Department of Building and Housing

Weathertightness – Estimating the Cost

29 July 2009

PRICEWATERHOUSECOOPERS

Restrictions

This report has been prepared by PricewaterhouseCoopers for the Department of Building and Housing to assist in developing a policy response to weathertightness issues. The report is provided in accordance with the terms and conditions of the contract signed April 2nd 2009.

In preparing this report and forming our views, we have relied upon, and assumed the accuracy and completeness of all information available to us from persons with whom we have spoken in the course of consultation, or from public sources, or furnished to us by the Department of Building and Housing. We have evaluated that information through analysis, inquiry and review but have not sought to verify the accuracy or completeness of any such information. We have assumed the accuracy of the information provided to us by other entities. We have not sought to independently verify this data.

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Background

The Hunn Report in 2002, a Select Committee inquiry and a Government review in 2003 separately determined there were significant issues with the weathertightness of certain residential buildings constructed in the mid-late 1990s. The issues were largely confined to buildings constructed with monolithic external cladding (either fibre cement, stucco or coated polystyrene) installed over untreated timber framing and without a drainage cavity between the cladding and the external walls.

At the time of the 2002/2003 investigations there were a range of estimates of the scale/cost of weathertightness problems, but no definitive research was done. In 2005 BRANZ estimated 40,000 dwellings could be "at risk", i.e: dwellings built with monolithic cladding. PricewaterhouseCoopers (PwC) then assessed the likely percentage failure based on the collective views of a range of building experts. It was estimated that 30 percent of the "at risk" dwellings might fail, i.e: 12,000 dwellings, and estimated the repair costs at $1billion.

Anecdotal information now suggests the number and cost of weathertightness failure could be higher than the 2005 estimates. The Government, therefore, wants to re-estimate the size and economic cost (including repair costs, legal costs and cost to the Crown of providing services) of the weathertightness problem, including:

- total number of affected dwellings
- how many homes have been repaired
- of these how many are beyond the statutory 10 year limit on liability
- who is bearing what costs, under current policy.

Methodology

The approach taken, in the current review, to estimating the extent of weathertightness failures can be summarised by considering two key tasks.

1. The derivation of a **national risk profile** grouped according to a) a risk rating based upon E2 / AS1 and b) the year of construction between 1992 and 2008. The size of this population is determined by a review of building consents over this period and their design characteristics determined by a closer examination of a sample of these consents.

2. The reconciling of **evidenced failure rates,** as reported through the WHRS and the courts, with **expert opinion** from building sector specialists and the experience of WHRS assessors. This reconciliation ensures that the study:

    a. estimates are based on the evidenced failure data collected from WHRS yet,

    b. reflects the practical experience that has yet to be rejected in the historical claims process.

Findings

Compared with earlier attempts to estimate the extent of weathertightness failure and damage, there is now considerably more data available.

There is a range of data (of varying nature, robustness, depth, coverage etc) from which potential failure rates might be estimated. There is also a large body of opinion on the likely levels of failures, the sectors of the housing market where these are likely to be concentrated.

To provide some indication of the potential range of failures:

- as a bare minimum the existing claims registered with the WHRS cover approximately 4,500 dwellings, this figure is likely to be an underestimate of the total failures; and
- some experts expect the vast majority of monolithic-clad dwellings constructed before 2006 will suffer weathertightness failures, as well as dwellings with other cladding types, which could amount to over 110,000 failures.

There is a parallel range of potential costs that might arise from failures (both of actual defects requiring repair and the associated transaction costs). This is because costs vary according to the extent of the damage caused by a failure.

Extrapolations can be made from the current recorded evidence of failure (principally WHRS claims). These extrapolations put the estimated total number of (extrapolated) failures in the range of up to 22,000.

There are very good reasons, however, to expect that 22,000 is nonetheless a significant under-estimate of the number of failures. In particular, opinion, both from experts sought and anecdotal evidence gathered during the analysis, provided the view that failures would be much higher. In addition, the evidence suggested that the failures would be concentrated in the segment of the dwelling population constructed before 2006, particularly those dwellings with so-called monolithic claddings. It is not necessarily the claddings themselves that are the problem. Rather, the use of such claddings during this period appears to coincide with more complicated building designs and construction methods that are vulnerable to water penetration through the exterior of the building and have low resistance to damage when this occurs.

There are a range of reasons for the low level of recorded failure compared to experts' best estimates of the ultimate failure rate, including:

- problems that have yet to visibly manifest (and of which home owners are, therefore, ignorant);
- denial behaviour by home owners of the existence and/or potential severity of problems and hence the urgency of need to address them;
- inability of some home owners to finance any form of major repair;
- the transaction costs of pursuing a claim;
- informal settlements between owners and builders (particularly outside of the major urban areas) or home owners simply fixing problems at their own cost;
- procedural obstructions to bringing claims on behalf of all owners within a multi-unit complex; and
- slower manifestation of problems in drier areas of the country.

There is also a view amongst the experts that the nature of damage and, hence, the cost of repairs, is likely to be weighted heavily towards the severe end of the spectrum. In this view, smaller and targeted repairs may temporarily resolve a visible problem, but experience to date suggests this will likely only postpone the underlying need for larger repairs.

Based on the context described above, the conclusions from modelling of the available data and agreed assumptions are as set out below.

Conclusions

Failure Rates

a) The total number of affected dwellings is estimated to fall within the range of 22,000 to 89,000. The consensus forecast (see chapter 4 for more detail) is for an estimated 42,000 failures.

b) Under current policy settings and resolution mechanisms, approximately 3,500 dwellings have undergone some form of repair to date.

c) It is estimated that approximately 9,000 of the failures will occur beyond the 10 year limitation period for legal liability.

d) Failure rates since 2006 appear to be much lower than in previous years, suggesting changes in the regulatory requirements and building practices have addressed the major problems identified in the past and reduced the incidence of weathertightness failures.

Failure Costs

a) For the consensus forecast of 42,000 failures, the total economic cost (i.e. repair and transaction costs) of remediation to all dwellings affected by weathertightness failures, is estimated as $11.3 billion (in 2008 dollars).

b) These costs are estimated to be distributed, under current policy, as follows:

- 69 percent to the owner;
- 25 percent to councils;
- 4 percent to third parties (e.g. builders); and
- 2 percent to the government (the cost of administering WHRS etc).

Owners carry the largest share, as:

i) they carry their own transaction costs;

ii) failures occurring after the 10-year liability limit are the owner’s responsibility;

iii) many failures will have gone unrecognised and will, therefore, remain the owner’s responsibility; and

iv) some owners are responsible for the building work (they are the developer) or failed to mitigate damage when recognised (contributory negligence).

1 Format of this Report

Our analysis followed a sequence of steps and this report is accordingly formatted around the conclusions reached at each step. More detailed information, including reporting of raw data, is contained in the Appendices to this report. The steps in the analysis and consequently the order of the chapters that follow are as listed below. For further detail, the relevant Appendix (ices) are listed.

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2 Background Discussion

History

"In February 2002, the Building Industry Authority (BIA) appointed a Weathertightness Overview Group to inquire into the weathertightness of buildings in New Zealand, and in particular the concerns regarding housing that is leaking and causing decay. The subsequent report (commonly referred to as the Hunn Report into Weathertightness)[1], identified a number of factors that have contributed to leaky buildings. Containing twenty-five recommendations that addressed and aimed to remedy the systemic failures within the building industry that had led to the weathertightness crisis, the Hunn report provided a blueprint for change across the industry."[2]

The so-called Hunn Report, a further Select Committee inquiry and a Government review in 2003 separately determined there were significant issues with the weathertightness of certain residential buildings constructed in the mid to late 1990s. It was thought then that the issues were largely confined to buildings constructed with monolithic external cladding (which includes claddings of fibre cement, stucco or coated polystyrene) installed over untreated timber framing and without a drainage cavity between the cladding and the external walls.

Comprehensive qualitative work was carried out by the Weathertightness Overview Group and subsequent actions were carried out based on these recommendations.

Nevertheless, there was still no firm view on the number of weathertightness-affected dwellings or the potential cost or liability for fixing them. A range of estimates of the scale/cost of weathertightness failures was derived based on high-level assumptions, but no definitive empirical research was done to test them.

Events shaping housing design

There are a number of factors contributing to the weathertightness issues. One way of examining these factors is to understand the key events happening at the time dwellings were being built.

The table on the following page sets out events that shaped housing design since 1990. The particularly significant events that stand out, based on the process for estimating failure rates, costs and liability, are highlighted in blue and italics.

[1] Building Industry Authority (2002), *Report of the Overview Group on the Weathertightness of Buildings to the Building Industry Authority*, Wellington New Zealand.
[2] http://www.dbh.govt.nz/whrs-publications-reports [May 2009]

Figure 1: Table of key events impacting New Zealand building standards from 1990 – 2008

Date	Event
1990	NZS 3602 required radiata pine to be treated if it was exposed to moisture.
1992 (1 July)	*Building Act 1991 came into force & also new national Building Code (under Building Regulations 1992), under the Code monolithic cladding (without a cavity) could be used as an alternative solution. First edition of B2/AS1 Approved Document provided for NZS 3602:1990 to be an acceptable solution to the Code requirements for timber framing.*
1993 (1 January)	Formal transitional period under Building Act 1991 ended, all new building work required a building consent under the 1991 Act from this date.
1993 (15 September)	Schedule 1 of Building Act 1991 amended to clarify that any repair or replacement of a component or assembly that has failed the durability provisions of the Code (clause B2) must be done under a building consent.
1995	NZS 3602 revised to allow use of untreated timber in certain circumstances. The use of untreated timber was an alternative solution for Code compliance.
1998 (28 February)	*Second edition of B2/AS1 Approved Document provided for NZS 3602:1995 to be an acceptable solution to the Code requirements for timber framing.* *Second edition of E2/AS1 Approved Document provided for plaster cladding on a rigid backing without a cavity to be an acceptable solution to the Code requirements for external moisture protection. (cf plaster cladding on a non-rigid backing requires a cavity to be an acceptable solution).*
2002 (31 August)	*Hunn Report on weathertightness published.*
2002 (26 November)	Weathertight Homes Resolution Services Act 2002 came into force.
2003 (March)	Government Administration Select Committee report on weathertightness released.
2003 (December)	NZS 3602 revised to no longer allow untreated timber to be used in framing for exterior walls.
2004 (June)	*Third edition of E2/AS1 Approved Document published but did not come into effect. This edition provided, among other things, for all stucco cladding to be fixed over a cavity in order to be an "acceptable solution" for the Code.*
2005 (31 March)	*Building Act 2004 came into force. Schedule 1 of the Act inadvertently omitted the 1993 provision requiring durability failures to be repaired under a building consent. Approved Documents now called Compliance Documents. B2/AS1 Compliance Document amended to refer to NZS 3602:2003 as the acceptable solution to the Code requirements for timber framing.*
2005 (1 July)	*Amended version of third edition of E2/AS1 Compliance Document came into effect requiring, among other things, stucco cladding to only be used over a cavity.*
2007 (1 May)	Weathertight Homes Resolution Services Act 2006 came into force. Key new provisions: future damage and general damages able to be claimed; easier for owners of multi-unit buildings to make claims, Weathertight Homes Tribunal established to adjudicate claims.
2008 (14 March)	Schedule 1 of Building Act 2004 amended to reinstate 1993 provision requiring durability failures to be repaired under a building consent.

Source: Department of Building and Housing, Unpublished (2009).

Definition of a weathertightness failure

A weathertightness failure is defined in the Weathertight Homes Resolution Services Act 2006. It is "a dwellinghouse into which water has penetrated as a result of any aspect of the design, construction or alteration of the dwellinghouse, or materials used in its construction or alteration."

This refers to water that has unintentionally penetrated the interior of the house. It is recognised that in some building designs it is expected that water will penetrate the primary cladding, but the design ensures the water will not cause damage. This is not a failure because the water has no opportunity to damage the interior structure of the dwelling. Weathertightness failure does not include water from internal sources such as bathrooms or kitchens.

When a dwelling is damaged by water ingress, there are invariably two considerations that are to blame:

- the failure to prevent water ingress into the interior; and
- the dwelling's inability to let water out and, hence, its inability to resist damage from water penetration.

Building professionals report that all houses will leak eventually and it is the ability to handle those leaks that determines if damage will occur. For example, a brick exterior is porous and will leak. Brick homes are, therefore, built with cavities and outlets at the bottom of walls to allow for drainage. Using this system, very few brick houses have experienced damage from water ingress.

For the purposes of the empirical analysis carried out by this report, the key elements of the definition of a "weathertightness failure" are:

- the failure must cause damage (i.e. by definition, no damage means no failure); and
- the failure must have occurred within 15 years of construction (i.e. within the NZ Building Code minimum requirements for durability of cladding materials).

Previous estimates

In 2005, on behalf of the Ministry of Economic Development (MED), PricewaterhouseCoopers (PwC) calculated estimates of the potential costs of the weathertightness problem. This analysis was conducted relatively early in the Weathertight Homes Resolution Services (WHRS) existence and at the time it had resolved relatively few claims. Further, very few claims had been resolved through the courts.

In the absence of relevant data, the analysis relied principally on scenarios generated from expert opinion of the potential number of dwellings that might be affected, which was between 8,000 and 12,000 dwellings. Costs of repairs and the transaction costs of achieving settlements were obtained from the experience of WHRS at that time.

The table below summarises the estimate of failures and costs, by two scenarios for dwellings constructed at the end of 2003.

Figure 2: Table of previous estimates of weathertightness failures

Scenario	Low	High
Failures (dwellings number)	8,000	12,000
Cost	$0.7 billion	$1.0 billion

Source: PwC analysis for Ministry of Economic Development, 2004.

In 2005, BRANZ estimated 40,000 dwellings could be "at risk", on the basis of the cladding type (a sub-set of those with monolithic cladding). It should be noted this was an estimate of the risk of failure, not of actual likely failures.

Subsequently, and with the passage of time a picture has emerged from the WHRS, court cases, further investigations by a number of parties and deepening expert opinion, of significantly greater costs than had previously been estimated. This increase is reflected in both the numbers of dwellings and the likely costs of rectification.

Anecdotal information suggesting the number and cost could be higher than the 2005 estimates led to the commissioning of this study and on data collection from a wide range of sources.

Purpose of this project

The purpose of this project is to provide the Government with a re-estimate of the size and total economic cost (including repair costs, legal costs and cost to the Crown of providing services) of the weathertightness problem. The project's objectives may be summarised as to estimate:

a) the number of dwellings built between 1992 and July 2008 at risk of being "leaky homes" as defined by the Weathertight Homes Resolution Services Act 2006;

b) the number of leaky homes repaired to date;

c) the nature of the damage that occurs in a leaky home; and

d) the total economic costs of repair and to show the breakdown between parties including owners, builders/developers, local government and central government.

The results of the analysis will be used by the Department of Building and Housing (DBH or the Department) to inform its own analysis and recommendations to the Government.

These recommendations will cover new and alternative options to the current policy approach for dealing with leaky homes, including options for variations to the current approach.

Context of this project

In approaching a quantitative analysis of the weathertightness issue, some key factors need to be taken into account, as they have some bearing on the analysis and the ability to predict future failure rates and volumes. These factors are briefly dot pointed below.

- Changing regulation and regulatory practice, including:
  - regulations on building materials and systems were changed in 1995;
  - growing awareness of the systemic nature of the weathertightness issue from 2002 onwards led to increased conservatism in consenting authorities (also, over the same period, every private sector Building Consent Authority ceased operation);
  - changes to the Building Act and Building Code after 2004 led to changes to building designs (use of wall cavities and treated timber) leading to increased building resilience to water penetrating the cladding.

The first dot point has particular importance as it appears that the majority of the systemic weathertightness issues emerged from the mid-1990s.

- Long time period to obscure change.
  - Some failures become evident very quickly; others over a much more extended period.
  - The most recent data available when the calculations for this project were carried out was effectively up to the end of the calendar year 2008.
  - A 15 year minimum durability requirement exists for key building materials but 15 years of data is available for very few dwellings.

> Only buildings constructed before 1993 have a 15-year building history (consistent with the period of minimum durability requirements) with which to assess failure rates within the durability time period.

- A building boom in the late 1990s and early 2000s.
  - The volume of buildings constructed in this period was significantly above the experience of the previous decades.

> This boom coincided with the emergence of the systemic issues, but there is a relatively small proportion that have extensive histories (10 years +) from which failure rates can be judged.

- The establishment of the WHRS in late 2002, with a 10-year limit on eligibility for claims.
  - The establishment of the WHRS generated a number of claims, but the 10-year eligibility criteria meant that some of potential claims from the early 1990s had little or no time in which to submit claims.
- Home-owner behaviour suggests low consumer-awareness.
  - Anecdotally, there has been a significant level of denial by home owners of potential weathertightness problems.
  - Further (and again anecdotally) many potential claims or problems (particularly outside of the main urban areas) have been rectified or settled informally between home-owner and builder.

Methodology and inputs

Analysing the weathertightness issue and projecting likely future failures is highly complex and presents some serious challenges. The raw time series, and analysis, is derived from a highly changeable set of circumstances described above.

Over the reference period, and as described in some detail in Figure 1:

- regulation was changed significantly;
- there was a building boom;
- new building designs and materials became prevalent;
- a formal mechanism was introduced to assist with identifying and resolving claims.

To reflect this history, the analysis, split the time series into three periods:

- 1992 to 1994;
- 1995 to 2005;
- 2006 to 2008;

This time periods have been selected to reflect, in particular, the different building standards and practices in place during these periods, and the impact these had. These standards and practices include redundancies in building design so as to accommodate moisture penetration of the cladding without damage to the building (i.e. not a weathertightness failure).

DBH facilitated the collection of data from published sources and established an expert group that included representatives of BRANZ, Council building divisions, building assessors, a major residential property manager, HOBANZ and experts from within DBH. Where there were knowledge gaps identified by the expert group, other experts were separately interviewed. DBH also convened a group of government officials to consider result of the analysis.

The basic approach to the analysis is conceptually simple:

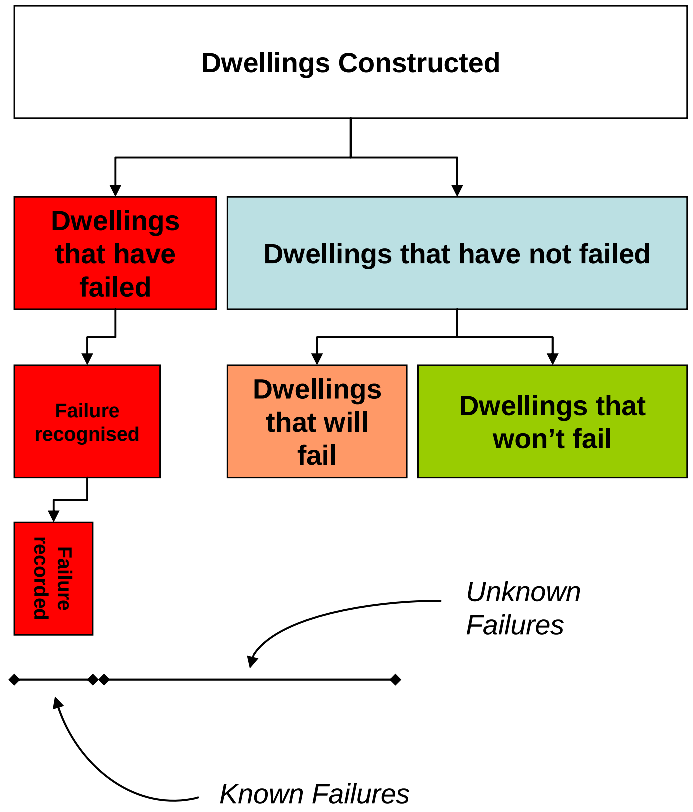
Step 1	Establish existing failure rates
Step 2	Project future failure rates
Step 3	Establish nature and costs of existing failures
Step 4	Project nature and costs of future failures
Step 5	Establish the distribution of liability and cost between involved parties for existing failures
Step 6	Project the distribution of costs for future failure
Step 7	Calculate the overall volume of failures, costs of failure and distribution of those failures between parties.

There are challenges in analysing the data, due to the environment in which the systemic weathertightness problems emerged and how they were then addressed.

Essentially, the numbers of dwellings constructed are known (from consents data). The number of failures officially recorded is also known (principally through WHRS). It cannot be said with any certainty how many other dwellings have already failed, nor how many will fail in the future. (The same challenge also applies to estimating the costs of weathertightness failures).

The diagram below summarises the key issues factors that useful impact on weathertightness failure.

Figure 3 Simplified Illustration of Factors Impacting on Weathertightness (Not to Scale)



Key Analytical Methodology

The methodology used in this analysis evolved over the course of the project, as existing data became available was analysed knowledge gaps identified and solutions to fill the gaps resolved.

A key tool used to collect data was a risk profiling tool based on E2/AS1[3]. This tool provides a method of scoring a building based on the prevalence of previously identified risk factors. The output of this tool is a **risk score** which can be translated into a category of risk.

This category of risk (low, medium or high) is referred to as the **risk rating**. The table below provides an estimate of the numbers of dwellings in each risk rating, based on the application of the E2/AS1 methodology to a sample of consents.

Figure 4: Table of risk ratings and risk scores estimated dwelling unity (1992-2008)

Risk Rating	Risk Score	Estimated units
Low	0 - 6	235,257
Medium	7 - 12	110,880
High	13+	54,813
Total Dwelling Units Built		400,950

Source: National extrapolation of sample data collected by TA's.

[3] E2/AS1 is the Acceptable Solution to Clause E2 of the New Zealand Building Code for External Moisture

E2/AS1 scoring was applied to WHRS claims data and to a sample of building consents allowing a link of failure data and general population data. The distribution of risk ratings is referred to in this report as the **risk profile** of a particular group of buildings.

Data and Information Sources

The principal data sources for the analysis are:

- Statistics New Zealand – aggregate consents data;
- WHRS – risk rating of sample of buildings subject to claims, findings on liability and settlements, assessed costs data, survey and other research into characteristics of claims;
- BRANZ – annual surveys of cladding types;
- Territorial Authorities – consents data;
- Crockers Property Group – confidentialised client data; and
- HOBANZ – confidentialised client data

3 Establishing Existing Failure Rates

Existing failure rates have been estimated using the risk profile of all New Zealand building consent and applying failure rate for this project calculated from data obtained from the WHRS.

Population of Dwellings

Base Data & Information

Numbers of consents for new dwellings were obtained from Statistics New Zealand for the period 1992 – 2008. This data is split into single unit and multi-unit dwellings.

No information is available from Statistics New Zealand on the nature of the multi-unit dwellings (e.g. terraced houses v's high rise; small unit numbers v's large unit numbers).

The Statistics New Zealand data provides the background information on the level of dwelling construction during the period under analysis.

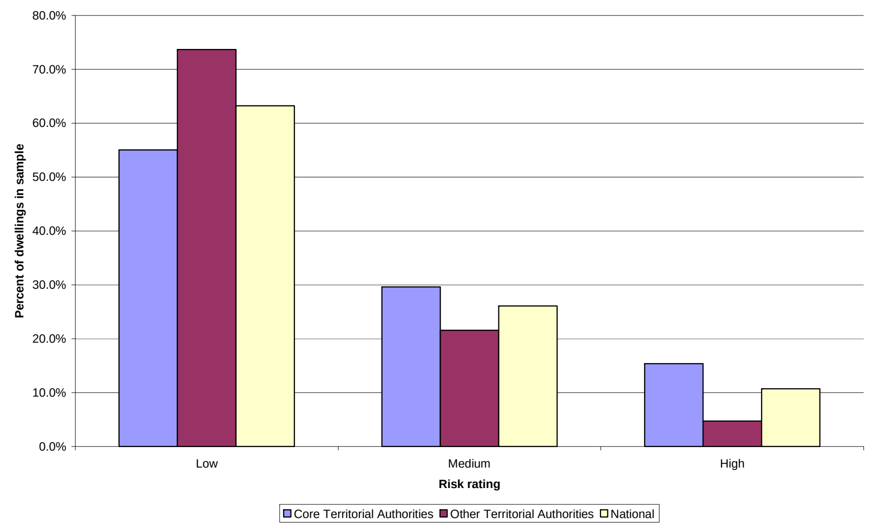
Estimation of Risk Factors

A survey was undertaken by 10 TAs, reviewing a total of 2786 consents. The E2/AS1 risk methodology was applied to the consent documents, to create a profile of construction by risk rating by year.

Figure 5 summarises the risk ratings for three groups of dwellings based on sample information:

1. core metro TAs (Auckland City, Christchurch City, Manukau City, Rodney District, North Shore City, Tauranga City , Waitakere City and Wellington City);
2. other councils represented by Upper Hutt and Dunedin; and
3. all of New Zealand represented by a weighted average of the first two groups.

Figure 5: New Zealand single-unit dwelling risk profile (average 1992 – 2008)



Source: Based on a sample of consents 1992 – 2008 sourced from Territorial Authorities.

Given the prevalence of monolithic cladding among evidenced failures, the number of monolithic-clad dwellings was also considered.

The graph below compares the estimates made by PwC against those derived in a survey of new dwelling conducted regularly by the Building Research Association of New Zealand (BRANZ), an independent research, testing and consultancy service. This provides an estimate of the veracity of the modelling.

Figure 6: Percentage of single-unit dwellings with monolithic cladding by data source 1998 – 2008

Key conclusions from this analysis are:

- 18.6 percentage of houses are high risk, based on E2/AS1;
- the number of high risk dwellings is considerably higher in dwellings with monolithic cladding (33 percent) than those with other claddings (13percent).

Issues to note regarding the use of the data are:

- the data is for consents, not construction completion;
- dwellings might not have actually been built entirely in accordance with consent documentation; and
- only a small number of dwellings from lower risk (i.e. drier) climates have been sampled.

Recorded failures - WHRS

Base data and information

The WHRS provided a record of all claims lodged through its service including the WHRS assessment of the cost of repairs.

The WHRS also applied the E2/AS1 risk methodology against a sample of 857 claims, to assess the split of claims between the low, medium and high risk categories into which the entire dwelling population had been split. WHRS also provided estimates of the split of claims between monolithic and other claddings.

Key conclusions from the examination of this data are reported in the figures set out in the remainder of the chapter.

- The split of failure rates based on the E2/AS1 risk methodology are approximately 10:4:1 (high, medium, low) for both monolithic and other dwellings.

The following table shows the results of risk profiling based on a sample of 857 WHRS records. It demonstrates the high frequency of reported failures in dwellings with a high risk rating.

Figure 7: Evidence from WHRS of the number of dwelling failures by risk rating

	Risk Rating		
Single-unit dwellings	**High**	**Medium**	**Low**
Number of failed dwellings	379	188	58
Percentage of failure	61%	30%	9%
Approximate ratio to low risk	6	3	1
	Risk Rating		
Multi-unit dwellings	**High**	**Medium**	**Low**
Number of failed dwellings	189	37	2
Percentage of failure	83%	16%	1%
Approximate ratio to low risk	95	19	1
	Risk Rating		
Overall (single and multi)	**High**	**Medium**	**Low**
Number of failed dwellings	568	225	60
Percentage of failure	67%	26%	7%
Approximate ratio to low risk	10	4	1

Source: Risk profile of claims from the WHRS claims database.

Analysis also showed that 85% of WHRS claims are for dwellings with monolithic claddings. The failure rates associated cladding are shown in Figure 8.

Figure 8: WHRS evidenced failures and failure rates by cladding type 2002 - 2008

	WHRS Failures	Total Dwellings	Failure Rate
Monolithic	3,923	113,999	3.44%
Other	692	286,952	0.24%
Total	**4,615**	**400,951**	**1.15%**

Source: WHRS

Failures since 2005

Data from WHRS also provided limited information on the failures from 2005.

- There is some evidence of declining failure rates in the period during which WHRS has been in existence. It is not yet clear, however, whether the reduction in claim numbers represents a permanent shift, or whether it is in fact that failures now occur later in the dwelling's life.
- The table below shows that the evidence to date shows that failures since 2005 have decreased significantly. The table compares the failures in the first three years for buildings that were given consent in the years between 2000 and 2004 with failures for equivalent periods for houses built between 2005 and 2008.

Figure 9: Table of evidenced failure rates acknowledged within 3 years of consent comparing 2000 – 2004 with the 2005 – 2008 period

Time claim submitted after consent (yrs)	Period 1 Failure rate data 2000 – 2004	Period 2 Failure rate data 2005 - 2008	Reduction from Period 1 to Period 2
One	0.12 percent	0.04 percent	68 percent
Two	0.11 percent	0.02 percent	83 percent
Three	0.13 percent	0.06 percent	57 percent

Source: PwC calculation of failure rate (related to all dwellings built in the period) based upon WHRS claims evidence.

Issues to note regarding the use of the available data are:

- because of the limited history of evidenced failures, only small periods of data were directly comparable; and
- failure rates are based upon samples of TAs and complete WHRS data.

Further detail and discussion of existing failure rates is provided in the Appendices (see especially Appendix C: Risk Failure, Appendix D: Identifying Failure and Appendix E: Impact of Failure).

Conclusion about existing failure rate

This chapter described the evidenced failures as reported through the WHRS from 1992 – 2008. Specifically a risk profile for these dwellings is described and the number of dwellings rated 'high risk' based on E2/AS1is analysed. In this chapter special attention was paid to data relating to 2005 – 2008 and comparing it to equivalent data from 2000 – 2004. This analysis suggests that the failure rate in buildings built during and after 2005 has dropped significantly.

4 Establishing Future Failure Rates

This chapter considers how the existing numbers of failures can be extrapolated to estimate the total failures relating to dwellings built between 1992 and 2008 (failures that occurred, even if unrecognised and failures likely to occur within 15 years called future 2008 failure rates). It then established an estimate of rate of failure (defined as percentage of the relevant building stock).

Extrapolating from recorded failures

Extrapolation from WHRS

A starting point for the analysis is to apply the current aggregate failure rate from current WHRS claims to the total building population is shown by Figure 10.

This will certainly be a significant underestimate, due to the fact that many dwellings included in the WHRS data have only been constructed recently. Indeed, very few have a 15 year history, and those with the longest histories were also built in an earlier period than when the majority of the problems appear to have arisen.

In order to accommodate these issues, extrapolations are calculated from the existing pattern of claims by:

- using the average rate of failure from the 1997-2001 years (i.e. the longest histories in the peak risk period); and
- extending this failure rate to reflect a full 15 year period, based on discussions with members of the DBH Expert Group.

As a further step, the failures assessed as arising as if the peak failure rates are applied across the rest of the portfolio.

Support from other data

In addition, an analysis of data provided by Crockers (a member of the DBH Expert Group). Its data covered the incidence of failure in the multi-unit dwellings under its management. This evidence resulted in the addition to the totals of 1,000 individual failures in multi-unit dwellings. Applying this failure rate to all multi-unit properties, suggests an evidenced failure rate for this category of approximately 6.5%.

These failure rates derived based on the approaches described above are provided in the table below.

Figure 10: Table of estimated failure rates (recorded data extrapolation)

	Single Unit	Multi Unit	Aggregate
Current WHRS Failure Rate	0.5%	3.9%	1.1%
Extrapolated WHRS Failure Rate	0.7%	6.5%	1.8%
WHRS Peak Failure Rate	2.3%	19.2%	5.6%

Source: PwC calculations based on TA sample and extrapolated data from WHRS and Crockers.

The next table shows the results of applying these failure rates to the total building population.

Figure 11: Estimated failures (recorded data extrapolation)

Numbers of Dwellingts	Single Unit	Multi Unit	Aggregate
Current WHRS Failures	1,541	3,074	4,615
Extrapolated WHRS Failures	2,111	5,212	7,323
WHRS Peak Rate Failures	7,313	15,333	22,647

Source: PwC calculations based on TA sample

Expert opinion

Expert opinion sought for this assignment focussed on cladding types in particular. Strictly, it is not the cladding type that is necessarily an indicator of the potential to fail.

There appears to be a strong coincidence of use of monolithic claddings during this period, however, without the building redundancies that would have prevented or significantly mitigated damage in the event of a moisture penetration of the cladding (e.g. wall cavities and treated timber).

As previously noted, some 85% of WHRS claims are for monolithic-clad buildings.

The opinions offered by experts can be summarised into two distinct opinion, the extreme view and the consensus forecast. These views are summarised by the following sections.

Extreme view

At the extreme, some experts considered that all, or at least the vast majority, of monolithic clad buildings built between 1992 amd 2005 would suffer some form of failure within 15 years. Estimates, based on this opinion, are shown in the table below.

Figure 12: Failure rates for high risk dwellings by cladding type (1992 – 2005)

Cladding Type	Failure Rate
Monolithic - EIFS polystyrene	80%
Monolithic - stucco	95%
Monolithic - fibre cement (flush finished)	80%
Plywood, fibre cement (with battens)	80%
Weatherboards, all types	2%
Brick	2%
Metal	2%
Concrete, Blockwork	2%
All other failures	2%

Source: Failure rate estimates based on May 2009 workshop, including assessors and building research experts and, confirmed by other expert opinion.

Consensus forecast

The opinion of government officials was that the extreme view, while possible, was likely to turn out to be an overstatement.

For the purpose of arriving at a consensus forecast, careful consideration was made of all the available evidence and it was decided that the cladding failure rates stated in the expert view should only be applied to the riskiest buildings (those in the high risk categories with a risk score of 13 points or more as defined by E2/AS1). An implication of this is that dwellings with a lower E2/AS1 risk profile would fail significantly less often.

Failures for those monolithic clad buildings have then been extrapolated from the "high risk" rate of failure using the proportions derived from the WHRS data (10 high risk : 4 medium risk : 1 low risk).

Figure 13: Estimated New Zealand failure rates: two views compared

	Single Unit	Multi Unit	Aggregate
Extreme View	20%	26%	22%
Consensus forecast	10%	13%	11%

Source: PwC model results based on agreed assumptions.

The Consensus forecast as derived from the assumptions agreed to by the government officials was approximately 42,000 failures.

Conclusions on estimates of future failure rates

Based on the various assumptions applied to calculate potential weathertightness failure rates, the number of dwellings unit failures range from approximately 22,000 to 89,000.

There is strong anecdotal evidence that existing WHRS failure rates do not reflect the actual volume of failures that have occurred to date. The upper end of WHRS extrapolations is probably, therefore, the lower end of the likely realistic range, approximately 22,000 swelling units.

The extreme view supports an upper end in the likely range an estimation of around 89,000

The consensus forecast sits below the midpoint but between both, at approximately 42,000 failures.

5 Establishing the Nature, Costs and Timing of Existing Failures

Weathertightness problems affect dwellings of all types. To date, repairs have been required across a wide range of building types, design, detailing and cladding. Repairs have also ranged from relatively minor (in cost terms), to very substantial. In this chapter considers the:

- costs of actual repairs; and
- transaction costs associated with seeking some form of settlement.

The principal source of information for these matters has been the WHRS. This chapter examines the implications of the WHRS data.

Repairs: nature of failures

Discussions with the DBH Expert Group, and other building experts indicated that damage could fall roughly into three types. These three types can be described using the nature of the required repair as:

- maintenance – a minor repair;
- targeted repair – re-cladding and associated work on a portion of a dwelling; and
- full re-clad – compete replacement of cladding, and associated required repairs to frames and interiors – this category includes demolition and rebuild if required.

WHRS and expert opinion

It has not been possible to determine for certain the nature of repairs that have actually taken place. This is principally due to the view expressed by a number of experts that there was a degree of repair and remediation work occurring entirely outside of the WHRS and other resolution mechanisms.

The table in Figure 14 below sets out the estimate of the type of repair required to adequately fix the weathertightness failure as a proportion of all predicted cases.

Figure 14: Estimated impact of failures by cladding type (1995 – 2005)

Cladding type	Type of repair		
	Full reclad	Targeted	Maintenance
Monolithic	75%	20%	5%
Non-monolithic	60%	35%	5%

Source: Based upon, expert opinion and WHRS and agreed by government officials

The key conclusion, based on an analysis of expert opinion is that the type of repair required to adequately fix the weathertightness failure, (for the population of dwellings as likely to fail) is very heavily weighted towards the more severe end of the spectrum.

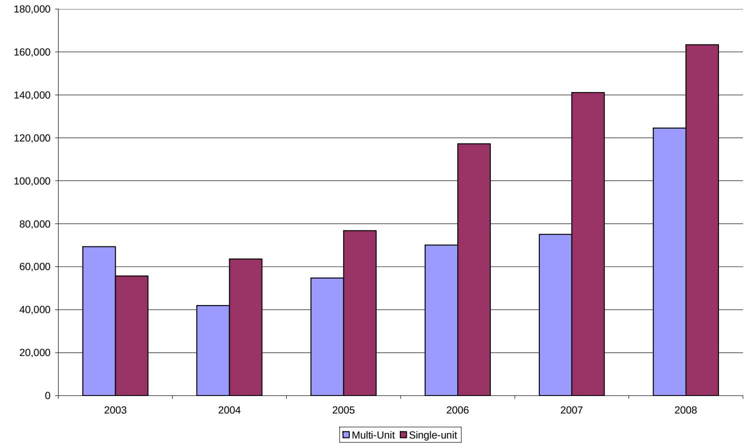
This may well be because:

- minor failures are not noticed;
- minor failures are ignored; or
- owners tend to deal with weathertightness issues themselves and they don't get included in WHRS data.

Repairs: costs

Since 2002 WHRS has offered low-cost assessments of the costs of repairs, as part of its resolution process. A summary of these estimated costs of repair is shown in the graph below.

Figure 15: Estimated cost of repair per unit (WHRS claims 2003 – 2008)



Source: WHRS unpublished data (2009).

The graph clearly indicates a substantial increase in estimated costs, based on the WHRS data over time.

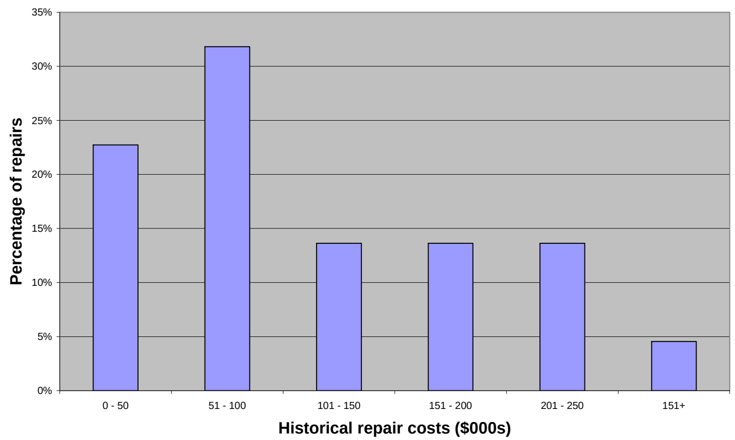
WHRS considers that this is primarily due to improvements over time in its assessors' understanding of weathertightness issues, rather than an increase in the severity of damage per claim. A further factor is that compensation for future likely damage was also incorporated into the assessments from 2006.

A survey by DBH of WHRS claimants generally supports this data when actual costs are compared with assessors' estimates, showing that:

- in the early years (2002 – 2005) there was an average variance from assessed cost of 180 percent; and
- in recent years (2006 – 2008) this variance reduces to 60 percent.

The actual report costs associated with repair as reported in the survey are shown in Figure 16 below.

Figure 16: Distribution of actual repair expenditure, 2002 - 2008 ($000s) per dwelling unit.



Source: WHRS Survey of parties named on weathertightness claims 2009.

Transaction Costs: Estimates

The three figures that follow provide estimates of the average total transaction costs (i.e. total for all parties to a claim) associated with securing some form of settlement of a claim (whether through WHRS or by some other means).

Figure 17 reports the estimated costs for single unit houses by type of repair. Figure 18 does the same thing for multi unit dwellings shown by cost of repairs to individual dwellings.

Figure 17: Estimated transaction costs for single-unit homes (2008 $)

	Type of repair		
Type of expense	Full reclad	Targeted	Maintenance
Design	$15,000	$5,000	-
Legal	$75,000	$30,000	$6,000
Experts	$10,000	$5,000	$1,500
Consequential	$10,000	$10,000	-
Total	**$110,000**	**$50,000**	**$7,500**

Source: PwC Estimates based on WHRS Survey and expert opinion

Figure 18: Estimated transaction costs multi-unit dwellings (2008 $)

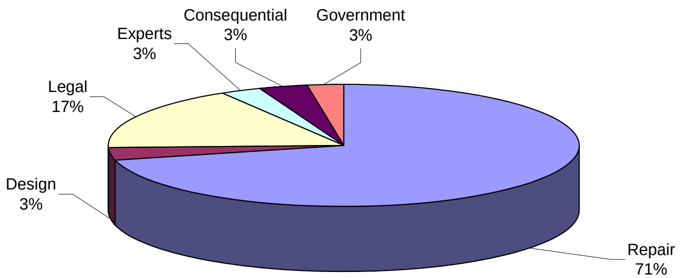
	Type of repair		
Type of expense	Full	Partial	Maintenance
Design	$2,750	$2,250	$250
Legal	$16,000	$14,000	$500
Experts	$5,500	$4,500	$250
Consequential	$12,000	$9,000	$250
Total	**$36,250**	**$29,750**	**$1,250**

Source: PwC estimates based on Crockers Property Group data, expert opinion.

While all transaction costs are estimated to increase with the severity of the damage, the key driver of costs is nonetheless legal costs.

The figure shows that only just over 70 percent of the total cost associated with a claim is for the physical repair. There are a large number of other costs associated with the process of getting repairs done. The below illustrates the distribution of total costs across the types of cost incurred, including repairs, transaction costs and the cost to government of running the WHRS.

Figure 19: Economic cost by type of cost 1992 – 2020

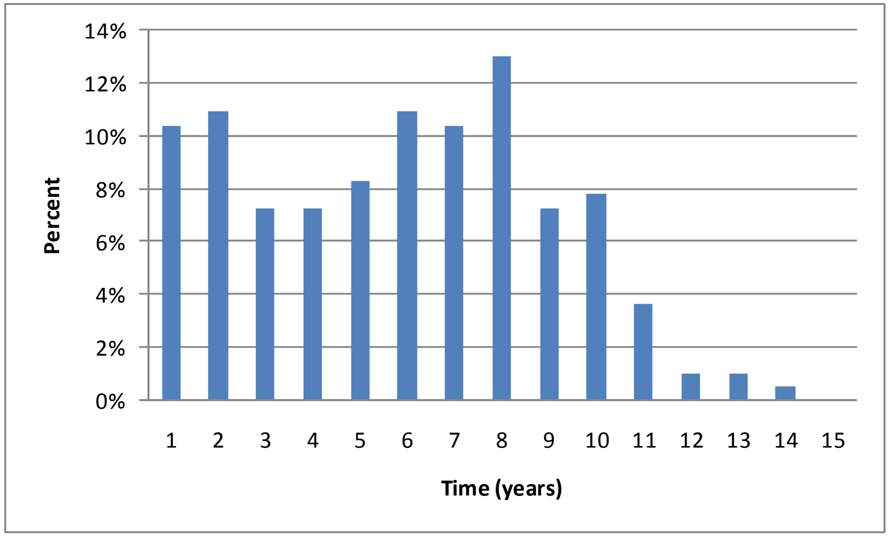


Source: PwC model.

Timing of Failures

Understanding the timing of failures gives an important insight to understanding the nature of failures. WHRS performed a survey of claimants (including rejected and withdrawn claims), to assess the time between building construction and a failure becoming evident. The results are illustrated in the figure below.

Figure 20: Time between build/renovation and evidence of failure



Source: Weathertight Claimant and Respondent Survey 2009

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Expert opinion

Discussions with building experts raised the following issues around the emergence and recognition of weathertightness problems.

- Climate may play a part in the timing of emergence. In drier areas of the country (Canterbury, Central Otago, Hawkes Bay), failures will occur, but are likely to take much longer to manifest.
- Denial of the existence or potential for problems by home-owners leads to postponement of remedial action.

Key conclusions from adding an examination of WHRS claims history to the expert opinion are described briefly below.

- Claims and other cases are very heavily weighted towards the more extensive end of the spectrum (although this provides no indication as to the wider prevalence of smaller failures).
- This is reflected in the relatively high average cost of repair.
- Finally, the large majority of failures in the claims are those that have emerged within the 10-year period.

Key cautions to note in relation to these conclusions are that:

- climate may affect the rate of failure and drier areas of the country may well be showing delayed failures, rather than overall lower rates of failure; and
- it is entirely possible that large numbers of small failures have not been notified to the WHRS. Expert opinion, however, suggests that these small failures have the potential to become severe problems.

6 Estimating the Nature, Timing and Costs of Future Failures

This chapter considers the nature and timing of the failures described in the previous chapter and describes how the study has applied the various sources of data to estimate the costs associated with future weathertightness failure.

Nature of failures

The nature of future failures, and the extent to which these mirror the current pattern of failures, is the key driver of overall costs. Current WHRS claims are heavily weighted towards failures of greater magnitude, as well as being heavily weighted towards monolithic cladding types.

As previously noted, the weighting towards larger failures could result from:

- simple self-selection (i.e. most claimants have only claimed because of the apparent magnitude of their problems, while those with small failures have not bothered with a potentially expensive claims process); or
- recognition of the failure (smaller failures or potential failures are not noticed or are ignored).

Projections based on WHRS failure rates

In the case of projecting forward failures based on existing WHRS experience, it would seem sensible to assume that the same distribution of failure rates persists.

Projections based on monolithic cladding failure rates

The consensus of expert opinion, as previously noted, was that the vast majority of monolithic-clad dwellings would fail within the 15-year period. The consensus was also that the nature of those failures would remain heavily weighted towards the more extensive failures. This view resulted from a number of factors summarised below.

- The disposition of the industry is to stay away from remediation work (because of reputational risk if the remediation fails). If remediation work is undertaken, then risk-averse solutions tend to be adopted.
- WHRS assessor estimates of repair cost are increasing significantly year on year. This includes the effect of the new provision for likely future damage as described in the 2006 WHRS Act.
- Industry experts reported an increasing number of dwellings have had targeted repairs and now require a more radical fix. These original targeted repairs were insufficient to repair the systemic weathertightness problem.

Treatment of the Pre-1994 and Post-2005 Periods

The quantum and nature of failures appears to have been substantially lower at the beginning and end of the period covered by this project. The consensus expert opinion was, therefore, that the damage to dwellings constructed in prior to 1994 and post 2005 would tend, when they did fail, to be less heavily weighted towards the full re-clad end of the spectrum.

Intuitively, this is sensible, given the changes to building design, including the use of cavities and treated timber. These design changes, if constructured according to building plans, mean that dwellings are fundamentally more resistant to damage when water does penetrate the cladding.

Conclusions

The nature of failures is likely to continue to reflect experience to date, for the period 1995-2005, but the damage from failures is likely to be much lower for dwellings constructed after 2005. Risk rateings used in the analysis are shown broken down by three periods in the Figure 21.

Figure 21: Estimated failure rates by cladding type, by period

		Cladding	
Year	**Risk rating**	**Monolithic**	**Non-monolithic**
1992 – 1994	Low	7.0%	0.2%
	Medium	25.0%	0.8%
	High	80.0%	2.0%
1995 – 2005	Low	7.0%	0.2%
	Medium	25.0%	0.8%
	High	80.0%	2.0%
2006 – 2008	Low	0.2%	0.2%
	Medium	0.2%	0.2%
	High	0.2%	0.2%

Source: Estimates of failure rates based on analysis of available data and agreed by Government Official Working Group, June 2009.

It is worth noting that the potential costs of weathertightness issues are most sensitive to the assumptions made around the nature of failures, rather than the number of failures. Relatively small changes in the weightings between the “full reclad” and “maintenance” categories can result in very large changes to absolute dollar amounts.

Repair and Transaction Costs

Repair and transaction costs are based on data from:

- WHRS claims and tribunal decisions;
- North Island Territorial Authorities;
- Crockers property group (multi-unit dwellings only); and
- HOBANZ.

Key cautions to note in relation to this data set include:

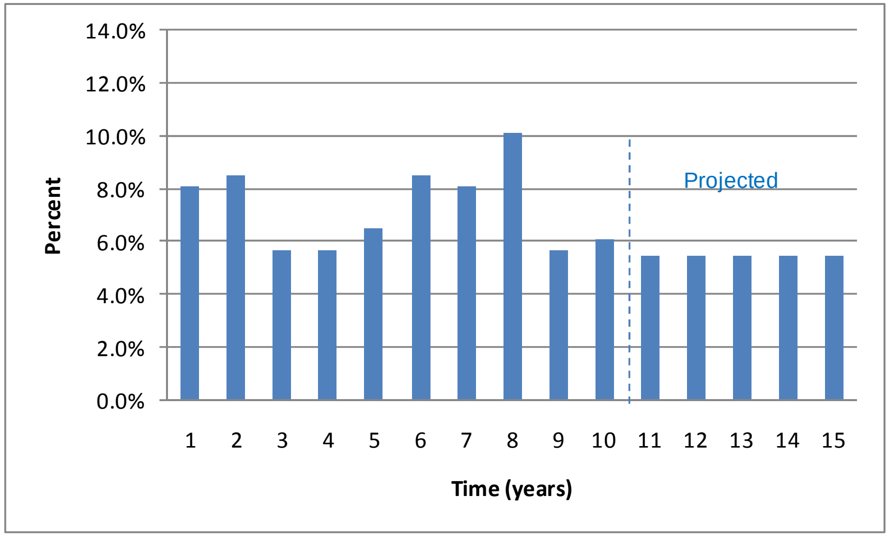
- the estimated parameters include the cost to all parties;
- there are no costs to reflect the opportunity cost of time invested by owners; and
- estimates are conservative, particularly as regards interest on the capital required for remediation.

Timing of failures

The timing of failures is important in this analysis in terms of understanding the proportion of failures that occur after the end of the WHRS current 10-year eligibility cap for making a claim.

Based on data from WHRS and a survey of those named on WHRS claims, the distribution of failures was derived. The estimated timing of failures is illustrated in the graph below.

Figure 22: Timing of failures (years after construction)



Source: This graph represents the timings of failure used in the model to estimate the cost of weathertightness issues.

The distribution in figure above determines when unrecognised failures will occur in the economic modelling.

7 Distribution of Liability for Costs

This chapter looks at the legal liability that has been apportioned in historical weathertightness claims and considers how that liability translates into costs for those involved with current and future claims.

The consensus of the experts interviewed as part of this research indicated that a typical adjudication might find the following legal responsibility for weathertightness issues:

- building parties: 60%;
- designer/architect: 10% – 20%; and
- building consent authority: 20% - 30%.

In practice, however, it is common to find that parties to weathertightness claims cannot be found or are financially unable to contribute to the resolution (not least through a large number of builders and property developers having been liquidated in the intervening period).

As a result, those parties with greater financial continuity, such as TAs carry a greater portion of the cost. As the cost of repair and the number of eligible dwellings increases, the capacity of third parties to pay decreases.

Figure 23: Council (local government TA) liability by repair type

Repair type	Value Range ($)	Council (TA) liability
Maintenance	0 – 50,000	40%
Targeted Repair	50,001 – 150,000	50%
Full (reclad)	150,001+	65%

Source: North Island Territorial Authorities.

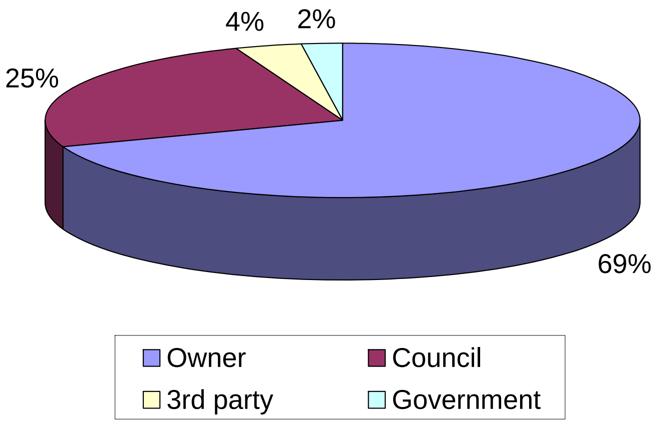
The figure above shows that the councils assume the greatest burden when cases go through the legal system.

Please note, however, that the council liability only applies to a small subset of dwellings that fail. This is because the number of failures that are recognised beyond the 10 year statutory limit, and those failures that go unrecognised, far outweigh the number resolved through the formal resolution mechanisms.

In these cases, the owner will assume the full financial liability for the failure. In mediations the owners share is also high because they will also have to absorb their own transaction costs.

The total share of cost incurred, when all types of resolution (including unresolved) are considered, is shown in the figure below.

Figure 24: Estimated distribution of weathertightness costs, by party (%, 1992 – 2020)



Source: PwC modelling estimate based on assumptions confirmed by expert opinion.

Key cautions to note in relation to settlement information:

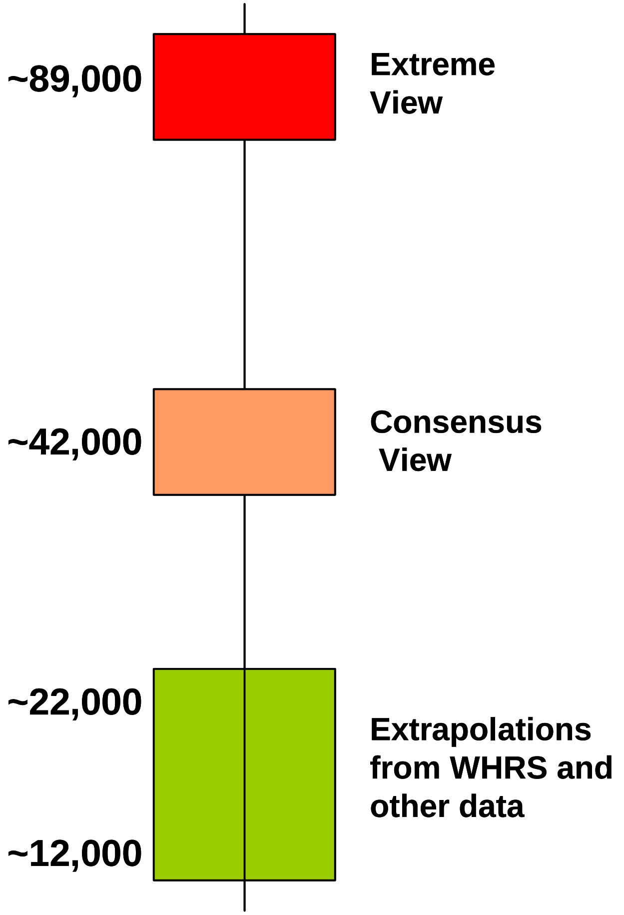
- examples are scarce and that data which is available represents only a small subset of all cases;
- legal adjudications in the courts or the WHRS tribunal do not accurately indicate the actual resolution or recovery of money, once ability to pay is taken into account;
- it is difficult to separate the data into its component parts; and
- any award or settlement does not fully consider the adequacy of the settlement to actually complete the repair work (i.e. the settlement might prove to not fully cover the actual repair expenditure).

8 Estimates of the Costs of the Weathertightness Issue

This chapter summarises the results of the analysis, combining the projections of failure rates, costs and distribution of liability.

The approaches taken to calculating failure rates fall into a range of scenarios, illustrated in the figure below.

Figure 25: Summary of Views of Potential Failures



Applying knowledge about the likely nature of failure and the consequential repair and transaction costs, the overall cost of the weathertightness problem can be derived.

This is illustrated for the different estimation techniques in the Figure 26 below.

Figure 26: Estimates of total weathertightness costs (2008 $m)

2008 $ million	Single Units	Multi-Units	Total (not including government costs
Extreme View	19,984	2,909	22,893
Consensus forecast	9,639	1,402	11,284
WHRS Extrapolation	5,173	753	5,925

Source: PwC modelled calculations based on agreed assumptions.

On the basis of the consensus forecast, that the total estimated costs are calibrated at $11.3 billion.

Figure 27 summarises the likely distribution of these costs, under current policy settings.

Figure 27: Estimate of weathertightness costs in $millions incurred by party by liability period 1992 – 2020 (with comparison of two legal liability periods)

	Legal liability period					
	(A) 10 year ($m)		(B) 15 year ($m)		Additional cost/ savings B – A ($m)	
Owner	$	7,833	$	6,631	-$	1,201
Council	$	2,817	$	3,868	$	1,051
3rd party	$	402	$	552	$	150
Government	$	243	$	340	$	97
Total	$	11,284	$	11,391	$	97

Source: PwC model of the consensus forecast of weathertightness economic costs.

Cost already incurred to date

The calculation methods have all produced results that are based, to greater or lesser extent, on views as to:

- the aggregate failure rate over time; and
- the risk factors that are evident in the 1992 – 2008 building stock.

The distribution of these failures in time and, hence, the proportion of the costs that have already been or are being incurred, remains highly uncertain.

Note that given the changes in the definition of council liability there is a shift in liability resulting on lower costs to home owners if the liability period is 15 years instead of 10 years.

Anecdotal evidence from expert sources, suggests that a large number of the less severe failures (particularly outside of the major urban areas) are being resolved independently (and un-recorded in any official statistics) between builders and home-owners. Similarly, expert opinion suggests that rates of failure in drier regions, hitherto much lower than the urban and wet areas, are now rising – and that the failures will be equally substantial as elsewhere, but just delayed by comparison.

It can be said with certainty that the WHRS claims are “in train”, and also information from members of the DBH Expert Group suggest that claims to be litigated through other sources are also in progress. What is almost impossible to determine from the information available at this stage is the extent to which:

- smaller problems have emerged, been identified and resolved without recourse to WHRS or the courts;
- the number of failures that are known by owners, but are not being remedied at all (whether through denial, financial constraints, or for some other reason);
- small failures that are unrecognised or indeed recognised might metamorphose into major failures through not being addressed early enough; or
- failures that are likely to occur, but have simply not yet manifested.

Intuitively, a line of reasoning is that the more serious failures would only be going un-addressed through:

- inability to address them (presumably principally due to financial constraints; or
- severe denial on the part of home owners (this might appear to be the case particularly with multi-unit dwellings, where it is known that some owners have, for their own often undisclosed reasons, refused to allow the building to be put into the WHRS claims process).

On this basis, one would expect that severe failures that had already occurred would be more likely to be known about or are being addressed by owners. As they do not appear to be (at least not via the courts or WHRS), it follows that the majority of the costs included in the total estimated costs of $11.3 billion have yet to be incurred.

Conclusion – the estimated cost of weathertightness

This chapter shows the size and division of weathertightness costs projected in this study. It indicates that under the current eligibility policy the owner will carry 69 percent ($7.8 billion) of the economic cost of the failure derived based on the consensus forecast. In the same scenario councils carry 25 percent ($2.8 billion).

Appendix A Glossary

Acceptable Solution	Prescriptive method for complying with performance requirements of the Code, not mandatory, one means of compliance, not the only means.
Alternative Solution	Method for complying with performance requirements of the Code that is not an "acceptable solution.
Approved document	Document issued by the Building Industry Authority under the Building Act 1991 that contains, among other things, acceptable solutions.
B2	Clause of Building Code that sets out performance requirements for durability of building work and building components.
BIA	Building Industry Authority.
Compliance document	Document issued by the Chief Executive of the Department of Building and Housing under the Building Act 2004 that contains, among other things, acceptable solutions.
DBH/Department	Department of Building and Housing.
Dwellinghouses	Definition from the Weathertight Homes Resolution Services Act 2006 "dwellinghouse (a) means a building, or unit within a building, that is intended to have as its principal use occupation as a private residence; and (b) in the case of a dwellinghouse that is building, includes a gate, garage, shed, or other structure that is an integral part of the building' and (c) in the case of a dwellinghouse that is an apartment or flat, or unit within a building, includes a door, gate, garage, shed, or other structure that – (i) is an integral part of the building; and (ii) is intended for the exclusive use of an owner or occupiers of the dwellinghouse; but (d) does not include a hospital, hostel, hotel, motel, rest home, or other institution".
E2	Clause of Building Code that sets out performance requirements for protection from external moisture.
E2/AS1	Acceptable solution that provides among other things for all stucco cladding to be fixed over a cavity in order to comply with the Building Code and is regarded as a turning point for building standards that led to a greater degree of weathertightness in dwellings.

HOBANZ	Home Owners and Buyers Association of New Zealand.
Economic cost	The amount of money that would need to be spent in order to fully rectify weathertightness problems in all affected dwellings.
Leaky home/Leaky building	The WHRS Act states that: “leaky building means a dwellinghouse into which water has penetrated as a result of any aspect of the design, construction, or alteration of the dwellinghouse, or materials used in its construction or alteration.”
Metro	The larger urban territorial authorities.
NZS	New Zealand Standard
Private Certifier	For a period, homeowners could choose to have building consents approved by Private Certifiers instead of Territorial Authorities.
PwC	PricewaterhouseCoopers.
Reference period	1992 – 2008.
Single-unit dwelling	Generally a stand alone dwelling with one household unit in it.
TA	Territorial Authority is a local governing authority (a city or district council).
Unrecognised failure	Dwelling where there is weathertightness failure which has yet to be acknowledged. There are many logical reasons why this happens, including consumer lack of awareness, direct denial, desire to sell houses, unwillingness to face up to the consequences.
WHRS	Weathertight Homes Resolution Service.

Appendix B Methodology Overview

This chapter provides an overview of the approach and methodology used in the analysis.

Approach

The approach to estimating the extent of weathertightness failures on a national scale considers three factors that contribute to the incidence and cost of leaky buildings. These are risk, failure and impact.

Risk refers to the prevalence of design and construction features in the national dwelling stock that are known to contribute to weathertightness failures. These features and their impact are defined by the compliance document E2/AS1. E2/AS1 provides a methodology for categorising dwellings into groups based on their risk score.

Failure refers to how often risk features translate to failures. The key component applied to translate risk to failure is the type of cladding used. While failures in cladding have been evident, it is also a good proxy for other features of dwelling failure including design detail(s) and higher probability of construction by tradesmen who have limited experience with the building materials used.

Impact refers to the damage that a weathertightness failure will cause to the dwelling. By definition any "failure" will result in damage (if there is no damage there is no failure). Impact is a measure of the seriousness of this damage. Three types of damage are considered, categorized by their severity and hence the nature of the repair that is required: maintenance, targeted repair and full reclad.

Risk – Identifying the risk of potential failure

To estimate the number of dwellings at risk of failure, a profile of the residential dwelling stock was constructed. Statistics New Zealand collects information on all building consents issued by councils for values above $4,999, and this data was used as the overall estimate of new dwellings built during the reference period specified by DBH. This data provided an estimate of single and multi-unit dwellings where each unit in a multi-unit complex was counted once. In total there were 400,951 dwellings of which 321,175 (80.1 percent) were single-unit dwellings and 79,996 (19.9 percent) were multi-unit dwellings.

In order to obtain greater granularity in the data, council building officials from ten Territorial Authorities (TAs) agreed to sample their building consents. They provided sample data for new residential dwellings from the reference period, 1992 to 2005, to produce a risk profile of new dwellings based on the E2/AS1.

Eight councils (Auckland City, Christchurch City, Manukau City, Rodney District, North Shore City, Tauranga City , Waitakere City and Wellington City) were used to represent themselves and those TAs with similar attributes[4] (referred to as core metro councils).

The eight councils account for 56 percent (224,120) of total consented dwellings (400,951). The size of the sample data collected to represent this population was 2,596.

[4] This includes Franklin, Papakura, Hutt City and Queenstown

Sample data from two additional councils, Upper Hutt City and Dunedin City were used to represent the remaining TAs, which include a considerable proportion of rural as well as urban dwellings. This data was taken as representative of the remaining 44 percent of new dwellings. The size of this sample was 190. Upper Hutt and Dunedin were selected to represent the remaining councils because WHRS data indicated that they had median failure rates of those not already sampled and were representative of the average TA.

Each TA produced a sample of consents. The accompanying plans for each consent in the sample were assessed against the E2/AS1 risk matrix.[5] The matrix identifies risk features and assigns a risk score, from a low of zero to a high of 13+, based on the presence of these features.

The risk scores are applied to estimate the number of dwellings in each aggregated risk rating. The following figure sets out the estimated number of dwelling units in the low, medium and high categories.

Figure 28: Table of risk ratings and risk scores of estimated dwellings

Risk Rating	Risk Score	Estimated units
Low	0 - 6	235,258
Medium	7 - 12	110,880
High	13+	54,813
	Total	400,951

Source: Total new dwelling units built 1992-2008, based on national extrapolation of data collected by TA's.

The risk features in E2/AS1 relate primarily to design features. Recent experience shows, however, that a monolithic cladding is also a good predictor of failure (see chapter 4). This is in part because monolithic cladding is typically used in houses with designs that also have risky design features. In this respect, it is a good proxy for predicting failure despite not being included as a risk feature in the E2/AS1.

On this basis, cladding information was also collected as part of the TA sample. This meant thatfor each dwelling the cladding and risk rating was known. The sample was then used to build a national profile of dwellings by cladding type and risk rating.

A limitation of this approach was that the sample size resulted in insufficient observations could be from Upper Hutt and Dunedin about the range of dwelling types. The sample design was sufficient to estimate the risk profile overall but not to estimate the number of dwellings with each combination of risk profile and cladding type. For this reason, the samples were combined when making the risk profile calculations for cladding types.

[5] Department of Building and housing, *External moisture – a guide to using the risk matrix*, Wellington New Zealand (2005).

Failure – Translating potential risk to failure

This chapter describes how the risk features described in the chapter above translate into incidences of failure.

Two key factors of risk were considered in estimating the number of failures:

(1) the rating of risk according to the E2/AS1 Risk Matrix; and

(2) the cladding type.

In order to relate the risk profile of the 1992 – 2008 sample to the stock of new dwellings, it was necessary to apply expert opinion to predict failure rates for high risk dwellings. In order to predict failures in low and medium risk dwellings it was further necessary to identify a sample of 857 WHRS claims and group them into risk categories using the same method that was used to assess risk according to E2/AS1 in the TA consent records. From the sample it was possible to derive the cladding type and risk profile of all evidenced failures to date. This made it possible to find the ratio of failures in high risk dwellings to the failures in low and medium risk dwellings. This ratio was the same for monolithic and non-monolithic clad houses. Then, based on an analysis of the WHRS claims database, the number of failures for medium and low risk buildings was derived using the ratios found earlier.

Analysis of the WHRS database and high cost claims shows that dwellings with particular monolithic cladding systems fail more often and often fail in ways that create serious consequences for the owner. The cladding systems both fail to prevent water ingress and fail to allow water egress because of the way they were applied. There are some designs where the cladding and polystyrene foam insulation were attached directly against the wooden frame. In other cases, the insulation absorbed water, which sometimes leads to the wooden frame being permanently damp.

Experts and stakeholders were interviewed and participated in workshops to consider the failure rates of particular cladding types. The range of estimates provided by experts were considered and applied where appropriate to the population of high risk dwellings.

It was also communicated during the project that there was a historical background rate of failure some of which relates to weathertightness failure that existed before 1992 and would exist after 2008. On average, failures will occur due to adverse circumstances or poor workmanship and a failure rate reflected this was applied to dwellings built from 2006 – 2008. The failure rate appears to be significantly lower in this period because of changes made in the Building Act 2004. This Act was introduced from the middle of 2005 and impacted on dwellings completed in 2006 onwards.

Impact – Assessing the damage of a weathertightness failure

To assess the impact of particular failures, the methodology assumes three classes of repair for dwellings as maintenance, targeted repair and full repair. These are described below.

These groupings are applied to be able to determine the extent of work required. The intention of these is to apply them for estimating the costs of remediation of leaky homes.

Maintenance – These repairs are small in nature and are similar in nature to the routine maintenance an owner might perform. In many cases these repairs may not have consent. These might include something as simple as repairing a joint, or sealing an identified point of water egress, or something as complex as the replacement of a window or repainting of a cladding. This covers work with an observed value between $0 – $50,000 with an average of $20,000. Many of the early claims under the WHRS were for this type of repair.

Targeted repair – For the purpose of this research, targeted repairs have been regarded as significant intrusions akin to a partial re-clad or significant reconstruction work. It may be as severe as re-cladding one elevation of the house. This covers work with an observed value between $50,001 – $150,000 with an average of $100,000.

Full repair – This is generally a full re-cladding of the exterior including demolition and repair of any internal walls that are affected. It can also include complete demolition and rebuild of the dwelling in extreme cases. When internal walls become involved expense can increase significantly. If an internal wall is affected, then typically the whole room will need to be repainted. If a bathroom or kitchen is affected then it may require retiling, adding significant cost to the work. This covers work with an observed cost of repair in excess of $150,001 and has an average cost of $300,000.

The same categories have been derived for multi-unit dwellings including similar work but covering a different range of costs.

By combining cost data from WHRS and other participating organisations with the qualitative opinion provided in workshops and interviews, PwC derived an estimate of the share of failures that would fall into each of the three categories and of the associated costs of each these types of failures.

Expert opinion

There are gaps in key data series about the attributes of dwellings and their constructions. These gaps include information about the nature of the failures, including causal explanation of the impact of dwelling design and building capability, assessment of the extent of the failures have been recognised, and judgement about what constitutes “normal” failure as opposed to “systematic” weathertightness failure.

In addition, the firm data that exists about weathertightness is based on those dwellings that have addressed these issues within the 10 year legal liability period.

For the period studied, 1992 – 2008, there are houses that were outside the legal liability period and there are houses still within it that are likely to pursue claims or undertake private remediation.

Qualitative data collection is a vital aspect of this study as it is required to answer key questions and fill data gaps. Expert opinion serves as an additional layer of data to be laid upon the numerical calculations, filling in gaps where hard data sources are not available or are inappropriate. This was particularly true when estimating the number of realised and unrealised failures.

The qualitative information has been collected using a combination of workshops and personal interviews with a range of parties of stakeholders and industry professionals.

The interviews and workshops were run differently, but both focused on the experience of the individual. Participants were asked to make quantitative estimates to augment the experiences they described during the consultation. In later interviews, the estimates of previous interviews could be tested and refined. During the workshops there was the opportunity to further test quantitative data and provisional estimates.

Ultimately the range of opinions collected in the consultation was laid side by side with hard data sources and an estimate for each parameter was made.

A list of those consulted is contained in Appendix H. Those enlisted were open and responsive to providing detailed data, information and knowledge as requested. It is important to note that the analysis in the report is a synthesis of the detailed data, information and knowledge. None of the individuals involved can be held accountable for the conclusions in this study.

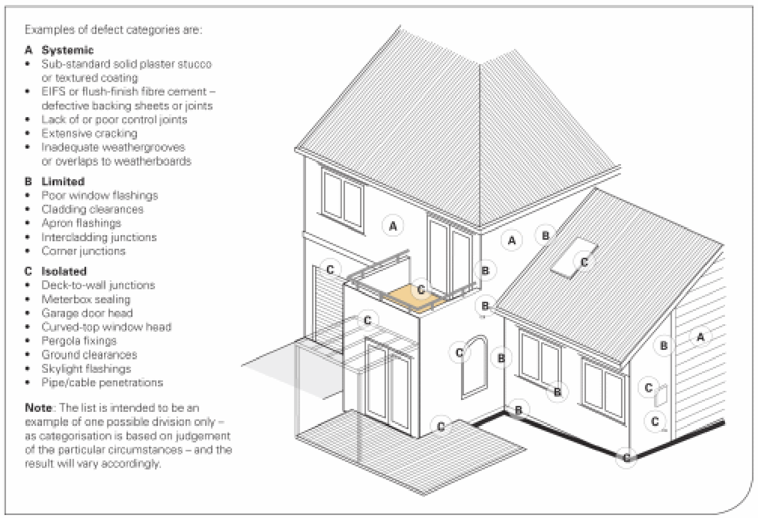
Appendix C Risk of Failure

This chapter describes the approach used to identify and assess the probability of the risk of weathertightness failures.

Risk refers to the prevalence of design and construction features in the national dwellings that are known to contribute to weathertightness failures. These features and their impact is defined by the compliance document known as E2/AS1. E2/AS1 provides a methodology for identifying design features where there is potential risk and for categorizing dwellings into groups based on these risk features.

To calculate risk, the research has assessed the size of the New Zealand building stock on aggregate and then applied the results of a sample of building consents collected by Territorial Authorities. This sample describes, among other things, how many buildings fit into each risk rating as defined by E2/AS1.

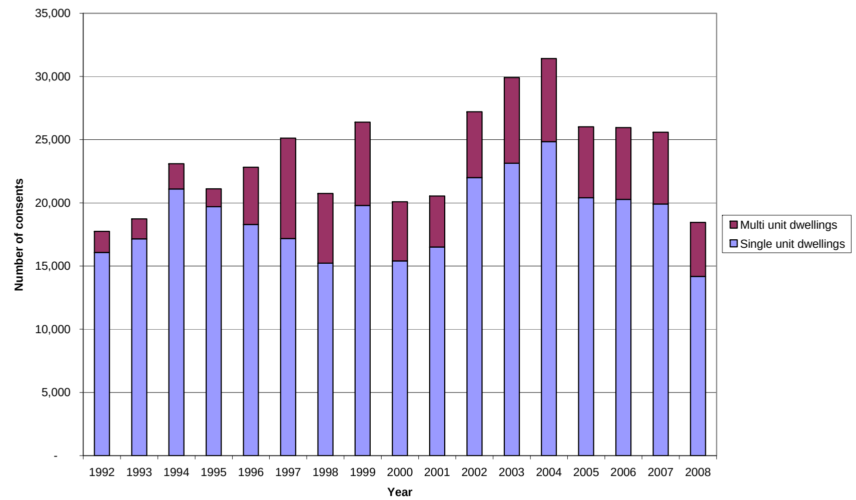
Figure 29: Examples of weathertightness issues and defects



New Zealand's building stock between 1992 and 2008

New Zealand's building stock has been estimated using data from Statistics New Zealand. Statistics New Zealand collects data on all building consents issued by councils for values above $4,999. Consents for 400,951 new individual residential dwellings were issued over the reference period of 1992 – 2008. The following graph shows the number of individual dwelling units by the year in which consents were issued.

Figure 30: Number of individual dwellings with approved consents by year of approval and type of dwelling (1992 – 2008)



Source: Compiled based on building consent data from Statistics New Zealand.

Figure 32 shows the number of individual dwellings that have received building consents based on whether the dwelling is a single-unit dwelling (a stand alone home) or part of a multi-unit. Multi-unit complexes include apartment blocks or a set of conjoined town houses. Each apartment in an apartment block or townhouse in a conjoined set is counted separately in an individual dwelling house.

The number of individual dwelling consents sets the backdrop for estimating the number of dwellings that are at risk of experiencing weathertightness problems.

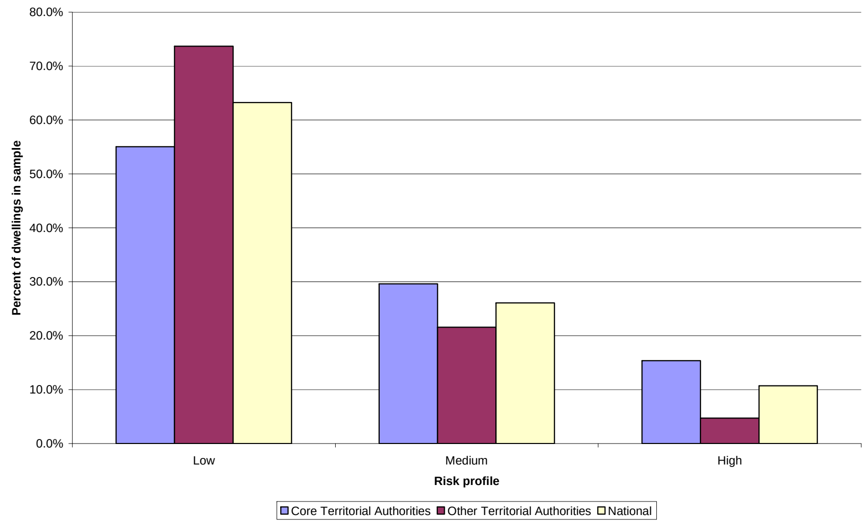
Recent, largely qualitative information, suggests that changes to the regulatory environment made in 2004 have significantly reduced the number and impact of weathertightness failures from 2006 on. 271,318 individual dwellings were built through the period of highest risk, 1995 – 2005.

Risk profile as determined by Territorial Authority sample

The risk profile of New Zealand's building stock is the aggregation of individual risk ratings as described in Appendix B and provides useful context for the discussion of the risk associated with cladding failures. The risk rating is a simple tool recognised by the building industry as providing guidance on the exposure to failure caused by design features.

As noted earlier, two samples of risk ratings were taken, one representing the core metro areas (56 percent) and one representing dwellings as reflected by consents authorised by the other TAs (44 percent). These samples showed significantly different results for single-unit dwellings. These are illustrated in the figure below.

Figure 31: New Zealand single-unit dwelling risk profile (average 1992 – 2008)



Source: Based on a sample of consents 1992 – 2008 sourced from Territorial Authorities.

The Upper Hutt and Dunedin sample representing the smaller TAs had too few multi-units to be representative of multi-units for those other parts of the country outside the eight other councils included in the sample. Because of this, all multi-unit dwelling samples were combined to represent the national average. A group that included local authorities, building sector representatives and DBH staff (referred to as the Quantitative Estimate Group) reported that the majority of multi-unit dwellings are in these core metro councils and so the risk profile for them is representative of national trends. Figure 34 on the following page sets out the risk profile for dwellings built between 1992 and 2008 based on the TA samples of building consents.

Figure 32: New Zealand dwelling risk profile (average 1992 – 2008)

	Risk Rating		
Sample	Low	Medium	High
Single Unit Core	55%	30%	15%
Single Unit Other	77%	19%	4%
Single Unit Total	63%	26%	11%
Multi Unit Total	35%	27%	38%

Source: Based upon a review of a sample of building consents by Territorial Authorities.

It is important to clarify that the sample of multi-unit dwellings represents assessments of distinct buildings. It is not weighted by the number of individual dwellings each building contains. Only a national estimate was possible. This distribution of risk scores is next applied to data that is broken down by multi-unit dwelling units.

Another feature of the data is that the TA exercise sampled dwellings and recorded the risk score against the time of issuing the developing building consent, not the time of build.

For the purposes of this analysis, it is assumed that the vast majority of consents will result in a dwelling completion within one year. Based on this assumption, the year of consent and the year of build are regarded as the same for the purpose of this analysis and reporting the results by this period.[6]

A review of the sample data compiled indicates that there are three significant factors contributing to the differences in risk profile, between the large urban centres (core TAs) and the rest of the country.

These are related to the style of the dwelling, the complexity of design and the quality of workmanship:

- typically the single-unit dwellings built within the jurisdiction of the core councils are larger and more complex with multi-story homes, including decks, flat roofs and a lack of eaves being more frequent in metro areas;
- style and fashion over the reference period resulted in a greater use of monolithic claddings and particular higher risk design features in the metro areas.
- it has been reported that the level of skill and supervision for some large developments in the larger metro areas may have been lower than elsewhere, particularly for multi-unit builds where large numbers of labour-only builders were contracted.

There are some notable exceptions to the average national trends. Christchurch, which is part of the core sample, had a higher proportion of brick veneer homes than others in the need to sample group. Experts noted that the brick veneer designs are closer to the more conservative design trend common for traditional South Island dwellings. Many Queenstown, Wanaka and other southern lakes dwellings built between 1992 and 2008, on the other hand, are similar to the large metro areas with many sizeable and complex single-unit homes built with monolithic cladding.

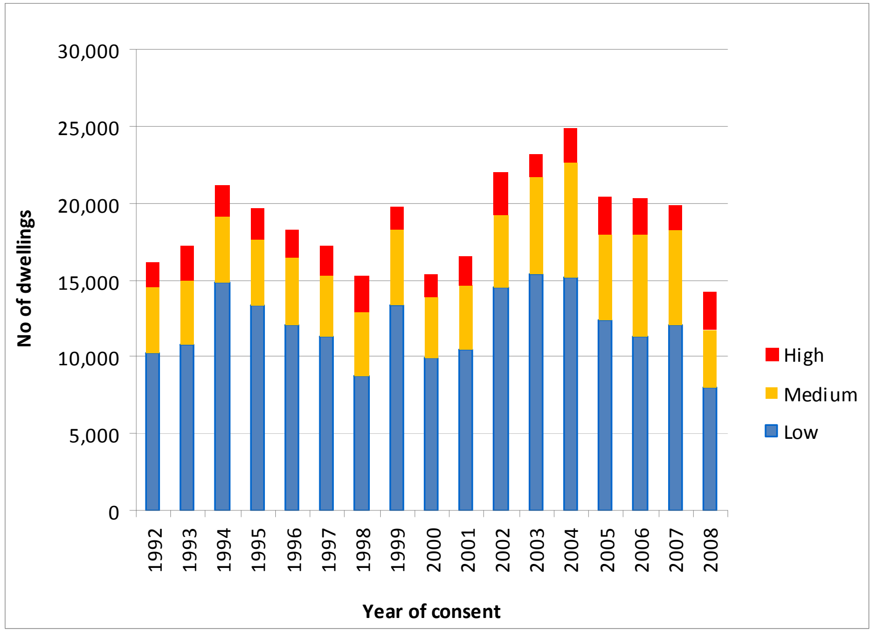
Experts indicated that building practices in the larger metro areas are also different from the rest of the country and likely to have contributed to the higher rate of failure (around 95 percent of eligible WHRS claims so far come from these areas).

[6] At the boundaries of time periods it is important to recognise that a proportion of houses will take longer than a year to build. In addition, as the building consents relate to a full calendar year, then a year of consent will differ from the year of build even when the dwelling is built in less than a year.

A large proportion of dwellings in the large metro areas, particularly multi-unit dwellings which are more infrequent in more rural parts of New Zealand, were built by labour-only contractors. It was reported that the overall skill level of the labour on these building sites is likely to have been lower. The key difference between the larger metro areas and other areas is the volume of building.

The figure that follows shows the risk profile of single-unit dwellings. Changes to the Building Act have had no evident impact on the risk profile of single-unit dwellings since 2004, according to the sample data. Since 2004, dwellings in the high risk rating have made up an average of 12 percent of dwellings as opposed to 10 percent from 1992 - 2004.

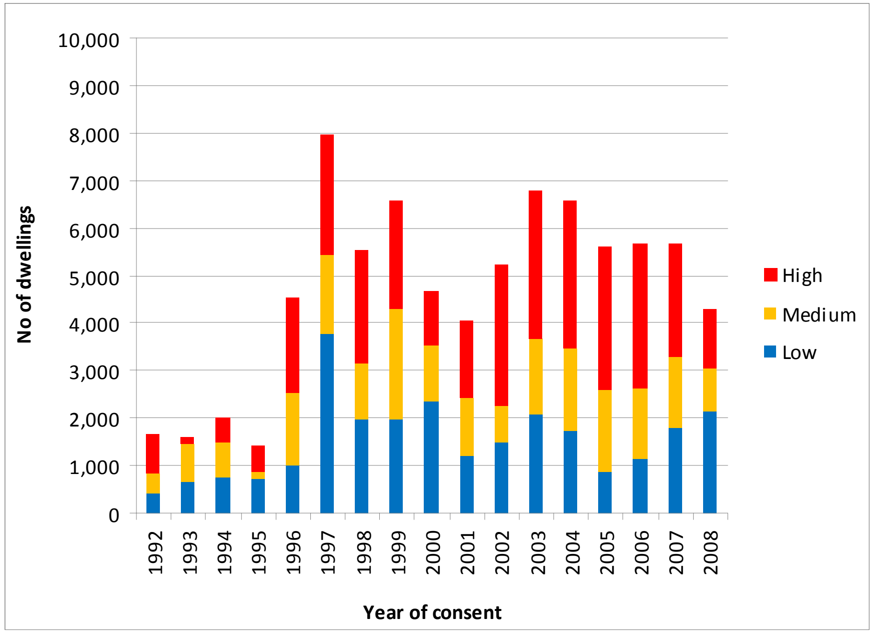
Figure 33: Single-unit number of dwellings by risk rating, based on the Territorial Authority building consent data 1992 – 2008



Source: Extrapolation based on TA sample of building consent data using E2/AS1.

Multi-unit dwellings where each unit in a multi-unit dwelling is counted separately showed a much higher risk profile, where 44 percent of multi-unit dwellings were high risk post-2004 and 41 percent in the dwellings built between 1996 and 2004. This is illustrated by the following figure that extrapolates from the sample building consent data collected by ten metro TAs.

Figure 34: Multi-unit number of dwellings by risk rating, as analysed by the Territorial Authority data 1992 – 2008



Source: Extrapolation based on TA sample building consent data using E2/AS1.

The risk rating is limited in that it only describes the risk associated with dwellings but is used as a proxy for the likelihood of sustaining a damage-causing leak. The risk score says nothing of how well equipped the dwelling is to deal with those leaks. Experts will point out that every dwelling leaks at some point, but that features such as cavities mitigate against the damage of a leak.

Despite an increase in the proportion of high risk dwellings since 2004 it is recognised that changes in building practices prevent the penetration of water to the interior. On this basis, a higher aggregate risk profile prior to 2005 does not equate to the same rate of failure after that date.

Data presented later in this paper will also indicate that the aggregate risk score is in fact decreasing over time despite the number of high risk dwellings increasing.

The risk rating is a well understood tool for assessing the risk of failure, but it is more useful as a tool for prediction when combined with information about cladding type.

Differences between consents and actual build

It is relevant to acknowledge that the risk profiling tool relies on the accuracy of building consent information. It has been reported by several parties, including TAs, that the design of the actual build may be different to the design details listed on the consent, in some cases significantly different.

This has been recognised as a weakness in the method and there was insufficient time for the extent and implications of this deficiency to be robustly tested. It is, however, thought that the cladding system is unlikely to change completely during build in the vast majority of cases.

Given that cladding type is the key factor used to predict the failure rates, the impact of any discrepancy is largely captured by the application of the cladding data to the calculation of the potential failure rate (see Chapter 4). Hence, the adjustment to the results of this research from examining the design in consents with actual build is likely to be small relative to the invasion of privacy that testing this assumption would impose upon the public.

Appendix D Identifying Failures

This chapter describes the approach to identifying failures in greater detail, concluding with an estimate of the failure rates for single and multi-unit dwellings in New Zealand between 1992 and 2008.

Failure refers to how often risk features, as described in the previous chapter, translate to failures. The key component that has been applied to translating risk profile to failure is the type of cladding used. While the cladding itself provides a basis for determining the likelihood of failure, it is applied because the use of different claddings during the period of this study indicates that it is a good proxy for other features that determine failure, such as design, the experience of builders and the extent of supervision of the actual build.

Cladding and failure

The TA sample provided a basis for examining the primary cladding of the dwellings, as well as providing a risk score. It is important to stress that the cladding is not the only factor that influences a failure. The risk score described by E2/AS1 refers to other design features. The Quantitative Estimate Group agreed, however, that cladding is a proxy for the features that contribute to the risk profile.

This is demonstrated in the figure that follows which shows that there is a higher than average percent of dwellings with monolithic cladding in the high risk rating. Based on the data tabulated in this way, it can be concluded that monolithic clad dwellings are at a greater risk of failure than those with other claddings.

To put this information in perspective, there were a number of experts who we interviewed who believe that there is an even greater percentage of monolithically clad dwellings built between 1992 and 2005 in the high risk rating. For the purposes of this analysis, a more conservative approach has been adopted, using the combination of the TA E2/AS1 and the cladding information to determine the probability of failure.

Figure 35: All New Zealand dwellings risk profile based on cladding type (average 1992 – 2008)

Monolithic cladding	Dwellings	Percent
Low risk rating	33,001	29%
Medium risk rating	42,862	38%
High risk rating	37,620	33%
Sub-Total	**113,483**	**100%**
Non monolithic cladding		
Low	174,372	61%
Medium	76,151	27%
High	36,945	13%
Sub-Total	**287,468**	**100%**

Source: PwC estimate based on Territorial Authority building consent sample using E2/AS1.

The data in the figure above has been compiled by combining building consent data with the sample of consents collected by Territorial authorities. To reiterate, even based on this conservative approach, the figure above shows that the risk profile differs significantly between dwellings with monolithic cladding and those without. Monolithic clad houses are, therefore, at a far greater risk of failure than those without it.

While this is not due solely to the cladding type itself, some failures *were*, however, due primarily to a defect in the cladding. More than 100,000 dwellings were built with monolithic cladding between 1992 and 2005. There is both legal and qualitative evidence that the cladding was rarely installed to specification and that generally the design lacked the necessary redundancies to deal with the cracks and splitting that often accompanies application of a monolithic cladding system.

Evidenced failures

A key source of data about the nature of weathertightness failure is that collected through the WHRS. The record of failures described by the WHRS provides a robust statement about evidenced failures. The available data includes mediations and WHRS Tribunal adjudications.

A small number of weathertightness cases have also been ruled on in the courts. There are lengthy delays in these processes, however, and as yet these private actions have not added significantly to the evidence-base. It is expected that more of these cases will be heard over the next several years based on the number that are already in progress or have a Court date. A challenge is that the courts have a large backlog of cases and in Auckland, for example, the earliest date that can be set is 2011.

Not surprisingly, remediation experts have reported that more cases are being solved through mediation. The challenge for this analysis is that the results of these cases are seldom made public.

This quality and quantity of failure data from the WHRS is constrained by the process it represents. Many potential claims have not been lodged or are not eligible because of the timing of the service. Dwellings built in 1992 (and less so in 1993) had a limited period of eligibility before reaching the 10 year statute of limitation set by the WHRS legislation.

In addition, the service did not begin until 2002 and so a lump of claims were lodged in that year, representing a backlog of failures from several years. This distorted the patterns around the timing of failure and the time then taken to lodge a claim, resolve the claim and carry out the remediation. This limits the application of the evidence to project future failures.

When the risk profiles of WHRS evidenced failures are assessed consistently with the risk profiles from the TA sample, it produces a conservative forecast of failures. The result of applying the peak failure rate described above suggests a failure rate of 3.75 percent (15,000 failures) over the period 1992 – 2008.

Applying the WHRS evidence using the same risk categories derived for the TAs from the E2/AS1 provides a different perspective on the relationship between risk profile and failure. In the WHRS cases, there was a much higher preponderance of dwellings in the high risk categories.

Figure 36: Percentage of failures by risk profile evidenced in WHRS claims from 1992 – 2008

	Risk Rating		
Proportion of dwellings	Low (Risk Score 1 – 6)	Medium (Risk Score 7 – 13)	High (Risk Score 13+)
All cladding types	7%	26%	67%
Monolithic cladding	7%	27%	66%
Other cladding	0%	28%	72%

Source: Evidence of risk profiles from the WHRS claims database applying E2/AS1 categories.

Eighty five percent of all eligible failures evidenced by the WHRS are for dwellings with monolithic cladding. Of those claims 66 percent were for buildings with a high risk score.

The WHRS evidence relating to the remaining dwellings, indicates that all of them were either medium or high risk buildings.

Evidence sampled from the WHRS, recorded by the table headed Figure 39 below shows that failures brought before the resolution service occurred in high risk dwellings nearly 10 times as often as they did in low risk buildings. They occurred approximately 2.5 times as often in dwellings in the high risk rating as they did in medium risk buildings.

Figure 37: Evidence from WHRS of the number of dwelling failures by risk rating

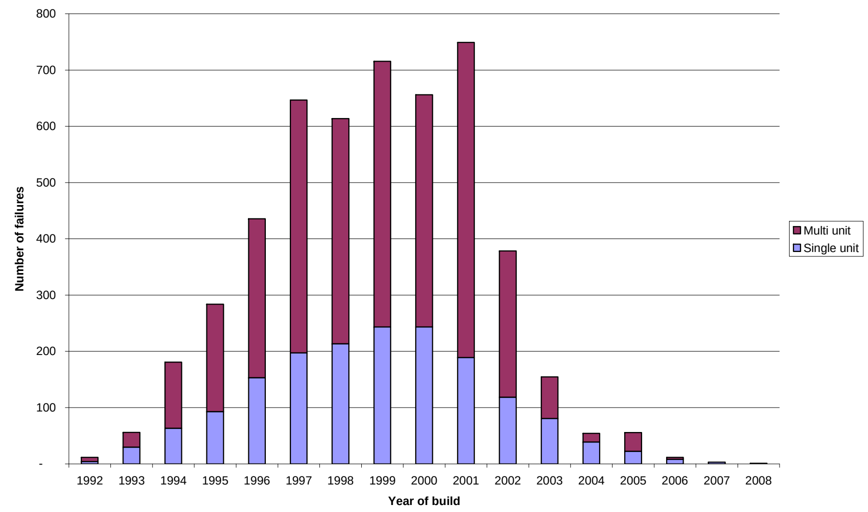
Risk Rating	Number of failed dwellings	Percentage of failures	Ratio to low risk profile
High (Risk Score 13+)	568	67%	9.5 times
Medium (Risk Score 7-13)	225	26%	3.8 times
Low (Risk Score 1- 6)	60	7%	1

Source: Risk profile of claims from the WHRS claims database.

Up to March 2009, the WHRS had processed 3,967 eligible claims with completed assessments covering 4,607 individual dwellings. One claim may represent more than one dwelling unit because of changes to the legislation permitting a single claim for a multi-unit complex.

The figure to the right graphs the 3,967 eligible claims by whether the claim relates to a single-unit dwelling or a multi-unit dwelling.

Figure 38: Number of eligible weathertightness claims lodged through WHRS by year of build and type of dwelling (1992 – 2008)



Source: Compiled based on WHRS Statistics.

The figure graphs the number of WHRS claims each year made based upon the year that the dwelling was built. It is possible to gain a perspective on several aspects of the remediation of weathertightness conditions from the above figure. First, the timing of the introduction of the WHRS has had an impact on the claims brought forward, as discussed above (with dwellings built in 1992 and 1993 having a very narrow window of opportunity to lodge a claim).

Secondly, it reflects the time frame relating to elapsed period of failure and when the failure is measured. For instance, dwellings built in 1992 are not necessarily less likely to fail (despite a low number of claims), but the timeframe available for people to make an eligible claim was short. Similarly, buildings constructed after 2005 have only existed for up to three years and may not yet have shown signs of failure.

Qualitative evidence suggests that a more likely scenario is that there are many dwellings within the 10 year statute of limitations that are yet to recognise that there may be a failure and to lodge a claim.

More claims for dwellings built in 2001 (749) have been lodged than for those built in any other year. Of the affected dwelling units built in 2001 that have lodged claims, 75 percent were from multi-unit dwellings.

It is too early to tell whether there were more dwelling failures in 2001 than in other years or whether this peak reflects a lag between recognising a failure and lodging a claim. Experts told us that there were a number of barriers that slowed recognition of failure in multi-units including the requirement that the body corporate acknowledge failure and agree to the claim being filed. There may be even greater barriers to recognition in single units as, for example, there are justified fears that recognition of failure will be reflected in the market value of the dwelling.

Use of WHRS data

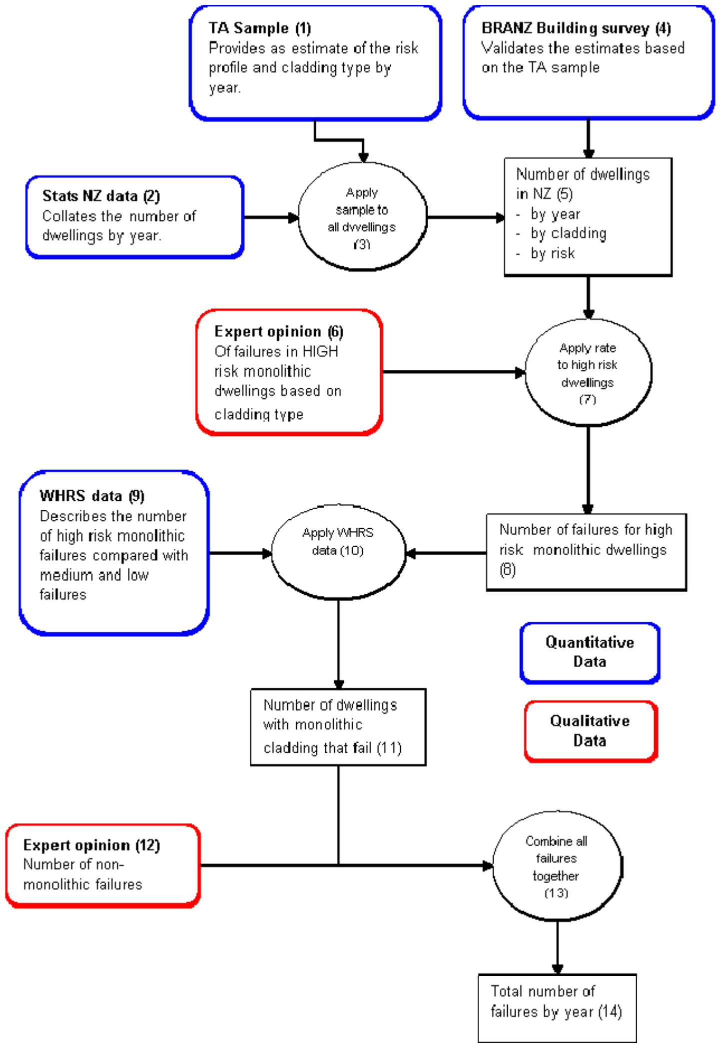
Two sets of data were used from the data collected by WHRS. The first is the full set of claims, the second is a sample of eligible claims for which cladding and risk profile information was extracted.

The data includes 4,364 claims covering 5,017 individual dwellings where each unit in a multi-unit complex is counted once. Of these claims there were 3,967 eligible claims for 4607 individual dwellings.

Of the 3,967 eligible claims, a sample of 857 were investigated further to assess the risk score according to E2/AS1 and the type of cladding and prevalence of risk features. This sample represented all of the most recent files that were available on site, and a sample of files (spread evenly across the other periods) from those records in the archives. This method minimised any potential bias but ensured the most recent records were all included.

Failures based on cladding type

Figure 39: Methodology used for the consensus forecast of failure rate



Steps to estimate the number of failures

(1) TA Sample: 10 Territorial Authorities sampled building consents to estimate the demographic of cladding type and risk profile (as defined by E2/AS1) of new residential dwelling units in their authorities.

(2) Statistics data: Statistics New Zealand collates new residential building consents and has routinely published the number issued in multi-unit dwellings by month and by year. This provides a basis for estimation of all new residential dwellings by year and the number of dwelling units contained.

(3) Apply sample to all dwellings: The results and ratios of risk profile and cladding type derived in the TA sample are applied to the total number of new single-unit and multi-unit dwellings.

(4) BRANZ building survey: BRANZ has conducted an annual survey of approximately 1,200 new residential dwellings which describes the primary cladding type of residential dwellings.

(5) Number of dwellings in NZ: The findings from applying the TA sample to the Statistics NZ data were compared with the BRANZ survey findings and adjustments were made where there were significant differences. An estimate of the number of individual dwellings that fit into each combination of cladding type, risk profile and year was then derived.

(6) Expert opinion – Experts provided their opinion on the failure rate of all cladding types. These were moderated by PwC.

(7) Apply rate to high risk dwellings: The failure rates provided by experts were applied to the population of high risk buildings for monolithic claddings.

(8) Number of failures for high risk monolithic dwellings: Applying the failure rates provided by experts resulted in an estimate of the total number of failures for high risk monolithic dwellings.

(9) WHRS data: DBH sampled eligible claims made through WHRS and found that for every fifteen failures, ten are from dwellings scored as high risk, four are from dwellings scored as medium risk and one is from dwellings scored as low risk.

(10) Apply WHRS data: The number of high risk failures was used as a basis to calculate the number of medium and low risk failures by applying the ratio found in the WHRS data.

(11) Number of dwellings with monolithic cladding that fails: An estimate of failures for all dwellings of monolithic failures.

(12) Expert opinion – Other cladding types: Experts provided their opinion on the failure rates of non-monolithic claddings.

(13) Combine all failure together: Failures for dwellings with all cladding types were combined.

(14) Total number of failures by year.

Consensus forecast of failure

Although the cladding system is not solely responsible for weathertightness failures, the monolithic cladding systems are over-represented in cases of acknowledged failure with 85 percent of WHRS claims involving houses with this type of cladding.

The presence of a monolithic cladding provides evidence of a design that is representative of houses with high risk factors.

Cladding, in combination with risk profile information, is also commonly used by industry players as a reference point for estimating failure rates for both of the above reasons.

For these reasons, it is logical to apply information about cladding when estimating the likely aggregate failure.

The Quantitative Estimate Group, which included members of the DBH Expert Group and DBH staff, agreed an estimate of the failure rates between 1992 and 2004 based on claddings. This can be seen in the figure below. These estimates were corroborated by assessors, industry professionals and other technical experts.

Figure 42 shows the failure rate parameters derived related to claddings. These are based on feedback from the expert workshop held in May 2009. The workshop derived the parameters for the period 1995 – 2004. The time period considered has been extended to 1992 – 2005 based on further expert advice since then.

It is noteworthy that some in the workshop and other experts expressed the view that the percentages below were on the low side and should be applied across a majority of all dwellings built with these claddings up to 2005.

Comparing the number of dwellings that would have high failure rates with the number of claims before the WHRS, this implies a very large population of dwellings with unrecognised failure.

For the purpose of calculating a consensus forecast in this study, the cladding failure rates are applied only to the dwellings in the high risk categories estimated from the TA sample building consent data.

Figure 40: Table of estimated weathertightness failure rates for high risk dwellings by type of cladding with year of build 1992 – 2005

Cladding Type	Failure Rate
Monolithic - EIFS polystyrene	80%
Monolithic - stucco	95%[7]
Monolithic - fibre cement (flush finished)	80%
Plywood, fibre cement (with battens)	80%
Weatherboards, all types	2%
Brick	2%
Metal	2%
Concrete, Blockwork	2%
Other	2%

Source: Failure rate estimates based on May 2009 workshop, including assessors and building research experts and, confirmed by other expert opinion.

Most of the professionals consulted will only see a part of the failure picture and will typically see cases at their worst. This limits how these estimates can be applied.

After careful consideration of all the available evidence, it was decided that these rates be applied to only the riskiest buildings (those in the high risk categories with 13 points of risk as defined by E2/AS1). An implication of this is that dwellings with a lower E2/AS1 risk profile would fail significantly less often.

[7] Experts estimated that the risk of failure for stucco dwellings was 100 percent. This was adjusted when deriving the consensus forecast to reflect a margin of error as it was thought unlikely that all homes with these characteristics would fail either within the 10 year statute of limitations or the 15 year durability requirement in the Building Code.

In order to apply the failure rate assessments in this way, the TA sample data was tabulated by cladding type including the risk rating assessment.

Estimates of the building materials used in New Zealand dwellings have been compiled as part of the BRANZ housing materials survey but only since 1998. These estimates were compared against the information on cladding collected as part of the risk profiling exercise described in the 'Risk Profile' section above. The comparison was faviourable and this study uses the TA sample estimates which are described in aggregate in the table below with a small adjustment built in to reflect BRANZ data.

Figure 41: Table of number of individual dwelling units built by cladding type 1992 – 2008

Cladding Type	Single-unit	Multi-unit
Monolithic - EIFS polystyrene	35,151	11,040
Monolithic - stucco	9,847	3,272
Monolithic - fibre cement (flush finished)	33,875	10,210
Plywood, fibre cement (with battens)	6,466	3,623
Sub total	**85,339**	**28,145**
Weatherboards, all types	62,739	12,960
Brick	149,358	24,509
Metal	4,316	4,273
Concrete, Blockwork	6,983	6,064
Other	3,327	1,695
Unknown / not specified	9,111	2,131
Total	**321,175**	**79,776**

Source: Derived based on Territorial Authority risk profile sample and expert parameters of failure rates by cladding type.

If the expert view of failure rates in Figure 42 are applied on a year on year basis to all the New Zealand building stock from 1992 to 2005 (the period of highest risk) it would indicate that NZ has the potential for 66,657 single-unit failures and 21,019 multi-unit failures[8]. A total of 87,687 dwellings could be affected.

Instead, however, the failure rates by cladding type have been applied only to those dwellings identified as high risk through the TA sample data based on E2/AS1.

Based on the evidenced failures seen in the WHRS statistics discussed above in every 15 failures 4 will be in dwellings with medium risk and 1 will be a dwelling with low risk. These ratios were used to predict failures for medium and low risk dwellings as defined by E2/AS1.

Failures calculated on this basis for dwellings with monolithic cladding can be seen in the table below.

Figure 42: Total failures for monolithic clad dwellings by risk profile and time period

Risk rating	1992 – 2005	2006 – 2008
Low	2,762	1
Medium	11,050	3
High	27,325	8
Total	**41,137**	**12**

Source: Derived based on consensus forecast data agreed by government officials.

[8] Each unit in a multi unit dwelling has been counted individually.

When failures for non-monolithic clad dwellings are included in this tally, the consensus forecast of failures between 1992 – 2005 is 41,960 affected dwellings of which 94 percent are in dwellings with monolithic cladding. This total estimate of 42,000 dwelling units for the reference period is identified as the consensus forecast.

Figure 43: Total failures by cladding type and period of build

Cladding type	1992 – 2005	2006 – 2008	Total
Monolithic	41,137	12	41,149
Other	823	29	851
Total	41,960	40	42,000

Source: Derived from the consensus forecast assumptions.

The estimate in Figure 45 represents the number of dwellings that are likely to fail because of weathertightness failures based on the consensus forecast.

Failures since 2005

The TA building consent evidence relating to risk profiles has shown that the risk profile of dwellings has remained much the same since the changes in building regulations from 2004. All experts agreed, however, that the changes in the building standards and approach to the code of compliance had improved the features of new dwellings built since the beginning of 2000 to prevent damage causing leaks.

Only 11 failures have been lodged through the WHRS since July 2005, which is a positive sign and, combined with expert opinion, supports the assumption that there will be less actual failure from 2006. Although this data only covers four years (2005, 2006, 2007 and 2008), it can be compared against failure data for buildings built between 2002 and 2004. This data is tabulated in the figure that follows.

Figure 44: Table of evidenced failure rates acknowledged within 3 years of build comparing 2000 – 2004 with the 2005 – 2008 period

Year claim submitted after year of build	Period 1 Failure rate data 2000 – 2004	Period 2 Failure rate data 2005 - 2008	Periods 1 and 2 compared - Reduction
One	0.12 percent	0.04 percent	68 percent
Two	0.11 percent	0.02 percent	83 percent
Three	0.13 percent	0.06 percent	57 percent

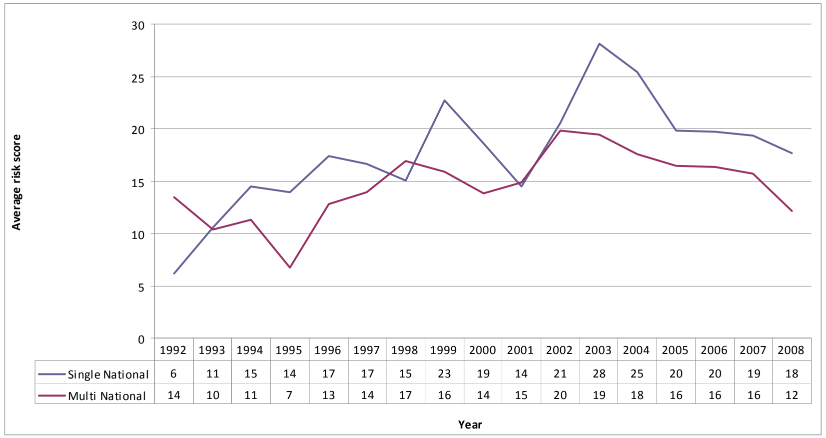
Source: PwC calculation of failure rate (related to all dwellings built in the period) based upon WHRS claims evidence.

The data in Figure 46 above shows the failure rate over the first three years for buildings built before and after the Building Act 2004 came into force (March 2005) bringing changes in building standards. Data before 2000 could not be compared because the WHRS was not established before 2002. The data, as rounded to date, provides evidence that suggests a decrease in the evidenced failure rate between the two periods.

More information on the changes to building practices designed to improve building quality can be found on the Department of Building and Housing's website, www.dbh.govt.nz.

The number of high risk buildings has increased over the period examined, based on the TA risk profile data from building consents sampled. Further analysis of the raw risk scores is set out in Figure 46. It shows a decreasing average risk score despite increasing proportions of high risk dwellings.

Figure 45: Graph of average risk score of buildings consented in years 1992 – 2008, single unit and multi-unit dwellings compared



Source: Territorial Authority risk profile sample of building consents

The use of high risk monolithic claddings has also dropped significantly since 2004, as shown in the figure below.

Figure 46: Table recording the percentage of dwellings with monolithic claddings, comparing the period 1992 – 2004 with the period 2005 – 2008

	Year of consent **Percent of Dwellings Built with Monolithic Claddings**	
Dwelling type	**1992 - 2004**	**2005 - 2008**
Single-unit	30 percent	18 percent
Multi-unit	36 percent	25 percent

Source: Territorial Authority sample building consents data.

Despite limited time to acknowledge and present a claim since changes in the Building Act, the evidence described in this chapter suggests that there has been a decrease in the incidence of failure since 2005. For the purposes of the estimation of the consensus forecast, then, it is assumed that the failure rate as defined by the WHRS legislation has reduced to historical levels from 2006 – 2008.

Historical failure rate

Building design experts agree that in any building cycle there will be an underlying failure rate due to workmanship and conditions (including, for example, exposed weather conditions) that has nothing to do with the systemic weathertightness failure. Some of these failures, however, will be covered under the weathertightness legislation and so a nominal rate of failure must be applied for non-monolithic claddings and future failures.

This rate has been cited to be as high as 3 percent, while the Quantitative Estimate Group estimated this level for non-monolithic failures at about 1 percent. On balance this estimated 1 percent also reflects some of the risky industry practices that were occurring prior to changes in the 2004 Building Act implementation in 2005. This implies that the 1 percent estimate may overstate the underlying rate related to weathertightness failure.

For the purposes of the estimation of the consensus forecast, the evidence suggests that the underlying failure rate is lower after the Building Act is implemented. It has been assumed that the failure rate is 0.2 percent for high risk dwellings after 2006.

This rate of 0.2 percent was the estimated failure rate for low risk non-monolithic clad houses during the high risk modelling period.

Appendix E Impact of Failure

Having established the weathertightness risk profile for dwellings and applied knowledge about the dwelling design to establish the number of dwellings likely to fail, the next step is to estimate the likely cost of dwelling failure. This requires knowledge about the impact of the failure.

Impact refers to the damage that a weathertightness failure will do to the dwelling. Any failure as defined above will result in damage (if there is no damage, there is by definition, no failure).

Further, the seriousness of the impact needs to be understood in order to estimate the economic cost of failure. Three types of damage are considered for the purposes of the consensus forecast. They are:

- maintenance;
- targeted repair; and
- full reclad.

Types of repair

Weathertightness problems affect dwellings of all types. To date, repairs have been required across the range of building types, design, detailing and cladding. In this respect, the nature of the repairs will vary considerably depending on the nature of all these variables. From a macro perspective, however, repairs due to weathertightness can be grouped into the three categories as listed above and described in Chapter 2. Initially, a considerable proportion of the repairs were targeted repairs, where a specific and isolated point of failure has been identified and the damage is contained to the one area. Increasingly, reclads are required, where there have been multiple points of failure, or where the single point of failure has caused extensive damage.

Reclads are also increasingly popular because of the desire to prevent future damage.

There have also been claims for maintenance which covers repairs that are more minor in nature. For example, this group includes dwellings where the repair consisted of the replacement of a window or the repair of cracks

Re-cladding is an expensive process requiring the removing and replacement of the cladding system. In the majority of cases, it also includes replacement of supporting framing.

A failure due to weathertightness issues that results in re-cladding may be caused by many different faults, for example cracks in the cladding, leaks from joins, guttering, eaves and/or decks, damage to joists or failed roofing.

The repair work, however, often centres around the damage inside the cladding, most usually the timber used for the framing of exterior walls. In 1995, guidance relating to the implementation of the building code changed to allow the use of untreated timber for this framing. Treated timber had previously been required to help prevent the effects of borer. It was an unanticipated advantage that this treatment had also made it more resilient to water. Changes to building design and insect management meant that it was believed that the treatment was no longer necessary and it was reasoned that as long as it was inside the walls, untreated timber was suitable for use in framing. Because the untreated timber was cheaper than its treated equivalent and supply of treated timber was limited, the majority of the houses in the reference period were built using untreated timber until compliance documentation affected its use in late 2003.

During this period, many designs, particularly those using stucco cladding, did not include a cavity between the frame and the cladding.[9]

[9] Compliance documentation required a cavity from 2004 onwards.

As a result, moisture was routinely trapped in proximity to the untreated timber causing rotting. To further exacerbate the problem, in the early stages this timber was unlikely to show the effects of rotting. There are examples where timber framing was dry on the outside of the timber but still damp at its core and rotting from the inside out. In any event, whatever is happening to the timber framing is very hard to see without extensive opening up of the house, either from the outside or from the inside.

There were a large number of targeted repairs to dwellings made during the late 1990s and early 2000s, usually paid for by the dwelling owner. There were few full reclads evidenced over this period. Even when the framing was rotting beneath the cladding, it was often not noticed, because inspection of the timber is an invasive process and even then the extent of the damage may not be immediately obvious.

Over time and with the establishment of the WHRS, it became increasingly obvious that the targeted repair was not sufficient to eradicate the dwellings' weathertightness problems. This was because building and design practices had created more extensive damage. Many of the problems that were fixed in one place with a targeted repair appeared elsewhere. Many times even a single point of leaking could not be successfully traced to fully isolate all of the damage because of subsequent drying that hid internal rotting or because the search for the damage was too restrictive.

With the experience of the last five years, it has become apparent to assessors and remediation experts that targeted repairs are ineffective in most instances, particularly those relating to monolithic cladding. Even when only a single elevation was affected, the replacement of the cladding on one side of the house has reasonably required the replacement (often including reframing and other redesign) all four sides to avoid future damage.

In summary, the recent evidence is that the nature of repairs for weathertightness failures is extensive and can often require full replacement of the cladding and a significant replacement of the timber framing in addition to remedial repairs required to stop the flow of water.

Trends in the cost of repair

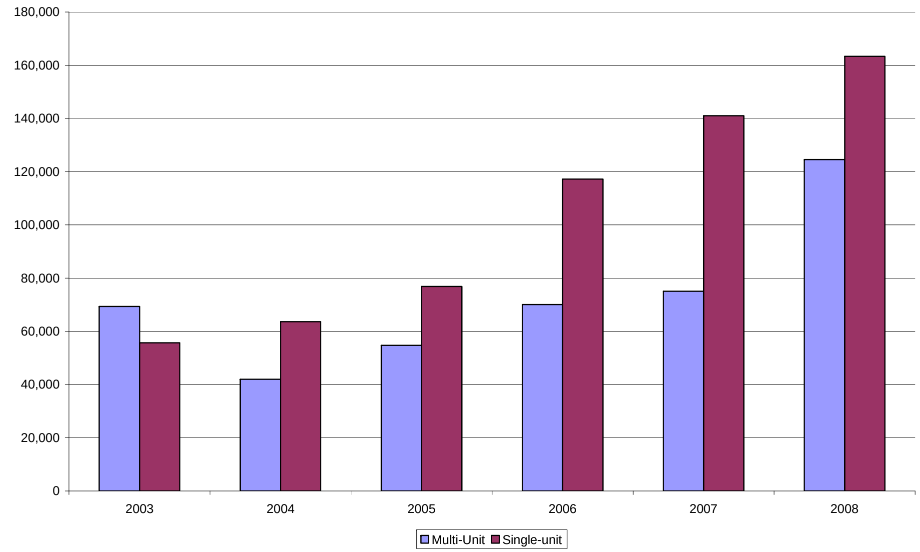
Available published data about actual claims shows that the costs associated with weathertightness work have escalated significantly in recent years. This appears to reflect a greater understanding of the extent of the weathertightness damage.

The 2006 WHRS Act also includes provision for future likely damage which led to increased cost estimates made by WHRS assessors and other industry professionals.

These cost increases have been further compounded by the risk averse approach to weathertightness of the building industry, councils and the adjudications of courts that has led to the greater use of designers, other building experts and professional advisors. Builders, architects, councils, private certifiers and makers of building products have all been found liable for weathertightness failures and so the requirements and professional standards applied to remediation work have been increasing in both complexity and cost.

The graph below shows the average value of the anticipated repair cost as assessed by WHRS assessors. The costs are tabulated to show the costs based on the year of the claim. As the approach to weathertightness has become more informed and more risk averse, the estimates of repair costs have increased significantly. Since 2003, the average estimate has increased nearly 300 percent for single-unit dwellings with a similar trend for multi-unit dwelling claims from 2004.

Figure 47: Average estimated cost of repair per dwelling unit based on WHRS claims lodged from 2003 – 2008



Source: WHRS Resolution Service (2009) unpublished sample data.

This WHRS cost data indicates there is considerable likelihood of under-estimation of costs associated with relying on historical data in the form of assessments, settlements and adjudications.

It suggests that the WHRS data to date needs to be carefully applied if it is to be used to predict current costs.

As an understanding of the remediation process has evolved, the costs of remediation have increased. With this in mind, the calculation of the consensus forecast relies more heavily on recent data and the views of experts to predict costs and settlements.

Figure 48: Assumed repair cost parameters in 2008 dollars

	Type of repair		
Dwelling type	Full re-clad	Targeted	Maintenance
Single-unit	$300,000	$100,000	$ 20,000
Multi-unit	$120,000	$ 90,000	$ 15,000

Source: PwC assumptions, agreed by the government officials, based on a synthesis of qualitative and quantitative data sources.

Impact of Damage

The impact of the damage that weathertightness has caused is as furiously debated by building industry professionals as the overall level of failures. At one end of the spectrum, remediation experts in the North Island are seeing the worst cases and are prescribing risk adverse solutions that ensure that further weathertightness damage is eliminated at all costs. They talk often of examples where limited damage is obvious externally, but extensive testing shows far more damage. From this point of view, most weathertightness problems are expected to result in extensive damage.

WHRS assessors and other technical experts share a similar view. Small isolated repairs may solve a single problem, but in general the issues are not isolated, instead they are systemic to the whole dwelling. If a flashing causes a window to be replaced then almost certainly all windows will need to be replaced eventually. A targeted repair, therefore, only delays the manifestation of symptoms indicating a larger problem. There are many anecdotal examples of ineffective repairs where targeted repairs misled owners as to the extent of weathertightness issues in their property.

Historical evidence from the South Island and Hawke's Bay suggests that weathertightness issues manifest more as targeted or maintenance repairs. In these areas, full reclads have been far less common than in the North Island.

One response to these differences is to suggest that the full extent of weathertightness problems have simply not had an opportunity to manifest yet. In warmer and drier climates, penetration to the interior framing is far more likely to dry and reduce the rate of decay. Some of the buildings from 1995 on are just now starting to show damage in the South Island. The speculation is that the climate has simply reduced the pace of deterioration but that the same fundamental damage is occurring and partial or full repairs will eventually be required because of weathertightness failure.

The following estimated parameters have been used to model the economic impact of these failures. They are the same for multi and single-unit buildings

Figure 49: Estimated impact of weathertightness failures by cladding type for the period 1995 – 2005

	Type of repair		
Cladding type	Full reclad	Targeted	Maintenance
Monolithic	75 percent	20 percent	5 percent
Non-monolithic	60 percent	35 percent	5 percent

Source: PwC assumptions based on expert opinion about the nature of the impact causing damage and agreed by government officials.

WHRS assessor estimates showed that the repair cost for monolithic clad houses is around 40 percent higher than for non-monolithic clad houses. This is a result of the larger number of full repairs for monolithic houses that sustain damage as above.

From 1992 to 1995, houses were still built with treated timber, though the level of treatment in was lower than during the 1980s. It is estimated that the rate of failure is the same for that period as for the period 1996 - 2005; however, the impact of failures before 1996 is less severe and this is reflected in the assumptions applied to calculate the consensus forecast. The difference can be seen by comparing the figures above and below.

Figure 50: Estimated impact of weathertightness failures by cladding type for the period 1992 – 1994

	Type of repair		
Cladding type	Full reclad	Targeted	Maintenance
Monolithic	25 percent	25 percent	50 percent
Non-monolithic	25 percent	25 percent	50 percent

Source: PwC estimates based on expert opinion about the incidence of impact causing damage and agreed by the government officials.

It is assumed that there is no difference between the impact of failure between monolithic and non-monolithic clad houses prior to 1995. Both types of cladding were installed over treated timber framing at this time.

Differences in costs

Assessment versus repair

There is diverse opinion on the accuracy of the cost estimates made by assessors. Indeed the only way to assess the true cost is to complete the repairs. Remediation experts have indicated that a thorough assessment is essential to support any robust legal process and there is a growing trend to do the remediation first and then pursue a claim based on the real and actual remediation repair and other costs.

A self-selecting survey conducted by DBH of claimants that used the WHRS suggests that in the earlier years of the WHRS there was a significant variance between assessor and observed repair costs. Based on this data, less than 20 percent of assessor estimates are within 25 percent of the final repair cost. An equal number of claims showed final repairs of more than 5 times the assessor estimate. Excluding those large variances, the average variance is still more than 80 percent of the assessor estimate. The later estimates indicate, however, that assessors are now performing more extensive inspections and the accuracy of these assessments is more robust than ever before.

It has also been reported that completing the work before the mediation or settlement results in a larger recovery for the owner. This may be because the actual repair work has historically been more expensive than the estimates. It may also be because the uncertainty around the repair costs can no longer be debated in court, which proves favourable to the claimant when assessing contributory negligence.

Mediation versus adjudication

Data from DBH on mediation and adjudication indicates that the average overall return to the owner from mediation ($124,547) and adjudication ($122,993) are similar.

Nevertheless, because costs are explicitly included in adjudications but are outside the mediation return, the comparison of repair awards shows that mediation returns are 14 percent higher than the adjudicated cost. This analysis is based on a small number of single-unit observations (and is shows lower costs than from recent claims settled). It has only been included in this discussion to illustrate that there is difference between the two methods of resolution.

Time to Fail

The focus of this project is on a 15 year time frame as it reflects the minimum Building Code durability requirements of building materials. A key issue relates to the time between a dwelling being built and when it fails. The WHRS failure data proved a useful source of data to analyse in relation to the time between build and failure. In this data, the failure is considered to have occurred at the point a claim has been lodged with the service.

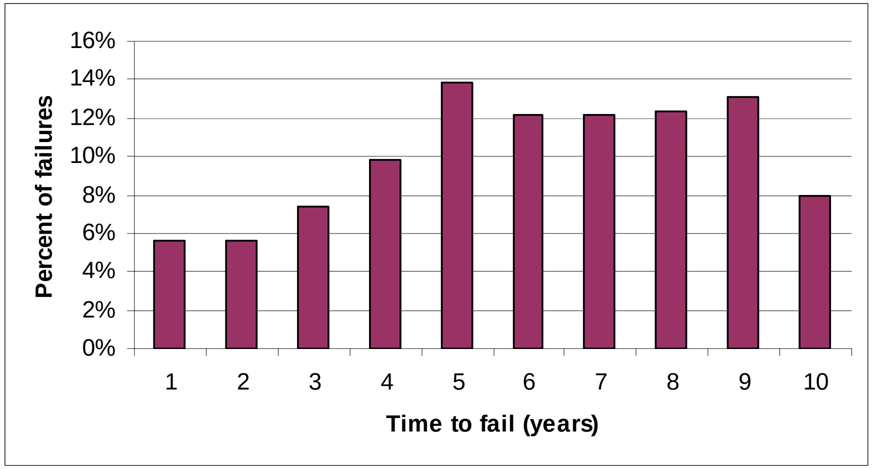
In reality, a failure may have occurred significantly earlier and may even have been recognised earlier. This timing is difficult to pin down exactly because the data specified by this information is the time the claim is lodged not the time the failure actually occurred.

The patterns seen in Figure 53 on the following page indicate a trend of increasing failures over time. Note, however, that the pattern is distorted by the retrospective nature of the legal claim process.

All claims from the full period 1992 to 2002 were lodged with the service in 2002. The implication is that any claim made for houses built in 1992 will invariably be reported as occurring in year 10. Claims for houses built in 1993 will be recorded in year 9 or 10, irrespective of when the failure actually occurred. This could be balanced by houses built post 2002, where the claims will be filed closer to the time of recognised failure. The challenge is how much to extrapolate from the later information as 6 years of data post 2002 has been recorded compared to 10 years prior to 2002.

The second issue with respect to the 15 year time fame is that failures occurring beyond 10 years are ineligible under the WHRS Act 2006, data related to dwellings that fail between 11 and 15 years after build is currently unavailable.

Figure 51: Time for dwellings to fail based on claims lodged with the WHRS for houses built between 1992 – 2008



Source: WHRS claims data graphed by PwC to relate time of claims to date of building consent.

The WHRS data provides an indication of the failure pattern but to obtain a more complete picture for this exercise, DBH surveyed claimants about a number of factors including:

- the year of build;
- the time the failure was first recognised;
- the time a claim was lodged; and
- the time the failure was repaired.

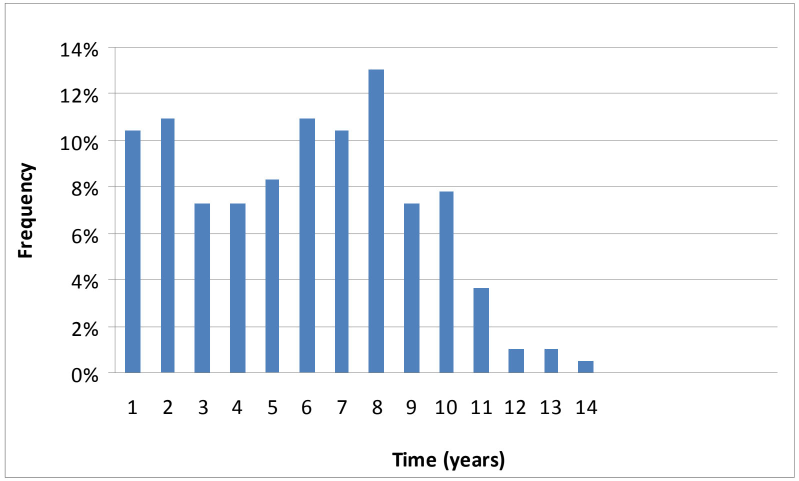
A total of 213 claimants responded with results reflecting closed claims due to resolution, ineligibility or being withdrawn. This data more fully details the features of the failure pattern seen in the WHRS claims database. It can be seen in Figure 54. It shows a trend that peaks in year 8 and declines after that point.

Years 11 to 14 are likely to reflect the nature of the claims process itself and are spurious for the purposes of predicting time to fail. This is because claims in this period are ineligible and any claimant would have their claim rejected.

The survey also provided evidence about the time between when it was built and when a problem was first recognised. The Survey showed that more than 20 percent of respondents noticed a leak within two years of build

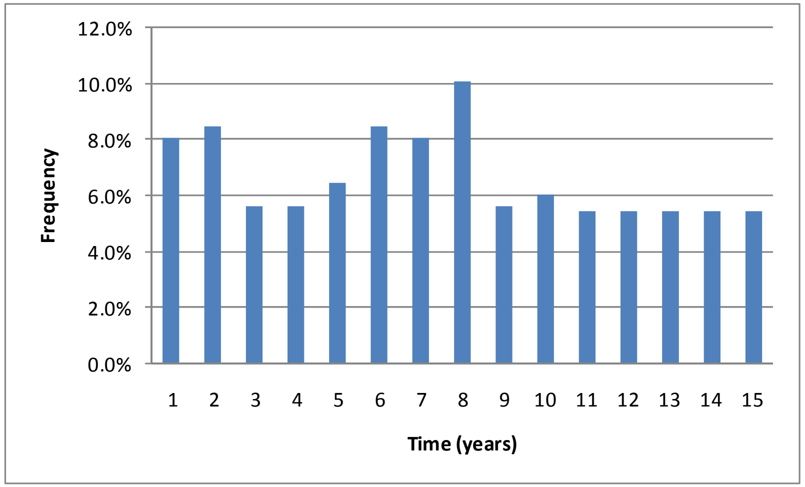
The trend illustrated by Figure 54 needs to be seen in the context. First, this means that it took more than eight years for just less than 80 percent of respondents to notice the leak. Secondly, it is based on those dwelling owners who have chosen both to recognise a failure and to undertake the process of lodging a claim. There is considerable evidence to suggest that this is a small subset of the total of weathertightness failure.

Figure 52: Time between build/renovation and noticing a leak



Source: Weathertight Claimant and Respondent Survey 2009, prepared for DBH by PS…Services, June 2009.

Figure 53: Time between build and failure



Source: Estimate used by PwC in the economic modelling

Figure 55 incorporates the data on time between building/renovating and noticing a leak from the WHRS survey with PwC's estimate for the amount of failures occurring outside the 10 year policy timeframe. The conclusion from the available evidence is that approximately 25 percent of failures will occur outside the 10 year statute of limitation.

Appendix F Cost, Claims and Liability

Having described the impact of the dwelling failures, the next step is to estimate the costs of repairs, the claims process and other costs. Once these are estimated, then evidence from claims to date is combined with qualitative information to calculate the liability for all the key parties.

All costs in this Appendix are expressed in Dec 2008 dollars.

Claimant costs

There are a range of associated and consequential expenses that are incurred with remediation work. These are design fees, legal fees, expert fees and consequential costs.

The analysis in this Appendix relies firstly on data provided by HOBANZ, Crockers Property Group, WHRS and TAs. The data from these groups were compared with the expert opinion provided by these groups and others including quantity surveyors, WHRS assessors and building industry experts including a lawyer and an architect. A final consensus forecast was derived based on a synthesis of the analysis of all data sources. Greater weight was placed on the most recent data.

In general, *design or architecture fees* are not included as part of the repair cost and must be added. These fees typically apply for failures requiring a building consent which it is assumed to be the case for targeted and full repairs. One in every four home owners that responded to the WHRS claims incurred expenses in relation to design and/or architecture fees and the average cost was $15,000.

Legal costs can be incurred simply for preliminary advice and guidance, while the larger claims will typically also involve a lawyer in mediation and/or trial. "The WHRS Act 2006, implemented from May 2007, makes changes to improve the effectiveness and efficiency of the services provided by the Weathertight Homes Resolution Service designed to deliver better outcomes for owners of leaky homes. An objective of the WHRS Act is to provide speedy, flexible and cost-effective procedures for resolving leaky home disputes as an alternative to the courts."[10]

Even with the issues in the Act, significant legal costs are still being incurred by most parties involved in a legal case for a significant repair. It is estimated that 90 percent of repairs costing more than $100,000 incurred legal fees and 50 percent of repairs below that threshold also incurred legal fees. Overall, legal fees are approximately 15 percent of the repair cost and average $20,000 per claim for single-unit dwellings. Industry opinion is that legal costs have increased significantly in the last five years, particularly for non-trivial claims up to $150,000.

It is not uncommon that the legal costs can equal the cost of repair for this size of repair for single-unit dwellings. Although multi-unit claims are almost certain to incur legal expenses, and incur more sizeable costs than their single-unit counterparts, when these costs are spread across all the affected parties, they tend to be a much lower proportion of the repair costs.

Further, there appear to be an increasing number of *remediation experts* who are being employed more regularly in relation to larger remediation jobs. These include technical building experts that may be used to give evidence in court or during mediation. These same experts and other remediation experts may be called on to provide advice on the most appropriate remediation solution or to project manage the rectification.

A handful of firms, particularly in the North Island, specialise in remediation. More of the work of these firms and experts relates to multi-unit complexes, but they are also significantly involved with cases involving larger single dwellings. For an average-sized

[10] http://www.dbh.govt.nz/weathertight-services [accessed May 2009]

single-unit dwelling, fees charged by these experts may vary in amount from $10,000 to $50,000 depending on their involvement. Assessment, contracting and project management, particularly for large multi-unit dwellings can be significantly more expensive. Some types of expense will be incurred for all cases even small ones, and average estimates range from $1,500 through to $10,000 for single-unit dwellings. For multi-unit dwellings, the costs can be reasonably spread across dwelling owners and the average cost is around $5,000 per individual unit.

Other *consequential costs* include alternative accommodation and financial servicing costs. As identified previously, the current advice is for remediation work to be completed before a claim is made. It can take up to two years to get a high court date at present, and the interest on money raised for repairs over that time can be significant. The repairs may be financed via savings, loans or mortgage extensions. The range of circumstances will vary between individuals and only the direct costs are taken into account. This means, for example, the opportunity cost of lost investment opportunities are not considered. Considering all the determinants, it is conservatively assumed that an average cost of $10,000 in consequential costs per partial or full repair is incurred.

Figure 54: Estimated cost parameters for single-unit dwellings in 2008 dollars

	Type of repair		
Type of expense	Full reclad	Targeted	Maintenance
Design	$15,000	$5,000	-
Legal	$75,000	$30,000	$6,000
Experts	$10,000	$5,000	$1,500
Consequential	$10,000	$10,000	-
Total	**$110,000**	**$50,000**	**$7,500**

Source: PwC Estimates based on WHRS Survey and expert opinion.

Single-unit cost parameters are similar to those for multi-unit dwellings, where repairs are typically cheaper on a per unit basis, but take longer to complete.

Multi-unit claims are increasingly likely to end up in the high court. Bringing a case or lodging a claim can be delayed by the process of working within the guidelines of the body corporate.

Figure 55: Estimated cost parameters (per unit) for remediation of multi-unit dwellings in 2008 dollars

	Type of repair		
Type of expense	Full	Partial	Maintenance
Design	$2,750	$2,250	$250
Legal	$16,000	$14,000	$500
Experts	$5,500	$4,500	$250
Consequential	$12,000	$9,000	$250
Total	**$36,250**	**$29,750**	**$1,250**

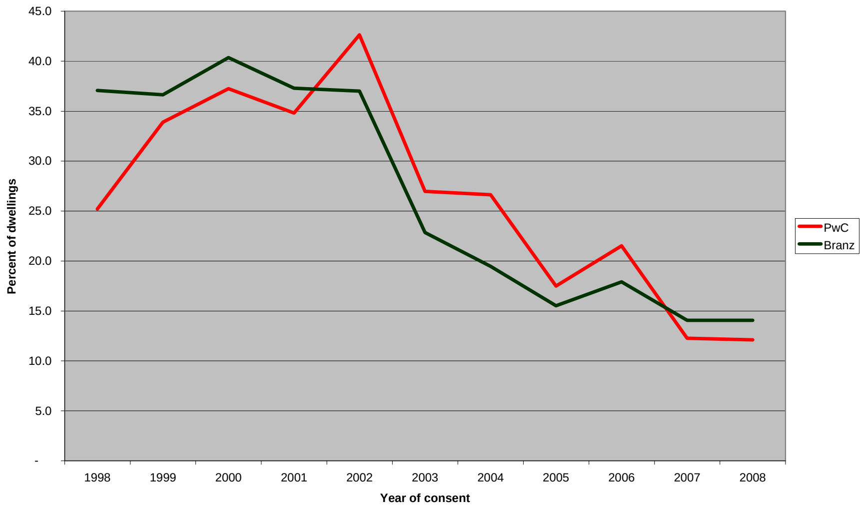
Source: PwC estimates based on data from Crockers Property Group and expert opinion.

Although the costs in Figure 56 and Figure 57 above focus on claimant costs, the legal fees also include an estimate of the costs for other parties such as local government.

These estimates include all the physical costs of repairing the dwelling including consents, assessments and council fees. It does not include any opportunity cost to cover the personal time spent by claimants pursuing repair and compensation.

A comparison between the moderated results of the TA data with BRANZ survey data available from 1998 to 2008 showed that the populations demonstrated similar properties when considering the percentage of monolithic cladding.

Figure 56: Percentage of single-unit dwellings with monolithic cladding by data source 1998 – 2008



Source: PwC model and unpublished BRANZ data

Legal liability

Qualitative evidence suggests that at least as many weathertightness cases are settled out of court or handled privately as go through WHRS. This suggests that they are largely outside of the view of the legal system. The evidence base collected from administrative and other public sources provides information only about those cases within clear view of the legal processes.

Although multi-unit claims dominate the WHRS statistics (because for a period, individual claims were noted for individual units within a multi-unit dwelling) very few of the multi-unit claims have been resolved. There is considerable difficulty getting the majority of members of a body corporate to acknowledge or participate in a weathertightness process, and the lengthy delays associated with managing a large group of individuals towards a consensus.

An upper limit suggests that up to 90 percent of weathertightness cases relating to multi-unit dwellings are not yet resolved even though increasingly the weathertightness failures are being recognised and acknowledged.

Those advisors, assessors and experts familiar with the larger multi-unit complexes and apartments suggest that up to 90 percent of these buildings built between 1992 and 2005 will experience weathertightness problems and require significant remediation at some point.

The data on legal liability suggests that the party with the greatest liability is the building party for example roofers, builders or labour only construction workers. Designers are also increasingly being required to contribute to re-mediation costs.

A typical adjudication might find:

- building parties: 60 percent;
- designer/Architect: 10 – 20 percent; and
- council: 20 -30 percent.

It is common to find, however, that when those parties are brought to account for their liability, that they cannot be found and/or are in no position to contribute to the liability. Liable parties have often gone bankrupt and out of business or have found a legal business structure where their assets are protected.

A DBH internal study from October of 2008 sampled 200 companies named as parties to weathertightness claims. The survey responses indicated that almost a third of the parties surveyed were in liquidation or had been struck off the companies register.

> "Where parties have ceased trading, claimants and other respondents consider the viability of joining the directors of companies, when these directors have undertaken work personally (and still reside in New Zealand). Claims advisors suggest this is more common when the cost of repairs is high - for example, above $100,000.
>
> Assessors suggest that the issue where no parties are available to settle is more prevalent in areas where building inspection services were contracted out - in these cases, it is likely that claimants will withdraw claims at an early stage.
>
> Stakeholders interviewed for the ... report also identified the issue of 'disappearing directors of fly-by-night development companies' as a real concern for claimants and other respondents."[11]

One example that was discussed during interviews was of a business that opened a separate company for each dwelling it built and closed it soon after the property was completed.

Because of joint and several liability, parties with greater continuity, mainly the councils are left sharing a far greater portion of the remdiation costs than was decided through the legal system. Councils are finding they bear an increasingly higher portion of the cost.

Data collected from councils (TAs) indicates that their share of the remediation costs has historically varied between 40 and 70 percent of the adjudicated costs and averages around 45 percent of the total settlement across single and multi-unit dwellings. The assumptions shown in Figure 57 have been used in the model to derive the costs for the consensus forecast of the number of failures.

Figure 57: Council (local government TA) share of remediation costs by repair type

Repair type	Value Range ($)	Council (TA) share
Maintenance	0 – 50,000	40 percent
Targeted Repair	50,001 – 150,000	50 Percent
Full (reclad)	150,001+	65 Percent

Source: North Island Territorial Authorities.

The table in the figure above shows that share of remediation incurred by local government increases with increases in cost of the repair. This implies that more parties are likely to turn up and contribute repair-cost to a settlement when the costs are low. As the repairs become more extensive, the ability (or the willingness) to contribute reduces significantly.

[11] Department of Building and Housing, *Internal Evaluation Report,* Wellington (2008), Chapter 6, p28.

Councils also acknowledge that many of the building parties that have been contributing to settlements historically may no longer have the capability to contribute to future settlements. As a result, councils are likely to carry an increasing share of the cost of remediation.

Other third parties such as former owners might also be found liable. A survey commissioned by DBH found that previous owners were named in settlements in 15 percent of claims.

Distribution of costs

Which party bears the cost is heavily dependant on the resolution of the failure. The resolution of a weathertightness failure leads to the specification of who bears what cost, differs according to the resolution process. These processes can be grouped in the following categories:

- legal recourse;
- out of court settlement;
- private repair;
- no repair/ unrecognised failure.

Each of the categories has particular drivers of cost (both of repair and transactional costs). Every home with a weathertightness problem will fall within one of the above categories.

Legal recourse

Cases resolved through a legal process include those that go through WHRS and those that go directly through the court system. Most cases involve the WHRS at some point even if that is simply to take advantage of the low cost assessment, but many cases will stay under the guidance of the WHRS taking advantage of mediation and tribunal decisions.

Many owners, though, especially those of multi-unit complexes (including body corporates) have elected, in the past, to take legal action in the general court system even if they have used the WHRS for its low cost assessment. Of these cases, most end up in the High Court because of the size of the claim (which may also include non-weathertightness defects) and because greater costs are typically awarded in the High Court.

DBH has noted the completion of more than 150 claims, of which 68 have been resolved by adjudications, 76 have been resolved by mediation and 9 have been settled in court.

If the failure is resolved in this way, the owner will typically receive a large contribution from other parties towards their repairs. Even in this case, they will still incur significant personal costs. Anecdotal evidence suggests that a single-unit claim for a full reclad will cost the owner around $100,000 despite recoveries from other parties.

Out of court settlement and mediation

Parties may wish to avoid the costs (and possible publicity) associated with the legal system and attempt to settle outside of court or through mediation without the overview of the WHRS. The owner is also incentivised to keep the process outside of the legal system to prevent disclosure of a weathertightness issue with the property and to speed up the resolution process. It is difficult to tell how the total cost to the owner will vary between this method of resolution and a legal resolution. Typically the owner has less bargaining power because of the informal nature of the resolution. It is likely, however, that there are other economic and intangible benefits that accrue from this method as discussed above.

It is estimated that the total cost of repair is less but that the owner bears a similar cost for out of court settlement as to the cost through formal legal recourse.

Private repair

There are cases where the owner of the property has simply decided to fix the problem privately without involving any other liable parties. This may be because the cost is small or because the work was completed beyond the ten year legal liability period. It may also be the case that no liable parties can be found, which is often the case, if a private certifier was involved. There are further cases, most often outside of the metro areas, where the owner and the builder will reach an agreement and the builder will come back and repair the dwelling.

There is evidence, with several examples of assessors who have gone back later when it is evident that more repairs are required, of a full range of private repairs going on. These vary from application of a tube of sealant or a coat of paint to repairing an external leak to full recladding and remediation. A common reason for the larger private repairs is the expiration of liability period. If an owner has not realised the extent of damage in time, then they may end up bearing the full cost of remediation. As noted elsewhere in this report, the WHRS legislation currently gives owners up to ten years to address their claims.

Some cases have been seen in court where the owner did a quick repair job and then sold the house, perhaps knowing that there is a more extensive underlying problem. When the owner is bearing the full cost of repair or repair is negotiated with the builder, low cost targeted repairs are popular but may not address the systemic problem. These instances of targeted repair are often seen as manageable by owners and self-employed building professionals who can manage them in between other jobs. A full reclad under this circumstance is uncommon.

The owner bears the majority of cost in the case of private repair while councils (TAs) have no exposure to liability under the current legislation.

No repair / unrecognised failure

According to assessors, quantity surveyors, HOBANZ and other experts consulted for this project, by far the largest group of failures are for those dwellings where owners are either unaware of any weathertightness issues, unable or unwilling to repair it or who either do not think it necessary to make repairs or do not want to face up to the reality of discovering whether a weathertightness failure exists.

There are a range of reasons to explain these behaviours, some more innocent than others. Some failures are simply not clear and identifiable, or are reasonably dismissed because there is little exterior evidence of damage. Where there is no damage to the internal faces of the dwelling, the average owner is unlikely to be convinced of significant structural damage without seeing it for themselves.

There are some owners, however, who do not wish to know about the damage. These are headed “unrecognised failures”, dwellings where there is weathertightness failure yet to be acknowledged. There are many reasons why this happens, including consumer lack of awareness, direct denial, desire to sell houses, unwillingness to face up to the consequences.

Deniability has been cited by experts as prevalent among owners. An owner who has not sought to discover whether there is weathertightness failure and hence who is not aware of extensive damage, can sell a house in good conscience and with little exposure to liability then shifted to the future owner.

The largest group of dwellings affected by weathertightness problems are those where the significant damage is unknown and/or unrecognised.

Although the classic signs of problems may be obvious to building professionals, they are not obvious to the lay owner.

The experts believe weathertightness issues go untreated, resulting in a build up of structural problems. In this situation, the owner is likely to end up bearing the full cost of repair and the significant structural problems are potentially going to turn out to be far more costly to repair than if they were recognised earlier.

Consensus forecast

Figure 58: Consensus forecast of weathertightness economic cost in $millions incurred by party by liability period 1992 – 2020

	Legal liability period		
	(A) 10 year ($m)	(B) 15 year ($m)	Additional cost/ savings B – A ($m)
Owner	$ 7,833	$ 6,631	-$ 1,201
Council	$ 2,817	$ 3,868	$ 1,051
3rd party	$ 402	$ 552	$ 150
Government	$ 243	$ 340	$ 97
Total	$ 11,294	$ 11,391	$ 97

Source: PwC model of weathertightness economic costs based on the consensus forecast.

The figure above shows the total economic cost for failures based on the consensus forecast is $11.3 billion. If the statute of limitation was changed from 10 years to 15 years, the cost split will change but less than $100 million additional net economic cost would be incurred by the country.

This additional $97 million in costs does not exist if the legal liability is shorter though the cost for failure still exists whether a legal claim for liability exists or not.

A change in limitation transfers the $1.2 billion of cost from owners to councils and 3rd parties. Given that councils have reported the pool of 3rd parties contributing to weathertightness settlements is decreasing, even more than $1.05 billion could fall on them.

Figure 59: Estimated share of weathertightness economic cost (percent) incurred by party by liability period 1992 – 2020

	Percentage share of legal liability 10 and 15 year periods compared	
	10 year	15 year
Owner	69 percent	58 percent
Council	25 percent	34 percent
3rd party	4 percent	5 percent
Government	2 percent	3 percent

Source: PwC model specified to incorporate findings from out.

Irrespective of the period, the vast majority of the economic cost is going to fall upon the owner.

The practice, as described in chapter 5, shows that the costs of remediation are growing at an accelerated rate. At the same time, there is evidence that suggests that owners will be increasingly unable to obtain funding for these repairs. For example, the banking system now requires more information to provide a mortgage due both to greater concern about the quality of the dwelling purchased and risk management since the economic downturn. (See the following chapter for more detail.)

The consequences of these trends raise a number of issues relating to the safety and liquidity of owners who are unable to fund repairs on their properties. They will suffer a deterioration of wealth, a decrease in living standard and exposure to unsafe homes in the form of mould contamination and structural integrity.

Although there are only a few reports of homes that have been deemed unliveable, it seems likely that as this generation of building ages, the structural issues will become increasingly prominent for the large number of owners who are not aware, unable, or not prepared to address their weathertightness issues.

Crown costs

The crown also incurs costs relating to its role of supervision and resolution of weathertightness issues. These include the costs of:

- subsidized assessments;
- claim and adjudication support;
- mediation services;
- consumer awareness; and
- Weathertightness Tribunal.

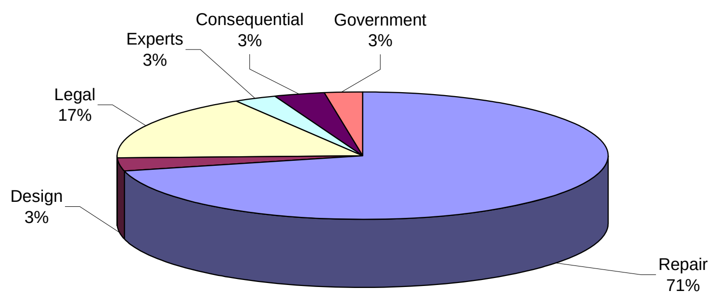
The estimates of these costs have been restricted to 2002 and later to align with the establishment of the WHRS.. This approach recognises the role of government in developing a solution to weathertightness issues and the cost incurred prior to and since the introduction of the legislation. Policy costs are not included.

The central government's costs in relation to weathertightness from 2002 to 2020 are estimated to be $243 million. This assumes that the statute of limitations around weathertightness remains at 10 years. If this was increased to 15 years then it is estimated that a further $93 million in costs would be incurred by the government dealing with the additional claims that would result. This assumes no other significant policy changes occur.

Repair versus transaction costs

Anticipated repair costs make up 71 percent of the total economic cost. Transaction costs, including design, legal, expert, consequential and government costs, make up 29 percent of the total costs.

Figure 60: Economic cost by type of cost 1992 – 2020



Source: PwC model.

In practice, design and expert fees may reasonably be included as part of the repair costs and not the transaction costs.

A remediation expert might, for example, be involved in assessing and managing the repair. In addition, they may also be involved in testifying in court or during mediation. In light of this, the distinction between repair and transaction costs in not immediately clear.

Recovery and adequacy

A further point to note is that the data on adjudications and settlements so far have indicated that the size of the settlement is significantly smaller than the cost to complete the work. While arguing a legal case, the repair portion of the claim is reduced through legal argument on the grounds of betterment[12], redundancy[13] and necessity. This portion has historically been low relative to the true cost of repair anyway and reduces further through legal argument. Data from territorial authorities indicates that the settlement value is between 45 and 55 percent of the claimed amount. In turn WHRS survey data indicates that the actual repair cost is typically 80 percent of the claimed cost. This suggests that non-repair costs and inaccuracies in the assessment cost the owner at least 20 percent before the case is even argued.

Three factors contribute to the final loss for owners.

a) Experts suggested that only two-thirds of the costs of non-repair damages can be recovered in a high court settlement suggesting that *at least* one-third of the legal, expert and consequential costs will be carried by the owner.

b) Historical assessments privately and through WHRS have failed to recognise the extent of the damage and have resulted in claims being made for an amount that is insufficient to complete the repair work. In many cases, these awards are grossly inadequate.

c) The homeowner will have the claim reduced for their own liability for maintenance and by defendant party claims around betterment and redundancy.

Two trends have increased the amount recovered by the owner in the last two years. Firstly, the increased quality of industry knowledge and assessments has led to more accurate awards at the time of adjudication. Secondly, owners are being advised to remediate first, which leads to larger and more accurate awards. This is because the uncertainty around cost is eliminated and there are real and actual costs that can be supported by the legal argument.

Despite these increases in shared liability, experts have indicated that owners of single-unit dwellings that require a full reclad should expect to incur costs of more than $100,000 to resolve the weathertightness issue.

This leads to an equally important question, which is, are the repairs actually being undertaken. If the settlements are not sufficient to complete the repair work then the legal resolution of a case does not compel the owner to subsequently make the remediation. Statistics from Auckland City Council suggest that it has no record of the building consent required to repair more than 34 percent of settlements. Of course, it is possible that the work may have been completed without consent or that it has not been untaken yet. In fact an error in schedule 1 of the Building Act 2004 made it was legal to do repairs without consent between March 2005 and March 2008. This statistic is still to be done useful anyway because it sets a benchmark for the amount of repair work.

[12] Betterment refers to changes in the design which represent an improvement in either the quality of the materials/design or modernisation of the house as a result. These costs are considered to be discretionary additions added by the dwelling owner.

[13] Redundancy refers to parts of the remediation that are not needed to repair the problem but provide a greater degree of safety and lower the risk of future failure. Redundancy is not necessary to repair the problem.

Appendix G Total Costs

Economic Impact

The focus of this study is on the size and economic cost of weathertightness issues. For the study's purpose, economic cost refers to the cost of repair across the whole household dwelling sector for houses built between 1992 and 2008 irrespective of whether they are repaired in practice or not. The scope of this project defines the economic cost as including repair costs (labour, materials, professional fees), legal costs, transaction costs (such as council consent fees). The study considers the economic cost to all parties including but not limited to owners, builders/developers, local government and central government, wether they have been incurred in practice or not.

The specificity of the purpose of this study has the potential to give an impression of the existence of exacting information. After assessing the available data that specifically reported weathertightness problems, a number of further assumptions were agreed. In effect, it became clear that the economic impact is significantly wider than the cost of claims to date because it relates to claims not yet settled, to claims not yet begun, to private repairs and to currently unrecognized failure that have a high probability of leading to repair costs within the 15 year timeframe scoped in the terms of reference.

While 10 years is the period when weathertightness claims can be lodged, the 15 year time period is also relevant as it applies to the minimum durability requirements of building materials. Application of this 15 year period to the study reflects the durability of cladding materials used for recent dwelling construction.[14] Both the 10 and 15 year periods differ from the expectation of owners that the dwelling will exist for at least the time that they live in the dwelling, from tax practice that allows a 2 percent per annum depreciation for dwellings (assuming a minimum life-time of 50 years) and from the wider perception (supported by standing houses built from time of New Zealand's colonization) that houses are built to last.

An important aspect of the longevity of any dwelling is that is receives regular maintenance. A relevant factor in some of the recent dwelling designs is the impression created through the promotion of the materials used that the design would be low maintenance. In addition, owners and builders lacked experience about how to maintain these new materials. In contrast, assessors, builders and designers noted that the building industry has much more extensive institutional knowledge (learned from experience) about the maintenance of traditional weatherboard and brick dwellings.

Finally, another context when thinking about the weathertightness economic impact is the expectation that at any time in their history, a certain percentage of dwellings will fail. This can be for a myriad of reasons, including poor quality construction in the first place but also lack of maintenance. This factor is one of the conditions that is assumed to remain the same throughout the period and so the failure rates adopted for failures including this percentage.

The definition of economic impact applied to this study is specific to the approach adopted to be able to analyse the available quantitative and qualitative data over a meaningful time frame given the need to meet an immediate deadline for reporting.

[14] Although the minimum durability requirement of cladding materials is 15 years it is expected that with routine maintenance their life will extend beyond 15 years.

With more time and access to reliable long-term data series, a general equilibrium model could be applied to bring additional depth. It would do so through describing and relating the economic responses to weathertightness, including the factors contributing to the prices of materials and the costs of repair.

Even the analysis of the results from a general equilibrium model, however, would require a considerable amount of information and knowledge beyond what was available for this project.

This is because there have been so many changes to the standards, codes and practices relating to dwelling construction over the period analysed. For example, there already appears to have been a behavioural response to weathertightness issues since changes in the Act and methods of code compliance were implemented in March 2005.

Given evidence that recent weathertightness problems are noticed as early as one year after the dwelling was built, the available evidence suggests that there have been only a few weathertightness problems in dwellings built since 2006.

The previous chapters have discussed the factors that have contributed to the failure rates, the basis for estimating the costs associated with weathertightness and have described the large number of unknowns. Even where there is exact data from claims, the information is about claims from builds over previous years and there is a range between the costs claimed and the actual costs of remediation. For the purposes of economic analysis a consensus forecast has been derived based on assumptions agreed throughout the project. The results are monetized in 2008 dollars for comparison purposes.

As the reasoning behind weathertightness failures becomes more understood and promulgated to designers, builders, home owners, councils (TAs) and governments, there will be changes in the degree and timing of recognition, the way that claims are settled, the way that liability is shared and so on. The projection is about what is most likely to happen in the future, based on current knowledge. It is important to note that the publication of these changes can itself have either a self-fulfilling or self-denying impact and this can lead to a difference between the projection and what actually happens in the future.

Costings

Figure 61: Assumed total cost parameters for remediation of single-unit dwellings in 2008 dollars

	Type of repair		
Type of expense	Full reclad	Targeted	Maintenance
Repair	$300,000	$100,000	$20,000
Design	$15,000	$5,000	-
Legal	$75,000	$30,000	$6,000
Experts	$10,000	$5,000	$1,500
Consequential	$10,000	$10,000	-
Total	**$410,000**	**$150,000**	**$27,500**

Source: PwC assumptions applied in its model of the consensus forecast.

Figure 62: Assumed total cost parameters (per unit) for remediation of multi-unit dwellings in 2008 dollars

	Type of repair		
Type of expense	Full reclad	Targeted	Maintenance
Repair	$120,000	$90,000	$15,000
Design	$2,750	$2,250	$250
Legal	$16,000	$14,000	$500
Experts	$5,500	$4,500	$250
Consequential	$12,000	$9,000	$250
Total	**$156,250**	**$119,750**	**$16,250**

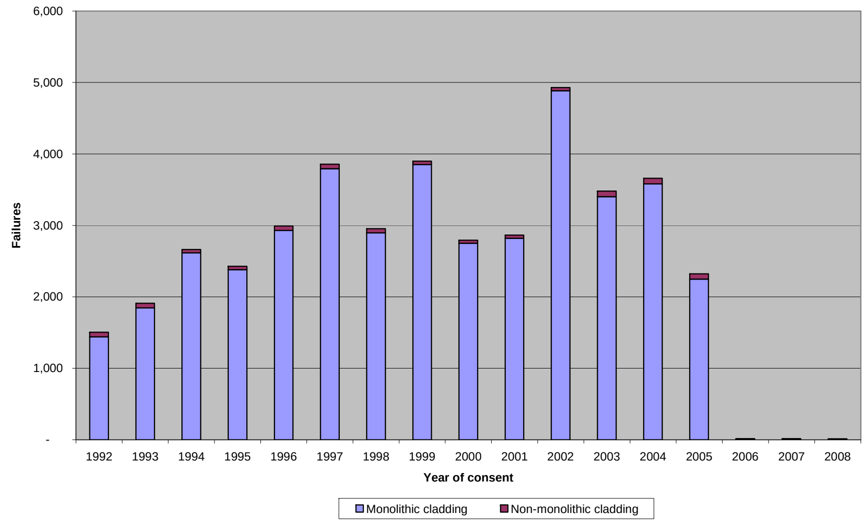
Source: PwC assumptions applied in its model of the consensus forecast.

Number of failures

The number of failures is derived based on evidence from the TAs and WHRS of risk characteristics as determined by E2/AS1 and cladding type. Expert opinion is overlaid to estimate the total number of high risk failures and the findings of analysis of WHRS data to provide of the consensus forecasts of 42,000 failures. An insignificant number of these, only 0.1 percent, are for homes built after 2005.

The figure below illustrates the estimated number of dwelling unit failures by year of build, broken down between single and multi-units

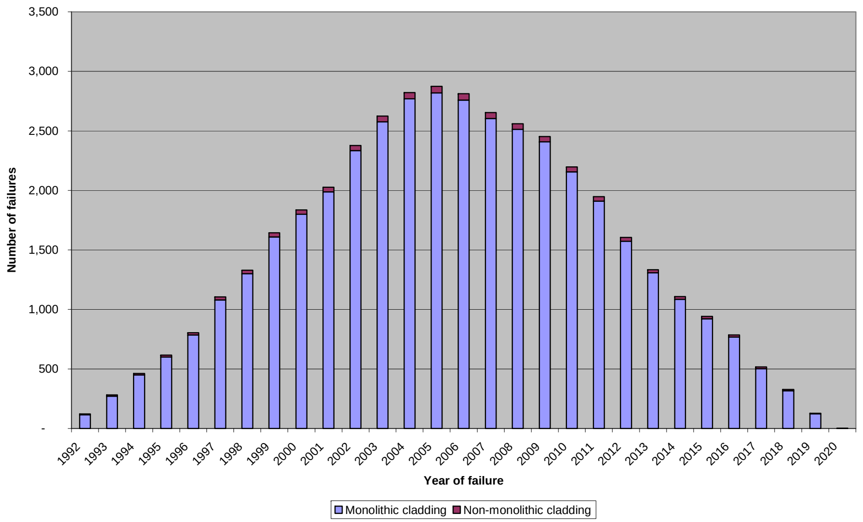
Figure 63: Estimated number of failures by year of build and type of cladding 1992 – 2008



Source: PwC model.

The figure that follows illustrates the estimated number of failures by year of the failure. It also breaks down the failures by type of cladding.

Figure 64: Number of failures by year of occurrence and type of cladding 1992 – 2020



Source: PwC model.

Number of repairs

Based primarily on the number of evidenced repairs, it is estimated that 3,476 repairs have been made to December 2008. It is anticipated that a further 3,332 would be repaired by 2020 in the current policy environment, all other things remaining the same. This brings the total for the whole period to 6,808.

The figure that follows shows the breakdown of the parameters in a way that illustrates the relationship between the actual repairs and the unrecognised failures that are likely to already require repairs.

Figure 65: Repairs completed to date and implications to 2020

	1992 – 2008 Actual	1992 – 2020 Estimated
Repaired	3,476	6,808
Not repaired but repair required	24,207	35,192
Total	27,683	42,000
	Consensus Forecast	42,000 units

Source: PwC model.

Who is bearing the cost?

The cost associated with weathertightness issues is falling heavily on the owner. This burden may be as high as 69 percent of the total cost under the current policy as illustrated by the figure on the following page.

Figure 66: Consensus forecast of weathertightness cost in $millions incurred by party by liability period 1992 – 2020

	Legal liability period		
Party	(A) 10 year ($ m)	(B) 15 year ($ m)	(B) – (A) Additional Cost
Owner	$ 7,826	$ 6,625	-$ 1,201
Council	$ 2,814	$ 3,865	$ 1,051
3rd party	$ 402	$ 552	$ 150
Government	$ 243	$ 340	$ 97
Total	$ 11,285	$ 11,382	$ 97

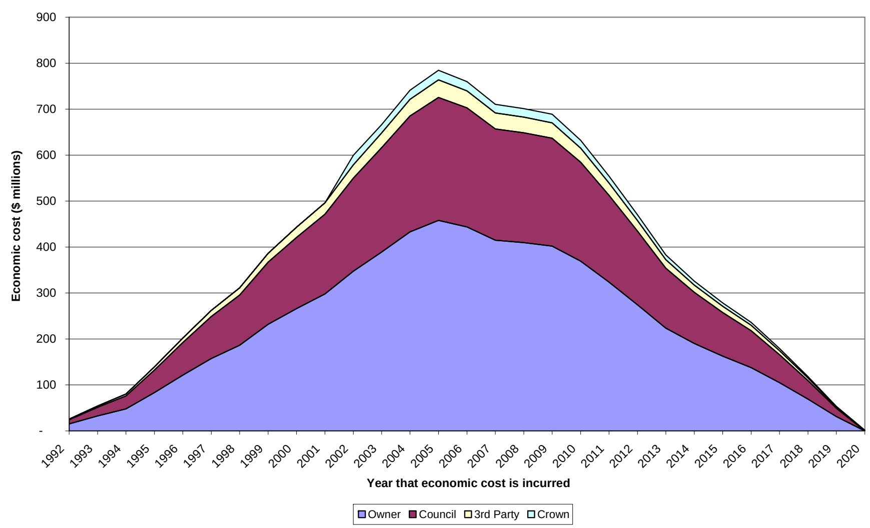
Source: PwC model based on consensus forecast.

When faults are unrecognised within the period of legal liability, the full cost of repair is borne by the owner

If the period of legal liability was extended from 10 to 15 years, local councils (TAs) and third parties between them could expect to incur an extra $1.2 billion. This amount factors in the owners of dwellings which will now become eligible for compensation from other parties. Under a 10 year liability model the cost, of failures recognised and acknowledged between 10 and 15 years after construction, is carried by the owner. Under a 15 year model this is shared by liable parties and transfers a significant amount of cost from the owners to Local Authorities and third parties.

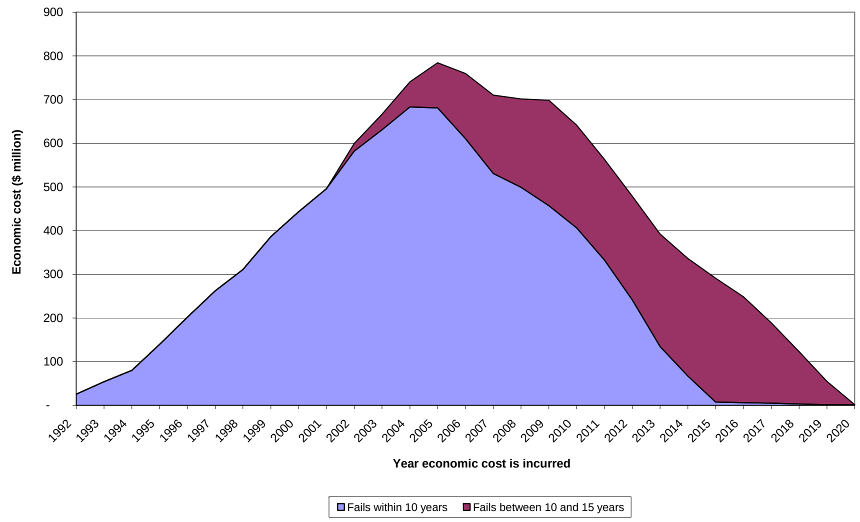
The following two figures graph the difference in the distribution of economic cost over future years comparing the 10 and 15 year timeframe.

Figure 67: Economic cost incurred by liable party by year cost is incurred 1992 – 2020



Source: PwC model.

Figure 68: Economic cost incurred by period of failure 1992 – 2020



Source: PwC model.

Sensitivity

When the economic model developed for this research is used to carry out scenarios, it shows that changes in key modelling parameters, such as the proportion of homes requiring a repair full reclad, can lead to large changes in the overall economic cost.

Figure 71 that follows shows the impact on total economic cost given changes in key parameters. The analysis asks three questions.

- What if the cost of a full reclad was to decrease by $50,000?
- What if the number of failures that require a full reclad decreases by 20 percent?
- What if the rate of failure for high monolithic dwellings decreased by 20 percent?

Each of the variations described in the questions above will have a economic impact on the total cost of weathertightness failure. Table 71 summarises the answers to these questions.

Figure 69: Cost sensitivity analysis ($ million)

Failure Scenario	Base Case Cost of Failure ($ million)	Stand alone full reclad (decrease by 50,000)	Monolithic failure rate (decrease by 20%)	Full reclad impact (decrease by 20%)
22,000	6,168	5,612	4,750	4,684
42,000	11,285	10,248	8,640	8,519
89,000	23,135	20,985	17,652	17,401

Source: PwC model

Modelling Assumptions

There are a number of assumptions that have been made to produce the economic model that is applied to identify the consensus forecast and circulate its implications. The assumptions centre on the nature of the failure rates and the associated costs. It is important to keep these in mind when considering the implications of the consensus forecast of failure and economic cost.

Failures

a) The cost of a failure will be incurred when the failure is identified.

b) Failures that are not recognised within 15 years but have occurred within that period will still impact on owners at a later date even if they are the only liable party.

c) The cost for these unrecognised faults is recognised in the modelling and is incurred with the same distribution of failure time as other faults.

d) Failures that occur beyond 15 years, whether they are recognised or not, are not considered failures under this definition and excluded from analysis.

e) Based on the discussion with experts relating to failures since 2005 and the insignificant number of reported failures, it is assumed that failures have retreated to historical levels from 2006 through to 2008.

f) Failures occurring in dwellings built from 1 January 2009 on wards are excluded from the model. The modelling only covers failures in homes built between 1992 and 2008.

g) Only failures due to the systemic weathertightness failures and the ingress of water are included.

Costs

a) All costs are represented in 2008 dollars and based on 2008 market prices.

b) Interest expenses on money borrowed for remediation work has been included but at a conservative level.

c) The cost of repairs is constant over all scenarios despite changes to supply and demand that may result in different prices of materials, labour and/or professional services.

Appendix H Experts Consulted

The following individuals participated in interviews and workshops as part of the weathertightness project. This list does not include any government officials that participated in workshops or interviews.

Surveyors / Remediation Specialists
Matt Early – Hampton Jones
Kevin Longman – KLHB
James White – Quanta
Ted Arbitrage – CoveKinloch

Lawyers
Tim Rainey – Grimshaw and Co

Architect
Colin Orchiston – Building Disputes

WHRS Assessors
Haydon Miller – Central Adjustors
John Lyttle – Quality Building Solutions Ltd

Building Industry
Derek Baxter – Certified Builders Association
Warwick Quinn – Registered Master Builders Federation
Colin Prouse – Building Element Assessment Laboratory
Ian Page – BRANZ

DBH Expert Group
John Gray – HOBANZ
Wayne Sharman – BRANZ
Irene Clarke – Local Government New Zealand
Russell Cooney – NZ Institute of Building Surveyors
Helen O'Sullivan – Crockers Property Group
Stephen Cody – Wellington City Council
John Buchan, – Christchurch City Council
Bob de Leur – Auckland City Council
Sally Gray – Auckland City Council
Department of Building and Housing
Department of Internal Affairs
Local Government New Zealand

Government Officials
Department of Building and Housing
Department of the Prime Minister and Cabinet
Treasury

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