District Planning Scheme Second Review, December 1979, p. 119.

subdivision, roading pattern and the grouping of service uses near the proposed reserve adjoining the zone to the north (i.e. to the south of Birch Street).

The facts indicate that whilst some preliminary earthworks and minor roading (a 12 metre wide industrial standard road into the employment zone which is now part of Wetlands Grove) was provided, there was no development of substance in the zone before 1989.

1989 (Local Government Amalgamation) – 1995 (Proposed District Plan)

From 1990 the CCC set about preparing a proposed change of zoning for the land. This resulted in proposed Plan Change 57 being notified in August 1991. Plan Change 57 essentially divided the former Employment 1 Zone into two parcels. In rough terms the northern half of the zone was rezoned Residential 1 and the southern half Recreation 5. Plan Change 57 was made operative in September 1992 following the resolution of appeals and approved consent order from the Planning Tribunal.

From the various material made available from the CCC, including the Plan Change 57 document itself, the CCC Town Planning Report, the CCC decision and the record of Determination of Appeals by the Planning Tribunal, it is clear that the issues associated with the potential for, and risk of, lateral spreading and liquefaction did not feature in any of the aspects of the decision making process. Rather, issues such as (in no particular order) loss of industrial land, wildlife values, the boundary between the residential zone and recreation zone and roading patterns were the dominant considerations behind the decision to rezone the land to a mix of residential and recreation.

Further to the above, a small consideration was given *“drainage issues”*. Some objectors to Plan Change 57 expressed concerns that development permitted of the residential zone (i.e. housing) in the northern half of the site *“will worsen flooding problems in the areas”*¹⁵. The view of the Reporting Officer was that a flooding problem is unlikely to occur because the flooding situation in the area is related to tidal levels in the estuary and is quite a different situation for example, to the ponding which occurs of the Heathcote catchment after prolonged rain. The officer added that *“the problem of flooding in the Bexley area is a real one but are (sic) a consequence of development undertaken in the past at natural ground levels rather than land required to be filled”*. It was suggested that with the substantial amount of filling that had occurred and the requirement for more filling (minimum ground level and minimum floor height) that this issue could be successfully resolved.

1995 (Proposed District Plan) – 2011 (22 Feb 2011)

In 1995 the confirmed Residential 1 and Recreation 5 zonings over this area were carried over into the new City Plan - the first Christchurch Plan to be produced under the RMA 1991. The zoned areas largely remained the same be it that the zone titles changed to Living 1 and Conservation 1 respectively. Records relating to the process and issues for the continuation for that zoning pattern from 1992 to 1995 and beyond were not available for this exercise. There is no record of any subsequent zoning changes after the Living 1 and Conservation 1 zones became operative in 2005.

¹⁵ Paragraph 4.26 of Plan Change 57 Town Planning Report (CCC)

4.2.4 Variation 48

In 2001, the CCCI promulgated Variation 48 to the proposed City Plan (as modified by decisions released in 1999), and it finally became operative on the 31st January 2011. The Variation identified flood management areas (FMAs). The rules applying to those areas require a resource consent to be obtained for the filling of sites and the erection of buildings and provided the CCC with discretion over the floor level of new buildings and adverse flood management related effects associated with such buildings including building additions and the filling of sites.

The FMAs were a mix of undeveloped areas and existing developed areas both in, or around, ponding areas.

The Plan rules classified all filling and building development in a FMA as a Restricted Discretionary Activity with the Council's discretion restricted to minimum floor levels and the effect of the filling on inundation on erosion upstream, or downstream, of the site. In setting minimum floor levels a 0.5% annual exceedence probability was identified as an appropriate flood event on which to base such levels, plus an allowance for freeboard of 400mm.

A map showing the geospatial extent of Variation 48, relative to the study area is included in Appendix 8.

4.2.5 Comment on liquefaction studies in the period 1977-2011

Prior to 1979 (and effectively prior to the inception of the Study Period in 1977), one of the few references to liquefaction and lateral spreading in a planning context was a Canterbury Regional Planning Authority Report entitled *"Regional Policy No. 6: Restraints on Urbanisation (Physical Constraints – climate, flooding, soil stability and earthquake considerations)"*¹⁶. This 1977 report outlined the planning implications of the physical environment between the Waipara and the Rangitata Rivers. The report noted that many parts of the region to some degree are unsuitable for urban use and that *"whilst the likelihood of flooding, tsunamis (seismic waves) earthquakes, or even slipping cannot be predicted with any certainty, some estimate of their significance must be made"*¹⁷. To this end, the report assessed the risk from each of those potential hazards.

Under Chapter 8: Earthquake Considerations, the report noted that the immediate and after effects of the earthquake cannot be prevented at the time but that *"the potential for these dangers can be reduced by building safer structures and avoiding the areas in this report as liable to slipping, subsidence, or 'banks down' flooding"*¹⁸.

In terms of the implications for planning, the report commented on four factors including (of relevance) siting of urban areas, urban form and building design. However, all of this discussion focussed on generic and non-site specific solutions. In fact, the report commented that *"as site investigations and preparations for major engineering works allow for possible ground failure in*

¹⁶ CRPA Technical Report No. 13 September 1977

¹⁷ Page 3 CRPA Technical Report No. 13 September 1977

¹⁸ Page 30 CRPA Technical Report No. 13 September 1977

*an earthquake, no useful purpose would be served by an attempt to classify fault zones or other areas with foundation problems at a detailed scale*¹⁹. This was reinforced in the conclusion which noted that *"it is considered that the differences in likelihood of shaking (greater in the north of the region) and ground response to shaking (greater than alluvial material) can be compensated for, without significant additional cost, by appropriate design of urban areas and buildings within them"*²⁰.

As discussed in section 4.2.3 of this report, the 1977 report does not appear to have influenced the zoning pattern that developed post 1977. Anecdotal evidence suggests that the report was prepared to assist the Regional Planning Authority in determination of the boundary between settlement and rural in the 1979 Regional Planning Scheme. It is not known if this report was more widely available to authorities outside the Canterbury Regional Planning Authority (CRPA).

Interviews with the majority of respondents, particularly the technical scientists and engineers from ECan and CAENZ, indicate that whilst scientific publications on liquefaction and lateral spreading have existed for many decades, the specific application to the New Zealand and Christchurch context is more recent. In this respect those sources suggested that the earliest studies were in the 1991-1992 period and involved the following two seminal publications:

- Elder et al 1991, Natural Hazards in Canterbury; and
- Brown & Weeber 1992, Geological Map of Christchurch 1: 25,000, GNS Science (incorporates a liquefaction hazard map in the text).

The first application of this science to Christchurch planning appears to be in 1995 Christchurch Engineering Lifelines Study²¹. That study focused on the risk of seismic events (and other natural hazards) to major infrastructure and utilities in the Greater Christchurch area (i.e. roads, bridges, telecommunications etc). That study did not comment on risk of liquefaction or lateral spreading to residential development.

Furthermore, there was general consensus that the first significant residential development in the greater Christchurch area to reflect limitations from, or risks associated with, liquefaction and lateral spreading was Pegasus New Town which was zoned by the Waimakariri District Council in 2000.

The next series of information on liquefaction appears to be an ECan series of studies from approximately 2003 to a final report in 2005 (Beca Carter Hollings & Ferner Ltd. (2005). *Christchurch Liquefaction Study - Stage IV (Addendum Report)*, Environment Canterbury). These studies were completed after the zoning decisions for the study area were made, however, they have been used in LIMs, as detailed in section 4.3.6 below.

The full references of these and other documents are included in the list of source material provided in Appendix 4.

¹⁹ Page 31 CRPA Technical Report No. 13 September 1977

²⁰ Page 33 CRPA Technical Report No. 13 September 1977

²¹ Risks and Realities, Christchurch Engineering Lifelines Group, 1997

4.3 Consenting for subdivision development

4.3.1 Process

The process of development for the purpose of this study is focused on subdivision. Subdivision involves not only the establishment of property boundaries, but it also concerns the establishment of services (road, sewer, water, power, telecoms) and building platforms.

For the period 1977 to 2011, subdivisions were processed under the Local Government Act 1974 (Part 20) and the RMA. During this period there were different local government bodies with differing roles in the process. Prior to 1989, where a subdivision application included a new road, CCC was required to send the application to the Canterbury Drainage Board (CDB) for comment and potential conditions. CCC also sent applications to CDB where there were known flood prone and low-lying areas for comment and potential conditions. The prevailing practice was generally for CCC to accept any such conditions, which often related to minimum ground levels and minimum floor levels to address potential drainage issues. Samples of the types of conditions are included in Part B of Table 1 (Appendix 5).

Post 1989 local government amalgamation, staff from the CDB went into the subdivision team of newly formed and enlarged CCC, and issues regarding flooding were addressed by that team. This arrangement continued with the RMA coming into effect and the change from scheme plans to subdivision consents.

4.3.2 Development Issues

In considering subdivision consents, there was no evidence found of the consideration of liquefaction or lateral spreading, either in the documents sourced or the interviews undertaken.

The main development issues for the CCC Subdivision Development Control Team were:

- a) Flooding - from the Avon River and tidal influences – ensuring minimum ground levels and floor heights;
- b) Services – ensuring that there was sufficient fall for the provision of sanitary sewers and that the proposed development area was serviced by mains sewer and water; and
- c) Foundations – that land was suitable for the construction of light framed dwellings.

As noted in the zoning commentary above, the majority of land within the overall study area was zoned for residential purposes prior to 1977. Therefore, there was an expectation that the land was suitable for development to the permitted density and lot sizes specified in the district scheme/plan and that subdivision consenting requirements were largely an administrative process.

These issues were addressed primarily through the imposition of conditions of subdivision consents. A sample of the types of conditions imposed, are set out in Part B of Table 1 (Appendix 8).

4.3.3 Development Sequence

With the majority of the land within the study area zoned pre 1977, there were still areas that had not been developed. In general these areas included:

- a) Low lying land subject to flooding and tidal influence – required filling;
- b) Market Gardens – larger parcels of land zoned residential that were developed when economics of land value increased;
- c) Land in multiply ownership – required joint approach by those owners or purchase by a developer; and
- d) Infrastructure servicing – some areas not serviced by way of sewer could not be developed until that service was provided (e.g. parts of Areas 4 and 5).

Part B Development of Table 1 sets out the time period for the development of the individual study areas 1-15. On review of this information, and taking into account the relative area (i.e. hectares), it is Areas 1, 4, 5 and 15 that have the greatest level of development within the study period post 1977. Research was therefore concentrated on these Areas. The Schedule of subdivision consents (Appendix 18) sets out the subdivisions granted for these areas since the enactment of the RMA (1991). The schedule does not cover Area 15 as development within this area was prior to 1991.

It is noted that other individual study areas have smaller levels of development (e.g. Area 2 = 8 lots, Area 10 = 13 lots) or information regarding the development of those areas was not able to be obtained.

4.3.4 Development of Areas 1, 4, 5 and 15

Area 1 (Bexley South) – This area was able to be developed following the finalisation of the Environment Court consent orders in 1992. The area was developed in approximately nine Stages between 1993 to 1997.

Area 4 (Kate Sheppard) – This area has been zoned fully for residential development since 1979. The area was developed from approximately 1994 to 2002. This area includes the Kate Sheppard Retirement Village, identified as 4A on Area Map 4 and in Table 2. Area 4B (37 Chimera St) – is one of the last stages within Area 4 to be developed in approximately 2002.

Area 5 (Burwood) – Similarly, this area has been zoned fully for residential development since 1979. Developed occurred from approximately 1989 to 2008. The area has been broken down into 5 sub-areas as follows (See Area 5 Map):

- a) 5A – Whittington Block – developed 1989-1994;
- b) 5B – Blair Block - developed 1989-1997;
- c) 5C – Dixon Block - developed 2006-2009;
- d) 5D – Ryan's Block - developed 2007-2008; and
- e) 5E – Balance Area - developed pre 1989.

The eastern part of this area was able to be developed following the construction of a mains sewer along New Brighton Road.

Area 15 (Avondale North) -The western end of this area was originally land that belonged to the Canterbury Drainage Board. This sub-area was low lying and used by the Drainage Board as a dumping site for dredging from the Avon River. The sub-area west of Avondale Road was developed pre 1977. The sub area east of Avondale Road was developed after 1983 moving towards the east.

Development also occurred from the eastern side of Area 15, moving in a westerly direction from 1980 to 1991.

4.3.5 Decisions and Conditions of Consent

The examples of subdivision consents able to be viewed for specific developments in the individual study areas made no reference to liquefaction or lateral spreading. The most recent subdivision consent document sourced was from 2001 (37 Chimera Crescent). There are no reasons for the decision included in the example consent – nor for any of the other subdivision consents obtained and reviewed.

All of the subdivision consents of the individual study areas viewed contained a range of conditions and information memorandum to address issues around drainage and stability. A sample of these conditions is set out Part B Development of Table 1 (Appendix 5).

4.3.6 Land Information Memorandums (LIMs)

LIMs are a mechanism by which a potential purchaser or developer of a property can find out the known land characteristics from a territorial local authority (Section 44A of Local Government and Official Information Act 1987). In the case of CCC, the known characteristics of a specific site are stored on a property file. This may include information regarding historical filling or stability issues as noted section 4.3.3 above.

In addition, the Council has other more general information that it includes on LIMs, such as information regarding the zoning under the District Plan. Included in this more general information is information on liquefaction. This information was received from Environment Canterbury as a series of studies from approximately 2003 to a final report in 2005 as referred to in section 4.2.4 above (Beca Carter Hollings & Ferner Ltd. (2005). *Christchurch Liquefaction Study- Stage IV (Addendum Report)*, Environment Canterbury).

It is understood that since 2005 the CCC LIMs contain a broad/generic statement as to whether or not a property is within Liquefaction Study Area (note that the study area does not include the Port Hills and Banks Peninsula) and refers the reader to Environment Canterbury for further information.

Since September 2010, the CCC LIMS include specific information for those properties affected by liquefaction and lateral spreading from the 4 September earthquake as identified by Tonkin and Taylor in late 2010.

4.3.7 Section 274 of the LGA and Section 106 of the RMA

These sections of the respective pieces of legislation provide local authorities with the power to decline subdivision consents in certain circumstances (e.g. erosion, falling debris, subsidence, slippage or inundation from any source). No documentary evidence of the use of these sections of the Acts being used for the purpose of declining subdivision consent was discovered and neither was this raised in any of the interviews conducted

5. Conclusion

The purpose of this fact-finding study commissioned by the Ministry for the Environment was to determine the extent to which information on liquefaction and lateral spreading hazards were known, available and factored into planning and development processes for the residential component of the eastern suburbs of Christchurch in the period from 1977 to the present.

Based on the information sources available to the study team during the course of the research, this information was non-existent in the zoning and consent decision making process.

In addition, the majority of the zoning of land within the study area occurred prior to 1977, while for subdivision development after that time the major issue addressed in the consenting process was drainage.

Part B: Consideration of liquefaction and lateral spreading hazards in the zoning and development of Brooklands, Kaiapoi and Kairaki/The Pines from 1977 to 4 Sept 2010

6 Introduction

6.1 The Brief

The brief for the Kaiapoi, Brooklands and Kairaki/The Pines area is essentially the same as the initial Christchurch Eastern Suburbs Study with the following exceptions:

- The geographic extent of the areas to be reviewed are Kaiapoi, Brooklands and Kairaki/The Pines
- The time period is from 1977 to 4 September 2010²² as the areas of Kaiapoi, Brooklands and Kairaki/The Pines were more severely impacted by the 4 Sept 2010 earthquake.

The specific details of the above parameters are contained in the brief in Appendix 9.

6.2 The Approach and Methodology

Similarly, the same approach and methodology employed in the Eastern Suburbs Study was employed in undertaking this study. The specific differences in the approach and methodology are set out below.

Step 1: Ascertaining zoning changes pre and post 1977

The first exercise was to establish a residential zoning baseline prior to 1977 and then identify the changes to that baseline for the residential areas in the settlements. This involved reviewing the Christchurch City Council and Waimakariri District Council district scheme and district plan maps, as well as the Waimairi County (later Waimairi District), Rangiora County, Kaiapoi Borough and Eyre County district schemes and maps.

The District Scheme and District Plan Maps used for this exercise were as follows:

- Christchurch City District Scheme – Operative 1986;
- Christchurch City District Plan – Proposed 1995;
- Christchurch City District Plan – Decisions Version 1999;
- Christchurch City District Plan – Operative 2005;
- Waimairi County District Scheme – Operative 1965;
- Waimairi County District Scheme – Operative 1974;
- Waimairi District District Scheme – Operative 1983;

²² The Eastern Suburbs Study period extended until 22 February 2011

- Waimairi District District Scheme – Operative 1989;
- Kaiapoi Borough District Scheme – Proposed 1967;
- Kaiapoi Borough District Scheme – Operative 1972;
- Kaiapoi Borough District Scheme Change 3 – Operative 1974;
- Kaiapoi Borough District Scheme – Proposed 1984;
- Kaiapoi Borough District Scheme – Operative 1986;
- Rangiora County District Scheme – Proposed 1975;
- Rangiora County District Scheme – Operative 1980;
- Eyre County District Scheme – Proposed 1981;
- Eyre County District Scheme – Operative 1983;
- Waimakariri District Plan – Plan Change 19 – Proposed 1991;
- Waimakariri District Plan – Plan Change 19 – Operative 1994;
- Waimakariri District Plan – Proposed 2000;
- Waimakariri District Plan – Proposed 2005.

Copies of these schemes and plans were kindly provided by current and former staff of Christchurch City Council, Waimakariri District Council and former land developers – or sourced from Archives New Zealand. The changes to the residential zoning from these documents were compiled onto:

- *Scoping Map 1: Brooklands residential zone changes by planning period* (Appendix 10)

Due to there being only discreet or no changes to residential zoning at Kaiapoi and Kairaki/The Pines, residential zone maps for these areas were not produced.

Step 2: Overlaying Tonkin and Taylor maps of major to severe lateral spreading and minor to severe liquefaction

The next source documents to be used related to the identification of the areas affected by liquefaction and lateral spreading. The source maps used for this task are from the Canterbury Recovery Project Orbit website. Orbit Map 02 – Liquefaction Property v1.0 (4 September 2010), prepared by Tonkin and Taylor, was used as the reference to identify those areas subject to minor to severe liquefaction and major to severe lateral spreading. It is these areas that were used as the base for this aspect of the study.

The information from this two-step methodology provided the baseline to examine the decision-making process for zoning and consenting in the settlements for the period 1977 to 4 Sept 2010.

6.3 Results - The study area

A comparison was then made of the areas of intersection of “new zoning” and areas affected by “minor to severe liquefaction” and “major and severe lateral spreading”. As part of the same exercise, those areas where there had been a change in the cadastra, that were affected by minor to severe liquefaction and major and severe lateral spreading were also identified. The resulting areas were used to create:

- *Scoping Map 2: Kaiapoi* (Appendix 11).

Kaiapoi is the only settlement where discreet areas were identified, these being K1 (Askeaton Drive) and K2 (Courtenay Downs). For Brooklands and Kairaki/The Pines these settlements were investigated in their entirety. These are shown in:

- *Scoping Map 3: Brooklands* (Appendix 12) and
- *Scoping Map 4A and 4B: Kairaki/The Pines* (Appendix 13).

7 Information collection and collation

7.1 Methodology

The Scoping Maps (Appendices 10-13) were used in discussions with the professionals involved in the development of areas in the various settlements to assist in the identification of the chronological order of development and to identify where consideration was given to liquefaction and lateral spreading in zoning and development decisions.

A range of people were interviewed to assist in identifying relevant information, including:

- current and former local authority staff (Environment Canterbury (ECAN), Christchurch City Council (CCC), Waimairi County and District Councils (WCC), Waimakariri District Council (WDC), Rangiora County Council (RCC), Kaiapoi Borough Council (KBC), North Canterbury Catchment Board (NCCB), Canterbury Drainage Board (CBD), Canterbury Regional Planning Authority (CRPA) and the Canterbury United Council (CUC) involved in zoning and consenting decision making; and
- current and retired surveying, engineering and planning practitioners;
- former land developers.

Original source material was also reviewed. This included:

- a partial set of district plan maps from 1967 to 2006;
- district schemes and plans;
- Plan Change 19 documentation;
- technical reports; and
- examples of subdivision consent decisions and memoranda of information.

A full list of original source material is set out in Appendix 14.

It should be noted that not all of the information sought was available due to circumstances affecting its retrieval as a result of the earthquakes and the short timeframe involved.

7.2 Results

The information obtained from the above sources is presented in tabular and map form as follows:

- **Table 1 - History of zoning and development for Brooklands (1965-2010) (Appendix 15)**

- Table 2 - History of zoning and development for Kaiapoi (1967-2010) (Appendix16)
- Table 3 - History of zoning and development for Kairaki/The Pines (1975-2010) (Appendix 17)

Tables 1-3 are composite tables that summarise for each area the zoning and development history as follows:

- Part A of the table covers the zoning sequence for the various planning documents from the first district schemes (Brooklands 1965, Kaiapoi 1967, and Kairaki/The Pines 1975) through to the District Plans at 2010.
- Part B of the table summarises the development sequence (where known) for the each of the areas from 1977-2010.

In both parts, the table indicates for each area the extent to which information on liquefaction and lateral spreading were taken into account in the zoning and consenting decision making process.

The information in these Tables is elaborated on in the thematic commentary which makes up Section 3.

8 Thematic Commentary

8.1 Context

As with the Eastern Suburbs Study this final stage (Stage 3: Information Review) of the report endeavours to present a précis of those themes in terms of undisputed fact and informed professional opinion of interviewees. It follows the same presentation of factual themes into the following two categories:

- c) District plan zoning; and
- d) Consenting for subdivision development.

Whilst focussing on the 1977 to present period, a discussion on the zoning and development baseline that existed prior to 1977 has been included. This is because, as was the case with the Eastern Suburbs Study, there is very little residential zoning post 1977 to comment on because the current zoning pattern was largely in place well before then. As such, the pre 1977 zoning process and decision-making takes on more significance than originally anticipated in the brief.

The scoping maps (Maps 1 - 4) and tables (Tables 1 - 3) developed in section 7 of this report, and included in the appendices, are the key references for this commentary.

8.2 District plan zoning

8.2.1 Brooklands

By the inception of the Study Period all but a small component of the Brooklands beach settlement was zoned for residential development. As such, whilst the following section does describe the zoning process for that post 1977 rezoning, it also importantly describes the basis for the zoning that was already in place in 1977 and the extent to which the decisions associated with that zoning contemplated seismic risk.

The starting point is 1965 at which time the Brooklands settlement was included in the operative Waimairi County District Scheme. This Scheme was produced under the 1953 Town and Country Planning Act. There were no reports available to explain the decision-making associated with the inception of the residential zoning. It appears from the district scheme itself that the Brooklands settlement was well established by the time that the plan was first notified (circa early 1960s) with the planning map in the operative District Scheme indicating approximately 120 dwellings having established on approximately 150 allotments. The Operative District Scheme zoned Brooklands as 'Residential A'. This zone permitted residential dwellings along with farming and recreation activities.

The 1974 operative District Scheme continued the 'Residential A' zoning over the same area of land covered by the 1965 District Scheme. There were no zoning extensions or any material changes to the policies or rules that existed in the previous 1965 District Scheme.

In 1983 the number of dwellings had grown to 175 and the entire zone was re-zoned from 'Residential A' to 'Residential Brooklands/Spencerville' ("Residential BS") in the proposed Waimairi District Scheme²³. The 'Residential BS' zone was one of three special residential zones in the district (the other being Kainga to the north and the Residential G1 zone for larger areas of undeveloped land).

Reports associated with the rezoning were not discovered but the statement and rules for the zone show that the 'BS' zone appears to have permitted residential development but acknowledged servicing limitations in the entire zone; particularly in the form of sewage disposal (i.e. all allotments were reliant on septic tanks).

Between the District Scheme being notified in 1983 and it becoming operative in 1989, the Waimairi District Council either resolved to implement or implemented a sewer extension to service the entire Brooklands / Spencerville area plus Kainga / Stewart Gully to the north. This appears to have resulted in the replacement of the 'Residential BS' zone with the 'Residential G' zone around 1989/90²⁴.

In 1990 the 'Residential G' (General) zone comprised the entire metropolitan suburban residential area of the former Waimairi District. That district covered the northern, north-western and north-eastern suburbs of Greater Christchurch and extended to the south bank of the Waimakariri River to the north.

The zone essentially incorporated the former 'Residential A' and 'Residential B' zones in the former 1974 District Scheme and some of the special residential zones from the 1983 scheme such as the residential BS zone. It did exclude a number of undeveloped areas within the Waimairi District which were separately zoned as 'Residential G1'. In this respect, the zone largely recognised the existing development pattern within the District including the development pattern at Brooklands that had established as early as 1960 and possibly earlier as a beach and fishing settlement.

Again there are no Planning reports available to indicate the decision making associated with the application of the Residential G zone to Brooklands. The only reference is to the zone purpose itself which was to provide for a range of residential uses. The significance of the 'Residential G' zoning was that it placed Brooklands on the same zoning basis as the rest of suburban Christchurch.

²³ The Waimairi District Scheme was publicly notified in 1983 and was made operative in 1989 just prior to local body amalgamation when Waimairi District Council was amalgamated into an enlarged Christchurch City Council.

²⁴ The Planning Maps and the Scheme statement are at odds with each other in that the Planning Maps clearly show the Brooklands area being zoned Residential G but the scheme statement still contains a reference to the Residential BS zone. Personal Communication with former District Planner for Waimairi District Council suggests that the Scheme Statement is probably in error and was not updated to reflect a zone change either as part of the decisions resulting from the district scheme process between 1983 and 1989 or a zoning change immediately after the District scheme become operative in 1989. In either event, the information suggests that the Residential BS zone was replaced with the Residential G zone.

In 1995 the Christchurch City Council published its first District Plan under the Resource Management Act 1991. The entire Brooklands area previously zoned 'Residential G' was re-zoned 'Living RS (Rural Settlement)'.

The zone recognised that Brooklands (and Spencerville) is a small settlement surrounded by a rural environment and that they are both sited on low lying land between the Styx River and Brooklands Lagoon, and are therefore subject to periodic flooding and drainage problems.

Noting that the settlement had been serviced with a sewage disposal scheme, the rules provided for further development of vacant land within the residential boundaries of the settlement.

The Planning Reports associated with this rezoning were not discoverable. Again guidance has been taken from the zone statement and associated rules. The following themes are identified:

- The zone recognised that improvements to stormwater drainage were necessary, particularly given the potential anticipated increase in residential development of existing vacant sites within the zone.
- The zone rules permitted residential buildings at low density of building coverage and low heights (generally 1-2 storeys), in keeping with the environment of the rural settlements, but with variety in building design and style.
- The rules also sought to provide protection of sites and buildings from flooding through raised floor levels, and ample on-site permeable ground surface for groundwater soakage.

Hence there was a sole focus in even the first RMA district plan on drainage and flooding as opposed to any other potential natural hazard.

The 1995 proposed City Plan also marked the first residential re-zonings in Brooklands (i.e. from non-residential to residential). In this respect, the following four areas (as shown on Scoping Map 1) were re-zoned from Rural G to Living RS:

- Area 1; northern Brooklands, straddling Lower Styx Road, north of Kainga/Harbour Road (known as Bakersfield Place);
- Area 2; north-eastern Brooklands north of Harbour Road and Nirvana St;
- Area 3; west Brooklands, west of Lower Styx Road near Dartford St;
- Area 4; central Brooklands, west of Lower Styx Road, north of Dartfield St, south of Anfield St and west of Beacon St.

There is no evidence that issues other than flood risk, as acknowledged in the Living RS zone, were considered as part of the section 32 analysis associated with the re-zoning of these four parcels of land.

In addition, surveyed allotments straddling Beacon St and halfway down that street were removed from the 'Residential G' zone and re-zoned 'Conservation 1A'. Similarly, there is no evidence to suggest that hazards other than flooding motivated this restrictive zoning alteration. The land affected by the removal of the 'Residential G' zone appears to be a waterway associated with the Brooklands Lagoon.

Variation 48 (as detailed in the Eastern Suburbs Study) classified the entire township of Brooklands as an FMA (Flood Management Area) (known as the Lower Styx ponding area). Accordingly, any new development (including extensions to existing residential buildings) required resource consent as a Restricted Discretionary Activity. However, because of the effect of section 20²⁵ of the RMA, these rules did not come into force until the Council issued their decision in January 2011. On this basis the effect of the variation on the development of Brooklands has been negligible. Even if it had some influence it would have been ineffectual in respect to liquefaction for two key reasons:

- The majority of residential development occurred well before 1977
- The policies and rules guiding development in Brooklands were directed towards flooding and servicing limitations as opposed to seismic hazards.

8.2.2 Kairaki/The Pines

Both of these beach settlements established prior to the first District Scheme for the area being promulgated.

Both settlements were zoned 'Urban' in the 1975 proposed Rangiora County District Scheme (operative 1980). This was the first District Scheme produced by the Rangiora County²⁶ Council under the Town and Country Planning Act 1953. There was a paucity of information available in relation to the zoning history associated with these settlements. Accordingly there has been a reliance on the policies in the District Schemes and District Plans in the absence of any section 32 reports.

The 'Urban' zone had as its stated purpose:

"The control of development in small townships and coastal holiday settlements, providing for their continued development as rural service towns and holiday centres while avoiding any detraction from their safety, efficiency or pleasantness which might result from the form of the development."

The rules in the zone permitted a mix of residential dwellings, farming, and open space/recreation activities (including halls and camping grounds). Dwellings were permitted provided certain controls on septic tank installation and operations were adhered to, which reflects that the area was un-serviced at the time. The planning maps in 1975 indicate that whilst the street pattern that resides today was established back then, the number of residential allotments was limited.

The 1980 Plan prevailed until 1998 when the Waimakariri District Council notified its proposed District Plan. However, the Council reprinted (as part of its Transitional Plan) the operative 1980 Rangiora District Scheme and this showed that the extent of allotment creation between 1975 and 1998 was non-existent.

²⁵ Section 20, before it was repealed, stated that "A local authority may, before publicly notifying a proposed plan, resolve that any rule in the plan does not have effect until the plan becomes operative"

²⁶ The Rangiora County became Rangiora District in 1986.

The 1998 proposed Waimakariri District Plan zoned both these settlements as 'Residential 3'. The 'Residential 3' zone applied solely to the beach settlements and small rural towns in the Waimakariri district and reflected *"the view of the community that the beach settlements...are different in character from the four main towns in the district. These differences largely stem wither from their origins as holiday settlements, their small size, and low density of building."* The zone description indicates that the settlements comprised a high proportion of small dwellings and baches, as well as, camping grounds.

Overall, there is no indication in the provisions of any of the district planning instruments (both Town and Country Planning Act and RMA; and both pre and post 1977) controlling development in these two beach settlements, to indicate that seismic issues were considered in the land use zoning pattern.

8.2.3 Kaiapoi

As with Kairaki/The Pines, the information pertaining to the zoning's history of Kaiapoi was not discoverable. There has been a reliance on information from National Archives and other sources including former Kaiapoi Borough staff and land developers.

At the time of the first District Scheme being produced for Kaiapoi, the township as it appears geographically today, was administered by two former local authorities; namely Kaiapoi Borough Council and Eyre County Council. The vast majority of the township was within the Borough, however areas in the south-east of the existing township were administered by Eyre County Council.

It appears that the first District Scheme for the Borough of Kaiapoi was notified in 1967 under the Town and Country Planning Act 1953. The first District Scheme for Eyre County Council was first notified in 1981 and made operative in 1983.

An analysis of both of these District Scheme Planning Maps shows that, with the exception of one principal area (known as Courtney Downs), the entire suburb of Kaiapoi affected by the Study Area (i.e. subject to liquefaction and lateral spreading), was already zoned for residential purposes. The basis for this zoning and the matters taken into consideration are not known.

It is clear from the 1967 planning map for Kaiapoi Borough that the area to the north and north-east of the Kaiapoi River, known locally at the time of subdivision as Sunny Meadows/Golden Grove, although zoned for residential purposes, was largely undeveloped north of Cass Street and west of Meadow Street.

The second District Scheme for Kaiapoi was proposed in 1984, (i.e. during the Study Period), and became operative in 1986. The 1984 Planning Map indicates that the majority of the undeveloped land in the Sunny Meadows/Golden Grove area had been developed with the exception of an area around Askeaton Drive (known then as Commercial St). The development sequence for these areas is outlined in greater detail later in this report. However, the point to be made is that there was no material indicating the rationale for continuing the 1972 operative residential zoning into the 1984 proposed District Scheme for this particular area of Kaiapoi. It is assumed that the 1984 zoning merely reflected that the area was already zoned residential and had presumably gradually been subdivided between 1972 and 1984. In fact, plan change number 3 to the Kaiapoi District Scheme, which appears to be operative sometime between 1975 and 1979, indicates that all of the Sunny Meadows/Golden Grove area (with the exception of Askeaton Drive) had been subdivided during this earlier time period.

Completing the zoning sequence for Kaiapoi, the Waimakariri District Plan (the first plan produced for the district under the RMA) was notified in 1998 and became operative in 2006. All those residential areas in Kaiapoi within the study area were zoned either Residential 1 or Residential 2 in that Plan. There were no reductions in residential zoning.

Returning to Courtney Downs, this was the only area of Kaiapoi within the Study Area that was re-zoned from non-residential to residential in the Study Period. The Courtney Downs area is shown on Scoping Map 5 (Appendix 17). It was subject to a private plan change in 1991 by a company known as the Alliance Group. The crux of the plan change was to re-zone land associated with the former Kaiapoi Freezing Works. The land was predominately zoned as 'Freezing Works' in the Eyre County District Scheme and the proposal was to re-zone it for residential purposes. Approximately 27ha of land was proposed to be re-zoned. This was complemented by approximately 8ha of former freezing works land being re-zoned to 'Rural 3'. A small portion (approximately 1ha) of the former freezing works land was also zoned 'Industrial'.

The plan change was first notified in 1991 and was the first plan change for the Waimakariri District Council under the newly enacted RMA. The plan change included a number of reports on surveying, engineering, traffic, services, iwi, ecology and landscaping. The plan change went through the normal notification procedures and whilst there were a number of submissions lodged to it, the re-zoning was largely confirmed in a hearing held in October 1993.

The documentation associated with the plan change, the Council processing of it and the decision itself indicate that there was no consideration of potential liquefaction or potential lateral spreading issues. The only natural hazard to be considered was the potential for flooding as a result of an outbreak from the Waimakariri River/Courtney Stream. To this end, controls on minimum ground levels for subdivision and floor levels for buildings were included in the operative plan change. Essentially, the relevant development standard required all land to be filled to a minimum level of 2.0m above MSL, with localised fill being placed along the south-east boundary of the development to a level of 3.0m MSL. In addition, all floor levels for buildings were required to be at least 2.25m above MSL and 300mm above road kerb level.

8.2.4 Comment on liquefaction studies in the period 1977-2010

As with the Eastern Suburbs Study, prior to 1979 (and effectively prior to the inception of the Study Period in 1977), one of the few references to liquefaction and lateral spreading in a planning context was a Canterbury Regional Planning Authority Report (CRPA) entitled "*Regional Policy No. 6: Restraints on Urbanisation (Physical Constraints – climate, flooding, soil stability and earthquake considerations)*"²⁷. The CRPA report covered the areas of Brooklands, Kaiapoi and Kairaki/The Pines. This report and its implications are fully set out in the Eastern Suburbs study and is not repeated here.

While applicable to the Eastern Suburbs, the two seminal publications;

- Elder et al 1991, Natural Hazards in Canterbury; and
- Brown & Weeber 1992, Geological Map of Christchurch 1: 25,000, GNS Science (incorporates a liquefaction hazard map in the text).

²⁷ CRPA Technical Report No. 13 September 1977

did not include the areas of Brooklands, Kaiapoi and Kairaki/The Pines.

The first application of this science to Christchurch planning appears to be in 1995 Christchurch Engineering Lifelines Study²⁸ which included the Brooklands area. As noted in the Eastern Suburbs Study this publication focused on the risk of seismic events (and other natural hazards) to major infrastructure and utilities in the Greater Christchurch area (i.e. roads, bridges, telecommunications etc) and did not comment the risk of liquefaction or lateral spreading to residential development.

Again as noted in the Eastern Suburbs Study, there was a general consensus that the first significant residential development in the greater Christchurch area to reflect limitations from, or risks associated with, liquefaction and lateral spreading was Pegasus New Town which was zoned by the Waimakariri District Council in 2000. However, it is noted that Pegasus New Town is not within the study area.

For Brooklands, the next series of information on liquefaction appears to be an ECan series of studies from approximately 2003 to a final report in 2005 (Beca Carter Hollings & Ferner Ltd. (2005). *Christchurch Liquefaction Study - Stage IV (Addendum Report)*, Environment Canterbury). These studies were completed after the zoning decisions for the study area were made, however, they have been used by CCC in LIMs, as detailed in section 8.3.6 below. The 2005 study indicates a range of low to high liquefaction potential for Brooklands under various scenarios.

For the Kaiapoi and Kairaki/The Pines areas specifically, the first major publication relating to liquefaction risk appears to be in 2000, with the *Liquefaction Study Waimakariri District (Beca Carter Hollings and Ferner Ltd), ECan Pub. No. U00/12, August 2000*. The study identified the majority of eastern coastal Waimakariri District as having a high susceptibility to liquefaction hazard.

The next study that covered the Kaiapoi and Kairaki/The Pines areas, appears to be the Earthquake Hazards Assessment for Waimakariri District, (Geotech Consulting Ltd) May 2009, prepared for Environment Canterbury. The purpose of the study was to "*place the earthquake hazard in context*" and to "*provide some general comments on the vulnerability or exposure of engineering lifelines*". This study identified the eastern area of the District within 5-8 km of the coast as having a low to high potential for liquefaction.

The full references of these and other documents are included in the list of sources material provided in Appendix 14.

8.3 Consenting for subdivision development

8.3.1 Process

As with the Eastern Suburbs Study, the process of development for the purpose of this study is focused on subdivision. Subdivision involves not only the establishment of property boundaries,

²⁸ Risks and Realities, Christchurch Engineering Lifelines Group, 1997

but it also concerns the establishment of services (road, sewer, water, power, telecoms) and building platforms.

For the period 1977 to 2010, subdivisions were processed under the Local Government Act 1974 (Part 20) and the RMA. Prior to 1989, subdivisions were processed by the various local authorities for the areas, Kaiapoi – Kaiapoi Borough and Eyre County; and for Kairaki/The Pines – Rangiora County. Post 1989 subdivisions for these areas were processed by Waimakariri District Council. Similarly, for Brooklands pre 1989 subdivision consents were processed by Waimairi District and post 1989 by CCC. Subdivision files for approximately pre 1995 were not discoverable for the all the areas in this part of the study. Samples of the types of conditions imposed on subdivision consents are included in Part B of Tables 1 – 3 (Appendix 15-17).

The Schedule of subdivision consents (Appendix 18) sets out the subdivisions granted for Brooklands and two parts of Kaiapoi (K1 – Askeaton Drive and K2 – Courtenay Downs) since 1995. These are the areas that have had a high level of development since the enactment of the RMA (1991).

8.3.2 Development Issues

In considering subdivision consents, there was no evidence found of the consideration of liquefaction or lateral spreading, either in the documents sourced or the interviews undertaken.

The main development issues for the Brooklands, Kaiapoi and Kairaki/The Pines areas were:

- d) Flooding - from the lower Styx, Kaiapoi and Waimakariri rivers and tidal influences – ensuring minimum ground levels and floor heights;
- e) Services – ensuring that there was sufficient fall for the provision of sanitary sewers and that the proposed development area was serviced by mains sewer and water; and
- f) Foundations – that land was suitable for the construction of light framed dwellings.

As noted in the zoning commentary above, the majority of land within the overall study area was zoned for residential purposes prior to 1977. Therefore, there was an expectation that the land was suitable for development to the permitted density and lot sizes specified in the district scheme/plan and that subdivision consenting requirements were largely an administrative process.

In the case of Brooklands these issues were addressed primarily through the imposition of conditions of subdivision consents. A sample of the types of conditions imposed, are set out in Part B of Table 1 (Appendix 15). In the case of Kaiapoi and Kairaki/The Pines, these matters were initially dealt with through reliance on the District Pan provisions (early 1990s), however, a change to the imposition of conditions occurred in about 2003.

8.3.3 Development of Brooklands

As described above, Brooklands is a beach settlement and the major development in the form of subdivision (rather than the construction of dwellings) occurred from 1996 to 2008. This development began to occur after the provision of reticulated sewage system to the Brooklands area in the late 1980s.

The earlier subdivision development was of larger lots in the centre of the settlement and the camping ground at what is now Blue Lagoon Drive and Shammys Place. These areas were developed 1996-1998. The latter subdivisions, 2002 - 2008 were on the edge of settlement adjoining the Styx River and Brooklands Lagoon. A number of applications were the subject of consent hearings where the main issue was building platforms encroaching into the flood plain and potential affecting flood levels on adjoining properties. This issue appears to have been address by way of excavating the river to provide for additional flood storage.

Examples of subdivision consent conditions were able to be viewed for the developments in the period 1996-2008. There is no reference to liquefaction or lateral spreading in the examples viewed. All of the subdivision consents viewed contained a range of conditions and information memorandum to address issues around drainage and stability. A sample of these conditions is set out Part B Development of Table 1 (Appendix 15).

8.3.4 Development of Kairaki/The Pines

No information was able to be obtained relating to the subdivision development of Kairaki/The Pines. This is due to the records either being in a building that is not accessible or that the records are not currently retrievable from storage.

From a review of the cadasta comparing the District Scheme Maps for Kairaki/The Pines from the Rangiora District Scheme 1975 to the Waimakariri District Plan Maps 2006, there appears to be no change in the subdivision pattern.

8.3.5 Development of Kaiapoi

Two areas of Kaiapoi have been identified as being developed within the study period. The areas are identified as K1 and K2 on Scoping Map 2 in Appendix 11.

The Area K1 (Askeaton Drive) was the subject of subdivision development in 1998. This appears to be the last area within the residential zoned land on the north eastern side of Kaiapoi to have been developed. Conditions on these subdivision consents required reports from geomechanical specialists as to the suitability of each lot for development, as well as, filling to NZS4431.

Area K2, is known as the Courtenay Downs development and the rezoning of this area has already been detailed in section 8.2.3 above. The subdivision of this area occurred in seven stages from the period 1994 to 2001. As noted in section 8.2.3 above, the District Plan set out minimum ground levels for subdivision development in this area along with minimum floor levels. These standards were not duplicated in the conditions of subdivision consent. As with Area K1, the conditions of subdivision consent required reports from geomechanical specialists as to the suitability of each lot for development, as well as, filling to NZS4431.

8.3.6 Land Information Memorandums (LIMs)

As noted in the Eastern Suburbs study, LIMs are a mechanism by which a potential purchaser or developer of a property can find out the known land characteristics from a territorial local authority

(Section 44A of Local Government and Official Information Act 1987). That study addressed CCC processes around LIMs which also apply to Brooklands.

For Kaiapoi and Kairaki/The Pines, it is understood that WDC has, since late 2000 or early 2001, included supplementary information on liquefaction risk since the completion of 2000 Beca Carter Hollings & Ferner Ltd report detailed in section 8.2.4 above.

In addition, since 19 May 2011, the WDC LIMS include specific supplementary information on requirements for building consents for those properties affected by liquefaction and lateral spreading from the 4 September 2010 earthquake as identified by Tonkin and Taylor in late 2010.

8.3.7 Section 274 of the LGA and Section 106 of the RMA

These sections of the respective pieces of legislation provide local authorities with the power to decline subdivision consents in certain circumstances (e.g. erosion, falling debris, subsidence, slippage or inundation from any source). No documentary evidence of the use of these sections of the Acts being used for the purpose of declining subdivision consent was discovered. Instances where Council had requested further information regarding how potential flooding issues would be addressed by applicants were raised in interviews. Where these issues were difficult for the applicant to address, the Council did not receive a response to the s92 request. Therefore it was a no response to the s92 request rather than a decline under s106, that led to such applications not progressing.

9. Conclusion

The purpose of this fact-finding study commissioned by the Ministry for the Environment was to determine the extent to which information on liquefaction and lateral spreading hazards were known, available and factored into planning and development processes for the residential component of Brooklands, Kaiapoi and Kairaki/The Pines in the period from 1977 to the present.

Based on the information sources available to the study team during the course of the research, this information was non-existent in the zoning and consent decision making process.

In addition, the majority of the zoning of land within the study areas occurred prior to 1977 and for subdivision development after that time the major issue addressed in the consenting process was flood risk.