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91007



NEW ZEALAND QUALIFICATIONS AUTHORITY  
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## Level 1 Geography, 2018

### 91007 Demonstrate geographic understanding of environments that have been shaped by extreme natural event(s)

2.00 p.m. Friday 9 November 2018

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate geographic understanding of environments that have been shaped by extreme natural event(s).	Demonstrate in-depth geographic understanding of environments that have been shaped by extreme natural event(s).	Demonstrate comprehensive geographic understanding of environments that have been shaped by extreme natural event(s).

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

Excellence

TOTAL

20

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**INSTRUCTIONS**

Name ONE type of **extreme natural event**, and an **environmental case study (or studies)** of this event, that you will use to answer ALL of the questions in this booklet.

Extreme natural event: Earthquake

Environmental case study (or studies): Canterbury Earthquakes → 4 September 2010  
→ 22 February 2011

**QUESTION ONE: NATURAL PROCESSES**

Read the geographic concept below and refer to it when answering this question.

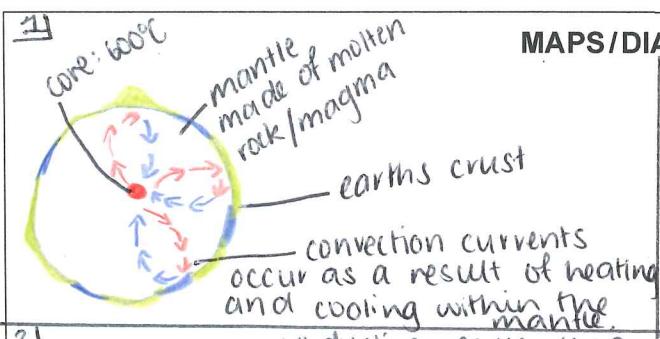
**Geographic concept: Interaction**

**Interaction** involves elements of an environment affecting each other and being linked together. Interaction incorporates movement, flows, connections, and interrelationships. Landscapes are the visible outcome of interactions. Interaction can bring about environmental change.

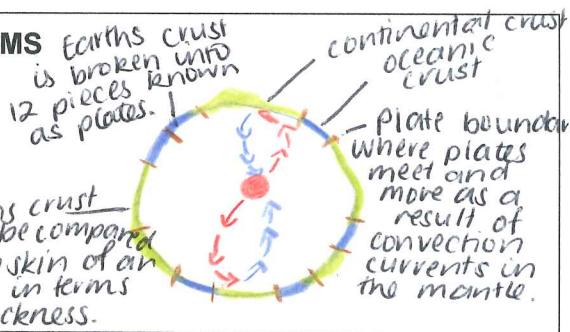
Fully explain the natural processes that operated to produce the extreme natural event in your environmental case study (or studies).

In your answer, include geographic terminology, the geographic concept of interaction, and integrated detailed supporting evidence from your environmental case study (or studies), along with supporting diagrams and/or maps.

**PLANNING (OPTIONAL)**



## MAPS/DIAGRAMS



- 3) Subduction occurs when oceanic and continental plate boundaries meet. Oceanic dives under continental e.g. Indo-Australian + Pacific in Fiordland.
- Transform faults occur when two plates slide past each other e.g. San Alpine Fault
- Diverging plate boundaries move away from each other allowing new magma to rise and cool e.g. mid-Atlantic Ridge.

- 4) Plate boundaries catch on rocks etc and can't move freely.
- Friction causes stress energy which builds up over 100s - 1000s of years.
- When the pressure becomes too great, the energy is suddenly released in an earthquake.



The core is in the centre of the earth and is believed to be solid iron and 6000°C. The heat of the contributes to a process involved in earthquakes: convection currents. Convection currents are caused by molten rock/magma being heated in the mantle by the core and then moving to the earth's surface to cool before beginning the cycle again as seen in diagram 1.

Another process involved in earthquakes is plate tectonics. The earth's crust is broken into 12 pieces which are forced to move because of the convection currents in the mantle, as seen in diagram 2. Most earthquake activity occurs at or near plate boundaries.

Plate boundaries will either converge, subduct, diverge or transform. Converging plate boundaries are two continental crust boundaries that collide and push each other up. Subducting

plate boundaries occur when oceanic and continental boundaries collide. Oceanic crust is denser so subducts under continental plates, for example the Indo-Australian Plate subducts under the Pacific Plate south of Fiordland, New Zealand. Transform faults are two plates sliding past each other e.g. Pacific and Indo-Australian Plates in the Alpine Fault, Southern Alps, New Zealand. Diverging plate boundaries occur where two plates move away from each other and allow magma to rise, cool and form new crust. An example of this is the mid Atlantic Ridge. When plates can no longer move freely and catch on one another, stress energy occurs and builds up over 100's to 1000's of years as seen in diagram 4. When the pressure becomes too strong the plates suddenly move and rupture causing an earthquake to occur. Seismic waves are released and travel along existing fault lines or create new faults.

The September 4 2010 earthquake was caused by the Greendale Fault, 40 km SW of Christchurch. Christchurch is located near the Alpine Fault and is also close to the Pacific Ocean. New Zealand is located on the plate boundary of the Pacific and Indo-Australian Plates. The Greendale Fault was previously unknown because it had been covered by 6000 years of gravel on the Canterbury Plains.

The February 22 2011 earthquake was caused by the Port Hills Fault, 10km SE of Christchurch in the hard basalt rock of the Port Hills. The basalt rock focused much of the earthquakes energy into Christchurch. The Port Hills Fault was also previously unknown.

The Greendale rupture resulted in a 7.1 magnitude earthquake while the Port Hills resulted in a 6.3 magnitude earthquake.

(more on page 15).

Extra space if required.  
Write the question number(s) if applicable.

1. The interaction of the two processes; convection currents and plate tectonics is what causes earthquakes all around the world everyday although most are too small to be felt. Without the interaction of the two processes, earthquakes would not occur. //

**QUESTION TWO: EFFECTS**

Read the geographic concept below and refer to it when answering this question.

**Geographic concept: Change**

**Change** involves any alteration to the natural or cultural environment. It occurs at varying rates, at different times, and in different places. Some changes are predictable, recurrent or cyclic, while others are unpredictable or erratic. Change can bring about further change.

Fully explain ONE effect that your chosen extreme natural event has had on the natural environment in your case study (or studies).

In your answer, include geographic terminology, the geographic concept of change, and integrated detailed supporting evidence from your case study (or studies), along with supporting diagrams and/or maps.

**PLANNING (OPTIONAL)**

Liquefaction - Bexley, Brighton, Avonside, Kaiapoi

- silty sandy soils, rising water table after September
- increased pressure and movement
- 400,000 tonnes of liquefaction

## MAPS/DIAGRAMS

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The soil and water layers then settle with some instability remaining and larger volumes of water in the soil layer for a longer period of time.



Once bonds are broken the soil and water combine to form liquefaction. The pressure from the earthquake forces this substance through the ground surface.



The water sits below the soil surface with a small amount remaining in the soil structure.



Liquefaction.

During an earthquake the soil is moved around and bonds broken due to the immense water pressure.

One effect that the Canterbury earthquakes had on the Christchurch city and surrounding areas was the liquefaction which was particularly bad after the February 22 2011, 6.3M earthquake\*. The liquefaction affected the Bexley, Brighton, Avonside and Kaiapoi suburbs and townships the worst.

This is because they are built on extremely swampy soils which contain a lot of silt and sand. The September 4 2010 earthquake damaged the soil structure of these areas and weakened therefore weakened the soil stability and support bases. As a result of this, the water table rose dramatically to fill new air pockets which had been created. Due to this rise of water tables and reduced soil stability, liquefaction after the February 22 2011 earthquake was worse than before with over 400,000 /

tonnes needing to be removed //

The intensity of the February 22 2011 earthquake combined with increased ~~ea~~ underground pressure on the soil by the water table meant that less pressure was required to move liquefaction to the surface, and ensured there was greater movement of soil substances and in larger quantities. The suburbs affected were located near the coast which added to the risk of devastation and increased the impact of the liquefaction //

- \* Liquefaction is caused when soils, which are normally solid substances act as liquids with the increased water components //

Liquefaction was also worsened by a 1.6m vertical land lift in the September earthquake in some places and another 1.5metre vertical land lift in the February earthquake //

### QUESTION THREE: LONG-TERM RESPONSE

Read the geographic concept below and refer to it when answering this question.

#### Geographic concept: Sustainability

Sustainability involves adopting ways of thinking and behaving that allow individuals, groups, and societies to meet their needs and aspirations without preventing future generations from meeting theirs. Sustainable interaction with the environment may be achieved by preventing, limiting, minimising, or correcting environmental damage.

Examples of long-term responses to extreme natural events include:

- rebuilding (houses, business, infrastructure, etc.)
- relocating (moving in order to avoid the potential effects of future events)
- researching (causes, reasons for damage, ways to minimise the potential effects of future events, etc.).

Fully explain at least ONE way in which people responded, in the long term, to the extreme natural event in your environmental case study (or studies).

In your answer, include geographic terminology, the geographic concept of sustainability, and integrated detailed supporting evidence from your case study (or studies).

#### PLANNING (OPTIONAL)

- Red Zones.
- Avon River construction.
- CERA - Christchurch Earthquake Recovery Association.
- Green spaces plans for previously red zones residential areas.
- Stricter building codes.
- New lifts, centres and other infrastructure.

The people of Christchurch, Canterbury and the rest of New Zealand have used the earthquake and long-term response period to partially or completely redesign the Christchurch City and move towards being a more sustainably focused city. This started with zoning areas. Red zoned areas are considered unsafe for building on as there is too much potential risk if another earthquake was to occur. By zoning areas it has allowed them to be used for other purposes instead of residential. One such area is the strip along the Avon ~~and Heathcote rivers~~ river through Christchurch's south-east side which is now being considered for a Greenspaces idea where it will be turned into parkland and incorporate grass and planted areas as well as the planting of native trees and shrubs to help with increasing native wildlife populations and reducing carbon emissions. Aside from zoning, and greenspaces, other parts of the city are being turned into pedestrian only zones to help increase public safety and encourage healthier residents and a 'healthier' city area.

CERA (Canterbury Christchurch Earthquake Recovery Association) was established to help produce plans for the redevelopment of the city and assist with public consultation on ideas, projects, plans and news involving the Christchurch rebuild.

With over 10,000 homes ~~damaged~~ demolished and many thousands more damaged, there has been a lot of time and money spent on rebuilding homes and repairing to help increase

the population of the city once again //

Many other infrastructure projects have been completed like the new Library and Arts Centres, as well as plans to restore the Cathedral which was severely damaged in the February 22 2011 earthquake.

GeoNet has worked alongside Universities and other organisations and individuals to carry out in depth research about the impacts of the earthquakes, the history of the Greendale and Port Hills Faults, the location of new and previously unknown faults as well as the chances of an event like this occurring again, the potential impacts and ways to minimise risk and damage.

As a result of the damage caused by the Canterbury earthquakes, new stricter building codes have been put in place and enforced which has meant the strengthening or demolition of buildings not only in Christchurch but throughout New Zealand //

E7

## Excellence Exemplar 2018

<b>Subject</b>	Geography		<b>Standard</b>	91007	<b>Total score</b>	20
<b>Q</b>	<b>Grade score</b>	<b>Annotation</b>				
1	E7	The candidate has fully explained the natural processes that operated to produce the Canterbury Earthquakes. There is a clear sequence of events, and detailed supporting evidence has been integrated into both the diagram and the written response. The candidate uses geographic terminology within the answer and some insight is shown in the final paragraph. The concept of interaction has been included but not integrated throughout the answer.				
2	M6	The candidate has explained the effect that the Canterbury Earthquakes had on soils (liquefaction). The process is well explained and there is detailed supporting evidence (i.e. locations where this occurred). The response is supported by a good diagram; however, it does not have the insight required for an E7 grade to be awarded. The candidate has attempted to include the concept of change in the response; however, it is not accurately used and does not meet the criteria for an E7.				
3	E7	The candidate has fully explained some long-term responses to the Canterbury Earthquake. Detailed supporting evidence has been integrated into the answer, and the student has included the concept of sustainability in the opening statement. Geographic terminology (e.g. zoning, infrastructure, population) is used throughout and there is some insight shown. An E8 requires the candidate to fully integrate the concept of sustainability throughout the answer.				