The Future of Redcliffs School

by the Redcliffs School Board of Trustees

This submission is in response to:
Hon Hekia Parata's proposal to close Redcliffs School.

30 June 2015

Through Challenge and Encouragement Comes Success

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Executive Summary

1. The Minister's proposal to close Redcliffs School, announced on 23 March 2015, was shocking and unexpected for the Redcliffs School Board of Trustees (Board), the students, staff, parents and the wider Redcliffs community.

2. The Education Report identified that the Minister's key concern was the risk of ongoing uncertainty, in particular:

    a. the risk of future and ongoing disruption due to the need for ongoing monitoring and assessment of the cliffs above Redcliffs School; and
    b. the uncertainty of time frames for return due to cliff-top demolitions.

3. To address the first point, the Board commissioned Don Macfarlane of AECOM to provide further geotechnical advice and specifically to consider the risk of future disruption from future events. Following consultation with the leading geotechnical experts in Christchurch, AECOM provided a further report. This demonstrates:

    a. The school site, with the proposed mitigation measures in place, is safe:

        - the mitigation measures (revised site boundary and a 4m earth bund) have been designed based on the best science available, including worst case scenario rockfall modelling, which the experts agree is extremely conservative
        - the modelling enabled the experts to determine the distance from the cliffs beyond which there is negligible life risk (safety line)
        - the revised site boundary is further from the cliff than this safety line
        - the bund is further again from the cliff, inside the school boundary, as an additional safeguard
        - the bund has been specifically designed to remain effective, ensure safety and to avoid disruption – rocks are not expected to reach either the revised site boundary or the bund in any scenario, including the very worst case cliff collapse
        - the nearest school buildings are a further 25m from the bund.

    b. Future disruption due to the need for ongoing monitoring or reassessment is highly unlikely because:

        - the mitigation measures will prevent disruption in all but an extreme event, which is extremely unlikely to occur
        - if an extreme event occurs, any disruption from the need for reassessment would be in the context of similar disruption on a massive scale across the city
        - removal of debris from the bund is unlikely to be required even for extreme events – four extreme events would need to occur before the bund is filled
        - minor rockfall or weather events will require only routine monitoring, which can be dealt with by way of an operation and maintenance plan.

    c. While the mitigation measures themselves are enough to prevent disruption, site planning will further ensure this, even in an extreme event, by:

        - creation of exclusion zones – playground space, not school buildings will be closest to the bund

- a maintenance zone/roadway, located on school land, will provide easy access to the bund for any maintenance required
- these factors make the need for any temporary relocation extremely remote. However, to account for this possibility, the Board would put in place a contingency plan, as is standard practice for any event such as fire or flooding.

4. The second point has largely resolved itself as most cliff-top houses have now been demolished. The Board and community are comfortable with the likely timing of a return to site and recognise that the construction of the bund and rebuild of the school buildings will take some time. However, this time frame will not be further delayed or extended due to the demolition of the remaining two cliff-top houses.

5. The desire for certainty as previously expressed by the Board on behalf of the community is for the certainty of the school returning to the Redcliffs site, not for certainty as to an immediate return. The current arrangements at van Asch are working in the short-term.

6. With clear evidence of the safe and sustainable nature of the Redcliffs site, the Board, school and local community feel strongly that the negative impacts of closure, both short and long-term, far outweigh the minimal risk of potential future disruption.

7. Redcliffs School has an objectively verified track record of providing high-quality education. It has demonstrated capable leadership and governance through the challenging years since February 2011. The huge potential of the school and staff to deliver quality education to local children would be lost permanently if the school closes. Critically, the continuity and familiarity of the school environment, which has enabled children to "bounce back" after the earthquakes would be lost, causing upheaval in the lives of many families.

8. Closure of the school would require enrolment of Redcliffs children at neighbouring schools. This would have immediate negative impacts:

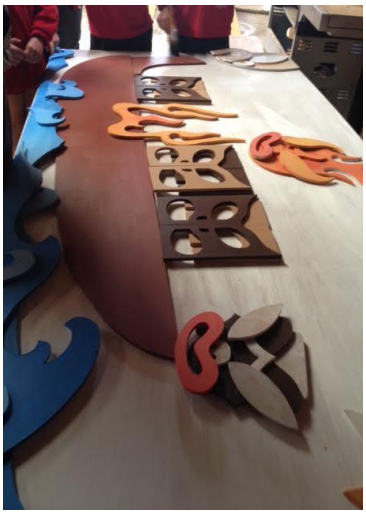
    - most children will have to travel to school by car, due to a combination of distance (between 2.4km and 3.3km), steep topography, unsafe roads and no footpaths
    - additional traffic will exacerbate current congestion, which is already severe due to the geography and single road access. This will in turn create safety issues for motorists and pedestrians
    - Redcliffs will suffer socially and economically – it will lose its identity as a distinct community with all age brackets, due to flight of families to neighbouring suburbs to be closer to neighbouring schools
    - disruption will result for Redcliffs School children in terms of social upheaval and disrupted learning with the loss of the school community that has been their support network
    - pressure on neighbouring schools is inevitable in terms of site space and roll size, which will increase in the future as the population of those suburbs increases.

9. These issues demonstrate that closure is certain to cause disruption, whereas returning the school to site is very unlikely to cause disruption.

10. In summary:

    - the expert evidence shows that the risk of disruption from the need for ongoing monitoring is minimal following any future events
    - time frames for return will not be affected by the cliff-top demolitions

- the risk of any ongoing uncertainty is therefore very low
- there are no other stated reasons to justify abandonment of the Redcliffs site and closure of a school that is delivering an excellent education to its students
- the minimal potential for disruption must be balanced against the certain daily disruption and elevated safety risks the Redcliffs School community will face if the school closes
- the cumulative negative effects of closure outweigh any risk of future uncertainty – closure is not the certainty the Board and school community desire
- The Board and school community are fully informed and firmly believe that Redcliffs School should remain open and be returned to its Main Road site.



1. Introduction

1.1 What the Submission Covers

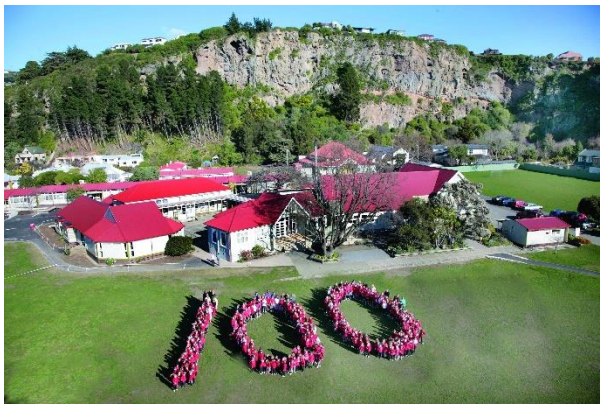
This submission sets out the response by the Board of Trustees of Redcliffs School, on behalf of the school and wider Redcliffs community, to the Minister's proposal to close the school from July 2016. It seeks to address the stated reasons for the initial closure proposal and in particular the two considerations that the Minister noted as being key to her decision:

- the risk of future and ongoing disruption to learning; due to the need for ongoing monitoring and assessment of the cliffs above Redcliffs School; and
- uncertainty about a return date due to demolition requirements of the remaining cliff-top houses.

The reality of the risk of future disruption to school operations is addressed in Section 3 by drawing on geotechnical expert opinion that was previously unavailable to the Minister at the time of the decision to propose closure. Current and future learning quality for students of Redcliffs School is covered in Section 4. Finally, Section 5 notes the wider contribution that the school makes and the permanent impact of its loss for families, the Redcliffs community, and adjacent cluster schools.

1.2 School History

Redcliffs School was opened in 1907 with a roll of 50 students. In earlier times Redcliffs was quickly recognised as a desirable area for settlement by pioneer families travelling from Sumner and Lyttelton to Christchurch. Many family names in the area today can be traced to those pioneer families.



Its sheltered location beside the sea made it a desirable area since pre-European times. In 2007 past and present students and parents celebrated the school's centenary.

The school roll (pre-earthquake) had steadily increased as a result of growth in building in the area. The Board of Trustees implemented an enrolment scheme in 1994 to prevent overcrowding. Despite the enrolment scheme, growth continued, so much so, that in 2003 the Ministry assisted in the purchase of additional land to address space deficiency and the population increase.

The vast majority of students live within the school's zone. Approximately 15% of the school population is of Maori descent. There is an increasing variety of other ethnic groups represented.

Prior to February 2011 there was a large community/school hall located on site, along with 19 classrooms, a library, a multi-purpose room, two adventure playgrounds, two substantial sandpits and a well-presented administration area. Recent property developments included improvements to the library, sports shed, senior classrooms, and the hall. The school is well equipped with modern teaching equipment, assisted by a supportive PTA, fair committee, and Board of Trustees.

Cultural aspects are well provided for by curriculum programmes, Kapa Haka, school choirs, orchestra, itinerant music teachers and visiting performers. A biennial production is a tradition in the school, and participation in both the Christchurch Schools' Cultural and Music Festivals. A spring fair held annually has a city-wide reputation. The school is part of the Bays Cluster; an active and collaborative community of five local full-primary schools.

Figure 1: Redcliffs School pre-earthquake, at the heart of its community

1.3 The Journey since the 2011 Earthquakes

For the whole of Christchurch – including Redcliffs School – the 22 February 2011 earthquake was an event that will never be forgotten. Despite this, the school was reopened after a month of repairs and prevention work so that it could play an important community role in providing a stable and nurturing environment for local children during a period of immense psychological and emotional turmoil.

Two further strong aftershocks on 13 June 2011 caused more rockfall behind the school grounds and led to a decision to temporarily leave the site and relocate first to Sumner school and then at the end of term 2 to the van Asch Deaf Education Centre.

Redcliffs School has provided stability to children whose lives have been disrupted by the loss of family homes, and a school 'across the road'.

Since then the school community has worked with enormous energy and determination to continue to provide a great educational experience for Redcliffs children and for the school to remain as a pillar of the Redcliffs community. School leadership, consistently supported by local people, has persevered in this, despite the frustration of repeated delays in completing the geotechnical data for the site through 2011, 2012 and 2013. When the MWH geotechnical risk assessment report was finally published in August 2014 and found that the site would be safe to occupy with appropriate remediation work, the school community felt they had certainty – Redcliffs School would return.

The Board of Trustees and Principal have worked closely with Ministry staff over the temporary van Asch arrangements, while jointly working to understand what would be necessary to return safely to

the original site. With the geotechnical assessment available every indication was that the school would reopen on the Redcliffs site.

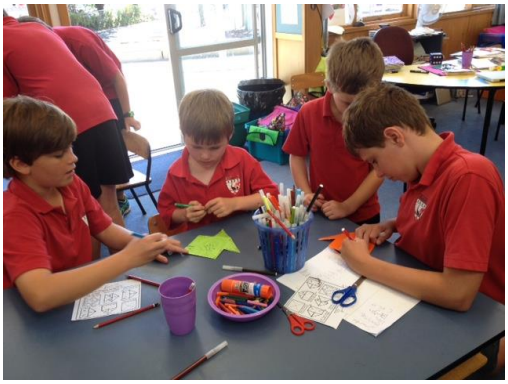
The Board remains positive about the future of the school and determined to demonstrate to the Minister and Ministry advisors that disruption concerns and community uncertainty do not, in fact, represent a basis for closure.

Key events since 22 February 2011:

- School closed for one month after the February 2011 earthquake while repairs and prevention works were undertaken. Some buildings, including the hall, were taken out of use. Four classrooms were eventually relocated further forward on the school grounds away from the cliff.
- Two very strong aftershocks on 13 June 2011. No rocks fell close to the revised fence boundary erected after February.
- Decision that Redcliffs School could not reopen on site as the danger from further rockfall was considered a potential risk. School relocated temporarily to share the Sumner School site.
- As the end of term 2, 2011 approached it was clear that the school was not going to be able to return to the Redcliffs site as quickly as everyone had first thought. The decision was made to relocate to the van Asch Deaf Education Centre in Sumner, where there were available classrooms and adequate space for a longer stay.
- At the end of November 2011 it had become obvious that decisions and actions to repair, remediate and return to Redcliffs were still some time off. The Board of Trustees made the decision with the Ministry of Education that the school would stay at van Asch for all of 2012. Nine classroom buildings were removed from the Redcliffs School site, and relocated at other schools in Christchurch.
- Again at the end of 2012 and then 2013, a lack of final geotechnical data prevented plans from being put in place to enable our return to Redcliffs. The Board was left with no choice but to agree to remain at van Asch into 2013 and 2014.
- School received an extremely positive ERO report in 2013 and was confirmed on a 4/5 year review cycle.
- During 2014 the Board of Trustees developed a new future-focussed Strategic Plan, through consultation with the school community.
- In August 2014 the final geotechnical data became available and a rockfall risk and remediation report, commissioned by the Ministry from MWH (NZ) Ltd, was completed for the original school site, stating the site could be made safe.
- Throughout the remainder of 2014 and early 2015 the Ministry staff worked on an Education Report for the Minister about the future of the school. Every indication, including early drafts of the report, was that the school would reopen on the original site with the recommended mitigations.
- The final Education Report was released in March 2015. The Education Report raised two issues of concern: the risk that the school would need to temporarily relocate following a future rockfall event to allow reassessment of the site, and uncertainty about return time frames due to required cliff-top demolition. The Ministry did not obtain any specific technical reports to assess the potential relocation risk.
- The Minister decided, on the basis of the Ministry's report, to propose closure, noting her primary reasons as concern about future learning quality should disruption occur,

and providing community certainty. Concerns appear to be based on newly raised and unevidenced issues.

- After further dialogue with the Board, the Ministry agreed to allow engineers previously engaged by it to participate in discussions with the expert geotechnical engineer engaged by the school to write a report addressing the basis of the Minister's concerns.
- In April 2015 the Minister agreed to extend the consultation period to 1 July.



2. Potential Disruption to Learning at the Redcliffs School Site

This section introduces new expert evidence that addresses the Minister's concerns about future disruption at the Redcliffs School site.

- All parties acknowledge that with the proposed mitigation measures in place the Redcliffs School site is safe.
- With a revised boundary and a bund, the risk to life is equivalent to the background life risk that all New Zealanders are exposed to in their daily lives.
- A technical expert group convened by Don McFarlane from AECOM considered the extent of ongoing assessment required of the cliff slope and/or removal of rock or repairs to the bund. These are issues not covered by the Ministry-commissioned MWH report.
- The technical expert group considered a number of scenarios that would trigger the need for either reassessment of the cliff and/or maintenance behind the bund.
- Significant monitoring or reassessment would only be necessary in an extreme event. Such an event would also cause major disruption across the city.
- Removal of debris from behind the bund is unlikely to be required.
- Four extreme case earthquakes would have to occur before the bund was filled.
- Minor rockfall or weather events would require only routine monitoring, which would be the subject of a specific operations and maintenance plan.
- Site planning can also create an additional buffer zone to protect the school from disruption in an unprecedented event.

The Minister has raised a concern about the potential disruption to education of students at Redcliffs School. The Board has responded to this concern and sought expert advice on this potentiality.

In recognition of the need for this analysis the Ministry has offered the services of MWH to meet with the Board's advisor. The Christchurch City Council (CCC) has also offered their geotechnical expertise.

The advice of this group indicates that the circumstances that could give rise to potential disruption are extremely unlikely. Even in such an extreme case, the Board is confident that disruption could be eliminated by careful site planning.

The Board is confident that with this scientific analysis now complete, the Minister can be assured that Redcliffs School can return to site and continue to offer an excellent level of education to its students without disruption.

2.1 Site Safety

The safety of the Redcliffs School site was considered by MWH in their August 2014 report[1] prepared for the Ministry. The report is based on extensive assessment of the cliff behind the school carried out by GNS Science, whose analysis was internationally peer-reviewed.

The MWH report concluded that the site would be safe in the event of a major cliff collapse, as long as the mitigation measures recommended by the report were implemented.

The report modelled various worst case scenarios of cliff collapse and boulder-roll using very conservative parameters, and produced a safety line at the back of the school site, forward of which there is negligible risk to life.

In the MWH report, it was proposed that the school boundary be redrawn to take this line into account, effectively retreating from approximately 10% of the school site.

Life risk on the revised school site would be an annual fatality risk of 1 in 1,000,000. This is the background level of risk that all New Zealanders are exposed to in everyday life.

The report states that this is an acceptable risk level for sensitive developments such as schools. Note: the level of risk that has been determined as suitable for occupation of residential properties in Christchurch is 100 times higher at 1 in 10,000.

To account for any uncertainty in the theoretical modelling, the MWH report also recommends that the rear boundary of the school be protected by a 4m high engineered earth bund.

The bund is effectively a further safeguard against any uncertainty in the model and any events of unprecedented severity.

The Ministry accepted the findings of the MWH report and acknowledged that the school can be made safe for educational purposes as stated in the executive summary of the Education Report to the Minister.

2.2 Future Rockfall – New Expert Opinion

The MWH report offers assurances of safety, however, its scope did not include any investigation of the potential for disruption, nor the degree of ongoing assessment and monitoring required in the future.

In order to investigate these issues and fully address the Minister's concerns, the Board has engaged the services of geotechnical expert Don MacFarlane from AECOM. The Ministry of Education has also provided the services of MWH to consider the previously unconsidered question of future disruption on the school site.

Mr MacFarlane was the leader of the Port Hills Geotech Group, which was convened by CERA to assess slope stability and rockfall in the aftermath of the 22 February 2011 earthquake. In the process of producing the report, Mr MacFarlane met with the following geotechnical engineers who have also been involved in the assessment of the Port Hills over the past four years:

- Dr Ian Wright – Senior Geotechnical Engineer, Christchurch City Council

[1] 'Cliff instability hazard and mitigation at Redcliffs School', MWH (NZ) Ltd, August 2014

- Steven Wood – Geotechnical Engineer, MWH Ltd. Author of the MWH Report
- Chris Massey – Geotechnical Engineer, GNS Science. Major source of data input into the MWH report
- Dr Jan Kupec – Chief Geotechnical Engineer, CERA

The findings and analysis regarding potential disruption are contained in the AECOM report at Appendix A. The report investigates:

- what sort of event would trigger rockfall that would require reassessment of the cliff
- the probability of such an event occurring
- how long the assessment would take
- whether any material would need to be cleared after such an event.

2.3 Potential Causes of Future Rockfall

Future rockfall will be caused by either gradual cliff degradation or earthquakes. In terms of **cliff degradation,** the geotechnical experts agree that minor rockfall events, caused for example by rainfall, will continue to occur. However these events would have no impact on the safety measures and therefore have no potential for future disruption.

The sort of **earthquake** event that would trigger significant rockfall would be a greater than 2 PGA earthquake – an earthquake similar to that of 22 February 2011. GNS tables indicate that the probability of such an event occurring within the next 50 years is a 1:50,000 chance per annum. In more colloquial terms the AECOM Report refers to the probability of such an event as “extremely unlikely”.

2.4 The Extent of Future Rockfall

The new expert analysis in the AECOM report includes significant analysis of the practical implications of future rockfall.

Rockfall and its Proximity to the School

The AECOM Report examines in more detail the proximity of the modelled rockfall to the school boundary and presents research that indicates it is extremely unlikely that flyrock fragments would fall outside of the proposed bund location.

This analysis makes it clear that the bund and the revised boundary are inherently conservative and are designed to withstand the worst case scenario. Furthermore, the need for any maintenance or clearing of debris is unlikely, however, if required the report demonstrates that there is ample space in which to do this.

A pictorial cross-section at Figure 7 of the AECOM report demonstrates these points and the specifics are summarised in the table below.

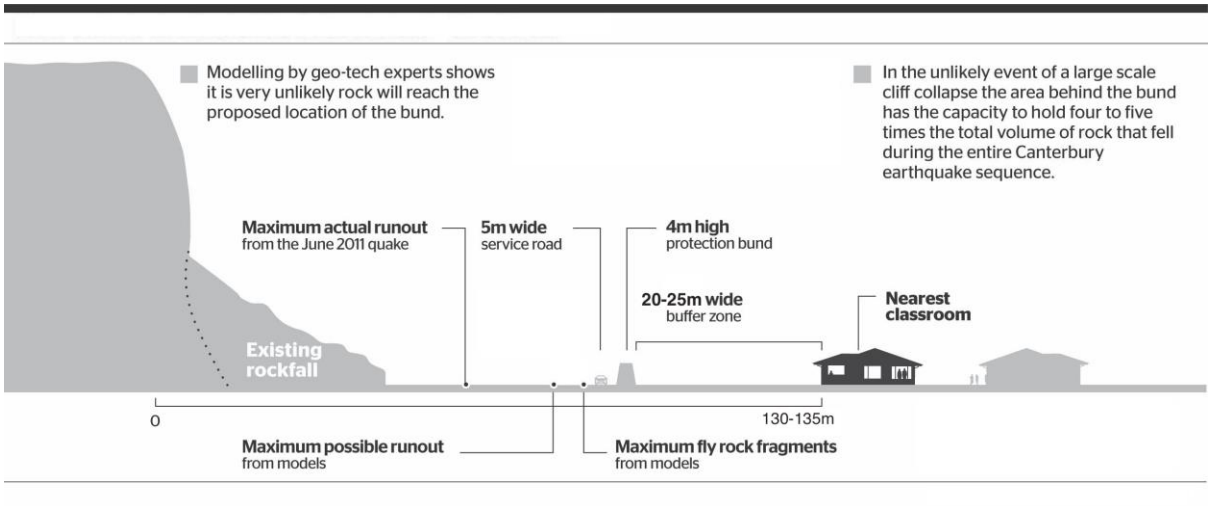
Table 1: Modelling results for debris in relation to the proposed bund

Description of line at base of cliff	Angle down from top of cliff	Distance from back of proposed bund
Limit of the main large debris	48°	54m
Limit of any rock debris observed	37°	37m
Maximum limit of estimated (modelled) debris	33°	11m
Maximum limit of estimated (modelled) flyrock	31°	5m

This table indicates that using very conservative modelling; the closest any form of rock (in this case small fragments or flyrock) will get to the bund is 5m.

Even though it is very unlikely that clearing behind the bund will be necessary, there is more than sufficient space for maintenance to be carried out as illustrated in the cross-section diagram of the cliff and site at Figure 2.

Figure 2: Cross-section of the cliff and school site with the recommended mitigation measures



The Volume of Future Rockfall and the Capacity of the Bund

The Ministry's Report states that "modelling cannot determine the extent...of future rockfall" (para. 88). By contrast, the AECOM report sheds more light on what would occur behind the bund in an extreme case earthquake. The report states:

> *"While it is correct to say that there is always some inherent uncertainty in modelling, it is possible to obtain estimates of the extent of rockfall runout that allow for the uncertainty with a high degree of confidence."*
>
> (Appendix A, section 2, para. 2).

The Minister can be assured that if an extreme event were to occur, the bund is designed with the capacity to remain effective, to ensure safety, and to minimise disruption. This critical point can be

demonstrated by looking at the volume of rockfall from a worst case scenario, and comparing it to the capacity of the proposed bund as shown in the table below, taken from Table 4 of the AECOM report.

Table 2: Outline of worst case scenario used in AECOM report to test bund protection

Maximum earthquake strength	Greater than 2g of Ground Acceleration (PGA)
Likelihood of this occurring over the next 50 years	1 in 50,000 annual probability
Estimated total volume of rock produced	158,000m^3
Equivalent volume of rock produced per metre of cliff length	528m^3
Total capacity of the bund per metre of cliff length	2275m^3

An extreme case scenario is expected to generate 528m^3 of material per metre of cliff face. This contrasts with the volume of rock required to fill the bund, which is estimated to be 2,275m^3 per metre of cliff face.

This means that the bund will be able to contain over four times the amount of rockfall expected to be generated by an extreme earthquake.

There could be at least four major earthquakes (each of 1 in 50,000 annual probability) before the bund would come close to being filled. In addition, this does not account for the fact that after each event there would be a reduced amount of rock available to fall, and if necessary, the existing rockfall could be cleared.

2.5 Maintenance and Monitoring Requirements

As stated in the MWH report, rocks will continue to fall from the cliff over the coming years, from both seismic activity and weather effects, and a routine maintenance plan will need to be put in place to monitor the area behind the bund. The technical experts agree that potential maintenance and assessment could be required in the following scenarios:

Minor Events

A material change in the cliff face, such as development of new cracks or new rockfall could occur with or without earthquakes. The AECOM report states that rainfall-induced failure of the cliff is considered very unlikely to cause cliff collapse on the scale of a large magnitude earthquake. The modelling would therefore rule out major maintenance requirements due to minor events.

The report also states that if required, such changes can be assessed by appropriate technical experts within hours if necessary.

Major Events

GNS tables state that there is a 1:50,000 chance per year of a large magnitude earthquake. An event of this kind would almost certainly cause significant rockfall from the cliff.

However, the AECOM report states that if the rockfall debris accumulates between the bund and the cliff in accordance with the modelling it will not necessarily need to be removed.

The report also states that a reassessment could be completed in days or weeks, depending on how schools are prioritised following a major event that would cause extensive damage throughout the city.

In this worst expected scenario, there could be up to 528m^3 of additional debris deposited per metre along the cliff. But given that a further three major events would be required before the capacity of the bund came close to being exhausted, it is unlikely that any clearance would be required.

In terms of the need to remove material from behind the bund in any of these scenarios, the Executive Summary of the MWH Report states:

> *"Generally it is anticipated that no removal of this rock will be required."*

It is also important to note that if any work in the service area immediately behind the bund was required, it would be considered low risk as it sits within the zone in which someone might carry out maintenance on a green-zoned house.

Damage to the bund is not considered likely to occur in any of the above scenarios. If it did occur, it is likely to be minor and easy to repair. Again, the need to remove debris would need to be assessed based on the actual outcome of a specific event.[2]

Unprecedented Event that Questions Modelling Assumptions

The technical experts agree that it is highly unlikely that the bund will be hit by rocks. However, should this occur, it would indicate that the design assumptions based on the GNS life safety risk model are incorrect.

We suggest this in itself is highly unlikely given the time, expert analysis and peer-reviewed rigour that has gone into the development of the numerous reports and scientific studies. If this unlikely and unprecedented event occurred, the bund would have to be inspected for damage, maintenance requirements, etc., and the hazard and risk at the site would need to be reappraised. Given that a comprehensive data set already exists for this location, any new appraisal would benefit greatly from this existing body of knowledge.

While the AECOM report notes that this scenario would require the hazard and risk at the site to be reappraised, this must be viewed in the context that it is the most unlikely scenario. This scenario lies outside the bounds of the very conservative scientific modelling used in all the reporting of the Canterbury earthquake sequence.

If such an event were to occur it would call into question the theoretical and empirical geotechnical studies to date, as well as any policy decisions made as a result of this research, including the land zoning decisions in Christchurch. It could, furthermore, necessitate a wholesale reassessment of geotechnical modelling practice in Christchurch, and require reassessment of the level of risk at dozens of other public facilities and thousands of private residences.

Even if this highly unlikely scenario developed the Board is confident that with some prudent site planning Redcliffs School could continue to operate safely while such a reappraisal was conducted.

[2] Again, the issues raised as to removal of debris in this situation must be viewed in the context that damage to the bund is considered beyond the modelling and therefore very unlikely.

2.6 New Site Planning

The Education Report states that the school would be unable to operate while any assessment and required repairs or removal of rock were carried out. However, as noted above, the likelihood of rocks reaching the bund is extremely low, (less than one in one million) so the chance of any damage requiring repairs and reassessment is even more remote.

Given that this extremely remote possibility may still be a concern for the Minister, the Board believes that some careful site planning can be implemented to avoid disruption during an unprecedented event.

Buffer Zone

If there was a need to remove rocks from behind the bund, an additional buffer zone could be implemented to increase the distance between the cliff and any school activity, without any detrimental impact on education and learning.

Utilising the current site layout, the buildings closest to the cliff are approximately 25m from the proposed front face of the bund. This means that while repairs, rock removal, or in the most extreme case, reassessment were being carried out, this area of the school site could be made out of bounds until the work was completed. This approach is illustrated on the site plan below at Figure 3, which makes use of the current site lay out.

This means that in a worst case and unprecedented scenario, the students would not have access to a relatively small area of playground space. The bulk of the school's play area is on the front field, and the school also has the luxury of alternative playground space immediately opposite at Redcliffs Park.

Long term, the planning of future buildings on the school site could be done with a view to further increasing the distance of classrooms from the safety line and the bund (see Appendix C).

Figure 3: Concept plan for the site showing the potential buffer zone (black dashed line) and utilising existing layout

Maintenance Planning

In the unlikely event of the need to remove material, and gain consents for that removal, the Board intends to plan the site to enable free and easy access to any maintenance zone/roadway via school land. It should also be noted that the neighbouring properties are red-zoned and owned by either DoC or the Crown.

Aesthetics

The Minister also expressed concern about the intimidating visual effect of the mitigation bund. The Board has sought the advice of architects and landscape specialists who have offered assurances and conceptual planning that would negate any perceived negative visual effect of the bund.

2.7 Return Time Frames

The Ministry's report highlighted uncertainty about a time frame as to when Redcliffs School could be returned to its original site due to the need to demolish cliff-top houses. The Board does not believe this is a valid concern as the comments in the Ministry's report appear to have been based on information from 2013 when there were 16 houses due for demolition. The Board's understanding is that there are now only two houses remaining and that planning for the removal of those houses is well advanced.

The Board is confident that by the time the necessary work has been completed to prepare the school site for occupation, the cliff top will be free of buildings. This issue is therefore not in any way an impediment to when the school can reopen.

The greater source of uncertainty for children and parents would be from the delays noted by the Ministry in students relocating to other schools where new facilities will need to be built and numbers are uncertain.

Whilst time is required to build the proposed protection bund, when the school returns to the original site, students and families would have the certainty of knowing their future schooling situation.

2.8 Summary

The expert evidence demonstrates that, because of the extremely conservative nature of the proposed mitigations, the risk of disruption to school operations at the Redcliffs School site is extremely low.

Ongoing changes in the cliff face pose very little threat of disruption and are easily managed and assessed. Only a very severe event equal to or greater than the 22 February 2011 earthquake might require significant action, and even an event of this severity, may not necessarily cause major disruption.

With the proposed mitigations in place, the school would face less risk of disruption from rockfall than the risk encountered by many other schools across New Zealand that are vulnerable to circumstances requiring short periods of closure such as heavy snowfall, flooding, emergency building work, malicious damage, etc.

Expert advice also indicates that careful site planning could act as an additional level of mitigation that would minimise and potentially eliminate the threat of future disruption on the Redcliffs School site.

3. Student Learning Quality

- Redcliffs School is a high performing school with a strong record of providing quality education for the Redcliffs community. Students achieve well academically, socially and physically. The school is currently on a 4–5 year ERO review cycle.
- Despite the challenges of being relocated out of its catchment area for the past four years, the school has continued to achieve highly; determined to have a positive attitude and to encourage students to perform at their best. Staff members have kept abreast of current educational pedagogy and best practice.
- Priority learners in the Redcliffs community are extremely well-catered for. Highlights of the school's culture include excellence in provision for students with special needs (including five ORS-funded children); and outstanding programmes for children and whanau identified as Maori.
- The Redcliffs Board and community have significant concerns about the continued upheaval, on the health and well-being of the children in Redcliffs. Closure of the school will most certainly create disruption to learning for present and future children residing in Redcliffs.

This section seeks to address the Minister's concerns over student learning quality being affected during any potential future disruption. It demonstrates the continued strong educational track record of Redcliffs School through the difficult recent years and highlights both the valuable contribution the school makes to priority learners and the negative impacts on learning if the school were to close.

3.1 Strong Educational Track Record

Redcliffs School is a proud and strong full-primary school that has served its community for 108 years. The school has long maintained a good reputation as a respected school providing a well-rounded and high-quality education for children in the local area.

In recent years the school has become widely known for its delivery of high-quality teaching and learning programmes, offering a wide range of opportunities, strengths in the Arts, and academic success in a range of areas. National Standards results have consistently been well above national average. The examples below of achievements by students and staff provide external validation of the learning quality offered to students.

- Year 8 students frequently attaining scholarships to top independent schools for Year 9
- NZ finalists of Future Problem Solving competition on three recent occasions and a world champion in Writing
- Year 8 winners of the Christ's College science competition two years running
- Regular prizewinners at the Canterbury Science and Technology Fair
- Frequent placings at many zone and inter-zone events in traditional sporting codes, and less traditional including skiing, sailing, orienteering and surf lifesaving
- Past students ongoing successes at secondary school – academic, leadership, sport and music

- ERO 4–5 year review cycle (from 2013 report)
- Principal awarded the CPPA research fellowship in 2013; paper written on *Collaborative Learning Communities*
- Deputy Principal asked to present workshops at two Canterbury conferences in 2014 and 2015 for school leaders; on the topic of 'flipped teaching'

An independent review by Lois Christmas, a leading independent education consultant, of Years 5–8, commissioned by the school in order to review and plan further developments, in late 2012 also confirmed the school's strengths, commenting:

> *"Redcliffs School is a very strong learning community, well led by a capable senior leadership team. Teachers feel valued and believe that the leadership team works hard to create a very caring and professional culture. The high ratings the teachers gave to the eight dimensions is an exceptional result and indicative of a superior school culture. Such a school provides optimal conditions for teaching and learning and for consistently good outcomes for children. "*

3.2 High Performance through Adversity

Redcliffs School has faced enormous challenges since February 2011 but has succeeded in continuing to deliver high-quality education and great outcomes for its students. This has demonstrated the sustained commitment of parents, staff and Board, but also the inherent strength and capability of the school as an organisation and community, which will be lost if the school is closed permanently.

There is no disputing the fact that the students, parents, staff and Board have rallied together to successfully and positively overcome many obstacles that may have proved insurmountable for other schools. Being relocated and sharing a site for four years to date has not been easy. Creating a temporary school environment and maintaining a high-level focus on learning has required significant commitment from staff and parents. The challenges of retaining student enrolments when the school is relocated out of its catchment area can be a challenge and difficult resourcing decisions have had to be made.

However, these challenges have been and will continue to be met and the school is justly proud of how successfully it has thrived during relocation. Highlights of the school's success through the recent period of adversity are shown below, supported by comments from the complimentary 2013 ERO report.

- A 'business as usual' attitude at all times, despite the challenges the school has faced.
- Determination to have a positive attitude and show resilience; this experience is a life lesson for the school's children:

> *"ERO observed high levels of student engagement in learning activities across the school. The school has a well-developed and highly effective curriculum. There is a strong focus on literacy and numeracy, and developing students' thinking skills. School values are actively promoted and well-integrated into the school culture."*

- Student achievement reports and tracking of school achievement data shows the upheaval has been managed with minimal detrimental impact on learning:

> *"Students are achieving highly in reading and well in mathematics and writing. They have made significant progress in literacy and numeracy despite the Christchurch earthquakes and changing the school site."*

- Governance and leadership have continued to be of high quality, remaining focused on raising student achievement and outcomes for all students:

"Board and school leadership is highly effective and strategic. The strong partnership between the board and senior leadership team is consistently improving learning and achievement. The principal works collaboratively and provides leadership opportunities using the strengths of the staff."

- The staff at Redcliffs School is a pivotal factor in its success. The majority of staff members have been at the school since prior to 2011. They are committed to the care and well-being of their students. They have shown courage, resilience and loyalty beyond normal expectations:

"Teachers consistently demonstrate high-quality teaching practices. They provide interesting programmes that motivate students to ask questions and enjoy their learning. Teachers use a range of effective approaches to make sure that students understand the expectations for learning and achievement. They provide useful feedback that helps students decide on their next learning steps. Students are confident learners who take responsibility for their own learning and achievement."

- Excellent school organisation and administration systems, including coping with the ongoing management of the extra workload created by the relocation situation:

"The school is very well placed to continue to sustain and improve its performance. The board's strategic plan provides clear direction and is focused on improving learning and teaching. The principal provides comprehensive reports to the board on progress towards achieving the goals specified in the strategic plan."

- Enhancements and innovations continue to be made to teaching practices, including in the education of priority learners – Māori students and students with special needs:

"The curriculum is strongly inclusive. It caters well for children with special needs. It increasingly includes te reo and tikanga Māori. Teachers provide well-planned and delivered programmes that make good use of student achievement information. Programmes successfully include students' interests and encourage them to make choices. Students told ERO that learning is fun at this school."

- Introduction of Modern Learning Practices: 2014, involved professional learning for teaching staff and Board, communication and information for parents and students, resulting in a 2015 trial of co-teaching in pairs across the school. This development is progressing well, despite no alterations or changes made to physical classroom spaces at van Asch:

"The principal and teachers regularly evaluate the effectiveness of the school curriculum and the impact of their teaching practices to bring about positive change for learners. There is a school-wide culture of rigorous, critical reflection. The self-review of school operations and curriculum is robust and focused on improving what happens for all students."

- Introduction in 2014 of a new learning and values model, 'Reddy to Learn', which is student-centred and was developed through extensive consultation with students and staff.
- Successful introduction and implementation of a Teacher Inquiry-based performance management system from 2012 onwards.

- Partnerships and relationships with the community – ongoing positive interaction with a wide range of stakeholders has engendered much goodwill and support, including: local ECEs; Christchurch City Council; Ministry of Education staff; Fulton Hogan; VADEC staff; local businesses in Sumner and Redcliffs; high-profile celebrities, musicians and performers; many other schools nationwide who have helped us; Go Bus transport company and many more:

"The school successfully engages its community in partnerships for learning and the life of the school."

The school has also maintained strong governance and management practices, including retaining consistent Board membership, excellent Charter delivery, a high standard of annual financial reporting and receiving very positive audit reports. Fundraising has remained effective with the annual Redcliffs School Fair often raising in excess of $50,000 for the school. Support systems continue to be reviewed and improved; the Ultranet student management system was implemented in 2013, and Xero is now being used for financial management.

Having overcome the challenges since 2011, the school is more than capable of maintaining high performance for the time needed to prepare its original site for reopening. A decision to close the school would, in contrast, permanently dismantle a capable organisation.

3.3 Future Potential for Priority Learners

Redcliffs School has a strong and well-established focus on priority learners that has been recognised by ERO and offers the potential of future benefits if the school remains open.

Special Education Provision

The school operates a three-tier system of support for children with special education needs, which currently caters to five Ongoing Resource Scheme students who live in the Redcliffs area, as well as a greater number with significant though lesser needs. Inclusion in the programme is driven by data collection and teacher nomination for students who are at risk of, or are not achieving. The special education programme utilises National Standards data to identify areas of needs and learning support each term and is operated collaboratively across the school and within the Bays Learning Cluster. Relevant ERO comment from the 2013 report:

"The school makes effective use of student achievement targets to continually improve the performance of all students, particularly those students who are not yet achieving at National Standards."

"The curriculum is strongly inclusive. It caters well for children with special needs."

"The school successfully engages its community in partnerships for learning and the life of the school."

Māori Student Achievement

At the end of last year 26 children (12%) at the school identified as Māori. They are proud of their cultural distinctiveness and successfully participate in and contribute to Te Ao Māori. Many excel academically.

The achievement levels of this cohort are reviewed annually to identify trends and put recommendations into place, guided by the principles outlined in *Ka Hikitia.* National Standards results from 2014 show that achievement in reading and mathematics in particular continue to strengthen for the Māori cohort. The percentages for Māori students achieving at or above the reading, writing and mathematics standards were similar to the percentages at these levels for non-Māori students.

Children achieving below the standards have been identified in all areas. They also receive extra assistance within the classroom and with teacher aides. There is no 'cluster' of Māori students in any year achieving below the standards. Reading support programmes are implemented for any Māori students who are achieving below the reading national standard after 40 weeks of school.

In addition to individually focused efforts, the school operates a variety of programmes and approaches within classes and across the school community to support the learning and successful experience of Māori children. These include running a whanau group of children, which meets throughout the year to work collaboratively and celebrate Te Ao Māori through hangi, carving and other activities. The school's kapa haka group is strong and regularly performs to a high standard within the school, at cluster school events and out in the wider community. Māori signage is visible around the school, proverbs are in newsletters, basic te reo is frequently used during school and class activities and macron capabilities have been added to computers. Teachers' planning includes a Māori perspective where appropriate on the topic being studied. The links between Ako (two-way teaching and learning) and modern learning principles are investigated through staff professional development opportunities.

Overall, respect and enthusiasm for learning about Te Ao Māori are embedded within the Redcliffs School culture. Māori students and their whanau are provided with opportunities to share, celebrate and learn about their culture.

Each year Māori students are surveyed to gauge their attitude towards a number of statements derived from "Tātaiako – outcomes/examples of learner voice." Survey results are analysed and included in the annual report on Māori student achievement to the Board of Trustees. In 2014 all students strongly agreed with the following statements:

- It feels good to be Māori at Redcliffs School.
- My teacher knows what works for me and my learning.
- My teacher believes I can succeed.
- My teacher respects my culture.
- My teacher knows my parents and whanau.
- My teacher talks to me about my learning.
- I get the chance to be a leader at school.

Their comments and survey results over time showed that our Māori children feel a growing pride towards their culture and identity and are increasingly proud to be at Redcliffs School. They speak very highly of their teachers and the various ways they feel supported by them.

ERO again confirmed a positive and successful approach within the school, commenting:

> *"Māori students have many opportunities to experience success as Māori. They are able to learn about their language and culture and to meet regularly as a whānau to share information and ideas. Along with their peers, they experience success beyond literacy and*

numeracy. They are school leaders and participate fully in the arts, science and other learning areas."

"Māori students told ERO that they felt special when their teachers and peers celebrated their culture. The school is continuing to build on the effective practices they are currently using to enable Māori students to experience success as Māori and to further improve their achievement in learning."

"During 2012, significant progress was made in improving Māori student achievement. Māori students achieved at slightly higher levels than Māori students in other schools. They also achieved at similar levels as their non-Māori peers in reading and writing."

3.4 Negative Impact of Closure on Learning

Closing a school will always impact on students. In this case, however, there is a disproportionately large negative impact on students and an increased risk to their ability to learn successfully because of the stresses created by the earthquake and protracted rebuild, and the geography of the Bays area.

Impact on Redcliffs students

The students at Redcliffs School have endured a large amount of upheaval in their lives since February 2011. Many live in homes that were severely damaged in the earthquakes. Many have had to move multiple times while their houses are repaired. If Redcliff School is closed and children are forced to change schools it will be another significant upheaval that will undoubtedly cause them further distress and dislocation. The children will be separated from their friends who live in different parts of Redcliffs if the enrolment zone is split as proposed. They will have to adjust to new teachers who do not know them or their learning needs, to new school routines, culture and values, and strive to re-establish themselves in social and learning contexts.

One of the strengths of Redcliffs School during this time of upheaval is that the school has largely retained the same teaching staff that the children have had since starting school. The Redcliffs School learning and values model was created by the students, they live it and own it. It is unique and authentic. It relates to the history and environment of Redcliffs. Sumner and Mt Pleasant Schools have their specific learning models, which are aligned with their local environments, not the Redcliffs environment.

Redcliffs School families have relied on the school and its community for support over the last four years. Historically, Redcliffs has always been a strong community and since the earthquakes this support has been called upon time and time again. By splitting the children and families and sending them to different schools the community and its support networks will be weakened. Families and children are still struggling in our community.

School families have been looking forward to returning the school to the heart of its community. Many parents have stated that during the time their children have been busing to van Asch Deaf Education Centre there has been a loss of connection with others at the 'school gate'. The school has worked hard to provide opportunities for parents to come together so that the connection is still strong but it is not able to provide that daily interaction that comes from being able to walk to your local school with others. Strongly connected communities are good for families and good for children and their learning.

Impact on Neighbouring Schools

Sumner and Mt Pleasant Schools do not want Redcliffs School to close, and they do not want to enrol the students from Redcliffs, should it close. Sumner and Mt Pleasant Schools are community schools who serve their local community families. Students and families who attend these schools live close by and enjoy all the benefits of growing up together in a nourishing community atmosphere. If the schools are forced to widen their enrolment zones to take the children from Redcliffs then the sense of local neighbourhood community will be compromised.

To accommodate approximately 100 or more children at each of the two schools will create a disruption to the teaching and learning for the students of Redcliffs, Mt Pleasant and Sumner Schools. A swift and significant increase in resources, staffing, learning space, amenities, furniture, equipment and administration will be needed at both Sumner and Mt Pleasant Schools.

Geographically the areas of Mt Pleasant, Sumner and Redcliffs are all distinct from one another. The land is steep and hilly. There is only one main arterial road to travel along; this road and the surrounding side roads are damaged, and many have inadequate footpaths or space for cyclists.

As the areas continue to grow in population in the long term the two schools remaining (Mt Pleasant and Sumner) will not be large enough to cater for the entire area. They do not have large land space, particularly at Mt Pleasant School.

The geography of the area also creates problems in the event of another significant earthquake because of the risk that parents from Redcliffs would be unable to get to those two schools to pick up their children. If Sumner and Mt Pleasant Schools have large numbers of children from outside their natural geographic area then they will need significant health and safety plans and resources to cater for the Redcliffs children for many hours and possibly overnight. Whilst the likelihood of another earthquake is low this possibility places a weighty responsibility on the two schools, and creates stress and worry for Redcliffs parents.

The Bays Cluster of schools has additionally made a collaborative submission to the Minister, which highlights the value of Redcliffs School as a member of the community of schools, and puts forward concepts for future developments that would be advantageous for the whole cluster should Redcliffs School remain open.

Summary

Overall, the Board has significant concerns about the detrimental impact on the welfare of students and their ability to learn successfully if the school closes, students disperse to other schools and the Redcliffs community is weakened. There is ample evidence of the vital role schools play in children's and communities' recovery from traumatic events. The Redcliffs School 'family' has been, and continues to be, a strong source of familiarity and well-being in many young lives. In addition, the geography of the Bays area, with its distinct communities separated by a single busy road and with little space to substantially expand school facilities to cater for projected long-term population growth, magnifies the social and practical impacts for neighbouring schools.

4. Wider Negative Impact of School Closure

- Redcliffs is a geographically distinct community, which is now recovering from the devastation of the 2011 earthquakes. It is rebuilding and growing once more, and is a popular area with high real estate values.
- If the school closes there will be significant detrimental effects both economically and socially for the Redcliffs community.
- If the school closes the Redcliffs children will have to travel between 2.4km and 3.3km to school, compared to an average of less than 1.5km to the original site.
- Travel to Sumner or Mt Pleasant Schools would involve negotiating a busy main road or going up a hill in addition to the much greater distance – consequently most children will travel by car.
- The single road access point is already congested on a daily basis, and will be much worse if Redcliffs children have to travel to Sumner or Mt Pleasant Schools.
- Demographic analysis and predictions show that the local population will return to pre-quake levels. Closing the school is short sighted and the remaining Bays area schools will struggle with capacity space in the long-term future.
- Families have clearly stated their preference to return Redcliffs School to its Main Road site.

The school plays a central role in the geographically distinct Redcliffs community and as part of the schooling provision in the Bays area that encompasses Ferrymead, Moncks Bay, Redcliffs and Sumner.

4.1 Geographically Distinct Community

Redcliffs is a very geographically distinct community, tightly defined by the Avon-Heathcote estuary to the west and steep hills on three sides, and with a single busy arterial road providing access. Early Maori found Redcliffs useful as a base, as artefacts from local caves and excavations on the school site indicate.

From nomadic Maori and the first European settlers in the mid-1800s, the population of the area has steadily grown as a desirable place to live. This has continued in recent times with the population of the Bays area reaching 11,790 in 2006, of which about 3500 lived in Redcliffs, having grown 10% over the previous decade. During this period the number of five to 11 year olds grew even faster as families with younger children were attracted to the area. This long-term trend, interrupted by the 2011 earthquake, is very likely to continue given the natural beauty and inherent attractiveness of the lifestyle available in the area. A recent surge in building consents in the Bays area highlights the desire of people to return to the area.

The community is strongly connected with many alumni of Redcliffs School having returned to the community to raise their families after living and working in other parts of the world. The businesses and other facilities lining the main road provide everything families need day-to-day. These include a medical centre, library, supermarket (being rebuilt), petrol station, park and playground, and cafes.

For 108 years Redcliffs School has been at the heart of the community and has helped to shape the family-friendly community that exists today. The school has the support of local parents, the vast majority of whom chose to keep their children enrolled through Years 7 and 8 instead of moving them out of the area to intermediate or private schools.

Figure 4: View from the north of Redcliffs community bordering the Avon-Heathcote estuary with Sumner to the left and Mt Pleasant to the right, both accessed around large rocky headlands.

4.2 Impact of Closure on the Redcliffs Community

As a distinct community, connected in part by its school, closure will change the area profoundly and adversely affect the social and economic well-being of Redcliffs families and residents.

Social

The school is a community hub, providing an opportunity for parents to socialise, which is sometimes the only opportunity for adult interaction during the day for parents with younger children. This would be lost with closure and the community less connected. The community would be split in two, removing children from their local area and sending them to one of the neighbouring schools depending on their home's location within the new zoning structure. The disruption to the lives of many Redcliffs people would be sizeable.

Without a local school Redcliffs would become a less desirable suburb for young families and its demographics would change. Families would leave, vibrancy would decline and the proportion of older people would grow, despite them not being easily serviced by the centralised health facilities in the city.

Business

The temporary relocation to van Asch School in Sumner has caused significant loss of business within the local business community. A survey by University of Canterbury students found that 87% of businesses had noticed a reduction in foot traffic related to the relocation of the school and supermarket. These businesses, like others across Christchurch, have struggled through the post-earthquake years, waiting for families to return to their rebuilt homes and the school to return to the heart of the community. A closure decision will change the area, permanently reducing foot

traffic and sending people out of the area to shop. Some businesses will close and Redcliffs will become less attractive and self-contained. Business owners commented:

> *"With the kids busing we still get some after school business but not nearly the same as when the school was in Redcliffs. That after school rush is a huge part of my business - I've lost 25-30% of my business with the school moving to Sumner and the earthquake … a big loss."*
>
> *"It's the big customers that keep me in business – the families feeding 4, 5, 6 people. If the school goes and we lose families from the area then my business may well become a one butcher shop or even worse."*
>
> *"I would definitely look to move if the school closes. A lot of mums shop here and if the school closes and we lose families in the area then this location won't be viable for me any longer."*
>
> *"We definitely don't see as many kids and parents before and after school. Not having the school here people are far less inclined to shop locally."*

4.3 Disruption for Families

Sending Redcliffs children to neighbouring schools would cause a significant and enduring disruption to local families. The geography of the area and the distance to Mt Pleasant and Sumner Schools makes it unlikely that many children will be able to travel to and from school on their own. Most children would need to travel between 2.5km and 3.3km either up a hill to Mt Pleasant or along the busy main road to Sumner school. Only 3% of families who responded to the survey were confident that their children would be able to walk, scooter or bike to their nearest school safely and practicably. Research shows the detrimental effects that being driven to school has on students' educational outcomes.

The Redcliffs School community has been reassured about the safety of the school site by the thorough evidence and expert opinion presented in the MWH report and more recently the AECOM report. No safety concerns have subsequently been expressed by parents and local people to the Board or school staff.

It is not clear on what basis the Education Report identified community concern as an issue, but it may in part be due to outsiders' perceptions, usually gained from the main road, of the threat the cliffs represent. Those who know the school site and are familiar with the presence of the cliffs in their daily lives are happy to accept the conservative mitigation approach and geotechnical engineering assurances. This is clearly evidenced by the survey of local families with children in which 97% of respondents said they would be happy to send their children to the school on the reopened site (see Appendix B).

4.4 Transport Impact from Closure

The single road access from Redcliffs west to Mt Pleasant School (and the city) and east to Sumner will magnify transport impacts from school closure. An assessment of these impacts by a transport expert using standard NZTA transport development methodology (included at Appendix D) identifies in particular:

- immediate direct impacts to students and parents of the additional commuting distance and time to neighbouring suburbs
- longer term impacts with regards to car dependency and the associated adverse health impacts

- indirect impacts of additional traffic on the neighbouring suburbs as a walking or cycling commute becomes impractical.

Whilst many children have traditionally walked or cycled to Redcliffs School, these forms of transport would not be practical for reaching neighbouring suburbs safely, particularly Mt Pleasant, which is a reasonable distance up the hill. The direct cost of the additional commuting resulting from closure is estimated conservatively at $47,000 p.a. with an additional environmental and health cost over four times larger at approximately $2.8M over a 40-year appraisal period.

With a significant amount of additional vehicles on the road ferrying pupils to and from adjacent suburbs, there will be an adverse impact on other road users. The current congestion around Sumner and Mt Pleasant School sites, particularly in the morning peak, will be worsened for all road users.

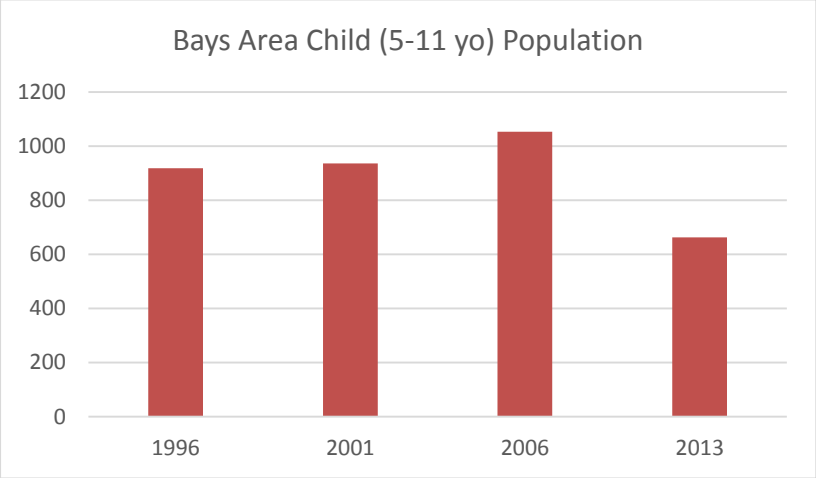
In addition, with accident rates almost twice as high around Sumner and Mt Pleasant schools compared with the Redcliffs School site, adding traffic to these higher risk roads, as well as increasing the total vehicle kilometres travelled is likely to result in increases in the number of accidents around the schools in the Bays area.

The Board also has significant concerns for the safety of students who may now need to travel from Redcliffs to Mt Pleasant School. The current configuration of the roading system does not accommodate safe crossing points for children, posing a real daily risk arising simply from the potential requirement to travel to school.

4.5 Future Bays Area Schooling Needs

The number of younger children in the Bays area has steadily increased and is projected to continue this trend once damaged homes are repairs or replaced. Reducing the number of sites used to meet this growing demand for primary schooling provision will clearly require considerable new facilities to be built immediately at Mt Pleasant and Sumner Schools, but also reduce the future flexibility of the Ministry to respond to growing demand over time.

Figure 4: Full primary age child population growth in the Bays area prior to the earthquake



5. Conclusion

The geotechnical advice in the AECOM Report confirms previous assurances about the high level of site safety provided by the proposed mitigation measures at Redcliffs School.

The conclusions of the report state that the risk of future disruption to school operations is extremely low and entirely manageable. On this basis there is no reason to abandon the Redcliffs site and close the school.

Reopening the school on its original site will allow a high-performing school to continue to provide quality education to its students, as it has done for over 100 years. It will also avoid disrupting the well-being of students, local families and a vibrant community. It will maintain and strengthen a robust network of Bays Cluster primary schools in which Redcliffs plays a key role.

Appendix A: AECOM Report - Rockfall Risk to Redcliffs School

AECOM

Rockfall Risk to Redcliffs School

Prepared for Redcliffs School Board of Trustees

17 June 2015

1.0 Background

Introduction

Redcliffs School is located below and in front of near vertical cliffs up to about 70m high (Figure 1) that consist of volcanic rocks (lava flows and ash deposits) overlain by loess (wind-blown silt and sand) and colluvium (locally derived erosion debris). During the Canterbury Earthquake sequence of 2010/2011, rockfalls of varying magnitude occurred from the cliff. Following the 13 June 2011 event, a decision to withdraw from the site until a detailed risk assessment could be completed was jointly made by CERA and the Ministry of Education (MWH 2014, p4).

A report subsequently prepared for the Ministry of Education (MoE) by MWH (dated August 2014) reviewed the hazard and risk assessments previously completed by GNS (2012, 2014). MWH proposed closing part of the school (to avoid the highest risk area closest to the cliff) and constructing a bund within the zone of negligible risk (determined from GNS life safety risk model) to protect the remainder of the site.

Figure 1. Aerial view of cliff behind Redcliffs School after 4 Sep 2010 earthquake. Small rockfalls indicated by darker patches of bare ground. (Photo: M Yetton)

In March 2015, the Minister of Education (Hon. Hekia Parata) initiated consultation on a proposal to close Redcliffs School. It is understood that the Minister accepts that engineering reports by MWH and others have shown that the school can be protected from cliff collapse and rockfall hazards by constructing mitigation works, and her greatest concern is the possibility of disruption to the students education rather than any physical risk associated with the cliff hazard. The closure option is reported to be due to concerns that further rockfalls may reduce the capacity of the (proposed) bund, or it may need to be repaired, and that during maintenance or risk reassessments following a future rockfall the students may need to be removed from the school site.

On 5 May 2015 a group of Technical Experts met in Christchurch to discuss questions raised by Redcliffs School Board of Trustees in considering their response to the Minister's concerns[3]. These experts all have site-specific knowledge of the school area and extensive experience with rockfall (cliff collapse and boulder roll) issues in the Port Hills. They were:

- Mr Steven Woods, MWH – adviser to MoE
- Dr Jan Kupec, CERA – adviser to the Crown
- Dr Ian Wright, CCC – adviser to Redcliffs School as per CCC offer to make information available

[3] Dr Chris Massey from GNS Science was unavailable for the meeting as he was out of the country

Mr Don Macfarlane, AECOM – adviser to Redcliffs School BOT through CCC

This report documents the outcomes of that meeting within the context of the publicly available existing information relating to the rockfall/cliff collapse hazard and risk at the school site.

Rockfall history of the site

GNS (2014, p26) reported that the cliff behind the school is an old coastal cliff and that erosion of the toe of the slope probably ceased approximately 3500 years ago. They estimated that the total volume of debris (talus) deposited as a wedge at the toe of the cliff before the earthquakes as a result of natural degradation of the slope was in the order of 30,000 cubic metres. Figure 1 provides an indication of the distribution and nature of the debris. The number, size and frequency of rockfall events that contributed to the formation of this debris is unknown.

MWH (2014) provide a summary description of historical rockfalls at the site and GNS (2014, Table 21) provide estimates of the volumes of debris that fell from the slope in each of the main earthquakes (see Table 1 below).

MWH (2014) reported that the scree (talus) slope at the base of the cliff behind the school prior to the 4 September 2010 earthquake included boulders of up to approximately $1m^3$ and the school was protected by a mesh fence approximately 2m high located on its southern boundary. There is no known evidence that rockfall debris had entered the school grounds prior to the September 2010 earthquake.

The 4 September 2010 earthquake caused rock fragments and boulders of up to $1m^3$ to fall from the cliff. A small amount of debris struck the school hall at the rear of the site (closest to the cliff) and a bund was subsequently constructed behind the hall using rockfall debris (MWH 2014, GNS 2014).

AS shown by Table 1, the 22 February 2011 earthquake generated the largest rockfalls at the site. MWH (2014) report that the previously installed protection works (bund and fence) contained most of the rockfall but "a number of rock fragments, cobbles and small boulders struck the school hall and rolled onto the playing fields" and "rock fragments were found approximately 45.5 metres from [past] the fence. Figure 2, an aerial photograph taken after the earthquake, shows dust (and presumably fine debris particles) on the rear of the roof of the school hall. Following this event additional protective measures were implemented, including ceasing to use the school hall, relocating three classrooms further from the cliff, installing a barrier of shipping containers, and construction of a 4m high 'fly rock' fence (see Figure 3).

Table 1. Estimated volumes of rockfall from Redcliffs cliffs in main earthquake events of 2010/11

Earthquake	PGA (g) [horizontal]	Approx volume leaving slope (m^3)
4 Sep 2010	0.33	60 ±10
22 Feb 2011	0.86	23,800 ±6,600
16 April 2011	0.50	1,170 ±110
13 June 2011	0.37	11,800 ±3500
23 Dec 2011	0.12	1,180 ±130

The 13 June 2011 aftershocks resulted in further rockfall from the cliffs in the Redcliffs area and much more dust and debris on the school hall and classroom roofs (see Figure 3). The greatest change in the cliff appears to be above the school hall. GNS (2014) reported that three discrete local cliff collapses of 1,000 to 2,000 m^3 that accounted for almost half the total rockfall from the cliff on that day. This information was obtained by comparing terrestrial laser scan surveys undertaken on 3 May and 15 June 2011. Following this event, the school was closed until a detailed risk assessment could be completed.

Figure 2. Aerial view of cliff after 22 February 2011 earthquake. Note dust on roof of the hall.

Determining the area at risk

The areas at risk from cliff collapse and boulder roll hazards were defined by GNS Science using the Fahrboeschung (F) angle and Shadow (S) angle, as illustrated in Figure 4. The F angle is the angle from the top of the cliff to the most distant end point of cliff collapse debris (talus), boulder roll or flyrock. The S angle is the angle to the boulder roll limit measured from the base of the source area. The limits defined in this way will change slightly as the cliff top retreats or the debris (talus) pile becomes higher.

Figure 3. **Aerial view of cliff after 13 June 2011 earthquake. Note that there is more dust on the roof of the hall and increased debris at base of the slope cf. Figure 2.**

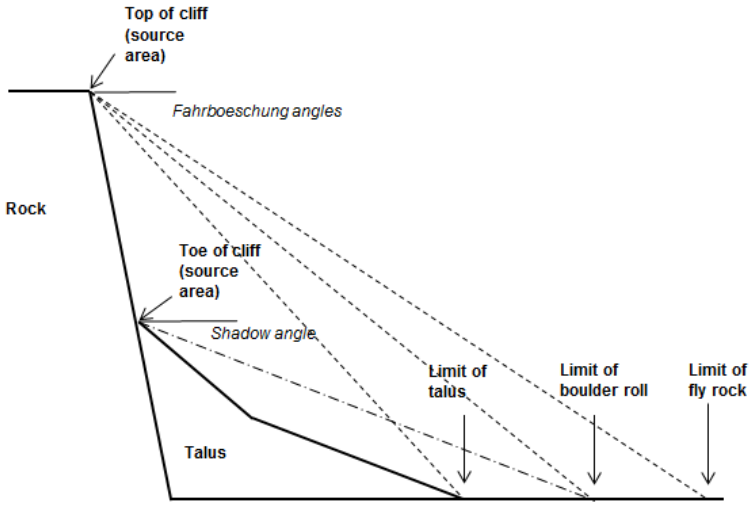


Figure 4. **Schematic illustrating the parameters used to assess runout distances for cliff collapse (modified after Figure 27 of GNS Science report CR2012/57)**

A recent publication (Jaboyedoff & Labiouse 2011) describes a range of F and S angles[4] determined by different researchers, as summarised in Table 2 where they are compared with the GNS values.

[4] In their paper the term 'Energy Line' is used for the line joining the top of the source cliff and the (far) tip of the rockfall/avalanche deposit

Table 2. Comparison of rockfall runout limit lines from top (F angle) or bottom (S angle) of the source according to various authors (from Jaboyedoff & Labiouse 2011).

Researcher(s)	Fahrboeschung (F) angle	Shadow (S) angle
Toppe (1987)	32°	
Onofri & Candian (1979)	28.5°	
Wieczoreck et al (1980)		22°
Evans & Hungr (1993)		27.5°
Lied (1977)		28°
GNS Science (2011, 2012)	31°	21°

NOTE: GNS Science (2012) clearly state that the minimum F angle is based on the extent of flyrock

Statistically, it can be expected that a very small proportion of fallen rock blocks could travel beyond the limits defined by these angles. Evans & Hungr (1993), for example, determined a shadow angle of 27.5° based on numerous case studies, but reported values as low as 24°.

We note that the Fahrboeschung (F) angle that GNS have used to determine the line beyond which there is negligible life risk (AIFR < 10^{-6})[5] from any particular source due to cliff collapse or boulder roll is based on the Port Hills rockfall dataset. As the field teams did not rigorously document the very small rocks and rock particles it is possible that some flyrock (mainly dust and small particles) will travel beyond the 31° line that GNS adopted to define the line of negligible life safety risk.

2.0 Assessment of Redcliffs School Site

Near field (<20 km distant) earthquakes such as the 2011 earthquakes (22 February, 16 April, 13 June and 23 December) that generate peak ground acceleration (PGA) of more than 0.4g are the most likely to cause future rockfalls at Redcliffs.

The MoE report to the Minister (paragraph 88) states that "modelling cannot determine the extent… of future rockfall". While it is correct to say that there is always some inherent uncertainty in modelling, it is possible to obtain estimates of the extent of rockfall runout that allow for the uncertainty with a high degree of confidence.

GNS (2014) have estimated possible future rockfall volumes and runout distances, defined by Fahrboeschung angles, from two different source areas on the cliffs (Figure 5) in the event of a future large magnitude earthquake. Their estimates are summarised in Table 3. It can be seen that

1. the uncertainty (shown by the ranges) in these estimates is much greater than indicated for the past earthquake events in Table 1;
2. the upper estimate for Source Area 1 is comparable to the upper range of the estimate for the 22 February 2011 total rockfall volume from the cliff area; and
3. the lowest estimated F angles are slightly above the 31° limit that the Port Hills field data has indicated for fly rock resulting from cliff collapse.

As shown by Figure 37 of GNS (2014), reproduced in part as Figure 6, even the most conservative (maximum runout distance, which captures the uncertainty) models indicate that neither rockfall debris nor flyrock from Source Area 2 will reach the western boundary of the school and that there is only a marginal probability of flyrock or boulders rolling down the debris cone reaching the proposed revised school (south) boundary from Source Area 1.

[5] Annual Individual Fatality Risk less than 1 in 1 million

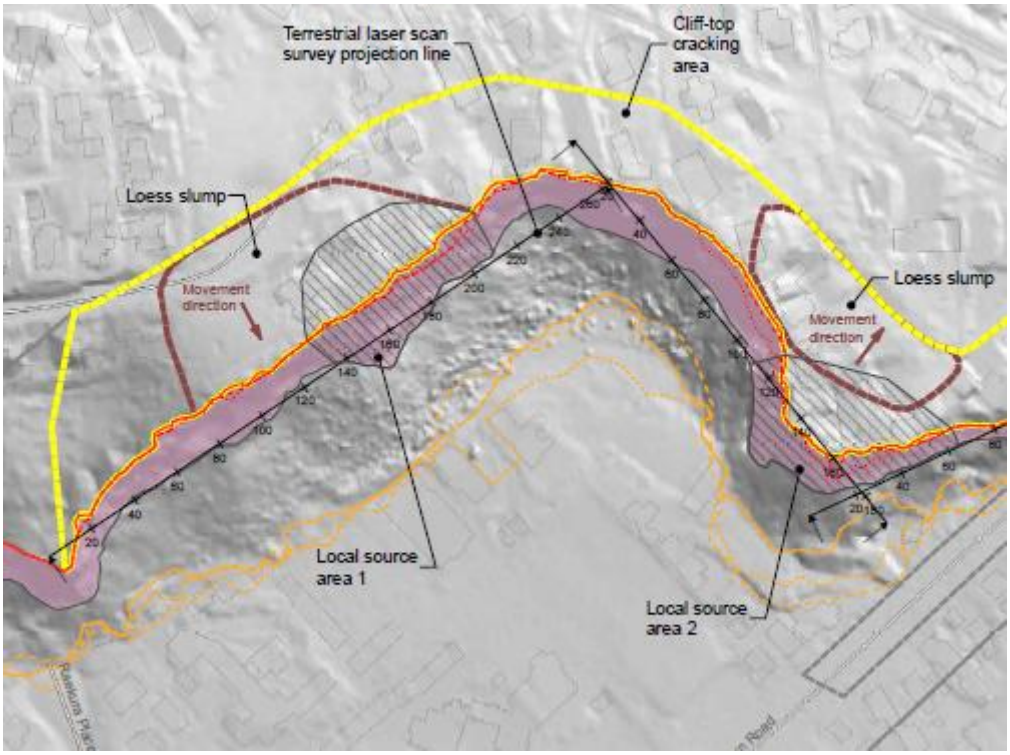


Figure 5. Local rockfall source areas identified by GNS Science (2014, Figure 18)

Table 3. Estimated volumes of future rockfall from two potential sources on Redcliffs cliffs

Source Area	Estimate	Volume (m^3)	F angle - talus	F angle – boulder roll
1	Lower	7,700	36.0°	33.0°
	Mid	12,800	34.9°	32.4°
	Upper	32,000	33.1°	31.4°
2	Lower	3,700	37.5°	33.9°
	Mid	9,400	35.6°	32.8°
	Upper	18,300	34.2°	32.0°

NOTE: cited F angle is mean – 1 std deviation (= lowest angle) to capture the uncertainty

MWH (2014) carried out a slightly different assessment of 'worst case' debris runout by estimating the future profile of the slope based on the assumption that it would be stable at 2:1 (approximately 26°). This is a conservative assumption for angular materials, which typically have a stable angle steeper than 30°. In addition, the time taken for the slope to reduce to such a profile through natural processes is likely to be many tens of thousands of years, possibly hundreds of thousands of years. Even with their conservative assumptions, MWH concluded that the 'worst case' debris runout would not reach the proposed bund at any of the 3 modelled section lines. Their models indicated that the debris would be at least 18m from the bund.

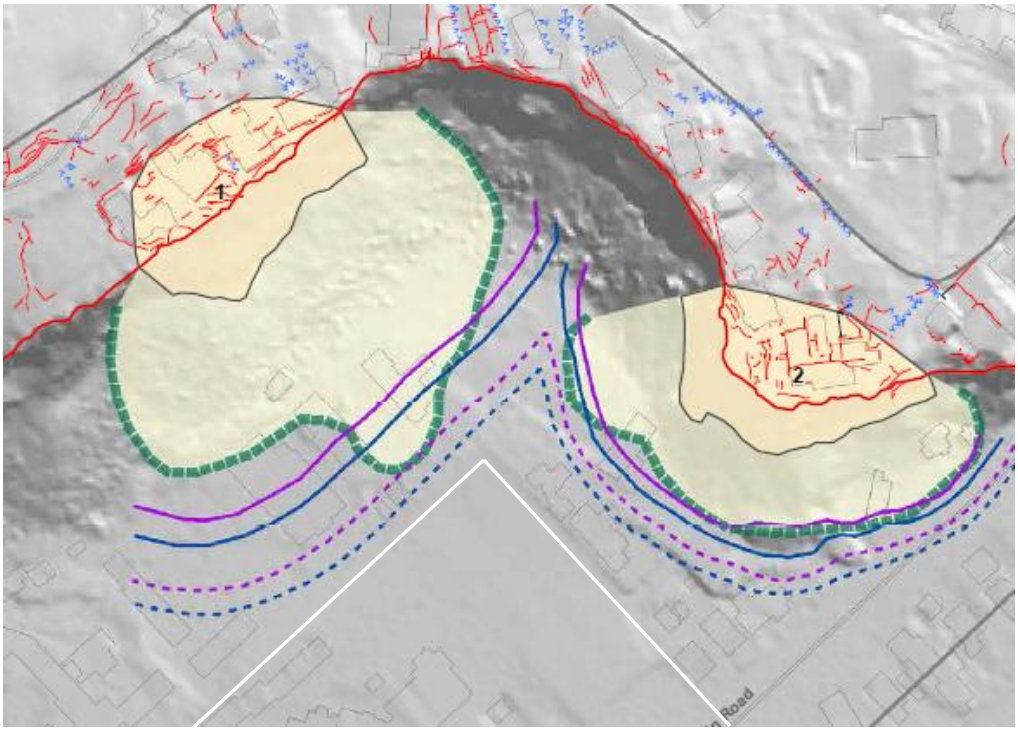


Figure 6. GNS modelled runout distances from Source Areas 1 and 2 from RAMMS model (green lines), debris avalanche/cliff collapse (purple lines) and boulder roll (blue lines). Dashed lines represent the worst case (maximum volume/maximum runout). White lines approximate the proposed revised school boundary.

GNS (2014) also discuss the possibility of rainfall-induced failures of the cliff behind the school (source areas 1 and 2 on Figure 5), noting that it is very unlikely that rainfall will cause cliff collapse on the same scale as a large magnitude earthquake. In their Table 28, GNS (2014) provide the following estimates of rockfall volumes for rainfall events:

Return Period (years)	No. of events	Annual frequency (probability) of event	Mean rockfall volume per event (m^3)
1 - 15	5.5	0.37	5
15 - 100	1.3	0.0133	170
100 – 1,000	0.7	0.0007	1,500
1,000 – 10,000	0.3	0.00003	10,000

Because of the relatively smaller volumes involved and the lack of momentum such as generated in an earthquake, it is expected that rockfall from a rainfall event would be arrested on or very close to the existing debris at the base of the slope.

Proposed Remedial Works

MWH (2014) have proposed a revised school boundary, as shown on Figure 6. This is beyond (further from the cliff) than the AIFR = 10^{-6} line defined by GNS on the basis of their detailed studies and modelling. Based on the models, and the site-specific observations documented by MWH and by GNS, it would be expected that no boulders or fly rock would reach the proposed boundary.

However, recognising that this cannot be guaranteed and that society has a particular aversion to risk on a school site, MWH have proposed additional protection in the form of a reinforced earth bund to form a physical barrier along (just inside) the revised school boundary to further reduce any residual risk that may not be captured in the GNS model. The proposed design of the 4m high barrier is outlined in MWH (2014) sections 5.2 and 5.3.

The MWH hazard mitigation proposal (bund) is based on the very conservative assumption that large scale cliff collapse will occur at some time in the future, resulting in larger volumes of rockfall debris than occurred in the 2010/11 earthquake sequence. The concept design is also based on conservative assumptions of rock size so the bund is capable of withstanding much higher impact energy than can reasonably be expected.

Technical Experts Assessment

The specific questions discussed by the group of Technical Experts on 5 May were intended to determine whether the group expects the proposed solution to prevent rockfall from disrupting the school (except in such extreme circumstances that similar or greater disruption would be occurring over a much greater area) or whether there is some flaw in the concept that would mean that it is reasonable to expect that the proposed solution could not prevent disruption under abnormal but not extreme circumstances.

The group of Technical Experts considered the following questions in making their judgement:

1. *What sort of event (size, extent) would give rise to a rockfall that would require the school to close immediately to allow reassessment of the cliff to be carried out?*
2. *What is the probability of such an event occurring?*
3. *How long would the subsequent cliff assessment take to complete?*
4. *What volume of rocks would need to be cleared from the bund after such an event, and how long would this take?*
5. *What is the expected extent of damage to the bund after such an event, and how long would it take to repair such damage?*
6. *On what basis would the remaining cliff be in a more dangerous state than currently after any future rockfall event?*

The Technical Experts agreed that

1. Technical information obtained from the GNS work on cliff collapse and mass movement is the best information available at this time, and is appropriate and sufficiently conservative to use as the basis for an engineering solution
2. The proposed/conceptual engineering solution contained in the MWH report is appropriate, robust and appropriately conservative
3. Because the proposed structure is sited beyond the calculated (modelled) limit of rockfall debris and flyrock, it is inherently conservative.
4. Zero risk is not achievable. However, it is believed that he Ministry is more concerned with possible consequences (in particular disruption of schooling) than risk, which they have accepted as extremely low.
5. Any further “significant” seismic event would be expected to damage the cliff and potentially loosen more rock – although the cliff would not necessarily be in worse condition than it is currently, it is likely that there would be further rockfall debris shed from the cliff.

The Technical Experts meeting identified three rockfall scenarios, each with different implications and levels of uncertainty that could require the school to close immediately to allow reassessment of the cliff to be carried out. These were:

Bund is hit by rocks

The Technical Experts agreed that it is highly unlikely that the bund will hit by rocks within the next 50 years. However, should this occur, it would indicate that the design assumptions based on the GNS life safety risk model were wrong. In this event, the bund would have to be inspected for damage, maintenance requirements, etc, and the hazard and risk at the site would need to be reappraised.

Large magnitude earthquake

Any earthquake event that is large enough to result in the school being evacuated (pupils sent home) will almost certainly cause rockfall from the cliff and further weakening of the rockmass. If rockfall debris accumulates between the bund and cliff (but the bund is not hit by debris) it will not necessarily need to be removed (depending on volume and location). A reassessment of risk could be completed in days to weeks (depending on how schools are prioritised).

Based on the current NZ Seismic Hazard Model such an event is possible within the next 50 years. The probabilities were not assessed by the Technical Experts but are given in Table 25 of GNS (2014) with estimates of debris avalanche (cliff collapse) volumes that may occur in events of different PGA in their Table 26.

Material change in cliff face

A material change in the cliff face (e.g. development of new open cracks, new rockfalls) could occur with or without earthquake because of the damage to the rockmass caused by the 2010/11 earthquakes. Such changes

in the cliff face are quite likely to occur over the next 50 years and can be assessed by appropriate technical experts within hours if necessary.

The volume of rocks that would need to be cleared from the bund after any of these events is not possible to accurately quantify but the worst case estimate in Table 4 (below) is only about 25% of the capacity of the bund. Removing rock should be quite straightforward but would possibly require third party land owner agreement and resource consent.

Damage to the bund

Due to its proposed location relative to the rock sources, damage to the bund is not expected to happen in any of the above scenarios. In a worst case (rocks reaching/impacting the bund), damage would be expected to be relatively minor and easy to repair.

The need to remove debris (and how to do it safely) would need to be assessed on basis of the actual outcome of any specific event.

Additional Assessment

Subsequent to the Technical Experts meeting, we have prepared a cross section through Source Area 1 (using Section R01 from GNS 2014 as a base) to illustrate expected maximum runout limits for talus, boulders and flyrock at the rear of the school. Figure 7 illustrates these expected limits.

In addition, we have summarised GNS' estimates of rockfall volumes from the cliffs behind the school for different intensities (PGA's) of earthquake shaking (see Table 4) and calculated the approximate volumes of debris that would be required to fill the area between the bund and the cliff, as follows:

Estimated volume to fill behind a 4m bund located just within the revised school boundary

Source Area 1 = 2275 m^3/m (approx). This is approximately double the MWH estimate of the volume of debris estimated for long term natural slope degradation to form a 2:1 slope below this source, and is approximately 4 times the average volume per metre of cliff that GNS estimate would fail in an earthquake generating PGA's in excess of 2g at the site.

Source Area 2 = 915 m^3/m (approx). This is approximately five times the MWH estimate of the volume of debris estimated for long term natural slope degradation to form a 2:1 slope below this source.

Table 4. Estimated total rockfall/cliff collapse volumes for earthquakes of different magnitude over the next 50 years (these are not specific to Source Areas 1 and 2).

PGA (g)	0.1 – 0.3	0.3 – 0.5	0.5 – 0.8	0.8 – 1.2	1.2 – 1.6	1.6 – 2.0	>2.0
Next 50 yr annual probability	0.0729	0.0148	0.0054	0.0014	0.0003	0.0001	0.00002
	7.29×10^{-2}	1.48×10^{-2}	5.4×10^{-3}	1.4×10^{-3}	3×10^{-4}	1×10^{-4}	2×10^{-5}
Est max volume, all sources (m^3)	8,700	19,300	33,800	55,400	81,500	108,700	158,500
m^3/m (300m cliff length)	29	64	113	187	272	362	528

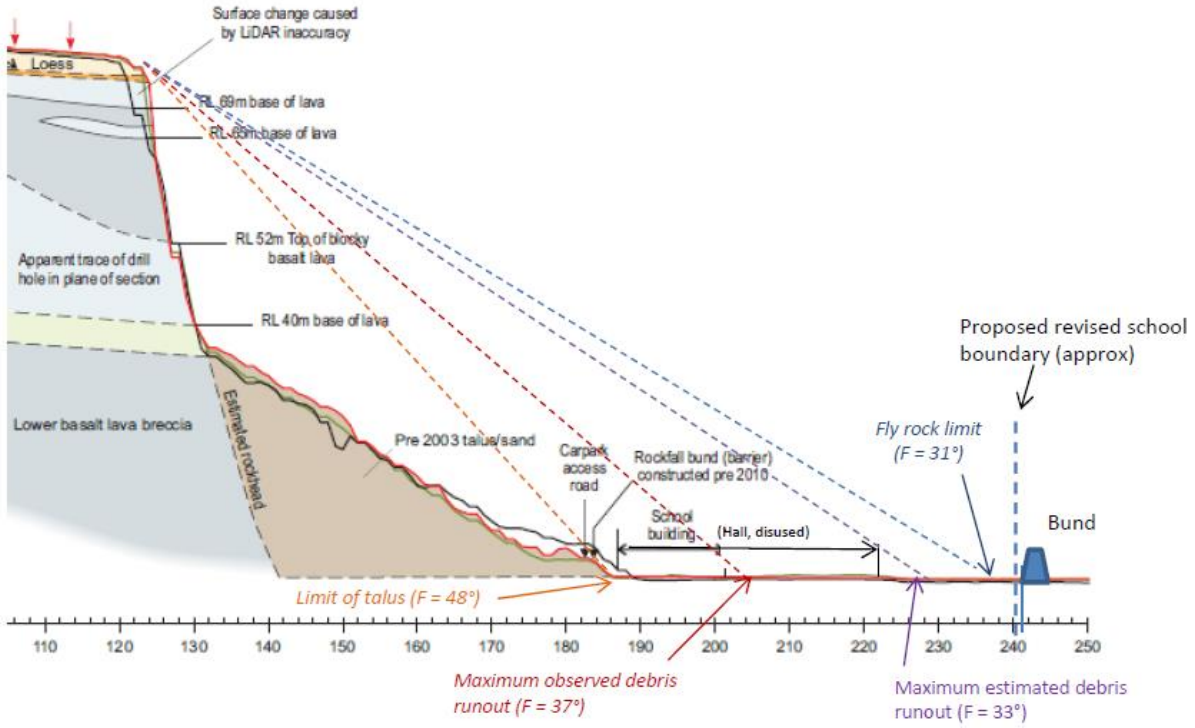


Figure 7. Observed and expected limits for talus, boulder runout and flyrock at cross section R01, Redcliffs School. Annotations on original GNS cross section (Figure 13, CR2014/78).

3.0 Conclusions

1. The Technical Experts agreed that the engineering solution proposed by MWH is appropriate, robust and conservative, and will prevent disruption of the school in all but a large magnitude earthquake that generates very high PGA's at the site.
2. Such an event will almost certainly leave large areas of Christchurch with significant damage, and thus Redcliffs is no more vulnerable or unsafe than other buildings and schools in the region.
3. It is difficult to estimate the probability of an earthquake leading to catastrophic collapse of the cliff behind the school but both the field evidence from the 2010/11 earthquake sequence and rockfall modelling by GNS and MWH indicate that the likelihood of an event large enough to cause rocks to impact the bund is extremely low.
4. The most pessimistic estimates of possible future rockfall volumes are very much less than the volumes required to fill the area between the cliff and the proposed bund.
5. The proposed bund is sited beyond both the previous and expected limits of rockfall runout and flyrock travel, effectively providing an extra level of protection by creating a physical barrier between the cliff and the school. This accounts for the uncertainty in the modelling.
6. Even in the unlikely event of rockfall debris or flyrock reaching the bund, reassessment of the hazard and risk, and determination of the volume of rock (from such an event) to be cleared from behind the bund, if any, should be able to be completed within a matter of days.

4.0 References

GNS Science (2012a). Canterbury Earthquakes 2010/11. Port Hills Slope Stability: Pilot study for assessing life-safety risk from rockfalls (boulder rolls). Report CR2011/311, March 2012.

GNS Science (2012b). Canterbury Earthquakes 2010/11. Port Hills Slope Stability: Pilot study for assessing life-safety risk from cliff collapse. Report CR2012/57, March 2012.

GNS Science (2014). Canterbury Earthquakes 2010/11. Port Hills Slope Stability: Risk assessment for Redcliffs. Report CR2014/78, August 2014.

Jaboyedoff , M.; Labiouse, V. (2011). Preliminary estimation of rockfall runout zones. *Nat Hazards Earth Syst Sci* 11, p819-828

Ministry of Education (2015). Consideration of the future of Redcliffs School, Christchurch. Prepared for Minister of Education

MWH New Zealand Ltd (2014). Redcliffs School Cliff Instability and Hazard Mitigation. Report prepared for Ministry of Education, August 2014.

Appendix B: School Family Survey Results

The online survey was conducted during May and early June 2015. 118* Redcliffs families with children between 0 and 12 years completed the online survey.

Q1. If Redcliffs School returns to the original site; with safety measures in place, would you most likely send your children there?

- 97% answered 'Yes'.
- None answered 'No'
- 3% were 'Unsure'

Q2. If the Minister does close Redcliffs School, and your children attend their next closest primary school – will they be able to walk, scooter or bike there safely and practicably?

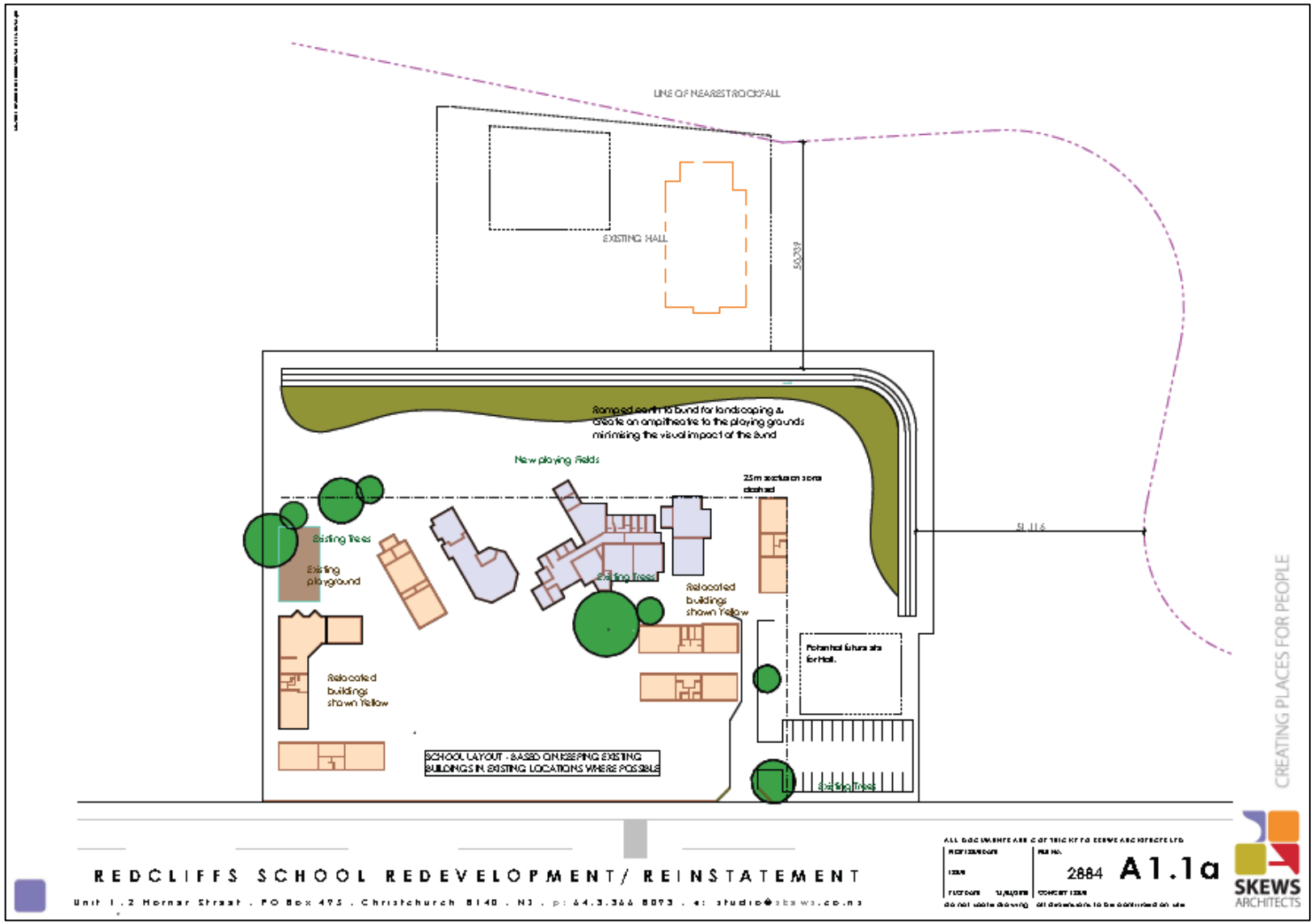
- 91% answered 'No'
- 2% answered 'Yes'
- 7% were 'Unsure'

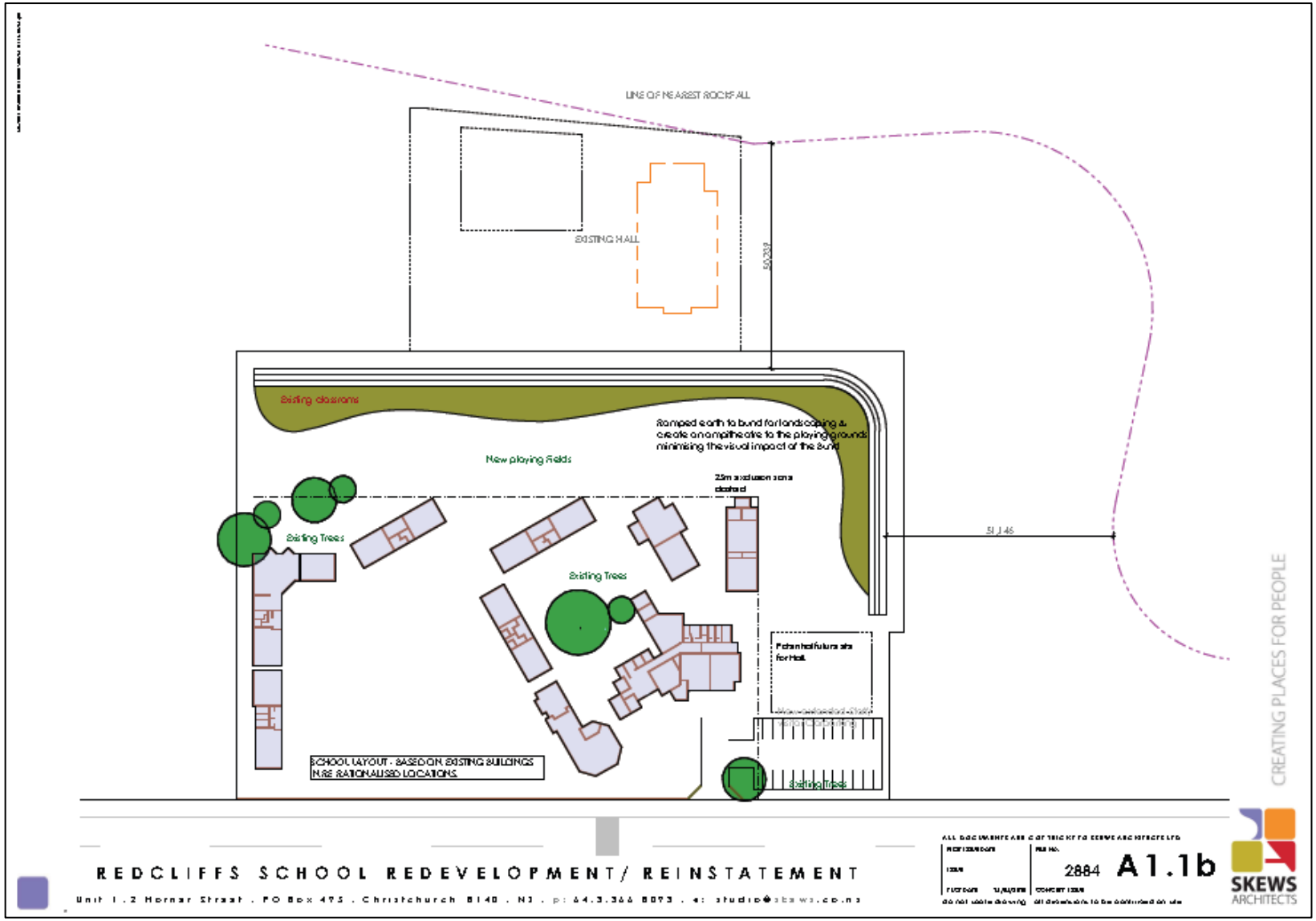
Q3. If Redcliffs School was to close this would have a very damaging effect on the Redcliffs area's economic and social well-being.

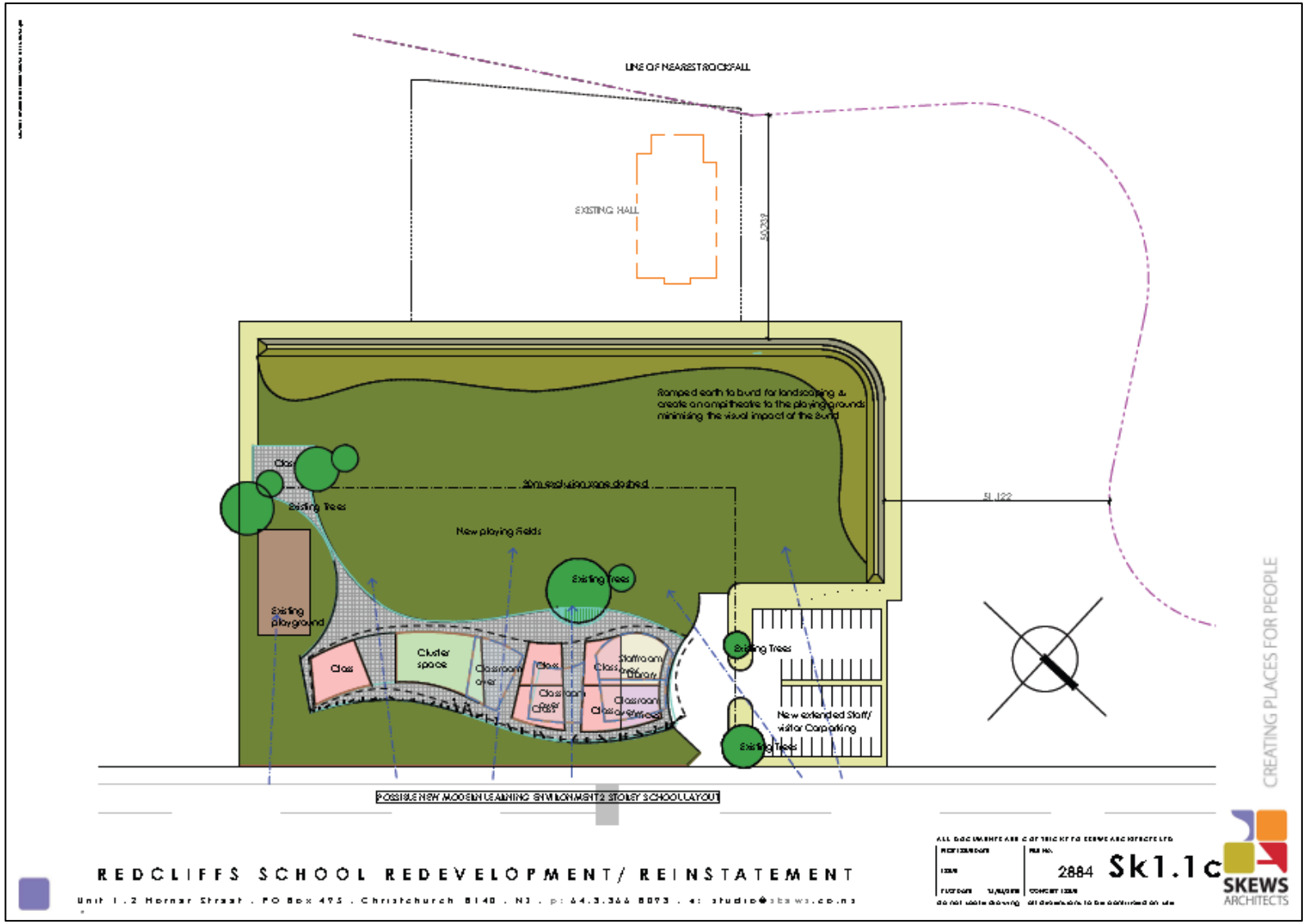
- 93% 'Strongly agreed'
- 6% 'Agreed'.

* One response was invalid and has been excluded from this analysis. The person answered 'No' to sending children to Redcliffs School, but doesn't actually live in Redcliffs zone or have children currently attending the school.

Appendix C: Indicative Concept Site Plans




LINE OF NEAREST ROCKFALL
EXISTING HALL
50.232
Existing classrooms
Ramped earth to bund for landscaping & create an amphitheatre to the playing grounds minimising the visual impact of the bund
New playing fields
25m exclusion zone cleared
Existing Trees
Existing Trees
51.146
Potential future site for Hall
Existing Trees
SCHOOL LAYOUT - BASED ON EXISTING BUILDINGS IN RE-RATIONALISED LOCATIONS.
REDCLIFFS SCHOOL REDEVELOPMENT/ REINSTATEMENT
Unit 1, 2 Hornar Street . PO Box 495 . Christchurch 8140 . NZ . p: 64.3.366 8093 . e: studio@skews.co.nz
2884
A1.1b
SKEWS ARCHITECTS
CREATING PLACES FOR PEOPLE


LINE OF NEAREST ROCKFALL
EXISTING HALL
50.239
Ramped earth to bund for landscaping & create an amphitheatre to the playing grounds minimising the visual impact of the bund
Existing Trees
New playing fields
Existing playground
Cluster space
Classroom over
Staffroom over
Library
Classroom over
New extended Staff/ visitor Carparking
51.122
POSSIBLE NEW MODERN LEARNING ENVIRONMENT 2 STOREY SCHOOL LAYOUT
REDCLIFFS SCHOOL REDEVELOPMENT/ REINSTATEMENT
Unit 1, 2 Hornar Street, PO Box 475, Christchurch 8140, NZ, p: 64.3.366 8073, e: studio@skews.co.nz
2884 Sk1.1c
SKEWS ARCHITECTS
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Appendix D: Transport Impact Assessment of Closure

It is important to note that when planned developments are being assessed, it is standard practice in New Zealand to undertake an Integrated Transport Assessment (ITA) considering the likely impacts of proposed developments. It is also standard practice to undertake an economic appraisal using the New Zealand Transport Agency (NZTA) Economic Evaluation Manual (EEM) when assessing new transport infrastructure. The NZTA has also produce a number of reports on the appraisal of transport infrastructure, including NZTA research report 420[6] which states the following:

"Consultation with 11 professionals who are involved with school travel found the following themes:

- *the transport, education and health sectors need to be more coordinated in providing guidance*
- *the strategic importance of schools within communities, and the transport around them, seem to get little political recognition*
- *changing parental attitudes and perceptions regarding the convenience and safety of school travel is an issue"*

These statements are consistent with the areas which we are considering in this submission.

We first consider the ways in which pupils could access Mt Pleasant or Sumner schools:

1. The existing cost of providing a bus service to the van Asch site is understood to be approximately $50,000 per annum. This provides a useful benchmark for the costs that would be incurred every year if pupils and parents were to continue to walk or cycle to the existing site where they could catch these buses.
2. It is not considered practical for children to walk or cycle to the neighbouring suburbs safely, particularly Mt Pleasant which is a reasonable distance up the hill (this is expanded upon below).

These analyses here are therefore predicated on children accessing the neighbouring suburbs by car. This may not be a reasonable assumption for those families without access to a car for transporting their children to school which either excludes these families from Redcliffs, or burdens them with the financial cost of an additional car in order to transport their children to school (noting that the financial cost of walking to school can be considered zero).

In order to understand the economic cost of this additional travel, two documents have been used:

- "Greater Christchurch School Travel Sustainability Potential (2014 Update), QTP, October 2014"produced for CCC including the School travel sustainability dashboard.
- The NZTA EEM

The distances that pupils currently travel to Sumner, Mt Pleasant and Redcliffs schools compared to in 2010 (pre-earthquake) and 2014 (post-earthquake, Redcliffs on Van Asch site) are shown in table 1.

[6] Improving school travel systems, H Mackie, November 2010

Table 1: Current and 2010 travel distances for students at Bay Area schools.

School	2010 distance	2014 distance	2014 sustainability rank
Mt Pleasant	1.41km	1.30km	57/122
Redcliffs	1.49km	3.17km	112/122
Sumner	1.10km	0.86km	2/122
Christchurch average	1.91km	2.07km	

As can be seen above, on average, the shift in site from Redcliffs to Van Asch has resulted in an additional 1.7km travel distance each day for Redcliffs pupils. The additional distance from Redcliffs School to the Mt Pleasant site is approximately 2.4km, and to Sumner school approximately 3.3km. It is important to note that the additional distance to the neighbouring schools involves travel around the headlands at Moa Cave (to Mt Pleasant) and Peacocks Gallop (to Sumner). Both of these passes are at risk of rock fall with containers protecting the road at both locations in June 2015, more than 4 years after the February 2011 earthquakes.

NZTA EEM procedures are not typically used for the appraisal of the impacts of a school closure and so where possible conservative values have been used, and where there is a risk of double counting in the benefits streams, the lower values may be discarded.

Direct impacts on displaced students and their "chauffeurs"

The immediate direct impacts to students and parents of the additional commuting distance and time to neighbouring suburbs can be calculated using procedures and values of time set out in the NZTA EEM. Indeed, for the majority of projects that receive funding from the National Land Transport Fund (NLTF), travel time impact typically comprise 80% of the quantifiable benefits claimed. Whilst detailed congestion information is not currently available, the following analysis is undertaken using the guidance provided in the NZTA EEM.

- Assuming a school role of 221 (2014 roll)
- An increase in travel distance of 1.7km based on the additional distance travelled to Van Asch (a conservative estimate given the additional distance to Sumner and Mt Pleasant schools)
- A value of time of $9.80/hour ($2014) based on a car driver (assuming the worst case situation that children are driven to school in both scenarios, the value of time to the pupils is not considered)
- An average travel speed of 30kph (noting that both Mt Pleasant and Sumner Schools are in residential areas)
- The increase in travel distance equates to an additional annual travel cost of approximately $47,000, or approximately $650,000 over a 40 year appraisal period.

This direct travel time cost assumes no increase in school role, does not consider the travel time cost to pupils and does not take into account the additional congestion, health and environmental impacts of increased vehicles on the road at peak times.

Impacts of mode shift from active modes to private vehicles

When considering the impacts of infrastructure that is likely to increase the number of walkers or cyclists, "Special Procedures 11" (SP11) from the NZTA EEM are used.

As outlined above, it will not be practical for pupils to be able to walk or cycle to Mt Pleasant or Sumner from Redcliffs. When new infrastructure facilitates additional walkers or cyclists then the health and environmental impacts of these additional walkers and cyclists is valued at $3.08 per pedestrian kilometre or $1.60 per cyclist km.

Assuming 50% of students cycle and 50% of pupils walk to the Redcliffs School site, and these would have to be driven to either Mt Pleasant or Sumner, then there is an additional environmental and health cost of approximately **$2.8M** over a 40 year appraisal period. Note that this does not include the impact on accidents due to larger numbers of schoolchildren converging on two school sites rather than three. The recent campaign for the lowering of speed limits on Mt Pleasant highlights the significant safety concerns at this site, and this issue would be exacerbated with additional pupils from Mt Pleasant.

Impacts on other users of the transport system

With a significant amount of additional vehicles on the road ferrying pupils to and from adjacent suburbs, there will be an adverse impact on other road users. A significant body of anecdotal evidence exists regarding the congestion, particularly in the morning peak, around Sumner and Mt Pleasant School sites. By intensifying the activity around these school sites, this congestion will worsen for all road users. These impacts have not been explored in detail due to time and cost constraints. Given that the minister believes that the potential disruption to Redcliffs pupils at the existing site is not acceptable, it is assumed that the minister has explored the level of disruption to Redcliffs pupils and residents of adjacent suburbs should the pupils relocate there.

Safety

Recorded traffic accidents have been collated for 2004 to 2014 from the NZTA Crash Analysis System with the accident locations highlighted as red dots in the plots below.

Figure 1: Mt Pleasant traffic accidents

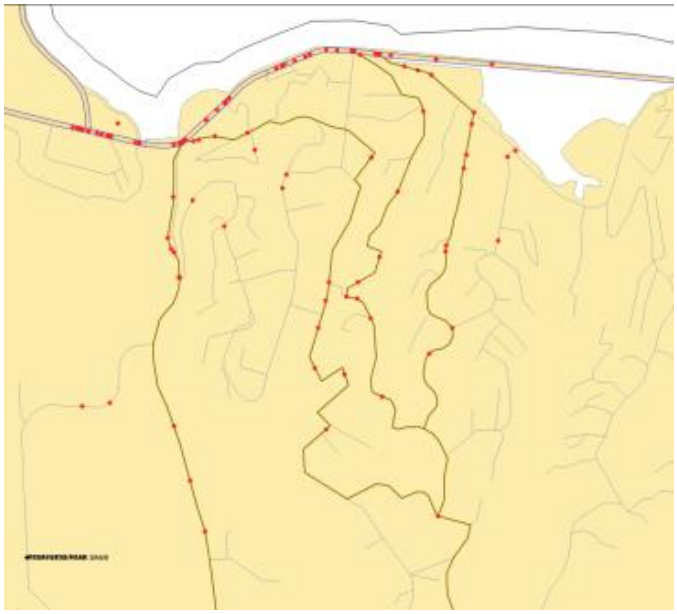

Figure 2: Redcliffs traffic accidents

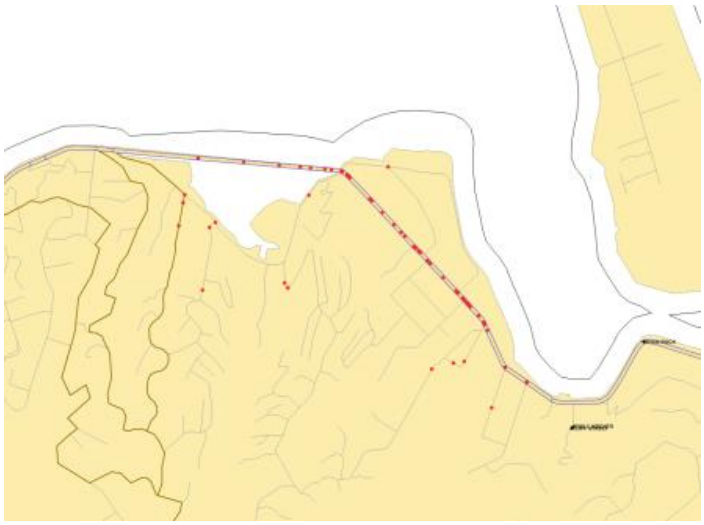

Figure 3: Sumner traffic accidents

Whilst a full crash analysis has not been undertaken, these crashes have been filtered to only include accidents that occur between 7.00am and 7.00pm, Monday to Friday (daylight hours with traffic patterns on a school day) on roads likely to be used for trips to or from the schools. This has resulted in the following numbers of crashes:

- Mt Pleasant School site: 40 crashes
- Redcliffs School site: 25 crashes
- Sumner School site: 40 crashes

With accident rates almost twice as high around Sumner and Mt Pleasant schools compared with the Redcliffs School site, adding traffic to these higher risk roads, as well as including the total vehicle kilometres travelled (VKT) is likely to result in increases in the number of accidents around the schools in the bays cluster. This will have not only a significant social and health impact on the communities, but also a significant economic impact.