

**BURRELL DEMOLITION LIMITED**

**RESOURCE CONSENT APPLICATION  
TO  
GREATER WELLINGTON REGIONAL COUNCIL  
FOR  
DEMOLITION AND CONSTRUCTION MATERIALS  
LANDFILL**

**LANDFILL ROAD  
HAPPY VALLEY  
WELLINGTON**

**MWA solutions Limited**  
Consulting Engineers  
P.O. Box 82  
Okaihau 0447

Revision 4 – January 2012

**BURRELL DEMOLITION LIMITED**  
**RESOURCE CONSENT APPLICATION**  
**FOR**  
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# **1 Assessment of Environmental Effects**

## **1.1 These Applications**

Resource Consents for

Resource Consent Application

Water Permit Application to Divert Water

Discharge Permit Application to Discharge Contaminants to Land

Discharge Permit Application to Discharge Contaminants to Air

Land Use Consent Application for works in Beds of Lakes and Rivers

Bridge and Culvert Design Information

are sought under the terms of the Resource Management Act 1991 to supersede existing Resource Consent for the development and operation of an existing landfill for construction and demolition materials at an existing landfill leased by Burrell Demolition Limited from Wellington City Council.

There are provisions with the existing Resource Consent and in the Resource Management Act for the matters that form part of this Application to be handled as a Section 127 Application, and it is by agreement with staff at Wellington Regional Council that this full Application is made in lieu of exercise of those provisions.

The Applicant seeks to extend the area covered by the landfill permitted by current Resource Consents, as indicated on the appended drawings. The reasons for this extension to the landfill are essentially those of future safety of the land and public, and aesthetics, and relate to the climate change and the need to create alternative (overland) flow so that the future use of the land is not compromised.

The extent of the drainage works now required includes the construction of up to 800 lineal metres of 900mm diameter culvert and a new overland flow channel, the location and details of which will be determined as the landfill develops. The culvert will be built over the next eight (8) years, and the open channel will be built as the landfill becomes progressively developed.

The period between the last and this present Resource Consent application has also brought forth several new publications, which need now to be recognised. Relevant sections of these documents are referred to herein as appropriate, together with an explanation of how the existing and proposed aspects of this landfill relate to them.

Changes sought in the nature, management or operation of the landfill include an extension of the range of materials permitted for disposal in the landfill to better reflect the nature of the waste stream received in the present day, and increased monitoring of the shape and location of the landfill, together with increased monitoring of the stormwater quality and additional environmental measures to permit the rehabilitation of the stream by Koaro.

The original Assessment of Environmental Effects "Burrell Demolition Ltd - Resource Consent Applications for a Landfill - Resource Consents - Application for a Permit to Divert and Discharge

Stream Flow and Stormwater Runoff - Application for a Land Use Consent for a Landfill Landfill”, Prepared by David Smith, Civil and Environmental Engineer, Devonport, April 1994 is taken as fundamentally applicable, and is appended hereto as Appendix 2, and the 1995 Resource Consents are appended as Appendix 3.

Alterations and amendments to the 1994 Assessment of Environmental Effects are noted herein.

## 1.2 Relationship with Site Management Plan

This application is accompanied by a Site Management Plan (“BURRELL DEMOLITION LIMITED - CONSTRUCTION AND DEMOLITION MATERIALS LANDFILL - LANDFILL ROAD, HAPPY VALLEY, WELLINGTON - SITE MANAGEMENT PLAN - Revision 4 – January 2012”).

The Site Management Plan (SMP) is intended to provide the landfill operational management and staff with a document that defines what is necessary to operate the landfill in compliance with the conditions of consent. It is therefore taken that matters raised herein will be completely satisfied by the implementation of the appropriate sections of the approved version of the SMP, and that the environmental effects will as a result be less than minor.

## 1.5 Drawings

The drawings are attached as Appendix 1 of this Assessment of Environmental Effects and are also contained in the Site Management Plan so that the latter document can be treated as a “stand alone” document for the operation of the landfill.

The drawings are necessarily schematic, with the intention that on the granting of consents detailed engineering design will be carried out as required to construct the immediately intended construction stages to support applications for engineering approvals from both Wellington City Council and Greater Wellington Regional Council.

## 1.6 Proposed Staging of Extensions

The drawings included in Appendix 1 of this Assessment of Environmental Effects show the construction of the landfill in up to 13 stages. The stages indicated are schematic only, and the operator may elect to build the landfill in a non-consecutive order and/or to construct more than one stage at any time, and or to build non-consecutive blocks of stages to provide continuance of habitat for aquatic species, and as operational conditions on the site become better known.

## 2 Background

### 2.1 Historical

The present construction and demolition (C&D) landfill is situated adjacent to Carey's Gully on Landfill Road approximately 1 kilometre west of Happy Valley Road and has been operated since 1978 by Burrell Demolition Limited.

The location of the landfill is shown on the drawings contained in Appendix 1 of this Assessment of Environmental Effects.

The operation is carried out on an area of land leased from Wellington City Council (WCC) and designated for landfill purposes (namely Pt Lot 29398 Gaz. 1972 p 733).

The watercourse within the lease is piped underneath the landfill in a 900mm diameter, concrete culvert.

The permitted status of the landfill was put in place under the Water and Soil Conservation Act 1967 Water right No WGN 760090.

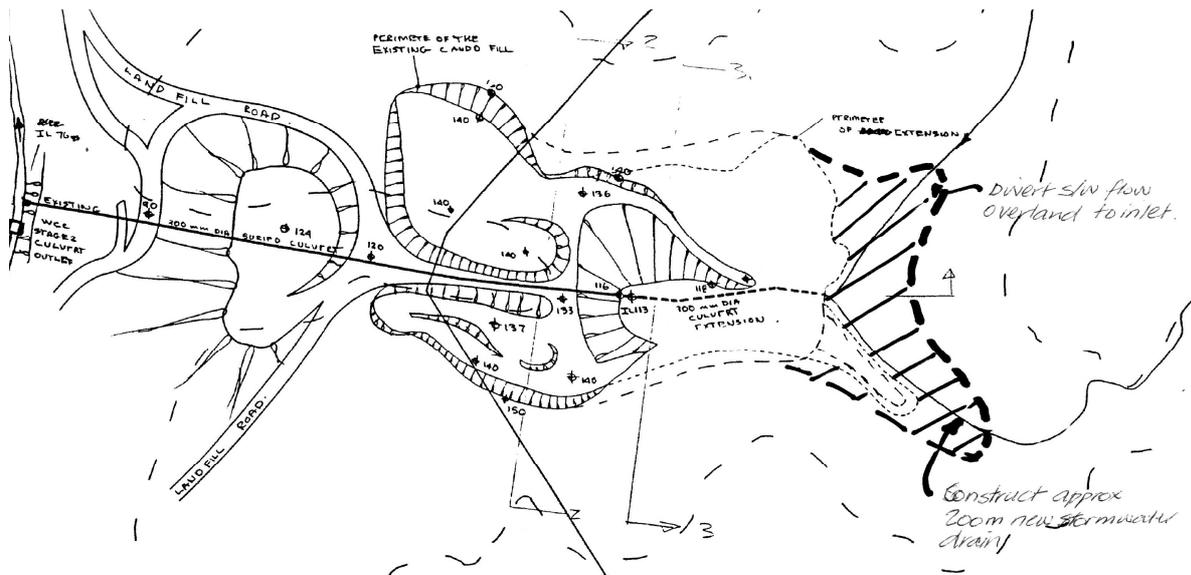
In 1994 Resource Consents were sought from Wellington Regional Council for the land use, to discharge contaminants to land, to divert water and for works in or on the beds of lakes or rivers. The application was heard by a joint tribunal of the Wellington Regional Council and Wellington City Council in May 1995, and was granted in June of that year.

Over the period since those consents were issued:

- the Applicant has learned a considerable amount about the specific requirements and risks involved in the operation of this particular landfill.
- At the same time, the Resource Management Act 1991 is now better understood, and the Applicant wishes to ensure that they hold a Resource Consent that is appropriate to the future operation of the landfill.
- There have also been a number of significant papers and guidelines published in connection with construction and demolition landfills, and with the risks posed from hazardous wastes.
- The effects of climate change have become better understood, at least at a qualitative level.

The most pressing concern is that the approved landfill acts as a "dam" in a natural valley, and the discharge of stormwater is solely reliant on a drain placed under the landfill. There is no route available for alternative overland flow for stormwater, and the fact that the culvert that lies beneath the landfill is in inlet control means that there is a significant head to hold any blockages in place in flood conditions.

While this situation can be controlled by maintenance during the operational life of the landfill, it is thought that there is a future potential for this maintenance to be burdensome upon the landowner (Wellington City Council), with the result of flooding in the valleys beyond the landfill and some increased risk of contamination of the stormwater flows.



It is also probable that global warming and the climate change accompanying it will increase the amount of stormwater runoff in this catchment, and hence the drainage situation. This matter is discussed briefly later.

There is no intention to alter the range or proportion of the materials that are received at the landfill. These are set by the present resource consent as:

- “12. All material disposed of at the landfill shall be cleanfill with no potential to produce harmful effects on the environment and shall be restricted to a natural material such as clay, soil, and rock, and other inert material such as concrete, brick or non-combustible demolition products (with no more than 5 percent timber or other non-hazardous construction materials).”

This has proved to be a fairly accurate reflection of the nature and proportions of materials actually received.

The environmental effects of landfill of these various materials is discussed in this Assessment of Environmental Effects.

It has also been found that complete immediate compaction of the fill materials is not practicable, and that the consolidation rate in the landfill after the fill is placed is accordingly substantially greater than the rate of 0.25% of the depth suggested in the 1994 AEE (Section 4.9.3, Page 45, para. 4)

## 2.2 Present Consent

The Resource Consent issued by Wellington Regional Council’s Joint Hearings Committee (File 940057, Dated 20 June 1995) for the operation of the landfill as a construction and demolition materials landfill, and that Consent contained a number of operating conditions that have formed the basis for the operation of the landfill up to the present date.

The Consent contains the following statement, which is still valid today:

*“The Proposal and Background Information*

*Since the beginning of the 1970's the area generally known as Careys Gully has been used for landfilling for various type of waste. The catchment area of the Owhiro Stream west of Happy Valley Road and upstream of its confluence with the Landfill Road Stream contains three operating landfills and two closed landfills.*

*These landfills are;*

*Operating C and D landfill, WCC Stage 2 Sanitary landfill, Ace landfill  
Closed WCC Stage 1 Landfill, WCC Landfill.*

*The C and D landfill is immediately to the west of the closed WCC Stage 1 Sanitary landfill. The landfill is situated within a steeply sloping valley and on land leased from the Wellington City Council (WCC). A stream in the valley is piped underneath the cleanfill in a 900 mm diameter concrete encased culvert. The location is generally described in the Fourth Schedule Amendment of Environmental Effects (AEE) which accompanied the application. This refers to the two un-named streams in the area as Landfill Stream and Demolition Gully Stream. Landfill Stream identifies the closed WCC landfill and its tributary, the Demolition Gully Stream is that involved in the present applications. For purposes of the consents, all locations are identified by the grid reference and description as an unnamed tributary of Careys Stream.*

*Burrell Demolition Limited have operated the C and D cleanfill since 1978 taking non-hazardous demolition material as fill. This material comprises concrete (reinforced and unreinforced), brickwork, masonry, some timber some roofing iron, and ridging and spouting. There has also been a small amount of asbestos in the form of fibrolite cladding. The present operation has up until mid 1993 taken only construction and demolition refuse from those demolition projects being carried out by Burrell demolition itself. Urban renewal in Wellington and the accompanying generation and disposal of construction and demolition waste peaked during the late 1970's and early 1980's. With the general downturn of economic activity from 1988 onwards these activities declined and effectively ceased during 1991 and 1992. 1995 has seen some upturn in economic activity and with it demand for construction and demolition waste disposal. During this period Burrell Demolition have been taking demolition generated by other demolition contractors. It is estimated that to date 250,000 cubic metres of material has been placed in the landfill.*

This statement remains correct, and the volumes received over the past 9 years reflect the predicted volumes fairly accurately. The present rate of waste stream materials is about 20,000 cubic metres of material as truck measure received annually, and this converts to about 25,000 cubic metres when initially placed in the landfill, which after initial compaction and long-term consolidation converts to about 15,000 cubic metres.

Note that the original AEE and, as a consequence, the resource consents granted from it, considered the Landfill to be a cleanfill. Later material from the Ministry for the Environment, which is discussed in more detail below, may alter this position.

The original AEE also discussed the staging of the works as:

#### 4.9.1 General

##### 4.9.1.1 Staging and Projected Life of the Landfill

*The projected life of the C and D filling operation in its present configuration is approximately 12 months by which stage the southern bench will be developed to its full extent westwards at present levels, and the northern bench will be raised to its finished level approximately 7.5 metres above its present level.*

*The present proposal is to extend the 900mm dia piped culvert along the stream bed to a new inlet point approximately 120 metres upstream. The filling operation will then be commenced by end tipping from the access roads on the south side of the fill and the western end. Any borrow material required will be taken predominantly from the southern side at levels below the final finished design level.*

*The projected life at this stage is 10 years on an average annual placement of 20,000m<sup>3</sup> which is similar to the calculated average for the existing facility to date. A further 10 years at this same rate will be achieved by raising the new area by 10 metres and an additional 5 years will be achieved by raising northern and southern zones of the present area by between 5 and 10 metres. Hence the projected life of the currently proposed stages is approximately 25 years within an overall lease area which has a potential for up to 100 years and storage at an average rate of 20,000m<sup>3</sup> per year. In the event of the rate of placement being exceeded over the long term due to either major redevelopment in Wellington, major disaster damage or the use of the facility as the main regional C and D landfill progressive development up the valley floor to a capacity of 1 to 2 million m<sup>3</sup> is considered to be quite feasible subject to the appropriate consents being gained. Within a 25+ year time framework it is quite likely that the filled material may well be removed, recycled and use for clean fill and related materials.*

The construction of the landfill roughly followed this programme, with the level at present somewhat above the RL 160.0m level. And perhaps as high as RL 210 in some places.

As a part of these consents retrospective consent is sought to formalise the present height of the landfill.

## 2.3 The Site

The 1994 Assessment of Environmental Effects contains the following description of the Site:

#### 4.2.1 General

*The site is located in a valley some 4 kilometres south west of the Wellington city centre. The site lies to the east of one of the many North East/South West orientated ridge lines on the Wellington peninsula. This particular one runs from Sinclair Head in the south through Te Kopahau, Hawkin's Hill and Polhill to finish at Kelburn in the north. Hawkin's Hill forms the highest point on the western peninsula of the landfill sites catchment boundary at 495 metres above mean sea level while the site itself lies at an average level with its valley of 120 metres*

AMSL. The distance from the top of the valley catchment to its junction with Landfill Road is approximately 1.3kms.

The site is located within a steeply sloping east/west trending valley whose vegetation is mainly gorse with some pasture and manuka scrub, and areas of regenerating bush particularly on the lower northern slopes of the ridges. The vegetation is pasture land reverting to bush and native forest. Soils are thin, sparse and bony and are formed by the weathering of the underlying greywacke/argillite rock.

Although the slopes of the hills and ridges are steep (30 to 35°) there is no obvious visual evidence of slips and erosion debris and hence the area would appear to be relatively stable in erosional terms to frequent rain and seismic events. There are no dwelling houses within sight of the facility which has a two lane sealed access via Landfill Road from Happy Valley Road and the nearest building not associated with the WCC sanitary landfill (located 200 metres from the C & D landfill) is 600 metres down Landfill Road and out of line of sight.

The site is part of a substantial area currently designated for use as landfill sites by WCC and adjacent to the substantially larger WCC landfill. In each case the natural water courses have been piped beneath the landfills and are referred to as Demolition Stream and Landfill Stream in this report as they are unnamed on the NZMS 260 series topographical map.

#### 4.2.2 Historical Site Use

It can reasonably be assumed that the whole site area was mainly in indigenous forest until the advent of European farming although parts may well have been burnt in Maori times. The area when taken over by Wellington City Council 15 years ago was predominantly in grass for sheep and since then has suffered incursion by gorse but is currently regenerating in native forest and fire remains the only current threat to the success of this transformation.

The area has been designated for landfill purposes and now consists of three such facilities, namely, a closed sanitary landfill, an operating sanitary landfill and present C and D landfill. Another landfill exists within the tributary catchment which drains to the Happy Valley Stream near the Landfill Road junction. This facility belongs to Ace Demolition but it is on private land Dot contained within the designated zone. The C and D landfill commenced in 1978 under a lease agreement with Wellington City Council and up until this year took only C and D fill from demolition projects in Wellington carried out by the landfill operator - Burrell Demolition. Over the fifteen years during which the facility has been in operation it is estimated that approximately 250,000 cubic metres of mainly concrete, bricks, gypsum, plaster, some timber and the like have been placed on site.

#### 4.2.3 Site Geology

The geological setting of the site is within the Carboniferous/Early Cretaceous sedimentary rocks of the Torlesse Supergroup, which are greywacke and argillite partly alternating with graded greywacke. The site exposures indicate heavily

*fractured and jointed greywacke/argillite with major joint or bedding planes dipping at about 20° to the north west (the exposures referred to are at the site entrance and on the site perimeter.)*

*The site is bounded on the west by three major active fault lines namely the Wellington Fault, the Ohariu Fault and the Makara Outlier. The presence of smaller faults within the major assembly is not fully known but it is assumed that the C and D gully itself is on or close to a minor fault line which can be considered to be active in a seismic context. References and visual examination of the site and valley area indicate the absence of karst type, limestone terrain.*

*The site area is steep and on visual evidence lacking any areas where landslips or landslides or other surface erosion have occurred in the recent past. The thin surface soils and underlying rock of the area appears to be stable and not prone to erosion from frequent flood and seismic events.*

#### 4.2.4 Climatic Conditions

*The closest representative meteorological station to the site is Karori Reservoir - E14271 - for which records are available from 1879 to 1980. These figures are set out in Tables 1 and 2 below which are taken from former New Zealand Meteorological Service publications. Table 1 gives depth/duration/frequency data for the period 1962-1978 and Table 2 gives the frequency of heavy rainfalls for the period 1879 to 1980.*

The tables of rainfall intensity presented showed the records available at that time, and a review of NZ Meteorological Service's records indicate that falls equivalent to 64mm/hour were recorded in 1998.

This, together with the effects of more recent storms (particularly those of February 2004) has underlined the need for additional measures in respect of stormwater control at this landfill.

The Ministry for the Environment has issued the following statement in connection with likely climate changes in the Wellington Region:

#### *Climate Change in Wellington, Kapiti & Wairarapa*

*Wellington and Kapiti are often windy because of their exposure to disturbed weather systems from the Tasman Sea and the Cook Strait, but apart from this they have relatively few climate extremes with warm summers and coolish winters. The Wairarapa region enjoys predominantly warm dry settled weather in summer and relatively mild winters.*

*A change in our climate as a result of global warming and other influences means we need to think about how we are going to plan for and manage the projected impacts of climate change in Wellington, the Kapiti coast, Wairarapa and New Zealand. But we also need to take appropriate action to reduce our share of greenhouse gas emissions responsible for global warming and climate change impacts.*

*Some of the predicted impacts of a moderate rate of climate change for Wellington, the Kapiti coast and Wairarapa include changes in average temperature, sea level rise and rainfall patterns. In general, the region will be warmer and the west of the region, like much of the west coast of New Zealand, is likely to become wetter.*

*Climate scientists estimate that temperatures in Wellington, the Kapiti coast and Wairarapa could be up to 3°C warmer over the next 70-100 years. This compares to a temperature increase in New Zealand during last century of about 0.7°C. To put this in perspective, the 1997/98 summer, which many New Zealanders remember as particularly long, hot and dry, was only about 0.9°C above New Zealand's average for the 1990's.*

*The west of the region could be up to 20% wetter while eastern areas could be up to 20% drier. The region as a whole is likely to experience more varied rainfall patterns and flooding could become up to four times as frequent by 2070.*

Given the location of this landfill, it is considered that the hydrology and consequent pipe flows presented in the 1994 AEE should be increased by a minimum of 20% to cover this expected long-term trend in climate change, and that overland flow should be provided over the completed landfill to give better protection to the stability of the landfill and reduce the possibility of the discharge of contaminants into natural waters.

## 2 Operation of the Landfill

### 2.3 Landfill quantities

This landfill has now been in operation for some 27 years. To that extent this facility is serving the construction and demolition industry in Wellington, and there is every reason to believe that it will be required to continue for many years to come as the development and re-development of Wellington continues.

The rate of growth in the construction industry is to some degree influenced by external economic factors and is therefore difficult to predict over a long period, but taking an average a figure of between 2 and 3% per annum would seem probable.

The rate of growth in the demolition industry is considered unlikely to rise above the 2% level, and may in time reduce slightly because of the effects of recycling, particularly of cementitious materials as the demand for aggregates depletes readily available supplies.

While the Greater London Authority's report "Waste Options Modelling Technical Report for the London Plan – February 2004, pp10-13" clearly indicates both the importance of reducing construction and demolition waste by recycling materials suitable for "backfill" it is considered that it may be some time before the economics of backfilling with recycled demolition materials (particularly concrete and masonry components) becomes economically attractive in comparison with the costs of quarried materials in the Wellington Region.

It is therefore likely that the demand for landfill capacity will continue to rise at about, on average, 2% per annum over the life of the present resource consent. This gives total growth as follows:

21.9% growth over present receiptal volumes	10 years from the present time
48.6% growth over present receiptal volumes	20 years from the present time
81.1% growth over present receiptal volumes	30 years from the present time
120.8% growth over present receiptal volumes	40 years from the present time
169.2% growth over present receiptal volumes	50 years from the present time

which leads to cumulative values of:

over 10 years total received volume =	1.17 times present annual volume
over 20 years total received volume =	4.78 times present annual volume
over 30 years total received volume =	11.38 times present annual volume

To some degree this landfill may, however, be regarded as a future resource as it could provided a source of hardfilling at some time in the future if the economics or recycling are favourable.

### 3.2 Nature of materials received

The materials received into the landfill are essentially those that arise from the demolition of buildings, and the construction of new buildings. The proposed acceptable materials are:

Sheet roofing material, generally in the form of galvanised steel, aluminium or zinc pre-formed sheetings, together with flashings, small quantities of which may include a lead-edge.

Framing timbers (both treated and untreated), generally as sawn or peeled timbers used for structural members, and timbers used in construction for formwork and shoring.

Small amounts of sawdust from construction

Wrought and cast iron

Steels, in the form of reinforcing rods, tendon and bar used for the pre-stressing of concrete, structural steel sections, pipe and tube

Galvanised structural steel section, pipe and tube

Concrete, in the form of plain, reinforced and pre-stressed concrete elements

Masonry – both brick and concrete, reinforced and un-reinforced

Gypsum-plaster based materials used as interior wall and ceiling materials

Cellulose-cement materials used as exterior sheetings or pipes

Cement-bonded materials used as exterior sheetings or pipes

Glass, in the form of glass used in buildings

Fibreglass insulation

Plastic materials used as electrical fittings

Plastic, ceramic and vitreous china materials used as plumbing and drainage fittings

Floor coverings that are fixed with adhesives to concrete or timber flooring elements

Excavated materials including clays, silts, and rock

Topsoils, which may include small quantities of natural organic and vegetative materials

Non-putrescible packaging materials such as polystyrene, polythene, polyurethane and similar products

Polystyrene, polythene, polyurethane and similar products as building components, in all forms, as used in construction and demolition activities and for the packaging of construction products.

Asphalt, in the form of used road strippings – either as chip seal, plantmix or hotmix.

Electrical or electronic wiring removed as part of demolition operations.

Floor coverings, in the form of carpet, vinyl or linoleum, fixed to flooring elements.

Cardboard and other paper-based products used as packaging in the construction industry

The total quantity of organic materials – trees and vegetative materials, timber, carpets, packagings etc. within the landfill materials shall not exceed 5% by weight of the landfill materials as a whole.

### 3.3 Materials specifically rejected

Materials that are specifically rejected include any form of refrigeration or electrical equipment or plant in an assembled state that may contain pcb's or freons, putrescible materials not included in the above, and liquid wastes of any type.

### 4.4 Recycling of Materials

Some materials are received at the landfill and are immediately sorted and stockpiled for recycling. These are items from the waste stream that generally contain metals – particularly steels, copper, brass and aluminium items – and some un-used plastic items such as ducting and piping.

More recent demand for scrap metals overseas has led to a major appreciation of the value of recovery and recycling, and the decision as to whether recycling of materials received is worthwhile will depend on the volume received and an assessment of whether recycling of that item is economically viable.

There has recently been some on-site recycling of cementitious materials (brick, masonry and the like) and the materials so obtained are removed directly to other places for use as filling materials. However, this type of activity has yet to find wide-spread acceptance in New Zealand as

- The cost of quarried material is generally less than the cost of recycled material, and
- The time required for carrying out the salvage and breaking down on site tends to hinder completion of the demolition work within currently acceptable timeframes.

Again, this current position may change if natural aggregates become scarcer and therefore more valuable.

While it has been normal in North America for some time for demolition contractors to be responsible for the dismantling and demolition of entire industrial plants, this has yet to become widespread practice here. Nevertheless, it is proposed to include the storage of some mechanical and electrical equipment as a part of the recycling operations on this site.

There is also likely to be a demand for shredded rubber, including tyres in the future. These are of considerable calorific value as fuel, but have some problems with the entrainment of the heavy

metals used in tyre reinforcing (belting) in the exhaust gasses, and until the design of exhaust gas scrubbers has advanced somewhat this is unlikely to be a normal operation at this site.

Nevertheless, it is proposed that tyres be accepted for shredding at this site as a part of the recycling operation, and that once shredded these will be removed to another place for disposal. The details of this operation will need to be determined in the light of knowledge at the time that recycling becomes economic.

It is noted that a recent study prepared for Enviro Landfill Trust (Waikato District and Regional Councils) indicated that there is little risk of contamination of air or water provided that appropriate water treatment is available. In that case on-site settlement ponds were shown to be adequate.

5 Regulatory Guidelines and the Nature of C&D waste

4.4 Wellington Regional Council Regional Policy Statement for the Wellington Region

Wellington Regional Council's policies, as they affect this Resource Consent Application, include the policy on Water, Soil and Air Quality, which appear to relate to this Application as follows:

(d) Water Quality

"Issue 1

Poor water quality is of concern to many people. The quality of fresh water is high on the list of the community's most significant environmental worries. Disposal of wastes into water is becoming more and more unacceptable to the regional community. For iwi, discharges of sewage are an affront to the mauri (life principle) of water bodies. However, sewage in fresh and coastal water is also of concern to the community more generally.

Freshwater bodies identified by the Wellington Regional Council as having impaired water quality include:

- Waikanae River Estuary, Ngarara Stream and Mazengarb Drain,(Kapiti District);
- Hulls Creek (mid-section) (Upper Hutt City),
- Waiwhetu Stream and Wainuiomata River (Lower Hutt City);
- Ngauranga and Makara Streams (Wellington City);
- Makoura Stream (Masterton District);
- The lower Ruamahanga River (South Wairarapa District); and
- The shallow groundwater aquifer in the vicinity of the former Waingawa freezing works (Carterton District).

Poor water quality reduces the use that can be made of the water and, in particular, downgrades instream values, for example, aquatic ecosystems, swimming, fishing and mahinga kai."

"...Water quality is primarily affected by discharges, although the severity of any discharge is related to the quantity of the water in a water body. Pollution discharges can result in reduced species diversity and ecosystem instability. Discharges include:

- Pollution spills, for example, from manufacturing processes, petrochemicals, timber treatment chemicals.
- Stormwater run-off from industrial zones and city streets, for example, heavy metals and chemicals.
- Sediment from land clearance, track and road construction, quarries and new subdivision, for example, silt, loess.
- Discharges from sewage treatment plants, septic tanks, and leaks from sewage pipelines, including trade wastes.
- Diffuse pollution (non-point source), for example, silt from eroding hill country, and nutrients, including nitrate and phosphorous from agricultural activities, animal excreta, and chemicals..."

"Objective 1

*The quantity of fresh water meets the range of uses and values for which it is required, safeguards its life supporting capacity, and has the potential to meet the reasonably foreseeable needs of future generations...."*

*“Policy 1*

*To manage the quantity of fresh water .so that it is available for a range of uses and values, and:*

- (1) Its life supporting capacity is safeguarded; and*
- (2) Its potential to meet the reasonably foreseeable needs of future generations is .sustained; and,*
- (3) For surface water, any adverse effects on aquatic ecosystems are avoided, remedied, or mitigated....”*

(e) Soil Quality

*“Issue 11*

Contamination of soil by agrichemicals, and by industrial waste and contaminants, can damage soil microorganisms, as well as insects, worms and other invertebrates which play a vital role in maintaining the soil's ability to support plant and animal life. There can also be adverse off-site effects when non-target organisms are affected and when groundwater is polluted. In addition, there are concerns about the impact of chemical residues on public health and on wildlife and ecosystems. When persistent agrichemicals are applied they can be carried in run-off from the soil into waterways and affect ecosystems far removed from their point of application. Damage can also occur when persistent chemicals that have been stored in the soil are released, perhaps years later, by earthworks or other disturbances. Discharges of waste or chemical pollutants onto land may reduce the life supporting capacity of soil, be visually offensive, create unpleasant odour and have potentially serious consequences for water quality and aquatic ecosystems.

Soil acts as a filter for water percolating through the soil profile. It removes contaminants or assists in their breakdown to less harmful forms. Soils vary, but all are limited in their capacity to perform this assimilative function. Rates of waste disposal in excess of this capacity, or disposal of forms of waste which persist in a harmful form, will result in the accumulation of contaminants and a consequent reduction in the ability of soil to support plant life and to purify water....”

*“Objective 1*

*The soils of the Wellington Region maintain those desirable physical, chemical, and biological characteristics which enable them to retain their life supporting capacity and to sustain plant growth.*

*Policy 1*

*To avoid, remedy or mitigate erosion and other \_ forms of soil degradation on susceptible sites and avoid off-site effects of erosion and other soil degradation, including the contamination of water, contamination of the beds of water bodies and the coastal marine area and contamination of air.*

(f) Air Quality

*“Objective 1*

*High quality air in the Region is maintained and protected, and there is no significant deterioration in air quality in any part of the Region.*

*Objective 2*

*Air quality is enhanced in those areas with degraded air quality.*

Objective 3

*The adverse effects of the discharge of contaminants into air on human health, local or global environmental systems and public amenity are avoided, remedied or mitigated...."*

"Issue 1

There is very little data on which to base an understanding of the current, or historical, status of air quality in the Region. Information about ambient (general) air quality is almost totally lacking. Information about emissions is very patchy and dated. Studies are limited to surveys of air quality in Upper Hutt during the winter in 1977-79, a survey at Kiwi Point Quarry in 1978-79, a survey of motor vehicles and air quality in Mount Victoria Tunnel in 1981-82 and some ambient air quality monitoring in Newtown and Naenae during the mid-1980s as part of the National Lead in Air Survey...."

"Issue 4

Another important amenity issue is the effect of smoke, dust and other particulate matter. Smoke is an issue in relation to rural and forestry burn-off in the Region and the cumulative effects of backyard or other domestic burning can also create nuisance effects in some areas. Dust and other particulates are typical contaminants from rural activities and are also associated with subdivision and mining activities. Particulates can cause damage to materials, nuisance effects and human health effects. They can also affect visibility (an important amenity value for residents and visitors to the Region) and are an obvious sign of deteriorating air quality."

"Objective 1

*High quality air in the Region is maintained and protected, and there is no significant deterioration in air quality in any part of the Region.*

Objective 2

*Air quality is enhanced in those areas with degraded air quality.*

Objective 3

*The adverse effects of the discharge of contaminants into air on human health, local or global environmental systems and public amenity are avoided, remedied or mitigated...."*

"Policy 1

*To identify and describe the existing air quality of the Wellington Region.*

Policy 2

*To identify pollution sources that currently degrade, or have the potential to degrade, air quality in the Region.*

Policy 3

*To identify and improve understanding of the links between atmospheric processes, air quality and the range of human activities that occur in the Region...."*

The ways in which this landfill meets these issues, objectives, and policies is set out in later parts of this Assessment.

#### 4.5 Ministry of Environment

The New Zealand Ministry of Environment have published three documents that appear to be helpful:

“Final Report – Basis for Landfill Classification System”, November 2001  
“A Guide to the Management of Cleanfills”, January 2002.  
“Land Use Planning Guide for Hazardous Facilities”, February 2002

In the “Final Report – Basis for Landfill Classification System”, the consultants responsible for preparation stated the assumption that

*“...the classification methodology will relate only to landfills intended to accept municipal solid waste (MSW) and not cleanfills, construction and demolition (C & D) waste landfills or industrial waste landfills or monofills...”*

As the nature of Construction and Demolition Landfills was clearly established at the time at which this document was prepared it would appear that it was intended that construction and demolition landfills would not be classified as municipal waste. However, it is also clear that the report intended that there be a distinction between cleanfills and construction and demolition waste landfills.

In “A Guide to the Management of Cleanfills”, cleanfill was defined as:

*“Cleanfill material is material that does not undergo any physical, chemical, or biological transformations that will cause adverse environmental effects or health effects once it is placed in a cleanfill. Cleanfill material has no potentially hazardous content and must not be contaminated by or mixed with any other non-cleanfill material.*

*Cleanfill material and cleanfills are defined as follows.*

*Cleanfill material*

*Material that when buried will have no adverse effect on people or the environment. Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of:*

- *combustible, putrescible, degradable or leachable components*
- *hazardous substances*
- *products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices*
- *materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances*
- *liquid waste.*

*Cleanfill*

*A cleanfill is any landfill that accepts only cleanfill material as defined above.”*

In “Land Use Planning Guide for Hazardous Facilities” the Hazardous Substances and New Organisms Act 1996 is recognised, and this in turn defines hazardous properties as:

- Explosiveness

- Flammability
- Oxidising capacity
- Corrosiveness
- Ecotoxicity
- Substances which, upon contact with water or air, develop any of the above hazard properties.

The only category of concern here is ecotoxicity, because the materials received at the landfill do not fall into any of the other categories.

It is clear that the nature of the materials received at this C&D landfill are such that:

Most of the materials received are inert by their nature – concrete, brick etc , and

It may further be argued that the other materials that are received are also inert while they remain within the matrix of this landfill, and while some elements of those materials are potentially ecotoxic those elements are not capable of being transported by air or water, and therefore do not pose a threat to the ecosystem outside the landfill itself.

Accordingly it is submitted that the subject landfill is technically not a cleanfill in that it contains materials that are potentially ecotoxic, but that it does not release ecotoxic substances.

#### 4.6 United States Environmental Protection Agency

##### (a) USEPA on the nature of Construction and Demolition Wastes

The United States Environmental Protection Agency (USEPA) would seem to be one of the foremost authorities on the matter of Construction and Demolition Waste, and it estimated that there were some 1889 C&D landfills within it's area of jurisdiction in 1994.

While the composition of C&D wastes in the United States is possibly somewhat broader than has been customary in New Zealand due to the amount of industrial plant handled by demolition contractors (it has been usual to remove such plant before a demolition contractor begins his work in New Zealand) the USEPA report "Construction and Demolition Waste Landfills" defined C&D Wastes as (p. ES1):

##### *"COMPOSITION OF C&D WASTE*

*Information on the composition of C&D waste is presented below. Most of this information was compiled from the literature by the National Association of Demolition Contractors (NADC); a small number of other readily available sources were used as well. These source documents provide only snapshots of the C&D waste stream in specific locations and at specific points (e.g., generation) rather than providing a complete cradle-to-grave picture of C&D wastes nationwide, or of the portion landfilled.*

*C&D waste is generated from the construction, renovation, repair, and demolition of structures such as residential and commercial buildings, roads, and bridges. The*

*composition of C&D waste varies for these different activities and structures. Overall, C&D waste is composed mainly of wood products, asphalt, drywall, and masonry; other components often present in significant quantities include metals, plastics, earth, shingles, insulation, and paper and cardboard.*

*C&D debris also contains wastes that may be hazardous. The source documents identify a number of wastes that are referred to using such terms as "hazardous," "excluded," "unacceptable," "problem," "potentially toxic," or "illegal." It is not necessarily true that all of these wastes meet the definition of "hazardous" under Subtitle C of RCRA [Resource Conservation and Recovery Act], but they provide an indication of the types of hazardous wastes that may be present in the C&D waste stream. They can be divided into four categories:*

- Excess materials used in construction, and their containers. Examples: adhesives and adhesive containers, leftover paint and paint containers, excess roofing cement and roofing cement cans;*
- Waste oils, grease, and fluids. Examples: machinery lubricants, brake fluid, form oil, engine oil;*
- Other discrete items. Examples: batteries, fluorescent bulbs, appliances; and*
- Inseparable constituents of bulk items. Examples: formaldehyde present in carpet, treated or coated wood."*

The report continues (pp2-1 to 2-2) to define the factors that influence the nature and type of demolition materials as:

#### *"FACTORS THAT INFLUENCE C&D WASTE COMPOSITION*

*C&D wastes are categorized in a variety of ways, and each category produces wastes with different composition and characteristics. For example, road C&D waste differs from bridge waste, which differs from building waste. Whereas road C&D generates large quantities of just a few different waste items (mainly asphalt and concrete), building C&D generates many different waste items in smaller amounts (with wood as the largest single item). Within the category of building C&D waste, the size and type of the building (e.g., an apartment building versus a single-family house) affects the composition of the waste. Even for one building type (e.g., a single-family house), the waste generated depends on the activity conducted (i.e., new construction, renovation, or demolition). For example, construction generally produces "clean;" unaltered, and separate waste items (e.g., unpainted wood, new concrete) (MVC, 1992). In contrast, demolition wastes may include more items that have been altered or mixed (e.g., wood painted with lead-based paint, concrete with hazardous waste spilled on it) (MVC, 1992).*

*Thus, three main factors affect the characteristics of C&D waste (MVC, 1992):*

*Structure type (e.g., residential, commercial, or industrial building, road, bridge);*

*Structure size (e.g., low-rise, high-rise); and*

*Activity being performed (e.g., construction, renovation, repair, demolition).*

*Additional factors that influence the type and quantity of C&D waste produced include (MVC, 1992; McGregor et al., 1993):*

*Size of the project as a whole (e.g., custom-built residence versus tract housing); Location of the project (e.g., waterfront versus inland, rural versus urban); Materials used in construction (e.g., brick versus wood);*

*Demolition practices (e.g., manual versus mechanical); Schedule (e.g., rushed versus paced); and Contractors' "housekeeping" practices.*

*Other factors do not affect the type and quantity of C&D waste produced, but do affect the type and quantity reported in the source documents and therefore in this report. These include:*

*How state regulations define what is and is not acceptable as C&D waste;*

*Where in the waste stream the C&D waste is measured (e.g., generation point, recycling station, landfill); and*

*How the C&D waste is measured (e.g., by volume or weight)....*

#### **COMPONENTS OF C&D WASTE**

*Overall, C&D waste streams are comprised mainly of wood products, asphalt, drywall (gypsum), and masonry (e.g., concrete, bricks). Other notable components include metals, plastics, earth, shingles, and insulation. In one county, waste identified by the source document as "hazardous" has been estimated to comprise 0.4 percent of construction waste by weight (Triangle J Council of Governments, 1993)<sup>6</sup>; this is discussed further in the final section of this chapter. Table 2-1 provides a complete list of components of C&D wastes mentioned in the source documents. The bold print denotes the "problematic" components, i.e., components that the source documents refer to as "hazardous," "excluded," "contaminants," "chemical constituents that could affect the use of the waste as fuel," "special," "unacceptable," "problem," "potentially toxic," "nonhazardous restrictive," or "illegal."*

*In general, wood comprises one-quarter to one-third of the C&D waste stream. Other generalizations are hard to make because (1) different studies address different segments of the nation's C&D waste stream (e.g., road and bridge waste may be excluded from some studies; information in another study may be for waste from construction only or demolition only) and (2) C&D waste composition varies greatly from one category to another. The graphs and tables in this section provide examples of the composition of portions of the C&D waste stream. Note that they vary with location (e.g., Florida versus Vermont) and category of waste (e.g., construction versus demolition). Viewed together, they provide a good overall picture of the North American C&D waste stream, and show important differences among different categories of C&D waste.*

#### **C&D Waste Including Road and Bridge Waste (Vermont)**

*Figure 2-1 provides a picture of the composition of Vermont's complete C&D waste stream by weight, based on a comprehensive C&D generation study. Asphalt*

comprises approximately one-half of the waste stream, wood one-quarter, and concrete one-sixth (Casper et al., 1993).

#### *C&D Waste Excluding Road and Bridge Waste (Florida)*

Figure 2-2 provides an example of the composition by volume of the C&D waste stream received at a C&D recycling facility in Florida. Although the source document (Casper et al., 1993) states that the facility accepts "the complete CID waste stream," it appears that the facility receives the complete building C&D waste stream, but does not receive wood or bridge waste, because asphalt is not listed as a component of the waste. Approximately one-third of the waste volume is wood (Casper et al., 1993). Drywall comprises one-sixth and paper and cardboard together comprise one-sixth of the total volume (Casper et al., 1993).

#### *Construction-only Waste Versus Demolition-only Waste*

Approximately one-third of the construction waste volume in Toronto is wood, and masonry and tile comprise less than one-sixth of the construction waste (Figure 2-3) (THBA, 1991). Demolition waste is also comprised of approximately one-third wood (in the U.S.), but concrete makes up over one-half of demolition waste (Figure 2-4) (Chatterjee-U.S. Army as cited in SPARK, 1991).

#### *C&D Waste by Housing Type*

Table 2-2 compares residential construction waste to commercial construction waste in the Twin Cities, Minnesota. Wood comprises one-fifth to one-third of the waste stream in both cases. Concrete, brick, and steel waste are greater from commercial construction than from residential, as would be expected.

### COMPONENTS OF C&D WASTE THAT ARE POTENTIALLY "PROBLEMATIC"

Hazardous wastes comprise a small percentage of the C&D waste stream (McGregor et al., 1993), and can potentially cause adverse effects to human health and ecosystems (Lambert and Domizio, 1993). For example, inhalation of urea formaldehyde (a resin used in insulation and as a wood preservative) has caused a health syndrome called "ultra-sensitive allergies" in demolition workers (Lambert and Domizio, 1993). Creosote (a wood preservative) can potentially leach into ground water and discharge into surface water, possibly adversely affecting drinking water or aquatic life if concentrations reach high enough levels (Lambert and Domizio, 1993).

This section describes the "problematic" components and constituents of C&D waste and, where information was available (i.e., for treated and coated wood), the proportion of those constituents in the waste item. Table 2-3 lists "problematic" components and constituents of C&D waste. These "problematic" wastes are not necessarily wastes that are classified as hazardous under RCRA Subtitle C. Some may be "problematic" simply because they are recyclable (e.g., cardboard) or because they are outside the definition of C&D waste as defined by a particular jurisdiction (e.g., garbage).

It is also important to note that wastes that some jurisdictions exclude from C&D landfills or recycling centers are sometimes brought to the C&D disposal areas nonetheless. In some cases these wastes are detected and rejected (Casper et al., 1993; Lauer, 1993), but in other cases they may not be screened out (Gates et al., 1993), and evidence shows that they are found in C&D landfills (Piasecki et al., 1990).

For discussion purposes, the "problematic" C&D wastes are divided into four categories:

*Excess hazardous materials used in construction and their containers;  
Waste oils and greases and other fluids from machinery;  
Other discrete items; and  
Incidental constituents that are inseparable from bulk C&D wastes (e.g., wood treatment chemicals).*

#### *Excess Potentially Hazardous Materials*

*Construction activities can produce excess "hazardous" materials and "empty" containers containing small quantities of "hazardous" materials. (The source, McGregor et al., 1993, does not define "hazardous," so these wastes may or may not be defined as hazardous under RCRA Subtitle C.) Adhesives and adhesive containers, leftover paint and paint containers, and excess roofing cement [adhesive] and roofing cement cans are a few examples. In some cases construction workers dump leftover paints or solvents on the ground (McGregor et al., 1993). Others may use sawdust, kitty litter, or masking tape to "dry" up empty paint cans and solvent containers (McGregor et al., 1993). "Hazardous" wastes may be disposed of in a dumpster, left at the construction site for a cleanup contractor, self-hauled to a landfill, or returned to the shop' (McGregor et al., 1993). Table 2-4 characterizes the 46 pounds of wastes referred to as "hazardous" from construction of a typical 1,850 square-foot single-family residence in Portland, Oregon. Assuming that the total waste weight produced by construction of some 1,810 square-foot houses in Oregon is typical, the 46 pounds would comprise less than 1 percent by weight of the total construction waste (including recycled waste), and less than 10 percent of the landfilled waste.*

#### *Machinery Lubricants*

*Waste oils, greases, and machine fluids are also generated by C&D activities. Examples include brake fluid, form oil, and engine oil (McGregor et al., 1993).*

It is usual to receive materials described as "excess potentially hazardous materials" above in New Zealand, but the quantities are generally very small because of the practice of salvage for later use elsewhere.

Machinery is not received into the landfill, so that the problem of lubricants is not an issue.

These materials were summarised in Table 2-1 of the report:

TABLE 2-1  
COMPONENTS OF C&D WASTE

<i>ASPHALT paving shingles</i>	<i>PAINT paint containers and waste paint products</i>	<i>WOOD Cabinets Composites Millends</i>
<i>EARTH</i>	<i>PAPER PRODUCTS</i>	<i>pallets, shipping skids, and crating</i>

dirt  
sand, foundry  
soil

**ELECTRICAL**  
fixtures  
wiring

**INSULATION**  
asbestos  
building  
extruded polystyrene (rigid)  
fiberglass (bat)  
roofing  
laminate

**MASONRY AND RUBBLE**  
bricks  
cinder blocks  
concrete  
mortar, excess  
porcelain  
tar paper  
stone  
tile

**METAL**  
aluminum (cans, ducts, siding)  
brass  
fixtures, plumbing  
flashing  
gutters  
mercury from electrical switches  
iron  
lead  
nails  
pipe (steel, copper)  
sheet metal  
steel (structural, banding, decking,  
rerod)  
studs, metal  
wire (e.g., copper)

cardboard  
fiberboard, paperboard  
paper

**PETROLEUM PRODUCTS**  
brake fluid  
form oil  
fuel tanks  
oil filters  
petroleum distillates  
waste oils and greases

**PLASTICS**  
buckets  
pipe (PVC)  
polyethylene sheets  
styrofoam  
sheeting or bags  
carpeting

**ROOF MATERIALS**  
asbestos shingles  
roofing, built up  
roofing cement cans  
roofing shingles  
roofing tar

**VINYL**  
siding  
flooring  
doors  
windows

**WALL COVERINGS**  
drywall (gypsum)  
plaster

Lumber  
particle board  
Plywood  
Siding  
trees: limbs, brush, stumps, and tops  
Veneer

**WOOD CONTAMINANTS**  
adhesives and resins  
laminates  
paintings and coatings  
preservatives  
Stains/varnishes  
Other chemical additives

**MISCELLANEOUS**  
adhesives and adhesive cans-aerosol  
Cans  
air conditioning units  
appliances ("white goods")  
batteries  
caulk (tubes)  
ceiling tiles  
driveway sealants (buckets)  
epoxy containers  
fiberglass  
Fines  
fireproofing products (overspray)  
floor tiles  
furniture  
garbage  
Glass  
lacquer thinners  
leather  
light bulbs, fluorescent and HID  
light bulbs, other  
linoleum  
organic material  
packaging, foam  
pesticide containers  
Rubber  
sealers and sealer tubes  
sheathing  
silicon containers  
solvent containers and waste  
street sweepings  
textiles I  
thermostat switches  
Tires  
transformers  
water treatment plant lime sludge

(b) Leachate

The USEPA report also carefully studied (by chemical analysis and measurement) the leachate from a number of landfills. The results of that study are summarised in the following excerpts from the report:

*“Organics*

*The frequency of detection of organics was generally low compared to metals and conventional parameters. Of the 34 organics listed in Table 3-3, only 8 were detected at half or more of the landfills at which they were sampled: acetone, benzoic acid, cis-1,2-dichloroethane, ethylbenzene, 4-methylphenol, phenol, 2,4,5-T, and xylenes.*

*Six organics exceeded their respective benchmarks at least once, including acetone, alpha-BHC, 1,2-dichloroethane, dieldrin, methylene chloride, and trichloroethene.*

*Of the six organic constituents found above their benchmarks, Table 3-4 shows that four (acetone, alphaBHC, dieldrin, and trichloroethene) were detected above their benchmarks at only one landfill. While this is noteworthy, these constituents are not subject to further assessment here because their exceedances cannot be considered representative.*

*The median leachate concentrations (among the detected values) of both of the remaining constituents -- 1,2dichloroethane and methylene chloride -- exceed their benchmarks. Neither of them exceeds its benchmark by a factor of 10 or more, however. Assuming that a 100-fold reduction in concentration is achieved between the leachate and a downgradient drinking water well (as would be likely, based on the dilution attenuation factor [DAF] of 100 developed for the Toxicity Characteristic rulemaking), the concentrations would fall well below the benchmarks at the point of exposure. Even if a smaller DAF of 10 is applied (as may be applicable at a monitoring well located closer to the landfill), neither constituent would exceed its benchmark. Again, these medians only account for detected values. Had the non-detects been included, the median concentrations of all but one of the organics would have been in the non-detect range.*

*Inorganics*

*Most of the inorganics listed in Table 3-3 were detected at half or more of the landfills at which they were sampled: aluminum, arsenic, barium, boron, cadmium, chromium, copper, cyanide, iron, lead, magnesium, nickel, potassium, vanadium, and zinc. The 11 constituents exceeding their benchmarks included aluminum, arsenic, barium, cadmium, chromium, cyanide, iron, lead, mercury, nickel, and zinc.*

*As shown in Table 3-4, seven inorganics were detected above their benchmarks at more than one landfill: arsenic, cadmium, chromium, cyanide, iron, lead, and nickel. The median leachate concentrations exceed the benchmarks for only three of these inorganics, however: cadmium, iron, and lead. None of the median leachate concentrations exceeds its benchmark by a factor of 100 or more, and iron is the only constituent whose median exceeds its benchmark by a factor greater than 10. Iron was detected at a1120 landfills at which it was sampled, and was detected above its*

benchmark at least once at 19 of them. Excluding the few non-detects, the median concentration of iron in leachate is 37 times higher than its drinking water standard, which is a secondary MCL based on taste.

#### *Conventional Parameters*

As would be expected, all of the conventional parameters were detected at most, and often all, of the sites at which they were analyzed. The conventional parameters with maximum concentrations exceeding their respective benchmarks included chlorides, fluoride, manganese, nitrate, sulfates, and total dissolved solids (TDS). Only chlorides, manganese, sulfates, and TDS exceeded their benchmarks at more than one landfill. Of these four parameters, only manganese and TDS have medians above the benchmark. The median level of manganese exceeds its SMCL (by 59 times), while the median level of TDS exceeds its SMCL by over three times. In addition to these parameters, more than one landfill had a measured pH value outside of the range of the SMCL for pH.

#### *SUMMARY*

Leachate sampling data for 305 parameters sampled for at one or more of 21 C&D landfills were compiled into a database, shown in Attachment 3-B. Of these 305 parameters, 93 were detected at least once. Almost all of the **212 parameters that were never detected were organics; most of the inorganic and conventional parameters sampled for were detected one or more times.**

**Of the 93 parameters detected in C&D landfill leachate, 24 had at least one measured value above the regulatory or health-based benchmark.' For each of the parameters exceeding benchmarks (except pH), the median leachate concentration was calculated and compared to its benchmark. Due to anomalies and inconsistencies among the sampling equipment used at different times and at different landfills, non-detects were not considered in determining median values. Thus, the median leachate concentrations represent the medians among the detected values, rather than the median among all values. The median concentrations among all values would in most cases have been lower than those calculated here.**

**Based on (1) the number of landfills at which the benchmark was exceeded and (2) a comparison between the median detected concentration and the benchmark, seven parameters emerge as being potentially problematic. The list of these seven parameters, shown below, was developed by eliminating from the original list of 24 parameters (1) any parameter that was detected at only one landfill (this was determined to be not representative) and (2) any parameter whose median leachate concentration did not exceed its benchmark.**

#### organics

- 1,2-dichloroethane • methylene chloride

#### inorganics

- \_cadmium • iron
- lead

#### conventional parameters

- manganese
- total dissolved solids (TDS)

For three of the seven parameters listed above (iron, manganese, and TDS), the benchmarks are **secondary MCLs (SMCLs), which are set to protect water supplies for aesthetic reasons (e.g., taste) rather than for health-based reasons**. None of the remaining four parameters exceeds its benchmark by a factor of 10 or more, indicating that concentrations in ground water where ground-water monitoring or drinking water wells may be located are likely to fall below the health-based benchmarks.

In the **case of pH, the "exceedances" were actually pH values below the regulatory range.**"

(c) Wood and wood based materials:

The USEPA report also included a statement of the contaminants contained in wood and wood-based products. This is reproduced below, and is not necessarily representative of New Zealand practices:

<b>Wood Product</b>	<b>Chemical Constituent</b>	<b>Amount of Chemical(s) in Wood Product</b>
pallets and skids, (hardwood/softwood)	pentachlorophenol lindane dimethyl phthalate copper-8-quinolinolate copper naphthenate	< 10 ppm
pallets, plywood	phenolic resins	2-4%
pallets, glued	epoxy	2-4%
painted wood, lead-based paint	lead	1400-20,000 ppm before 1950
painted wood, acrylic-based paint	acrylic acid, styrene, vinyl toluene, nitriles	<0.01%
painted wood, "metallic" pigments	aluminum powder, Copper acetate, phenyl mercuric acetate, zinc chromate, titanium dioxide, copper ferric cyanide	<0.01 %
plywood, interior grade	urea formaldehyde UF resins	2-4%
plywood, exterior grade	phenol formaldehyde PF resins	2-4%
oriented strandboard	phenol formaldehyde resins, or PF/isocyanate resins	2-4%
waterboard "Aspenite"	urea formaldehyde resins or phenolic resins	5-15% UF 2.5% PF 2% wax
overlay panels	phenol formaldehyde resins	4-8%, sometimes up to 10%
plywood/PVC laminate	urea formaldehyde polyvinyl chloride	2.5% UF 10% PVC

<i>particleboard</i>	<i>urea formaldehyde resins</i>	<i>5-15% UF</i>
<i>particleboard with PVC laminate</i>	<i>UF resins with polyvinyl chloride</i>	<i>4.5% UF</i>
	<i>10% PVC</i>	
<i>hardboard</i>	<i>phenolic resins</i>	<i>1.50%</i>
<i>fencing and decks: pressure treated southern pine</i>	<i>CCA or ACA</i>	<i>1-3%</i>
<i>fencing and decks: surface treated</i>	<i>CCA or ACA</i>	<i>1-3%</i>
<i>utility poles, laminated beams, freshwater pilings, bridge timbers, decking, fencing,</i>	<i>pentachlorophenol</i>	<i>1.2-1.5%</i>
<i>railroad ties, utility poles</i>	<i>creosote containing 85% PAHs</i>	<i>14-20%</i>
<i>freshwater pilings, docks</i>	<i>creosote - coal tar</i>	<i>15-20%</i>
<i>marine pilings, docks</i>	<i>creosote/chlorpyrifos</i>	<i>15-20%</i>

(d) Transferability of USEPA study to New Zealand conditions:

To some extent it must be acknowledged that the USEPA study is “nationwide”, and represents both industrial plant removed as part of the demolition process and the buildings themselves. Within the scope of demolition operations in the Wellington Region it is unusual for “plant”, particularly manufacturing plant, or demolition materials from roading works to be removed to a landfill, and to those ends many of the problem pollutants simply do not exist.

Further, the demolition of housing is less common in comparison with the removal of other types of building (because of the high value of recycling in houses and house components), so the relationship between commercial/industrial and house demolition is different.

There may also be a difference between the nature of commercial/industrial construction between the United States and New Zealand because of the difference in ages between demolished buildings in the two Countries.

(e) The Burrell Demolition C&D Landfill:

In the case of the subject landfill, these materials can be categorised into materials that are received, and those that are not received:

MATERIALS RECEIVED	NOTES
<i>EARTH</i>	
<i>dirt</i>	<i>Inert material</i>
<i>soil</i>	<i>Inert material</i>
<i>ELECTRICAL</i>	
<i>fixtures</i>	
<i>INSULATION</i>	
<i>building</i>	
<i>fiberglass (bat)</i>	<i>Inert material</i>
<i>roofing</i>	<i>Inert material</i>

*laminate*

**MATERIALS RECEIVED**

**NOTES**

**MASONRY AND RUBBLE**

<i>bricks</i>	<i>Inert material</i>
<i>cinder blocks</i>	<i>Inert material</i>
<i>concrete</i>	<i>Inert material</i>
<i>mortar, excess</i>	<i>Inert material</i>
<i>porcelain</i>	<i>Inert material</i>
<i>tar paper</i>	<i>Inert material</i>
<i>stone</i>	<i>Inert material</i>
<i>tile</i>	<i>Inert material</i>

**METAL**

*aluminum (cans, ducts, siding)*  
*brass*  
*fixtures, plumbing*  
*flashing*  
*gutters*  
*iron*  
*nails*  
*pipe (steel, copper)*  
*sheet metal*  
*steel (structural, banding, decking, rerod)*  
*studs, metal*  
*wire (e.g., copper)*

*Generally these materials oxidise slowly to form metal salts (oxides) – the process is slow because there is little available moisture.*

**PAINT**

*paint containers and waste*  
*paint products*

**PLASTICS**

*buckets*  
*pipe (PVC)*  
*polyethylene sheets*  
*styrofoam*  
*sheeting or bags*  
*carpeting*

*These are generally inert materials*

*Natural fibres may be subject to fungal decay*

**PAPER PRODUCTS**

*cardboard*  
*fiberboard, paperboard*  
*paper*

*Experience has shown that these materials degrade very slowly to form cellulose*

**ROOF MATERIALS**

*roofing, built up*  
*roofing cement cans*  
*roofing shingles*

*Not used in large volume in NZ*

*roofing tar*

**VINYL**

*siding*

*flooring*

*doors*

*windows*

*Only recently available in NZ and not seen at landfill*

*Not used in large volume in NZ*

*Not used in large volume in NZ*

*Not used in large volume in NZ*

**MATERIALS RECEIVED**

**NOTES**

**WALL COVERINGS**

*drywall (gypsum)*

*plaster*

*Generally inert if kept "dry"*

*Generally inert if kept "dry"*

**WOOD**

*cabinets*

*composites*

*millends*

*pallets, shipping skids, and crating*

*lumber*

*particle board*

*plywood*

*siding*

*trees: limbs, brush, stumps, and tops*

*veneer*

*These materials are generally subject to decay  
In a "dry-rot" process if not treated. If treated  
Slows dramatically.*

**WOOD CONTAMINANTS**

*adhesives and resins*

*laminates*

*paintings and coatings*

*preservatives*

*stains/varnishes*

*other chemical additives*

*Refer to notes below Section (c)*

**MISCELLANEOUS**

*adhesives and adhesive cans*

*aerosol cans*

*caulk (tubes)*

*ceiling tiles*

*driveway sealants (buckets)*

*epoxy containers*

*fiberglass*

*fines*

*fireproofing products (overspray)*

*floor tiles*

*furniture*

*garbage*

*glass*

*leather*

*light bulbs, fluorescent and HID*

*light bulbs, other  
linoleum  
rubber  
sealers and sealer tubes  
sheathing  
silicon containers  
solvent containers and waste  
street sweepings  
textiles I*

NOT RECEIVED INTO LANDFILL

*ASPHALT*

*paving*

*Not received into Landfill*

*shingles*

*Not used in New Zealand*

*EARTH*

*sand, foundry*

*Not Received at landfill*

*ELECTRICAL*

*wiring*

*(recycled as practicable)*

*INSULATION*

*asbestos*

*Not received into Landfill*

*extruded polystyrene (rigid)*

*Not received into Landfill*

*METAL*

*mercury from electrical switches*

*Not received into Landfill*

*lead*

*Not received into Landfill*

*PETROLEUM PRODUCTS*

*brake fluid*

*Not received into Landfill*

*form oil*

*Not received into Landfill*

*fuel tanks*

*Not received into Landfill*

*oil filters*

*Not received into Landfill*

*petroleum distillates*

*Not received into Landfill*

*waste oils and greases*

*Not received into Landfill*

*ROOF MATERIALS*

*asbestos shingles*

*Not used in New Zealand*

*MISCELLANEOUS*

*air conditioning units*

*appliances ("white goods")*

*batteries*

*lacquer thinners*

*linoleum*

*organic material*

*packaging, foam*

*pesticide containers*

*solvent containers and waste*

*thermostat switches*

tires  
transformers  
water treatment plant lime sludge

(f) Leachate

The quantities of leachate at the subject landfill are exceedingly small. This is because:

The drainage culverts that take water from the upper parts of the catchment are effective and well maintained

The materials that are received into the landfill are generally at stable moisture contents or are allowed to dry to a stable moisture content when they are placed.

There is little stormwater that permeates through the landfill. Rainfall on the exposed surfaces is absorbed locally in either in the clays used generally to cover the other fill materials, or in the landfill materials themselves, and these materials dry again in time. The drying is assisted by the wind conditions in this area.

As far as transfer into the leachate is concerned, there may be two classes of contaminant, depending on the manner in which they can transfer to the leachate:

Water-soluble materials may be transported in the water flowing through the landfill

Materials that are not water-soluble may slowly be washed through the landfill. This will result in higher concentrations of contaminant at the lower parts of the landfill, and transfer into the leachate as suspended solids.

Over the years monitoring of the quantity of leachate has shown no detectable contamination.

Copies of chemical analysis of the waters that have received the leachate from this landfill over the past 5 years are appended for information.

(g) Effect of Timber and Timber-based materials, and the contaminants they carry:

It has been stated that this is a dry landfill and that stormwater falling on the landfill itself is received into and stored in the clay overburden materials. This stormwater is released again by drying at the surface of the overburden, and the amount lost by downwards migration is small.

Again as earlier stated, there is no detectable leachate from this landfill, and the interior of the landfill is at a stable and fairly low moisture content.

The mechanism of timber degradation is therefore one of decay due to fungal activity rather than bacterial, and over long periods of time:

- Untreated timbers will decay (in a “dry rot” mechanism). The fungi feed on the organic wood components to leave the cellular structure of the timber weakened and capable of collapse.
- Timbers treated with water-soluble salts such as boron will suffer some loss of preservation salts; this loss will be slow and permit decay in a “dry rot” mechanism to take place slowly
- Timbers treated with insoluble salts (copper-chrome arsenate or pentachlorophenol) will decay at rates depending on the level of treatment, but such decay will be in any case be much slower than for those timbers that are untreated or treated with water-soluble salts.

The common wood-based products in New Zealand are sheet materials such particleboard, “customwood”, “strandboard”, plywood, and glue-laminated structural components (generally columns and beams). At the present time these materials are comparatively recent and arise more commonly from construction activities (as “off-cuts”) rather than from demolition. They are thus a small proportion of the total timber waste stream to the landfill.

Particleboard, “customwood” and “strandboard” are generally made from timber chips or particles bound together with a synthetic adhesive such as urea formaldehyde or phenol resorcinol. The wood component is usually untreated, and is subject to decay as for untreated timbers above, leaving the adhesive component with the products of the timber decay.

As there is little downward water flow through the landfill the preservation chemicals and adhesives are not washed through the landfill and remain contained in the landfill as contaminants.

There are small quantities of iron and zinc (and very small quantities of other chemical elements used in steel-making – chromium, vanadium, nickel, etc) that are contained in the hardware and builders’ ironmongery that is associated with timber elements. These “corrode” with time to form oxides that are contained in the landfill but are insoluble and again, given the low downward water flow, cannot migrate into the stormwater or leachate.

Taking the USEPA materials, and transferring these to the nominal types and volumes received at this Landfill:

Wood Product	Chemical Constituent	Amount of Chemical(s) in Wood Product	Received	Estimated Volume m <sup>3</sup> pa	Estimated Weight (kg)	Weight of Contaminant (kg/year)
pallets and skids, (hardwood/softwood)	pentachlorophenol lindane dimethyl phthalate copper-8-quinolinolate copper naphthenate	< 10 ppm	yes	30	19200	0.192
pallets, plywood	phenolic resins	2-4%	yes	10	6400	192
pallets, glued	epoxy	2-4%	not used in NZ			
painted wood, lead-based paint	lead	1400-20,000 ppm before 1950	yes	100	64000	7.68
painted wood, acrylic-based paint	acrylic acid, styrene, vinyl toluene, nitriles	<0.01%	yes	150	96000	9.6
painted wood, "metallic" pigments	aluminum powder, Copper acetate, phenyl mercuric acetate, zinc chromate, titanium dioxide, copper ferric cyanide	<0.01 %	not common in NZ	0	0	
plywood, interior grade	urea formaldehyde UF resins	2-4%	yes	20	12800	384
plywood, exterior grade	phenol formaldehyde PF resins	2-4%	yes	20	12800	384
oriented strandboard	phenol formaldehyde resins, or PF/isocyanate resins	2-4%	yes	10	6400	192
waterboard	urea formaldehyde resins or phenolic resins	5-15% UF		20	12800	1280
"Aspenite"		2.5% PF 2% wax				32
overlay panels	phenol formaldehyde resins	4-8%, sometimes up to 10%		10	6400	512
plywood/PVC laminate	urea formaldehyde polyvinyl chloride	2.5% UF 10% PVC	yes	20	12800	1024 320
particleboard	urea formaldehyde resins	5-15% UF	yes	30	19200	1920
particleboard with PVC laminate	UF resins with polyvinyl chloride 10% PVC	4.5% UF	yes	10	6400	288
hardboard	phenolic resins		1.50% yes	20	12800	192
fencing and decks: pressure treated southern pine	CCA or ACA	1-3%	yes	30	19200	384
fencing and decks: surface treated	CCA or ACA	1-3%	yes	10	6400	128

Wood Product	Chemical Constituent	Amount of Chemical(s) in Wood Product	Received	Estimated Volume m <sup>3</sup> pa	Estimated Weight (kg)	Weight of Contaminant (kg/year)
utility poles, laminated beams, freshwater pilings, bridge timbers, decking, fencing,	pentachlorophenol	1.2-1.5%	yes	10	6400	96
railroad ties, utility poles	creosote containing 85% PAHs	14-20%	generally recycled in NZ			
freshwater pilings, docks	creosote - coal tar	15-20%	generally recycled in NZ			
marine pilings, docks	creosote/chlorpyrifos	15-20%	generally recycled in NZ			
Framing timbers - treated	CCA or ACA	1-3%	yes	250	160000	3200
framing timbers - untreated			yes	250	160000	0
Totals					640000	10545



The total weight of contaminants that arise as a part of the timber and timber based products received at the landfill is therefore comparatively small, and these materials are either not water soluble and therefore not transferred with the small moisture movements within the landfill, or are not capable of being transferred in any great quantity by the small moisture movements within the landfill.

(h) Discharges to Air

Discharges to air that are either “harmful” or “nuisance” may be classified as:

- Materials or gasses that are hazardous within the terms of the Hazardous Substances and New Organisms Act 1996.
- Heat
- Dust Nuisance

The inert nature of the materials received is such that there is no anaerobic decomposition within the landfill, and there is therefore no generation of the gasses - methane, ammonia, hydrogen sulphide, and phosgene – that are normally associated with from the landfill. There is no release to air of any ecotoxic materials, and there are no exothermic reactions to generate heat within the landfill.

During operation there the landfill surface is covered with an overburden that is predominantly clay, and for safety and stability reasons, and to keep the interior of the landfill dry the working (open) face of the landfill, where the wastestream is received into the landfill, is kept as small as possible.

As a result there is some generation of dust arising from truck and plant operations during when the access roads and overburden is dry, but this is minimised by low traffic speeds within the landfill site.

The site is some {###} from the nearest residential uses, and transport of clay particles at a level that could constitute a nuisance over this distance does not appear to occur.

(i) Culvert Design

Given the possibility of Climate Change, the adequacy of the culvert and it’s inlet and outlet structures is of concern.

The 1994 AEE included a design report on the then-proposed (and now existing) culvert in Section 4.3.3.1. The calculation was based on accepted engineering principles and rainfall/depth/duration data obtained from measurements at the Karori Reservoir.

The flows were calculated for storms of 10 and 20 minute durations as:

For  $p$  (probability) = 0.02 (taken to be a 2% annual exceedance probability (AEP)),  $Q$  (the design flow rate) lies between  $11.3 \text{ m}^3/\text{sec}$  and  $7.3 \text{ m}^3/\text{sec}$ .

For  $p$  (probability) = 0.10 (taken to be a 10% annual exceedance probability (AEP)),  $Q$  (the design flow rate) lies between  $8 \text{ m}^3/\text{sec}$  and  $5.6 \text{ m}^3/\text{sec}$ .

Note that for the 10% AEP storm there is a disagreement within the text for the upper bound flow ( $8$  versus  $9 \text{ m}^3/\text{sec}$ ) and recalculation indicates that the figure of  $8 \text{ m}^3/\text{sec}$  is correct.

The culvert was then shown to be in inlet control – that is, that the required culvert flow can be achieved only by the provision of head at the inlet end, and this in turn results in the requirement for storage of stormwater.

The head required was calculated at 5 to 6 metres for a 2% probability 20 minute storm.

As the surface water runoff is directly proportional to rainfall intensity, the suggested (MfE) future rainfall in this location suggests that these figures should be modified to:

For 2% annual exceedance probability (AEP), the design flow rate may lie between  $13.5$  and  $8.8 \text{ m}^3/\text{sec}$ , and

For 10% annual exceedance probability (AEP), the design flow rate may lie between  $9.6$  and  $6.7 \text{ m}^3/\text{sec}$ .

The 1994 AEE stated that:

*“Using Figure 3.3 and Hw of 7.5, 5 metres and 3 metre respectively we obtain Hw ratios of 8.3, 5.5 and 3.3 respectively which gives Q values of  $5 \text{ m}^3/\text{sec}$ ,  $3.7 \text{ m}^3/\text{sec}$  and  $2.8 \text{ m}^3/\text{sec}$  respectively.”*

The storage assessment was then made and lead to the conclusion that:

*“...for the 10 minute and 20 minute storms of 0.02 probability the inlet head is likely to be between 5 metres and 6 metres. For longer duration storms of similar frequency but which will have lower average intensities the heads required to cope with inflow will be below those already calculated.”*

It is considered that since the capacity of the inlet to the culvert is proportion to  $H_w^{(3/2)}$  the head required under the future 10 minute 2% annual exceedance probability storm will be increased by about 13% to be of the order of 5.7 to 6.8 metres. This gives storage volumes that are consistent with the increased difference between inflow and outflow.

The Site Management Plan contains calculations of the expected stormwater flows in the culvert and sets out the requirements for design of the culvert and overland flow channel to satisfy both hydraulic capacity and the environmental conditions required for rehabilitation of the overland flow channel by Koaro.

(j) Culvert condition

A recent closed circuit television (CCTV) survey of the existing culvert showed that it contains some defects that are likely to affect its operational longevity, and these require repair before the

culvert is extended. Suggestions for the repairs required to this culvert are contained in a report prepared by MWA Solutions Limited dated 14 October 2010 contained in Appendix 3 and are based on recommendations from the Concrete Pipe Association of Australasia (APAA).

The state of repair of the existing culvert is such that its life cannot be predicted. The effects of failure may include blockage, either partial or complete, of the culvert leading to ponding to some depth at the upstream (inlet) end of the landfill, leading to saturation of the lower levels landfill. If the phreatic line breaks the eastern (Landfill Road) face of the landfill there may be some surface erosion and some discharge of silts and sediments into the natural receiving waters.

It is not considered that the saturation of the landfill would cause instability of the landfill as a whole, although there may be some minor slippages.

The extension of the landfill proposed allows the progressive construction of an overland flow channel to relieve reliance on the existing culvert, with the culvert becoming completely redundant on completion of the landfill.

Given the physical nature of the existing landfill it is not considered practicable to replace the culvert, or to construct an alternative "bypass" to it. In the event that failure of the culvert occurs before the landfill construction is complete any ponding would need to be pumped from the upstream end of the culvert to disposal in the completed sections of the overland flow channel system.

## 5 Risk Assessment

The Regional Policy Statement for the Wellington Region (1995) sets out Wellington Regional Council's policy on Natural Hazards in Section 11, sets out the Regional issues, objectives, policies, anticipated environmental results and responsibilities.

The Introduction states, in part, that

- “• *Natural hazard events will occur in the Wellington Region.*
- *Implementation of risk mitigation strategies is the key to successful risk reduction - good ideas and intentions are not enough.”*

and continues:

*“...The term "risk" as used here is a combination of a natural hazard event and our vulnerability to it. Risk may be measured quantitatively or qualitatively, and will be associated with a given probability or specified time period. Risk could be specified in terms of expected number of lives lost, persons injured, damage to property, disruption of economic activity or loss of essential services and facilities due to a particular natural hazard.*

*Reducing the impacts of natural hazards is one of the major functions of the Wellington Regional Council. The function spans resource management, warning, protection, awareness raising, provision of advice, and emergency response...”*

The issues identified are

### Issue 1

The Wellington Region is susceptible to a range of natural hazards which have the potential to cause substantial adverse effects on the environment. The scale of effects may range from ones that impact on an individual site (such as a landslip) to ones that impact on the whole Region (such as an earthquake).

### Issue 2

For the major natural hazards in the Wellington Region, such as flooding and earthquakes, it is not practicable to eliminate risks entirely. The aim should be to ensure that the level of risk is understood and acceptable. However, acceptable levels of risk are generally unknown.

### Issue 3

Current knowledge of the nature and potential effects of many natural hazards in the Wellington Region is limited. As a consequence, decisions on the use, development and protection of natural and physical resources are often made with inadequate information on natural hazards.

### Issue 4

The frequency and magnitude of natural hazard events can be increased or decreased by human actions. For example, many activities in the Wellington Region involve modification of landform to provide building platforms for development. This may result in the oversteepening of hill slopes, or the flattening of sand dunes with consequential interruption

to beach processes. Human actions can also reduce hazards, for example by the removal of steep slopes through recontouring of the land during the development of a new subdivision. In addition, some attempts to safeguard against natural hazards can themselves exacerbate the problems and may have other adverse effects on the environment. For example, sea walls can aggravate erosion, degrade the natural character of the coast and bring about a loss of intertidal marine habitat.

#### Issue 5

The frequency and magnitude of natural hazard events in the Wellington Region may also alter due to climate change. Warmer global temperatures may increase the Region's exposure to tropical cyclones such as the Wahine storm, which would increase the frequency of major flood and landslip events and may increase coastal erosion hazard from projected sea level rise.

#### Objective 1

*Any adverse effects of natural hazards on the environment of the Wellington Region are reduced to an acceptable level.*

An acceptable level of risk will be one that balances the benefits and costs of risk reduction measures, taking into account nonmonetary costs, community aspirations and the statutory responsibilities of relevant authorities. Public input is required to determine the level of acceptable risk.

#### Policy 1

*To ensure that there is sufficient information available on natural hazards to guide decision making.*

The two issues of primary concern are those of Wellington's seismicity, and stormwater.

The seismic issues were dealt with under the 1994 AEE in Section 4.2.10.2, and no further reference appears necessary.

The issue of Stormwater has already been discussed. It is of premium concern that the increases that are suggested in rainfall intensity as a result of climate change will increase the depth of the water required to be stored at the culvert inlet, and that the present configuration and position of the inlet, with no provision for overland flow, will create an unreasonable maintenance demand on the future.

In order to alleviate this situation a viable overland flow path is required, and this can only be achieved by changing the configuration of the landfill upper surface.

## 6 Site Ecology

The ecology of the site is described in the ecological report contained in Appendix 4 of this AEE. This report, prepared by Wildland Consultants Limited, describes the site flora and fauna.

In particular, the report describes the main effects of the proposed landfill as

- loss of stream habitat;
- loss of aquatic species; and
- loss of indigenous vegetation and some ecosystem functions.

The loss of stream habitat and consequent loss of aquatic species is discussed at length in the report, and follows strong efforts by the applicant to try to determine a method of landfill construction that would preserve the stream habitat for as long as possible to give the opportunity for recreation of new habitat to replace that destroyed by landfill construction.

Due attention has been given to describing how this fish-friendly environment could be achieved in the landfill development on the drawings and Site Management Plan.

However, Wildland Consultant's report indicates that

*This loss of stream habitat could in part be, eventually, mitigated by creating a 'natural' looking overland flow, and this option has been discussed with the client. This will require considerable thought and careful design as to how to provide access for aquatic species to the site once the fill is completed, as the additional elevation (especially the completed steep fill-cells nearest to Landfill Road) has the potential to create fish barriers. It will take many years before the new overland flow stream will have 'settled' in its course and for riparian vegetation to provide sufficient shelter for the newly created stream to be attractive to indigenous fish species. Even if this work was undertaken it could not be guaranteed that indigenous fish would re-colonise the newly created stream.*

The report further states that

*It is unlikely that many of the aquatic species presently known from the site, or likely to occur at the site, can be retained during the life of the fill. Koura (freshwater crayfish, At Risk-Gradual Decline) require permanently flowing water to survive and will not be able to persist, especially if the steeper streams are seasonally dry. Koaro (At Risk-Declining) do not tolerate increased sediment levels and are likely to be lost from the stream even if very effective sediment retention mechanisms were employed.*

*The other species require at least permanent pools, connected by a stream during higher flows, to survive. Piping of the waterway, for nearly its entire length, will remove all such pools. The total length of pipe (nearly 1,500 m, of which 1,000 m comprises permanent flowing water) exceeds the abilities of most aquatic species to travel through and can not be relied upon to re-establish aquatic species.*

With this in mind, while the applicant is prepared to construct the stormwater overland flow channel in such a way as to be as encouraging as possible for recolonisation by aquatic species, there is no warranty that such measures will be successful in achieving recolonisation.

As an alternative, to on-site mitigation for the loss of aquatic species, Wildland Consultants report also states

*Options to recreate fish habitat have been extensively discussed but given the uncertainty with regards to recolonisation by indigenous fish this may not be the best and most cost effective option. If fish habitat creation is the most preferred option then an overland flow with a 'natural' appearance will need to be created, with meandering waterways that contains pools, falls and riffles.*

*The base of such a 'natural' overland flow channel would comprise compacted rocks and soils, rather than a concrete channel as originally proposed. The overland flow channel detailing would include the placement of rocks to provide flow riffles to promote fish travel, and the construction of pools at 10 metre intervals over the length of the overland flow by deepening the depth of the channel by lowering the invert level by 300 mm. On steep slopes these pools would be arranged so that the nominal horizontal distance between them would not exceed 1 metre.*

*This overland flow will need to be surrounded by appropriate, eco-sourced, indigenous forest species, for a width of at least 10 m either side of the newly created overland flow (Drawing 9402/01). Plants along the overland flow channel will be spaced as close as practicable to help create rapid canopy cover and help shade the stream and should include indigenous grasses (closest to the waterway), shrubs and larger trees to provide shade.*

And continues:

*There is no guarantee that aquatic fauna can be retained or re-established on-site within the life of the consent, hence off-site mitigation may be required. Given the uncertainty this may be a preferred option over re-creating a 'natural' overland flow.*

*The client proposes to discuss this option with Greater Wellington Regional Council. Ideally a stream would be nominated for remediation that has an existing restoration group (or could be adopted by an existing restoration group) that could undertake the work. The client is proposing to contribute \$5,000 per annum for a period of 10 years towards the remediation, provided that the consents sought are issued.*

In summary, then, while the preferred option may be to attempt to recreate an environment suitable for recolonisation by aquatic species, there is no guarantee that they will, in fact, enter the stream.

The alternative, of protecting another stream in the vicinity, with contribution by the applicant towards the habitat improvement work, may provide a better chance of success, and the applicant seeks a decision from the Commissioners as to what the preferred solution will be.

IN the event that the off-site mitigation option is selected the stream bed the design features stated in the Site Management Plan and on the drawings need not be applied.

As far as mitigation for the loss of indigenous vegetation is concerned, Woodland Consultants' report states:

*The client proposes to undertake a staged replanting programme. The first phase will consist of the selective removal and/or spraying of noxious and non-indigenous weeds from the existing landfill area and progressive planting as indicated on the drawing*

*9402/01 attached to the Site Management Plan. This phase will commence as soon as practicable after the granting of resource consents for the landfill extension.*

*The second phase will consist of the rehabilitation of new landfill areas, and will commence on the completion of areas of the landfill that can be appropriately rehabilitated. As fill compartments are finalised the area will be shaped to create landforms that are stable, allow appropriate drainage and carry sufficient soils to allow the establishment of appropriate species. If a 'natural' overland flow channel was the preferred option then planting the new overland flow channel, to provide replacement aquatic habitat (Drawings 9402/06 and 9402/01), would be prioritised.*

*Environmental weed species that may occur on these finished faces will be selectively removed. Indigenous species that have already established will be retained to assist with the rehabilitation. Appropriate eco-sourced indigenous plant species will be planted in cleared areas to speed rehabilitation.*

The report concludes that

*In our opinion, the overall effects of this proposal will be moderate.*

7 Future use of the land

The future use of the land was discussed in the 1994 AEE, and the matters put forth in that report remain completely valid.

However, since the 1990's there has been some evidence that would suggest that electromagnetic radiation might constitute a major health hazard, and the proximity of a powerful radar station on Hawkins Hill adjoining the site further suggests that this area should not, while that is present, be considered as a site for future residential or commercial development.

Further, it is possible that the landfill will be subject to continuing settlements for some years after closure, albeit that these should be less than would be the norm for a sanitary landfill, and for that reason it is unlikely that the land could be used for buildings (residential or commercial) on any scale for many years after closure.

The major reason for this resource consent is to provide for overland flow for stormwater so that the long-term stability of the landfill is not dependent on the continued operation of a single culvert placed underneath the landfill.

While this drainage is possible, it is very likely that a number of the options available today may not be available some time into the future, and it is therefore not considered sensible to present fully detailed design-work for the closure drainage at this time. It is also possible that there will be better options available as a result of improved materials and design technology at the time of closure.

## 8 Conclusion

On the basis of the foregoing, it is submitted that:

The Wellington Region needs a place where it can safely dispose of the materials that arise from demolition operations;

The safety considerations include matters of public safety, ecotoxicity and

These materials need to be sufficiently concentrated to permit the best opportunity for future recycling to be economic.

There is also a need for the disposal of some of the more hazardous components of construction and demolition activities to be properly regulated. The disposal of these materials as municipal waste may not be the best option available.

This landfill does not in itself, constitute any threat to the environment while it is under the superintendence of an experienced and qualified operator.

There may be longer-term risks to the environment if the topographic nature of the landfill and the land in which it is located are not recognised and taken in the context of the expected effects of climate change.

There are ecological risks associated with this proposal that cannot be avoided but can be mitigated through the proposed site remediation plan using either the “on-site” or “off-site” options proposed for mitigation for the loss of habitat for aquatic species. “On-site” mitigation measures carry the risk that there is no guarantee that recolonisation by aquatic species will in fact take place.

The operational nuisances arising from the landfill are at an acceptable level.

Provided that the controls given in the Site Management Plan are implemented the environmental effects of extension of this landfill will be less than minor.

## **Appendix 1 – Drawings**

The appended drawings are:

MWA Solutions Limited Drawings

Number	Title	Revision
9402/01	SITE PLAN OF LANDEFILL DEVELOPMENT	D
9402/02	SITE PLAN OF LANDEFILL UPPER FINISHED SURFACE	D
9402/03	SITE PLAN OF LANDEFILL CULVERT DRAIN	D
9402/04	LONGITUDINAL SECTION ON IDEALISED CENTRLINE OF DRAIN	D
9402/05	LONGITUDINAL SECTION ON CENTRLINE OF NORTHERN SPUR DRAIN	D
9402/06	OUTLINE DRAINAGE DETAILS	D
9402/30	LANDFILL AERIAL PLAN	A

## **Appendix 2 – Existing Resource Consent Conditions**

The existing Resource Consents issued contain the following special conditions:

### *Applications to the Wellington Regional Council*

*To discharge contaminants onto land for the purpose of landfilling demolition fill, at or about Map Reference NZMS 260: R27;557.850 on land whose legal description is Lot 1, DP 293898. Terawhiti District, Wellington [DL 940057(O1)]*

*To divert water in an unnamed tributary of Careys Stream through a culvert under the landfill at or about Map Reference NZMS 260: R27;557.850 on land whose legal description is Lot 1, DP 293898, Terawhiti District, Wellington [WP 940057(O2)].*

*To place a culvert in a bed of an unnamed tributary of Careys Stream, at or about Map Reference NZMS 260:R27;557.850 on land whose legal description is Lot 1, DP 293898, Terawhiti District Wellington [LU 940057(O3)].*

## **2. The Decision**

### *Wellington City Council Application*

*Pursuant to sections 105 and 108 of the Resource Management Act 1991 the Joint Hearings Committee of the Wellington Regional Council and Wellington City Council by way of delegated authority in respect of the Application by Burrell Demolition Limited to the Wellington City Council hereby grants consent to the application to extend the area of cleanfill operation back into the existing gully system involving the extension of culverting of the stream and the removal of side slopes for the covering of material at or about Map Reference NZMS 260: R27;557.850 on land whose legal description is Lot 1 DP 293898. Terawhiti District subject to the following conditions;*

- (1) The location, design, implementation and operation of the C and D Landfill (Burrell's Cleanfill Landfill) shall be as generally described in the Burrell Demolition Ltd Resource Consent Applications for a Cleanfill and Fourth Schedule Assessment (Assessment of Environmental Effects), as prepared for the consent holder by David Smith, Civil and Environmental Engineer, dated April 1994, together with its associated reports and appendices and evidence presented by the consent holder at the hearing.*
- (2) That the activity be carried out generally in accordance with the Management Plan identified as paragraph 4.9 of the Assessment of Environmental Effects which accompanied the application.*
- (3) The activity shall be carried out generally in accordance with the provisions of the Landscape Report, February 1995 and Landscape Plan titled Landscape Plan for Burrell Demolition Limited C and D Cleanfill Happy Valley both prepared by John Powell Landscape Architect. And shall be carried out in accordance with the requirements of that plan in particular;*
  - (a) all protruding cleanfill visible from Landfill Road to be covered with a minimum off 600 mm overburden.*
  - (b) all areas not actively being filled and all exposed construction and demolition fill material to be covered with a minimum 600 mm overburden.*
  - (c) all over burden material to be quarried from within the lease boundary.*
  - (d) all cut plants and batters to be generally so constructed and treated to ensure their stabilisation.*

- (e) *all cut faces and batters to be hydro seeded to the extent necessary that they may be left to provide a natural seed bed for the re-establishment of native and other vegetation.*
  - (f) *all plantings to be generally as indicated on the Landscape Plan. Species are to be selected so as to maintain the natural ecology of the area. All damaged and destroyed native vegetation to be replaced as far as practicable.*
- (4) *The Wellington City Council may review any or all conditions of this consent by giving notice of its intention to do so pursuant to section 128 of the Resource Management Act 1991, at any time within six months of the grant of this consent for either of the following purposes;*
- (a) *To deal with any adverse effects on the environment that might have arisen from the exercise of this consent and which it is appropriate to deal with at a later stage.*
  - (b) *To review the adequacy of the Management Plan and/or Landscape Plan so as to incorporate into the consent any modification to the Management Plan or Landscape Plan which may be necessary to deal with any adverse effects on the environment arising from the management or operation of the landfill.*
- (5) *The Grantee shall, prior to the exercise of this permit, enter into and maintain a performance bond draw in terms to be agreed to provide for the continuation and/or completion of landscaping and rehabilitation work in accordance with the Management Plan and Landscape Report and Plan, referenced above in conditions of consent, which may be required to provide for the safety and amenity of the site and may be necessitated as a result of the unforeseen cessation of landfilling activity or closure of the landfill operation for any reason whatsoever. The bond shall be in favour of the Wellington City Council (Environment Division) and shall be to the value of \$10,000 in 1995 dollars, to be available immediately on the commencement of landfilling in the area of extension, subject of this consent.*

*Wellington Regional Council Applications*

*Standard Conditions for Wellington Regional Council Consents*

1. *This consent is subject to all relevant provisions of the Resource Management Act 1991, its amendments and any regulations made thereunder. It is the obligation of the consent holder to comply with all the statutory requirements relating to the exercise thereof.*
2. *The consent holder may keep all such records as may be reasonably required by the Wellington Regional Council and shall, if so requested, supply this information to the Wellington Regional Council.*
3. *This consent is subject to the Wellington Regional Council or its servants, or its agents, being permitted access at all reasonable times for the purpose of carrying out inspections, measurements and the taking of samples.*
4. *The design and maintenance of any works relating to the exercise of the consent must be to a standard adequate to meet the conditions of the consent.*
5. *An annual charge, set in accordance with section 36(2) of the Resource Management Act 1991, shall be paid to the Wellington Regional Council for carrying out its functions under section 35 (duty to gather information, monitor and keep records) of the Resource Management Act 1991.*

*WGN 940057(01) : Discharge of Contaminants onto Land*

*Pursuant to sections 105 and 108 of the Resource Management Act 1991 the Joint Hearings Committee of the Wellington Regional Council and Wellington City Council by way of delegated authority in respect of an application by Burrell Demolition Limited to the Wellington Regional Council hereby grants consent to the application to discharge contaminants onto land for the purpose of landfilling demolition fill, at or about Map Reference NZMS 260: R27; 557.850 on land whose legal description is Lot 1 DP 293898 Terawhiti District, Wellington subject to the Wellington Regional Council five standard conditions, and the following additional conditions;*

*Special Conditions*

- 6. The location, design, implementation and operation of the C and D Landfill (Burrell's Cleanfill Landfill) shall be as generally described in the Burrell Demolition Ltd Resource Consent Applications for a Cleanfill and Fourth. Schedule Assessment (Assessment of Environmental Effects), as prepared for the consent holder by David Smith. Civil and Environmental Engineer dated April 1994, together with its associated reports and appendices and evidence presented by the Grantee at the hearing.*
- 7. This permit shall expire on 14 June 2026.*
- 8. The Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to section 128 of the Resource Management Act 1991, at any time within six months of the second, fifth, 10th, 15th, 20th, 25th and 30th anniversary of the date of grant of this permit for either of the following purposes:*
  - (1) To deal with any adverse effects on the environment which may arise from the exercise of this permit, and which it is appropriate to deal with at a later stage;*
  - (2) To review the adequacy of any plan prepared for this permit and/or the monitoring requirements so as to incorporate into the permit any modification to any plan or monitoring which may be necessary to deal with any adverse effects on the environment arising from the management or operation of the landfill.*
- 9. The consent holder may apply, pursuant to section 127 of the Resource Management Act 1991, for the change or cancellation of any condition, other than the condition relating to the term of this permit at any time.*
- 10. All monitoring methods and procedures shall be to the specific approval of the Manager, Consents and Investigations, Wellington Regional Council.*
- 11. The consent holder shall, within three months of the date of first exercise of this consent, construct stormwater drainages to divert surface water around the cleanfill, to the satisfaction of the Manager, Consents and Investigations, Wellington Regional Council.*
- 12. All material disposed of at the landfill shall be cleanfill with no potential to produce harmful effects on the environment and shall be restricted to a natural material such as clay, soil, and rock, and other inert material such as concrete, brick or non-combustible demolition products (with no more than 5 percent timber or other non-hazardous construction materials).*
- 13. That no liquid waste, domestic, industrial and commercial waste, hazardous waste, contaminated soil, soil or clay in a saturated condition, trees, and garden trimmings shall be disposed of at the landfill.*
- 14. The consent holder may provide a temporary storage facility to allow for recycling or collection and removal of material such as structural steel, timber, or other non-hazardous construction materials.*

15. *The consent holder shall keep and maintain complete records of the volumes and nature of cleanfill deposited at the landfill, and make the records available to the Manager, Consents and Investigations, Wellington Regional Council at three monthly intervals, or on request.*
16. *The consent holder shall ensure that dust emissions are controlled so that dust is not objectionable at or beyond the boundary of the property. The methods of controlling this shall be addressed in the Operational Management Plan.*
17. *No cleanfill shall be tipped in the stream. The consent holder shall carry out monthly inspection of the unnamed tributary to Careys Stream (above the C and D Landfill) and remove any cleanfill that has accumulated in the stream.*
18. *All care will be taken with design and construction of the cleanfill batters to ensure their stability. Upon any slope or batter failure, all practicable means to minimise any resulting detrimental effects on the unnamed tributary to Careys Stream shall be immediately undertaken. Appropriate remedial action must be undertaken to ensure that any slide material does not impede or have potential to impede the flow of that stream.*
19. *The discharge of waste on to land from the C and D Landfill (Burrell's Cleanfill Landfill) shall not result in any of the following effects in the unnamed tributary to Careys Stream either above or below the cleanfill landfill:*
  - (1) *The production of any conspicuous oil or grease films, scums or foams or floatable or suspended material.*
  - (2) *Any conspicuous change in colour or visual clarity.*
  - (3) *Any emission of objectionable odour.*
  - (4) *The rendering of fresh water unsuitable for consumption by farm animals.*
  - (5) *Any significant adverse effect on aquatic life.*
  - (6) *Any visible deposition of iron oxide.*
20. *The consent holder shall carry out regular inspection of the unnamed tributary to Careys Stream above and below the C and D Landfill following times of moderate to heavy rain for compliance with condition 19.*
21. *The consent holder shall provide and undertake a monitoring programme that shall test the water quality of at least two surface water sample points and one groundwater sample point which shall include, but not be limited to:*
  - (1) *The inlet and outlet of the piped culvert;*
  - (2) *The seep at the toe of the landfill identified as a sampling location on page 16 of the applicant's Fourth Schedule Assessment (Assessment of Environmental Effects);*
  - (3) *Other water sample points that are mutually agreed to by the consent holder and the Manager, Consents and Investigations, Wellington Regional Council.*
22. *The consent holder shall monitor the water quality at the sampling points in condition 21 and for compliance with condition 24. Sampling shall be for the following parameters:*
  - *Lead*
  - *Copper*
  - *pH*
  - *Conductivity*
  - *Alkalinity*
  - *COD*
  - *Iron*
  - *Manganese*
  - *Zinc*

*This monitoring shall commence within three months of the date of first exercise of this consent. The monitoring shall be undertaken quarterly for the first year and then annually thereafter.*

23. *If there is a significant increase in any of the parameters of condition 22 either between the sample points in condition 21 or over time for the aforesaid sample points, or both, the consent holder shall determine the cause of the increase and identify and undertake whatever appropriate remedial action is required to mitigate the effects. The consent holder shall notify the Manager, Consents and Investigations, Wellington Regional Council, as soon as practicable.*
24. *The consent holder shall provide an annual report to the Manager, Consents and Investigations, Wellington Regional Council providing the results of the monitoring undertaken for conditions 21, 22 and 23.*
25. *That, prior to the expiry or surrender of this permit, the consent holder shall prepare, to the satisfaction of the Manager, Consents and Investigations, Wellington Regional Council, and implement a plan for either the closure or future management of the landfill and shall, not less than six months prior to such expiry or surrender, make application for such consents as are required for the future management of the site. The objectives to be met at all stages of this management are:*
  - (1) *to ensure the effective long term containment of cleanfill, and*
  - (2) *to protect Careys Stream and uses and values associated with these waters.*
  - (3) *to ensure the surface layer of the landfill is compacted and constructed in a manner that is appropriate to the intended future use of the landfill.*
26. *The Grantee shall prior to the exercise of this consent enter into and maintain a performance bond drawn in terms to be agreed to provide for the containment, including covering of a suitable depth of any landfill material discharged in the exercise of this consent, necessitated as a result of the unforeseen cessation of landfilling activity or closure of the landfill operation for any reason whatsoever. The bond shall be in favour of the Wellington Regional Council and shall be to the value of \$10,000 in 1995 dollars to be available. Immediately on the commencement of discharge of a containment onto land.*

*WGN 94005 7(02) - Diversion of an Unnamed Tributary of Careys Stream*

*Pursuant to sections 105 and 108 of the Resource Management Act 1991 the Joint Hearings Committee of the Wellington Regional Council and Wellington City Council by way of delegated authority in respect of the application by Burrell Demolition Limited to the Wellington Regional Council hereby grants consent to the application to divert water in an unnamed tributary of Careys Stream through a culvert under the landfill at or about Map Reference NZMS 260: R27; 557.850 on land whose legal description is Lot 1, DP 293898, Terawhiti District, Wellington, subject to the Wellington Regional Council five standard conditions, and the following additional conditions;*

*Special Conditions*

6. *The location, construction, and operation of the diversion shall be as generally described in the Burrell Demolition Limited Resource Consent Applications for a Cleanfill and Fourth Schedule Assessment (Assessment of Environmental Effects), as prepared for the consent holder by David Smith, Civil and Environmental Engineer dated April 1994, together with its associated reports and appendices and evidence presented by the consent holder at the hearing.*
7. *This permit shall expire on 14 June 2026.*

8. *The Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to section 128 of the Resource Management Act 1991, at any time within six months of the second, fifth, 10th, 15th, 20th, 25th and 30th anniversary of the date of grant of this permit for either of the following purposes:*
  - (1) *To deal with any adverse effects on the environment which may arise from the exercise of this permit, and which it is appropriate to deal with at a later stage;*
  - (2) *To review the adequacy of any plan prepared for this permit and/or the monitoring requirements so as to incorporate into the permit any modification to any plan or monitoring which may be necessary to deal with any adverse effects on the environment arising from the management or operation of the landfill.*
9. *The consent holder may apply, pursuant to section 127 of the Resource Management Act 1991, for the change or cancellation of any condition, other than the condition relating to the term of this permit at any time.*
10. *That the Manager, Consents and Investigations, Wellington Regional Council shall be given a minimum 48 hours notice prior to the exercise of this consent.*
11. *Construction activities shall be carried out with as little disturbance to the stream channel as possible. All reasonable steps shall be undertaken to separate construction activities from flowing stream water. Where construction activities cause significant discolouration or increased turbidity of stream waters such work shall cease until water clarity returns to a reasonable background level.*
12. *Any erosion of the stream bank or bed that is attributable to the works carried out as part of the stream diversion shall be repaired by the consent holder and appropriate measures shall be taken to prevent silt run-off from raw cuts and fills.*
13. *The Grantee shall prior to the exercise of this consent enter into and maintain a performance bond drawn in terms to be agreed to provide for the continuation and/or completion of any work associated with the diversion of stream water that may be required to avoid, remedy or mitigate adverse effects on the stream water or stream bed, necessitated as a result of the cessation of landfilling activity or closure of the landfilling operation for any reason whatsoever. The bond shall be in favour of the Wellington Regional Council and shall be to the value of 55,000 in 1995 dollars to be available on the commencement of work associated with the stream diversion.*

*WGN 940057(03) : Place Culvert in Bed of Unnamed Tributary of Careys Stream*

*Pursuant to sections 105 and 108 of the Resource Management Act 1991 the Joint Hearings Committee of the Wellington Regional Council and Wellington City Council by way of delegated authority in respect of the application by Burrell Demolition Limited to the Wellington Regional Council hereby grants consent to the application to place a culvert in the bed of an unnamed tributary of the Careys Stream, at or about Map Reference NZMS 260: R27; 557.850 on land whose legal description is Lot 1, DP 293898, Terawhiti District, Wellington subject to the Wellington Regional Council five standard conditions and the following additional conditions;*

*Special Conditions*

6. *The location, design, construction and operation of the culvert shall be as generally described in the Burrell Demolition Limited Resource Consent "Applications for a Cleanfill and Fourth Schedule Assessment (Assessment of Environmental Effects), as prepared for the consent holder by David Smith, Civil and Environmental Engineer dated April 1994, together with its associated reports and appendices and evidence presented by the consent holder at the hearing.*
7. *This permit shall expire on 14 June 2026.*

8. *The consent holder may apply, pursuant to section 127 of the Resource Management Act 1991, for the change or cancellation of any condition, other than the condition relating to the term of this permit at any time.*
9. *That the Manager, Consents and Investigations, Wellington Regional Council shall be given a minimum 48 hours notice prior to the exercise of this consent.*
10. *The culverts shall be constructed in accordance with best engineering practice and the manufacturer's specifications.*
11. *Construction activities shall be carried out with as little disturbance to the stream channel as possible. All reasonable steps shall be undertaken to separate construction activities from flowing stream water. Where construction activities cause significant discolouration or increased turbidity of stream waters such work shall cease until water clarity returns to a reasonable background level.*
12. *Fuel tanks shall be located clear of all floodways and the risk of spillage into the stream shall be kept to minimum.*
13. *On completion of the works all floodways shall be left in a tidy condition to the satisfaction of the Manager, Consents and Investigations, Wellington Regional Council.*
14. *That the consent holder shall arrange for a suitably qualified person to provide confirmation in writing, that the works have been constructed in accordance with the design plans/drawings submitted to the Wellington Regional Council and also in accordance with the conditions of the consent.*
15. *The culvert shall be laid to match the existing stream grade as far as is reasonably possible, any adverse effects resulting from a change 1:1 grade shall be rectified by the consent holder.*
16. *Any erosion of the stream bank or bed that is attributable to the works carried out as part of the culvert construction and operation shall be repaired by the consent holder and appropriate measures shall be taken to prevent silt run-off from raw cuts and fills.*
17. *If during construction activities, the consent holder uncovers any cultural, skeletal remains, or similar material operations shall cease in the vicinity immediately and shall notify the New Zealand Historic Places Trust and the New Zealand Police, if appropriate.*
18. *The consent holder shall carry out regular inspections of the culvert inlet and grillage, and clear any debris or gravel build-up.*
19. *The consent holder shall, within three months of the date of first exercise of this consent, construct stormwater drainages to divert surface water around the cleanfill, to the satisfaction of the Manager, Consents and Investigations, Wellington Regional Council.*
20. *The culvert shall remain the responsibility of the consent holder and shall be adequately maintained to ensure it performs as designed. Any damage to the culvert from flood flow shall be repaired at the consent holder's cost.*
21. *Not less than six months prior to the expiry or surrender of this consent, the consent holder shall apply for such consents as are required for the future operation and management of this site.*
22. *The Grantee shall prior to the exercise of this consent enter into and maintain a performance bond drawn in terms to be agreed to provide for the continuation and/or completion of any work associated with placing a culvert in the stream bed that may be required to avoid, remedy or mitigate adverse effects on the stream bed, necessitated as a result of the cessation of landfilling activity or closure of the landfilling operation for any reason whatsoever. The bond shall be in favour of the Wellington Regional Council and shall be to the value of \$5,000 in 1995 dollars to be available immediately on the commencement of work associated with placement of the culvert.*

### **Appendix 3 – Culvert Report**

MWA Solutions Limited report on existing culvert pipe condition dated 14 October 2010.

**Appendix 4 – Ecological Report**

Wildland Consultants Limited