Selwyn District Council

Planning Analysis - Quarrying

December 2017

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Appendices

1. Introduction

1.1 Purpose of this report

This report has been prepared by GHD Ltd for Selwyn District Council (SDC) to provide analysis as to the type of quarries that exist within the District at present, the key policy framework at a national, regional and district level, and the approach that other local authorities have taken to the issue of quarries within their district plans. The analysis is provided to facilitate the development of an appropriate approach for the management of new and expanded quarries in the District and forms part of the review of the Selwyn District Plan.

1.2 Scope and limitations

This report has been prepared for the benefit of Selwyn District Council for the purpose agreed between GHD and Selwyn District Council as set out in Section 1.1 of this report. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person. This disclaimer shall apply notwithstanding that the report may be made available to other persons for a permission or approval or to fulfil a legal requirement.

2. Background – Existing Scenario

2.1 Overview

Selwyn District contains over 200 existing quarries ranging from small Council pits to large privately operated quarries. There are currently three existing large, privately operated quarries, at least one new application for a significant operation is imminent, and several quarry operators are actively looking at opportunities within the District across a range of resources including gravel and limestone.

Quarries have been established within the District over several years via a range of pathways. Some are historic dating back to the early days of development in the District, while others have been established in more recent years to provide resources for the District's rapid growth and demand for natural resources.

Historically SDC owned and operated quarries have been provided for and protected by way of designations in the District Plan, or are relying on existing use rights. New commercially operated quarries have been established through the resource consent process, normally requiring a suite of resource consents from both SDC and Environment Canterbury. An example of this type of quarry is the Road Metals Company Limited 214 ha quarry on Wards Road/Sandy Knolls/Kerrs Road near Burnham, which was consented through the direct referral process to the Environment Court[1].

The Canterbury Plains are a rich source of aggregate given the number of braided rivers that cross them, and the changing course of these rivers over thousands of years. A geological investigation undertaken in 2009 by Geotech Consulting Limited in conjunction with Twelfth Knight Consulting identified areas across the plains that are likely to contain the most suitable gravels and classed them as Areas A and B depending on their reliability. Selwyn District includes large areas of both classes which are generally located on the fringes of Christchurch City and either side of the Rakaia River. A full copy of this report is included in Appendix A.

Given the anticipated growth in the District, consequential growth in demand for aggregate resources and the pressure on existing quarries in neighbouring Christchurch City due to residential growth and groundwater limitations, it is anticipated that owners of existing quarries will continue to look for development opportunities, and that some private operators will look to establish new quarries within the District. Selwyn District needs to consider whether it wants to facilitate growth in this industry within the District, and if so, how it is going to manage this increased demand. It is acknowledged that some of the District's demand for gravel is currently provided from river gravel. It is anticipated that these gravel takes will continue to play an important role in the provision of gravel resources to the growing district. However these takes are constrained by their location, and more specifically the transport costs associated with moving gravel from the riverbeds to the development location. Significant demand exists for resources that are located in close proximity to key development centres such as Rolleston and Lincoln, and rebuild projects and growth in Christchurch City are also seeing demand increase in Selwyn District.

2.2 Selwyn District Plan

As noted above, a number of consents have been sought for quarries in the District in recent years. These consents have enabled a high level of scrutiny of the existing District Plan provisions and in doing so have identified areas of tension between District Plan provisions and

[1] Road Metals Company Limited v SDC and CRC – Decision No [2012] Env C214 and Decision No [2013] NZEnvC085

the development of quarrying in the District. The following provides a brief summary of how quarries are currently provided for and assessed in the Selwyn District Plan.

The current Selwyn District Plan was the first Plan for the District under the Resource Management Act 1991 and replaced the Paparua District Scheme, the Ellesmere County District Scheme and the Malvern County District Scheme which were prepared under the Town and Country Planning Act. The Plan is split into two volumes, the Township Volume and the Rural Volume. Given the rural nature of quarrying activities this analysis only deals with the Rural Volume of the existing District Plan.

Twenty three townships and several small pockets of houses are scattered throughout the rural area, with several small settlements provided for as part of the rural zone. As a result of previous subdivision provisions, the District also contains clusters of lifestyle properties (particularly within the Inner Plains area) that are occupied by a range of often sensitive land uses.

The dominant land use in the Rural Zone is farming but the Plan acknowledges that many other activities need to be recognised and provided for within this area as part of promoting the sustainable management of natural and physical resources. The District Plan notes that these activities include forestry, mining and **quarrying (gravel, bentonite and limestone)** community facilities, business activities, outdoor recreation, residential activities and conservation.

2.3 Zoning

The Rural Zone is not split into multiple subzones but rather is split into areas to manage specific activities. The Plan notes that 'the different characteristics of the Plains have resulted in different land uses and intensity of subdivision and settlement'. These differences are reflected in the division of the Plains into Inner and Outer Plains for the management of subdivision and residential density.

2.4 Definitions

There are three key definitions associated with quarrying that are included in the District Plan. These are quarrying, industrial activity and rural activity.

Quarrying is defined as:

"to take, mine or extract, by whatever means, any rock, stone, gravel or sand existing in its natural state in land." "To quarry" has a corresponding meaning.

Industrial activity is defined as:

"any activity involving the manufacturing, production, processing, assembly, disassembly, packaging, servicing, testing, repair, direct handling, distribution and/or warehousing of any materials, goods, products, machinery or vehicles, but excludes mining, mineral exploration and quarrying and, for the avoidance of doubt, harvesting activities associated with plantation forestry

For the purpose of this definition an industrial activity is further defined as being either of the following:

(a) Rural Based Industrial Activity: means an industrial activity that involves the use of raw materials or primary products which are derived directly from the rural environment, including agricultural, pastoral, horticultural, forestry, viticulture and crops.

Or

(b) *Other Industrial Activity: means any other Industrial Activity that is not defined as a "rural based industrial activity" as stated in (a) above."*

Rural Activity is defined as "*the use of land or building(s) for the purpose of growing or rearing crops or livestock including forestry, viticulture and horticulture and livestock production and may include a dwelling."*

It is noted that the definition of "rural activity" in the Plan does not include quarrying. This is the case in many District Plans, and may continue to be appropriate for a range of reasons given the specific adverse effects to be managed in respect to quarrying. The definition of rural activity in the RPS in respect to the greater Christchurch area (which includes part of Selwyn District) specifically includes "quarrying and associated activities". The definition is, however, supported by a carefully worded policy on rural production (Policy 5.3.12) and confirms the view that quarrying is to be managed to ensure that its effects on the rural environment are acceptable.

These key definitions in the Plan identified above were heavily debated as part of the consent process for the Road Metals quarry in Burnham because the definition of quarrying does not include screening and processing activities that often go with quarrying activity. These activities are required to be classified as either a 'rural based industrial activity' or 'other industrial activity'. In the Outer Plains "other industrial activities" are a non-complying activity, but "rural-based industrial activities" are discretionary activities. The determination of whether the concrete batching plant associated with the Road Metals proposal was a rural-based industrial activity or an "other industrial activity" impacted significantly on the consideration of the application, with the Judge determining that it was a rural-based industrial activity.

Overall, it is considered that in this District Plan Review the opportunity to clarify the definitions associated with quarrying activity and associated processing activities should be given priority, as this will increase certainty to both quarry developers and adjoining landowners for future quarry developments.

2.5 District Policy Framework

Part B of the Rural Volume sets out the policy framework for the rural area and is split into four subsections, these being: natural resources, physical resources, health safety values and rural growth.

The natural resources section seeks to protect and maintain the life supporting capacity of soils and avoid activities that have the potential to result in contamination of the soil resource. Policy B1.1.7 specifically provides for the removal of large quantities of topsoil from sites in situations where the topsoil will be replaced, and the site replanted when the activity ceases. The question of appropriate rehabilitation remains an important consideration for any quarrying provisions in the District Plan Review.

Objectives and policies seek to manage land use activities (particularly earthworks) to protect water quantity and quality and natural character, and to provide for the special interest of Tangata Whenua in resource management issues relating to water. Policy 1.3.4 specifically seeks to manage activities which may result in surface runoff of contaminants or leaching of contaminants into groundwater.

The physical resources section includes objectives and policies that aim to avoid or mitigate the adverse effects of new or expanded activities on state highways and arterial roads, and recognises that some upgrading of infrastructure will be required to provide for new/expanded activities. Objective B2.1.1 seeks that new land uses do not compromise the safe and efficient operation of roads.

In relation to quarrying the Health Safety and Values section contains objectives and policies associated with the handling and storage of hazardous substances and the potential effects on human health, the amenity of the rural environment and the natural environment of these activities. It also includes policies associated with noise generating activities and seeks to ensure that continuous or regular noise is not at a level that disturbs people indoors on adjoining properties. Policy 3.4.19 seeks to mitigate nuisance effects caused by dust from earthworks and stockpiling of material.

Finally, this section also sets out objectives and policies that seek to provide for a rural area that is a pleasant place to live and work in. Objectives acknowledge the need to provide for a variety of activities in the rural area while maintaining the rural character and avoiding reverse sensitivity effects. The section notes that the rural area has a character that is distinct from townships and that people value the rural outlook. Policies and rules aim to maintain the quality of the environment through managing effects such as noise, vibration, outdoor signage, glare and odour. They allow for day to day farming and other activities that have effects typical of a rural area, but manage activities that have potentially more adverse effects. The rural area is recognised as principally a business area rather than a residential area.

Objective B3.4.2 recognises that the Rural Zone is an area where a variety of activities take place including primary production, outdoor recreation, a variety of business activities and residential activities and community facilities. This Objective seeks to recognise that while a variety of activities may be appropriate, rural character must be maintained and potential reverse sensitivity effects avoided.

Policy B3.4.4 relates specifically to the Inner Plains area and seeks to ensure that effects of "rural based" industrial activities are avoided, remedied or mitigated to the extent that the adverse effects are no more than minor.

Policy 3.4.16 seeks to mitigate nuisance effects associated with dust from earthworks or stockpiled material. This policy does not intend to prevent activities from occurring, but rather requires steps to be undertaken to reduce dust nuisance. Under the hierarchy set out in the Resource Management Act, these objectives and policies must give effect to the higher order planning documents, specifically the Regional Policy Statement. The relevant regional objectives and policies are discussed in Section 3 of this report.

The Rural Growth section considers reverse sensitivity effects. These objectives and policies attempt to avoid reverse sensitivity effects by maintaining a low level of residential density within the rural area and protecting lawfully established activities from other activities locating in close proximity to them.

Overall, while there are objectives and policies that provide for non-agricultural rural activities there are no specific objectives or policies which support quarrying in the District. Notwithstanding this, there are a plethora of general objectives and policies that can be applied to quarrying activities in Selwyn District.

2.6 Rules Framework

The Rural Zone rules framework is 'effects based' in that it focuses on the effects of the activity rather than the type of activity. The exception is a small number of listed activities that require assessment as a discretionary activity or non-complying activity, owning to the nature of effects associated with them. The following is a summary of the key rules associated with a typical quarrying activity. It is not intended to be a comprehensive list of all relevant rules in the Plan that may apply to quarries due to the varied nature of quarry activities and the environments within which they may locate.

Section 9 – 'Activities', classifies other industrial activities as a non-complying activity.

Rural based industrial activities are listed as permitted provide that two conditions are met including maximum building coverage (100m^2) and maximum number of FTE staff (2). If either of these conditions are not met the activity is discretionary if it is located in the Outer Plains area, or non-complying if it is within the Inner Plains.

Rule 9.13 relates to activities and vehicle movements and sets the maximum number of vehicle movements to any state highway or arterial road that is maintained by the Council at 30 ecm/day averaged over one week and 60 ecm/day for local and collector road. Any activity exceeding these limits must be assessed as a discretionary activity. Only the smaller quarries in the District would meet these requirements.

Rule 9.16 sets the noise limits at any living zone boundary and at the notional boundary of any dwelling, rest home, hospital or classroom in an educational facility. The daytime noise limits apply to the hours of 7.30am-8.00pm and night time noise limits the hours of 8.01pm to 7.29am. Any activity not complying with these noise standards requires assessment as a discretionary activity. With adequate bunding and setbacks many quarry sites could meet these requirements or provide additional mitigation measures. However, the hours of operation attached to the noise limits can be problematic for many quarry products which are required for early morning delivery to construction sites.

Section C1 includes rules relating to earthworks volumes, setbacks volume and site rehabilitation and provides for a range of earthworks activities as permitted. Quarrying activity would nearly always exceed these thresholds. While there are no specific rules associated with dust, assessment criteria include the potential for dust nuisance from stockpiled material.

Section C3 sets out rules relating to the construction of buildings and site coverage. These rules limit the size of any building to 35% of the allotment, or 500m^2, whichever is lesser for allotments less than 1ha in area, or 5% for all other allotments. These rules are not problematic for quarrying activities.

Overall, given the range of activities that are likely to take place as part of a typical quarry activity it is likely that a quarry would require consent (as a minimum) as a discretionary activity and possibly as a non-complying activity. This depends on the extent of any associated processing activities, the location of the site (Inner Plains vs Outer Plains) and interpretation of the definitions related to industrial activities. Specifically, the activity status is contingent on whether the processing and screening activities associated with quarry activities are Rural Based Industry or Other Industry. While the Road Metals decision discussed earlier assists with this interpretation, it will be more effective and efficient in terms of Section 32 of the RMA for the Reviewed Plan to address this specifically to reduce the tension that exists between the quarrying and related activity and the Plans objectives and policies.

3. Regional Policy Framework

3.1 Canterbury Regional Policy Statement

The CRPS became operative on 15 January 2013, and provides an overview of the resource management issues for the region. It contains issues, objectives, policies and methods to achieve integrated management of natural and physical resources. Chapter 5 (Land-Use and Infrastructure), Chapter 6 (Recovery and Rebuilding of Greater Christchurch), Chapter 7 (Freshwater), Chapter 14 (Air Quality), and Chapter 15 (Soils) of the CRPS contain objectives and policies which are relevant to the development of new quarrying provisions within Selwyn District. The general themes of these chapters are as follows:

- Chapter 5 includes issues, objectives and policies that apply across the whole region and focus on development which results in change to urban, rural-residential and rural areas together with the infrastructural services which support development. Policy 5.3.12 aims to maintain and enhance natural and physical resources contributing to the rural productive economy, and seeks to enable development provided that it has a direct relationship with, or is dependent on rural activities, rural resources or raw materials sourced from the rural area.
- Chapter 6 seeks to enable and support earthquake recovery and rebuilding for the Greater Christchurch area through to 2028. Policy 6.3.9 provides for new rural residential development as long as reverse sensitivity effects with adjacent rural activities including quarrying and agricultural research farms or strategic infrastructure are avoided. It is noted that this chapter only applies to the portion of the District located within Greater Christchurch.
- Chapter 7 seeks to ensure that the quality of water bodies, including groundwater bodies, is not degraded by changes in land use (Objective 7.2.3 and Policy 7.3.7). Chapter 7 also seeks to manage allocation of freshwater to avoid inefficient use. Objective 7.2.1 and Policy 7.3.5 seek to manage effects of land use activity on flows within surface waterbodies and the recharge of groundwater.
- The general policy direction of Chapter 14 is the maintenance and enhancement of air quality values, and locating discharging activities away from sensitive activities unless adverse effects can be avoided or mitigated (Policy 14.3.5).
- Chapter 15, particularly through Objective 15.2.1 and Policy 15.3.1, recognises the need to maintain soil quality and avoid, remedy or mitigate soil degradation.

Of particular note is the definition of Rural Activities for Greater Christchurch, which is as follows:

"means activities of a size, function, intensity or character typical of those in rural areas and includes:

- *Rural land use activities such as agriculture, aquaculture, horticulture and forestry.*
- *Businesses that support rural land use activities.*
- *Large – footprint parks, reserves, conservation parks and recreation facilities.*
- *Residential activity on lots of 4 ha or more.*
- *Quarrying and associated activities.*
- *Strategic infrastructure outside of the existing urban area and priority areas for development."*

This definition, along with the policy provisions applying to the wider region discussed above, confirms the overall position in the RPS that quarrying forms a legitimate part of the rural environment. It will be important for the District Plan Review to give effect to this direction in developing the objective and policy framework for the rural area.

The overall direction of the RPS in relation to quarrying is the management of land use activities in a way that avoids reverse sensitivity effects and protects groundwater resources both in terms of quality and quantity. It also focuses on the sustainable management of land once quarrying ceases.

With respect to air discharges the RPS provides a framework that favours the separation of activities that discharge contaminants to air while providing for them to be located in closer proximity when adequate alternative mitigation is available.

The operative Plan pre-dates the RPS and has a level of inconsistency with the newer framework set out in the RPS. It fails to appropriately recognise and provide for 'quarrying and associated activities' as a legitimate rural activity that needs to be carried out within the rural environment, albeit in a manner that internalises adverse effects associated with new quarries and avoids issues associated with reverse sensitivity for existing quarries in the rural area.

3.2 Land and Water Regional Plan

The Land and Water Regional Plan (LWRP) contains a suite of objectives, policies and rules that give effect to the direction set out in the RPS in relation to land and water resources. With respect to quarrying these are generally focussed on protecting water resources from contamination, and relate to the storage of hazardous substances and separation distances between groundwater and quarrying activities.

Policies 4.93 and 4.94 specifically recognise the value of quarrying to the region and seek to enable quarrying provided that any adverse effects can be sufficiently mitigated. Given the depth to aquifers in Selwyn District in many instances quarries are unlikely to require regional consents for bulk earthworks but may require consent for services infrastructure such as water supply, stormwater, wash-water discharges and the storage of hazardous substances. An additional suit of consents may be required for quarries establishing close to a water race, stream, wetland or lake. Furthermore it is noted that in some instances consent will also be required for the deposition of material (cleanfill) as part of the site rehabilitation process.

3.3 Canterbury Air Regional Plan

The Canterbury Air Regional Plan (CARP) provides the regional framework for managing air discharges within Canterbury. It includes objectives, policies and rules relating to air discharges from the handling of bulk materials as well as cleanfills and unconsolidated surfaces. Policies 6.9-6.12 focus on avoiding or mitigating adverse effects on sensitive activities taking into account district plan zonings and the internalisation of air discharge effects within sites. Most quarrying activities will require a suite of resource consents under the CARP for the handling and storage (stockpiling) of bulk materials and discharges from unconsolidated surfaces.

Rule 7.32 provides for discharges from unconsolidated surfaces as a permitted activity provided that a dust management plan is prepared and the discharge does not cause offensive or objectionable effects beyond the boundary of the site. Failure to comply with this requirement results in the activity being assessed as a non-complying activity.

Rule 7.35 provides for discharges from the handling of bulk solid materials as a permitted activity provided a number of conditions are met. This includes a maximum rate of handling (100t/hr), the preparation of a dust management plan, and a setback of 200m from any sensitive activity. The outdoor storage of bulk materials is also provided for as a permitted activity under

Rule 7.36 subject to limits on particle size, discharges beyond the boundary, compliance with a dust management plan and a setback of 100m from any sensitive activity. Provided that there are no objectionable or offensive effects beyond the boundary of the site, any activity that does not meet the standards of rule 7.35 or 7.36 requires consent as a restricted discretionary activity.

Air quality is acknowledged as one of the key areas of overlap and potential duplication under the current national resource management framework. Regional councils have a role to manage the effects of dust and odour as they relate to the discharge of contaminants and the effects of those contaminants, while territorial authorities have a role to manage the amenity effects associated with dust and odour discharges. As part of the current planning framework within Canterbury, most quarry applications are subject to scrutiny and consent conditions relating to air quality from both regional and territorial authorities. Within Selwyn District most quarry applications include an assessment of the potential nuisance effects associated with dust discharges as a result of the objective and policy framework and assessment criteria. This effect is also considered as part of the regional air discharge consent.

4. Cross Boundary Consistency

In order to understand how quarrying is dealt with elsewhere in the Region the provisions of the Christchurch City, Hurunui District, Waimakariri District and Ashburton District Plans were reviewed. The following provides a brief summary of the planning framework for quarries in each of these areas.

4.1 Christchurch City

The Christchurch District Plan (CDP) recognises quarrying as a legitimate rural activity and has a Quarry Zone that encompasses part of the wider rural area. A large number of substantial quarries are located within this zone, however limited scope for growth exists. Objectives and policies focus on protecting the amenity values of surrounding rural area and are particularly concerned with quarry site rehabilitation and end use. Within the Rural Quarry zone quarrying is a permitted activity provided that a range of development controls are met. This includes provision for some limited night-time operation and requirements for bunding and amenity planting, the development of a quarry site rehabilitation plan, and setbacks for crushing machinery. It is noted that the Quarry Zone is a legacy zone that encompasses historic quarries in Christchurch City.

Outside of the Quarry Zone quarries are provided for as a discretionary activity within the Rural Zone provided that a 250m setback is achieved between the site and a residential zone or Specific Purpose (School) Zone boundary.

Quarrying activity is defined in the CDP as:

"the use of land, buildings and plant for the purpose of the extraction of natural sand, gravel, clay, silt and rock, the associated processing, storage, sale and transportation of those same materials and quarry site rehabilitation. It may include:

1. *earthworks associated with the removal and storage of over-burden;*
2. *extraction of natural sand, gravel, clay, silt and rock materials by excavation or blasting;*
3. *processing of those extracted materials by screening, crushing, washing and/or mixing them together;*
4. *the addition of clay, lime, cement and recycled/recovered aggregate to extracted materials;*
5. *ancillary aggregates-processing activity;*
6. *workshops required for the repair of equipment used on the same property;*
7. *site management offices;*
8. *parking areas;*
9. *landscaping; and*
10. *quarry site rehabilitation and any associated clean-filling."*

4.2 Hurunui District

Like Selwyn District, the Hurunui District spans a range of different geological environments and as such contains a variety of different quarrying activities including gravel, limestone and sand. The Operative Hurunui District Plan (HDP) provides a policy framework that recognises quarrying as a legitimate rural activity that generates adverse effects that must be avoided,

remedied or mitigated. Policies also focus on land rehabilitation. The HDP enables small scale quarrying and mining in its General Management Area as a permitted activity and at a larger scale as a discretionary activity.

Quarry is defined as

"an open surface excavation for the extraction of stone, sand, gravel, and other building materials."

The Proposed Hurunui District Plan has been publicly notified, decisions released and is now at the appeals stage. The Proposed Plan adopts a similar philosophy to the HDP in that it recognises quarrying as a legitimate rural activity and includes specific objectives and policies that set out the key issues requiring consideration. The Proposed Plan retains small scale quarrying and mining as a permitted activity in the rural area with larger scale quarrying continuing to be a discretionary activity subject to setbacks from sensitive zones.

New definitions results in quarrying being included as 'mineral extraction' with mineral extraction activities defined in the Proposed Plan as:

"means activities carried out at a quarry or mine, and includes:

- *blasting;*
- *excavating minerals;*
- *processing minerals by crushing, screening, washing or blending;*
- *storing, distributing and selling mineral products;*
- *removing and depositing overburden;*
- *treating stormwater and wastewater;*
- *cleanfilling, landscaping and rehabilitation works; and*
- *recycling or reusing aggregate from demolition waste such as concrete, masonry, or asphalt."*

4.3 Waimakariri District

The Waimakariri District, like Selwyn and Hurunui, contains a variety of different quarry activities including gravel, sand and limestone. The Waimakariri District Plan (WDP) provides a broad policy framework for the extraction of minerals in the Rural Zone. While it is recognised as a rural land use, there are activity specific objectives or policies to support any application made under the plan.

Quarrying within the Rural Zone is provided for as a restricted discretionary activity, with Council's discretion limited to the following:

"i. *final contours and ground levels resulting from excavation;*

ii. location of plant and structures;

iii. vehicle circulation on-site from the area of disturbance or quarry face to the road;

iv. identification of the area used for processing, stockpiling and distribution of disturbed or quarried material;

v. drainage;

vi. measures to avoid, remedy or mitigate adverse effects on the surrounding environment including noise, dust, siltation, visual detraction and traffic generation;

vii. contingency provisions and emergency response procedures;

viii. remediation and restoration proposals for the site;

ix. the short and long term effects on flood potential beyond the earthworks;

x. for East Woodend Outline Development Plan area those matters over which control is exercised for controlled activities in Chapter 32: Subdivision – Rules;

xi. impacts on the operation, maintenance, upgrade and development of the National Grid;

xii. technical advice provided by Transpower;

xiii. the risk to the structure and integrity of the National Grid;

xiv. the risk of electrical hazards affecting public or individual safety, and the risk of property damage;

xv. compliance with NZECP 34:2001 "New Zealand Electrical Code of Practice for Electrical Safe Distances"; and

xvi. financial contributions as set out in Chapter 20: Financial Contributions and Chapter 34: Financial Contributions – Rules and development contributions as set out in Waimakariri District Council's Development Contributions Policy."

Quarrying and/or mineral extraction are not defined in the WDP.

4.4 Ashburton District Plan

The Ashburton District Plan (ADP) provides for quarries within the Rural Zone as a discretionary activity. The ADP states that the purpose of this rule is to ensure that the effects of activities associated with mineral extraction or quarrying are avoided remedied or mitigated. It is especially relevant to those effects associated with amenity, landscape, geo-conservation or natural conservation values and cultural values of Takata Whenua. This Council seeks to maintain discretion as to whether mineral extraction or quarrying should proceed and if so, impose conditions to mitigate adverse effects. The objective and policy framework that supports this is broad and general and not specific to quarrying as a rural activity and in this respect is similar in approach to the operative Selwyn Plan.

Mineral extraction is defined in the plan as

"the use of land and / or buildings for a purpose that results in the extraction, winning, quarrying, excavation and/or associated processing of minerals; and includes prospecting and exploration, excavation, blasting, crushing, screening, washing, blending, processing, storage, deposition of overburden, treatment of waste water and rehabilitation of sites."

4.5 Summary

Overall, it is considered that a degree of consistency exists across other Districts in the Region, in that quarrying is anticipated and provided for in the rural environment where its adverse effects can be internalised. These other Districts are reasonably consistent with their definitions of quarrying including some associated processing of material. The ADC definition is considered to be particularly helpful in that it is clear and concise and provides for an appropriate range of associated activities.

Cross boundary consistency has the effect of improving outcomes as quarry operators are able to improve the quality of information provided as part of the resource consenting and environmental management process.

5. Iwi Management Plan

The Maahanui Iwi Management Plan 2013 (MIMP) provides policy framework for the protection and enhancement of Ngai Tahu values and for achieving outcomes that provide for the relationship of Ngai Tahu with natural resources across mid Canterbury. It is endorsed by Ngai Tahu as the Iwi Authority and as such, is a relevant policy document under the Resource Management Act. The MIMP includes a range of relevant objectives and policies that should be considered in the development of quarrying provisions within Selwyn. The three key policy areas of relevance to quarrying are as follows:

- Discharges to air
- Water takes and discharges to groundwater
- Land use (region wide)

Discharges to air

The objectives and policies associated with air discharges seek to protect the mauri of air from adverse effects from discharges of contaminants to air. They also seek to control discharges to air to protect the cultural amenity of historic, traditional and spiritual sites. Dust emissions in close proximity to marae or wāhi tapu sites also require consideration.

Water takes and discharges to groundwater

The MIMP states that the discharge of stormwater or sediment to water or land where it may enter water is culturally unacceptable. It also outlines significant concerns regarding over-allocated water resources with respect to water takes.

Land use (region wide)

The Plan includes specific objectives and policies associated with quarrying. Of particular note are Policies P13.2 and P13.3 set out below:

"P13.2 To assess mining and quarrying proposals with reference to:
(a) Location of the activity

- *What is the general sensitivity of the site to the proposed activity?*
- *How well does the proposed activity 'fit' with the existing landscape?*
- *Is there significant indigenous biodiversity on the site, including remnant native bush?*
- *What waterways, wetlands or waipuna exist on the site?*
- *Are there sites of significance on or near the site?*
- *What is the risk of accidental discoveries?*
- *What is the wider cultural landscape context within which the site is located?*
  (b) Type of mining/quarrying
- *What resource is being extracted, what will it be used for, and is it sustainable?*
  (c) Avoiding and mitigating adverse effects
- *What provisions are in place to address sediment and erosion control?*
- *What provisions are in place for stormwater management?*
- *What provisions are in place for waterway protection?*
- *How will the site be restored once closed?*

P13.3: To require all applications for mining and quarrying activities to include:
(a) Quarry management plans for earthworks, erosion and sediment control, waterway protection, on site stormwater treatment and disposal and provisions for visual screening/ barriers that include indigenous vegetation; and
(b) Site rehabilitation plans that include restoration of the site using indigenous species."

These objectives and policies in the MIMP provide a clear understanding as to the issues that Iwi foresee from quarrying activities as the matters that require consideration as part of any

resource consent process. They provide a useful framework for the consideration of Iwi values as part of the process of determining provisions for the District Plan Review.

6. Industry Guidelines

To date there is no comprehensive suite of industry guidelines for the management of environmental effects associated with quarries in New Zealand. To date guidelines have focused on health and safety aspects of quarry operation rather than environmental management. Notwithstanding this, in order to comply with consent conditions it is becoming common practice for quarries to have 'Quarry Management Plans' that include an environmental management framework.

Consultation with local quarry operators has indicated that they are in the process of developing an industry code of practice for the establishment and operation of quarries locally. It is anticipated that this will be available in a draft form in early 2018. On this basis it may form part of future discussions on the management of quarries in Selwyn as part of this District Plan Review.

Notwithstanding the above, a number of best practice guides are available that are applicable to quarrying in Selwyn. These include the following:

- MfE Good Practice Guide for Assessing and Managing Dust
- MfE Guide to the Management of Cleanfills
- Hazardous Substances Toolbox

We understand that a guideline for silica emissions is also being developed. This should be considered as part of the District Plan Review.

7. Stakeholder Engagement

7.1 Quarry Industry

A meeting was held with Canterbury Aggregate Producers Group (CAPG) representatives (Tim Ensor, Senior Resource Management Planner at Tonkin and Taylor and Don Chittock, Resources and Sustainability Manager at Fulton Hogan) on Tuesday 7 November. The meeting with CAPG focused on obtaining as much feedback as possible on the challenges faced by industry operators establishing operating quarries in Selwyn District, and specifically in relation to the challenges under the existing regulatory framework.

Feedback from Mr Ensor and Mr Chittock centred around four key themes: the definition of quarrying in the operative Plan, future use of quarry sites, duplication of assessment under District and Regional Plans and silica monitoring. In addition, representatives from CAPG indicated that they were comfortable with quarrying being a discretionary activity throughout the rural area provided that there is a supportive objective and policy framework in place.

Definition of Quarrying

Both Mr Ensor and Mr Chittock felt that quarrying needed to be recognised and provided for as a rural land use, and raised concerns about the narrow focus of the existing definition of quarrying within the District Plan and the limitations it imposes. They highlighted that quarrying rarely involves simply the extraction of material from the ground but also a wide range of associated activities including the following:

- Cleanfilling/rehabilitation
- Processing
- Mixing/blending
- Storage and conveyance
- Site establishment
- Weighbridges and internal roads
- Sewer
- Water storage/tanks
- Machinery parks/storage
- Light engineering/workshops
- Hazardous substance/fuel storage
- Mobile refuelling
- Settling ponds/washing processing
- Truck parking
- Fixed and mobile plant
- Retail
- Lighting
- Extended hours of operation (some 24/7 scenarios)

They expressed a desire to be able to continue with existing rural uses while the quarry activities are developed. The representatives from CAPG noted that the hours for daytime and night-time noise limits make it difficult for quarries to meet the needs of their customers.

Future Use

It was identified that as part of the resource consent process operators are often locked into a method of site rehabilitation that limits or attempts to anticipate the future land use of the site that is often 20-30 years into the future. Both Mr Ensor and Mr Chittock expressed a need for the 'door to not be shut' on a range of possible future land uses as community needs and desires change over time, while still facilitating the eventual rehabilitation of the site in some form. A number of possible end uses including biodiversity banks, public facilities, sports facilities and energy generation were proposed.

Duplication of Provisions

The duplication of provisions under the District and Regional Plans was also discussed. A need for clarity and clear demarcation between the roles of the individual authorities especially in relation to air quality was recognised. As discussed earlier, under the RMA both regional and district councils have responsibility for matters relating to air discharges/contaminants and in the operative Selwyn Plan this includes nuisance effects associated with dust discharges. However, Section 33 of the RMA enables transfer of powers which could be investigated as part of this review process.

Silica Monitoring

Earlier this year residents living near a number of Christchurch quarries raised concerns about the long term health effects from silica dust that is generated by quarrying activities. In response to these concerns Environment Canterbury and local quarrying operators have been involved in a monitoring programme to monitor and assess the level of silica dust in key locations. Mr Chittock advised that further meetings are being held with Environment Canterbury to look at the results to date, and that monitoring is set to continue over the summer, including specific sampling locations. It is hoped that the end result will enable the assessment of potential separation requirements between quarries and sensitive receptors. This will be useful for Selwyn District in setting setback distances specified in the plan.

7.2 Christchurch City Council

Discussions were held with Christchurch City Council (CCC) Planners regarding their experience developing new quarry provisions for the District Plan. Adele Radburnd was responsible for the rural quarries section of the Replacement District Plan. Ms Radburnd advised that CCC considered three broad options including: expanding the existing quarry zone, a floating zone and providing for quarries as a discretionary activity. They ultimately reached the view that a broader quarry zone does not work well given the number of rules that are necessary to mitigate effects.

Ms Radburnd indicated that the quarry industry were opposed to a zoning approach as it had the effect of increasing land values. She stressed the importance of planning for site rehabilitation and end use from day one and indicated that this was supported in the District Plan hearings by industry experts. Ms Radburnd proposed a quality gravels overlay approach as a means of protecting gravel resources from more intensive residential development. This was ultimately removed from the Christchurch District Plan through the hearings process.

It is noted that the new Christchurch District Plan provisions have recently been tested in the Environment Court with the Harewood Gravels decision. The Christchurch City Council originally granted the application, however, this was overturned in the Environment Court. The main reasons for this are summarised in the following synopsis:

> *The Court addressed the strategic direction of the plan and the relevant objectives and policies noting that, although quarrying was a rural productive activity, this did not mean it was necessarily appropriate at the*

site and that the proposal was to be assessed on its merits in light of the plan objectives. The plan required decision-makers to ensure that the nature, scale and intensity of an activity recognised the natural and physical resources, character and amenity values of rural land, and to ensure adequate separation distances were maintained between new quarrying activity and incompatible activities. Further, new quarrying activities were to demonstrate site rehabilitation was achieved through a site rehabilitation plan. The Court also considered plan provisions as to traffic and noise before describing the receiving environment in which any effects of the proposal would be experienced..

…

Assessing the proposal under s 104D of the RMA, the Court concluded that the activity did not satisfy the first limb as to adverse effects. Turning to consider whether the application was contrary to the objectives and policies in the plan, the Court stated that HGL had not discharged its persuasive burden to provide evidence as to the future dust environment and rural character and so the Court was unable to determine whether the second limb of s 104D of the RMA was satisfied. The Court was not satisfied that the evidence established to the required standard that the use and development of rural land would support and maintain the amenity values of the rural environment, as required by the relevant objectives. While the policies recognised that quarrying was a rural productive activity, HGL had not proffered conditions ensuring the required setback and separation distances, and the proposal did not achieve policies regarding the management of noise, access and vibration. Further the plan's requirements as to site rehabilitation were not achieved and there was no stated end use objective for the site, on which the Court placed significant weight. Overall, the landscape evidence did not persuade the Court that the cumulative effects were such that rural character and amenity would be maintained, as the plan required.[2]

It is understood that the applicant has appealed this decision to the High Court. It would be helpful to keep abreast of developments in this case as the Selwyn quarry provisions are further formulated.

7.3 Environment Canterbury

A meeting was held with Olivia Cook and Lisa Jenkins from Environment Canterbury to discuss Selwyn's existing approach to quarrying, the challenges associated with duplication, particularly in relation to air discharge, and the options moving forward. While there are other issues of concern to Environment Canterbury a key issue when managing quarries in Selwyn is air quality. Ms Jenkins reaffirmed the RPS and CARP direction to internalise adverse effects and protect existing quarry activities from reverse sensitivity issues.

There was a discussion about ways to reduce duplication including the option of SDC transferring its functions under Section 33 of the RMA with respect to air quality to Environment Canterbury. Both Ms Cook and Ms Jenkin indicated that they weren't opposed to this option in principle but noted that they would not be well placed to manage amenity effects. It was subsequently acknowledged that with respect to air discharges from quarries, amenity effects are often dealt with as a subset of contamination issues. Further consideration of this option will require further exploration and dialogue by both Environment Canterbury and SDC.

[22] Yaldhurst Quarries Joint Action Group v Christchurch City Council, Summary by Alert24 Your Environment, Thomson Reuters 23 November 2017

8. Options and Recommendations

Based on the above analysis it is considered that there are three viable options for managing quarrying through the District Plan. They are:

- Retain the status quo;
- Develop new provisions centred around a specific quarry zone; or
- Develop new provisions that make quarrying anywhere in the rural area a discretionary activity.

Each option is discussed in more detail below.

8.1 Retain the status quo

As noted above, the existing provisions have been in place for several years and have been tested through the resource consent process on several occasions. The Road Metals decision (which is attached as Appendix B) identifies a number challenges associated with the current rules. These challenges align with the feedback that was provided in consultation and through our analysis of the existing provisions.

In summary, the operative Plan fails to recognise quarrying as a legitimate rural activity and provide a robust framework for assessing new activities. The operative Plan definitions create uncertainty as to the activity status of new activities and fails to recognise the associated activities that go hand in hand with the primary extraction activity. The objectives and policies do not assist in decision-making due to their general nature and lack of overt support for quarrying activity where adverse effects are able to be avoided or mitigated. This creates uncertainty both for quarry operators and for rural residents.

8.2 New Quarry Zone

As an alternative to retaining the existing provisions, the Council may consider a specific quarry zone and provide for new quarries within this zone. This approach would provide a higher degree of certainty to rural property owners as to the activities that could establish in proximity to them and reduce the tension between quarries and more sensitive activities. This approach would also enable buffers to be introduced around these zones.

The development of this approach would require a significant investment by the Council to identify those areas of high quality gravels that are suitable for a quarry zone, and to ensure that sufficient land was zoned in this manner to provide for growth in the district. A suite of comprehensive standards to be applied in the zone would also need to be developed. Given the size of the District this would be a significant piece of work. Furthermore, it would also still be necessary to provide a framework for considering quarries outside this zone.

Given the number of large existing quarries that have been established through the resource consent process it would be difficult to produce rules that captured all of the individual site specific requirements. Furthermore, it is noted that the adverse effects from quarries can be difficult to manage and much of the effective environmental mitigation comes from good management by the quarry operator. This would be difficult to capture in a general suite of rules.

Another concern is that this approach would “pick winners” potentially at the expense of those immediate neighbours, and potentially at the expense of allowing the market to determine appropriate locations for quarries. This approach may also lead to a cluster of quarries in one location with significant cumulative adverse effects on the surrounding environment. It is

considered that it could be difficult to get new quarry zones accepted through the district planning process without significant litigation. Any section 32 assessment would need to evaluate the effect of this strategy on land prices. Quarry operators have expressed a concern that this strategy would increase land prices within quarry zones.

8.3 Provide for Quarrying as a Discretionary Activity

The third option is to provide for quarrying throughout the District's rural area as a discretionary or restricted discretionary activity. This would recognise quarrying as a legitimate rural activity, albeit one that has the potential to result in adverse effects on the environment that must be avoided, remedied or mitigated. As part of this option it would be critical to better define quarrying and its associated activities to provide certainty as to what activities are and are not captured by the provisions. It would also necessary to provide a robust policy framework to support these provisions. As suggested by Ms Radburnd at CCC it may also be appropriate to include a 'high quality gravels overlay' or similar that signals those areas where quarrying is anticipated and to protect those areas from rural residential fragmentation.

With this approach it would be possible to have specific information requirements provided in the District Plan for any resource consent application. The Council could also devise a rule specifying that if an air discharge consent has been granted by Environment Canterbury then the effects associated with air discharges will not exempted as part of the SDC consent process. A range of standards could also be imposed associated with buffer distances, bunding, rehabilitation, hours of operation, noise and maximum numbers of vehicle movements.

The down side of a general discretionary activity approach across the rural area of the District is that there is no real certainty for rural residents and other sensitive activities where a quarry could next be proposed. A clear objective and policy framework outlining the circumstances where quarrying and its associated activities are appropriate in the rural environment would assist in reducing this concern.

8.4 Conclusion

Overall, it is considered that the existing provisions in the operative Plan fail to provide the degree of certainty that is sought from both quarry operators and rural residents and other businesses. The acknowledgement of quarrying as a legitimate rural activity is consistent with the approach taken in other districts and requires the implementation of a robust planning framework to manage the effects. There is the ability to develop such a framework for Selwyn through the District Plan review process.

It is noted that further consultation is recommended with quarry operators and rural residents to gauge support for this approach. Furthermore, the results of the silica monitoring currently being undertaken by Environment Canterbury are critical to the development of setback distances from sensitive activities.

It is understood that Environment Canterbury and Iwi are key stakeholders in this process and further dialogue and feedback is required to input into decisions made on the approach to be adopted in the District Plan Review. Landowner feedback will also be very important. The key recommendations for the District Plan Review from this planning analysis on quarrying in Selwyn District are as follows:

1. Provide for quarrying as a discretionary or restricted discretionary activity in the rural zone.
2. Collate from previous resource consent decisions (such as the Road Metals decision for the Wards/Sandy Knolls/Kerrs Road site) a suite of relevant issues

and conditions that could inform the development of appropriate standards or assessment matters.

3. Consider including a specific section in the Plan outlining minimum information requirements for assessing resource consent applications for quarry developments.

4. Amend the definition of quarrying to be circumspect in terms of quarrying and its associated activities in conjunction with reassessing the benefits/costs of a “rural-based industry” definition and “other industry” definition. It is considered that the definitions in the Christchurch District Plan and the Ashburton District Plan are the most helpful from a cross boundary consistency point of view.

5. Develop a robust objective and policy framework to manage quarrying in the rural zone, and which provides for quarrying to occur in appropriate locations while avoiding or mitigating adverse effects, particularly on sensitive receptors.

6. Consider a ‘high quality gravels overlay’ to protect key areas from more intensive rural residential development.

7. Investigate options for transferring powers associated with dust to Environment Canterbury.

Overall, it is expected that there will be increased demand for new quarries to establish within Selwyn, particularly gravel quarries within the gravel rich Inner Plains areas. If Selwyn wants to benefit from the growth of this industry then it is important to develop a robust planning framework that enables new quarries to establish and existing quarries to grow provided that the adverse effects are appropriately internalised. It is noted that a number of the challenges facing this industry are similar to those experienced by intensive farming. It may therefore, be appropriate to coordinate the consideration of these issues as part of the Plan development process where appropriate.

Appendices

Appendix A – Twelfth Knight Report

Report No's: UDS010809, UDS020909 & UDS011209

Greater Christchurch Urban Development Strategy

REGIONAL GRAVEL RESOURCE MANAGEMENT STUDY.

DEMANDS, RESOURCES AND CONSTRAINTS.

TWELFTH KNIGHT CONSULTING

Prepared for UDSIMG by Twelfth Knight Consulting – August, September & December 2009.

INTRODUCTION.

The constituent members of the Urban Development Strategy (i.e. Waimakariri and Selwyn District Councils, Christchurch City Council, Environment Canterbury and the New Zealand Transport Agency) consider that continued, long term access to a supply of suitable aggregates is important both to satisfy demand for their own projects but also to satisfy demands from local private sector projects and from central government for infrastructural asset development and maintenance.

Until recently, the demand for aggregates from within urban Christchurch has been increasing rapidly. Similar growth in demands have occurred in the adjacent areas encompassed by both the Selwyn and Waimakariri District Councils.

In light of these increases in demand the UDS team are undertaking a re-assessment of the area wide management of quarrying activities with a view to ensuring that regional demands for aggregates may be met economically throughout the time horizons adopted by the UDS.

In the first phase of this project Twelfth Knight Consulting was engaged to:-

- Determine the regional demand for aggregates to 2041.
- Provide an overall assessment of the sub-regional aggregate resource and its locations.
- Identify and prioritise location criteria and constraints for potential sites for new resources.

This document brings together the consequent three reports prepared by Twelfth Knight Consulting:

- *"Demands and Resources"*
- *"Geological Investigation of Potential Aggregate Resources"*
- *"Resource Access Constraints"*

The UDS team feel that it is important that the team, the industry and the community have an agreed factual basis on which to move forward with the project. We would therefore welcome your comments on the contents of these reports.

Please address comments c/o Twelfth Knight Consulting (email:rsenglish@xtra.co.nz, tel: (03) 348-6606 or post: 125 Waimairi Road, Ilam, Christchurch 8041.)

Closing date for comments is 26 February 2010.

(Please highlight any comments you may wish to be treated as confidential.)

Report No: UDS011209

Greater Christchurch Urban Development Strategy

REGIONAL GRAVEL RESOURCE MANAGEMENT STUDY.

DEMANDS AND RESOURCES.

TWELFTH KNIGHT CONSULTING

Prepared for UDSIMG by Twelfth Knight Consulting – December 2009

The information in this report is accurate to the best of the knowledge and belief of Twelfth Knight Consulting, acting on behalf of Christchurch City Council and the Urban Development Strategy Implementation Management Group. Whilst Twelfth Knight Consulting has exercised all reasonable skill and care in the preparation of information in this report, Twelfth Knight Consulting does not accept any liability in contract, tort, or otherwise for any loss, damage, injury or expense, whether direct, indirect, or consequential, arising out of the provision of information in this report.

Acknowledgement and thanks for the provision of information are due to staff of the following organisations:

- Fulton Hogan Ltd.
- Isaac Construction Co. Ltd.
- KB Contracting Ltd.
- Taggarts Earthmoving Ltd.
- Winstone Aggregates Ltd.
- Road Metals Co. Ltd.
- Blakely Construction Ltd.
- Peninsula Quarries Ltd.
- SICON Ltd.
- Environment Canterbury.
- Urban Development Strategy Team.
- Waimakariri District, Christchurch City and Selwyn District Councils.
- Opus Consulting Ltd.

TWELFTH KNIGHT CONSULTING

Twelfth Knight Consulting, 125 Waimairi Road, Ilam, Christchurch 8041.
Tel: 03-348-6606. Email: rsenglish@xtra.co.nz

SUMMARY.

Background.

Until recently, demand for aggregates within the Urban Development Strategy (UDS) area has been increasing rapidly, driven in the main by increasing rates of economic activity and population growth.

In light of these changes in demand it is prudent therefore that a re-assessment be undertaken of the area wide management of quarrying activities so that regional demands for aggregates may be met throughout the time horizons adopted by the UDS.

This report provides an assessment of the quantum of demands for aggregates within the study area (i.e. both the territorial areas and the UDS sections of Christchurch City, Selwyn and Waimakariri District Councils.) for the periods to 2026 and 2041, describes their potential distribution and the resources that will be required to fulfil those demands.

Existing Aggregate Production.

Study Area.

The area is effectively self-contained from an aggregate production and demand perspective. (i.e. there is little or no export out of, nor import of aggregates into the area.)* Hence production equates to demand. There is however evidence to show that there is a transfer of materials out of the Christchurch City Council (CCC) area - amounting to approximately 10 - 15% of CCC area production - into the Selwyn District Council (SDC) and Waimakariri District Council (WDC) areas.

Aggregate production from all sources (i.e. rivers and local authority and privately owned quarries) from within the area encompassed by CCC, WDC, and SDC has increased approximately as follows:

Production 1992:	1,800,000 tonnes
2002:	2,800,000 tonnes
2006:	4,200,000 tonnes
2008:	3,400,000 tonnes

Christchurch City.

Seven alluvial quarry operators produce aggregates from within the present Ru Q zones and two hard rock quarries operate on Banks Peninsula. (The Christchurch Council does not operate any quarries.) Aggregate production from these quarries has doubled since 1992.

Quarries within the CCC area presently provide approximately 60% of the total area demand and produce 90% of the materials from land based quarries in the study area.

*__Note:__ Materials produced for rip-rap, agricultural or industrial purposes are not included in this report.

Selwyn District.

Selwyn District Council owns approximately 200 relatively small lots, designated for aggregate production. These properties are scattered across the District in order to minimise haul distances. Approximately thirty of these areas are currently or were recently operational.

SICON Ltd manage the pits on behalf of the Council. The materials produced are predominantly used for roading construction and maintenance purposes within the district. The pits are also accessed by other private companies on a royalty permit system, generally for the production of materials also used for SDC roading contracts.

There are presently four privately owned pits / quarries in the district. The production tonnages from these pits / quarries is relatively small. Other pits may establish in the area in the near future.

Waimakariri District.

Waimakariri District Council owns four pits, one of which is exhausted. These pits, which are also operated on the Council's behalf by SICON Ltd, produce aggregates which are used solely for Council purposes – i.e. mainly for the supply of roading maintenance metal.

There is one privately owned quarry in the area however the majority of the shingle used is drawn from the Ashley River. Production volumes are understood to be small.

Rivers within the Study Area.

The Ashley, Eyre, Waimakariri, and Selwyn Rivers provide the majority of the river sourced materials for use in the study area. The percentage of river production as a proportion of the study area total has been increasing steadily. (i.e. from 20% in 1992 to 35+% in 2008) The quantities of materials being sourced from the Waimakariri River have also been increasing rapidly over the last few years and they now constitute over 80% of the river sourced aggregates.

Area Summary.

Area	Annual Production @ 2008 (tonnes)		
	Land Based Quarries	Rivers	Totals
Waimakariri District	45,000	140,000	185,000
Christchurch City Council	1,985,000	1,015,000	3,000,000
Selwyn District	130,000	65,000	195,000
Totals	2,160,000	1,220,000	3,380,000

Future Demand to 2026.

Background.

The demand for aggregates within New Zealand is dominated by construction and maintenance activities in the roading and building sectors, with the former being the significantly larger of the two. As a consequence the average demand per head of population varies between rural areas, where building activity is low but road construction and maintenance expenditure may be relatively high on a per head basis, and urban areas where demands generated by roading and building activities are more evenly split.

Prediction of future demand for aggregates is difficult to complete accurately as demand is often subject to wide swings. Accurate predictions at a regional and sub-regional level are further hindered by the potentially significant impacts of larger individual projects.

For example over the last few years there have been at least three projects that have placed significant "one–off" demands on aggregate production locally. The demand from two of these projects alone, over one twelve month period, amounted to approximately 10% of the total underlying local demand at that time.

Accordingly a list of potential one-off projects has been compiled which indicates an average "one-off" project demand, for at least the next seven years, of approximately 1 million tonnes annually. (c.f. present study area total demand of approximately 3 to 4 million tonnes per annum.) However it is important to acknowledge that recent demands already include a "one-off" element of approximately 350,00 tonnes per annum. Care therefore needs to be taken to ensure that "double counting" does not occur when making predictions concerning future demand.

Study Area.

Given the numbers of varying factors influencing future demand, and therefore the difficulty in making accurate predictions, a number of scenarios have been tested to provide potential upper and lower bounds for demand.

The upper bound is considered to be unlikely to occur and the lower bound to be too conservative for long term planning purposes.

The most likely scenario is considered to be for a step change in demand in late 2010, as a result of demand driven by the construction of the Southern Motorway Extension, underlain by slower than average growth until 2012. Growth is then anticipated to continue approximately in line with longer term national trends, with due allowance for a reduced rate of population growth. In terms of overall demand this is best described by an average, equivalent growth rate of 5% p.a.

Accordingly the "best estimate" for planning purposes is a demand of 8 million tonnes per annum in 2026. Total production required over the period would be approximately 100 million tonnes.

It should be noted that these scenarios do not purport to provide detail of demands at an annual level but rather to portray general trends based on predicted population and economic data. Where larger infrastructural projects are involved, this methodology, will tend to under estimate annual demand in the short term and over estimate annual demand towards the end of each period. However the total demand over the period, which is the key figure for this study, will be the same as if the demands for the individual years were modelled separately were sufficient data available to do so.

Christchurch City Council Area.

The City Council area population is projected to increase at a rate less than both long term national trends to date and that predicted for the overall study area. However the majority of the larger infrastructural projects over the period will be constructed within the city's boundaries. The combined impact of these two factors will, based on the study area's "best estimate", result in a demand growth rate best represented by 5% p.a.

Accordingly the best estimate for planning purposes is a total production requirement, over the period 2009 to 2026, of approximately 75 million tonnes.

Selwyn District Council Area.

In contrast to Christchurch City, the district's population is projected to increase at a rate greater than that for the overall study area and long term national trends to date.

However, since tonnage per head consumption is generally lower in urban than in rural areas, as the district becomes increasingly urbanised (in a relative sense) so will the average consumption per head decrease.

The combined impact of these effects are an average increase of 4.5% p.a. and a best estimate production requirement, over the period 2009 to 2026, of approximately 12 million tonnes.

Waimakariri District Council Area.

The area's population is projected to increase at a rate greater than that for the overall study area but however more in line with long term national trends to date than are the predicted trends for the CCC and SDC areas.

As noted previously, as the district's population density increases so will the average consumption per head decrease although this impact will be less marked than in the SDC area.

The combined impact of these effects, based on an increase rate of 3.5% p.a., are a best estimate production requirement, over the period 2009 to 2026, of approximately 10 million tonnes.

Future Demand to 2041.

Background.

Long run increases in demand - for the period 1947 to 2008 – have approximately correlated with the increases in population and Gross Domestic Product (GDP) over that period. This has been despite a range of influences relating to economic cycles and changes in methods of aggregate use. It has therefore been assumed for the purposes of predictions to 2041 that these overall trends will continue. (i.e. demand will continue in general to correlate with population and GDP increases.)

Study Area.

Population projections indicate that the study area population may increase from the present approximate 458,000 to a total of 585,000 by 2041. (i.e. 0.8% per annum) This rate of population increase is less than long term national trends to date. Accordingly an estimate has been based on the long term national demand increase plus an allowance for potential one-off projects (of say 20 million tonnes) less an allowance for the locally lower population increases – i.e. a base of approximately 4% per annum.

However these figures correlate to a potentially implausible annual consumption per head in 2041 of approximately 21 tonnes. It is the possible that economic factors, relating in particular to the escalating cost of aggregates, and the recently rapidly growing public awareness of sustainability issues are likely to reduce or even cap the recent increases in demand per head. It is felt that a more realistic increase rate, but still potentially conservative from a planning standpoint, would be of the order of 3% p.a.

Using a demand increase of approximately 3 % per annum, total aggregate demand, over the period 2009 to 2041, would be approximately 200 million tonnes.

Whilst effort has been made to provide a realistic estimate of future demand it is important to note that these, and the following figures are very tentative given the long term nature of the projections.

Christchurch City Council Area.

The area's population is projected to increase from a present approximate 372,000 to 453,000 by 2041 (i.e. less than long term national trends to date.) Accordingly the "best estimate" could be based on the long term national demand increase plus an allowance for infrastructural projects but less an allowance for the locally lower population increases – i.e. a base of approximately 4% per annum. As with the study area, such a rate of increase would however lead to potentially fanciful consumption per head figures. Accordingly a demand increase of approximately 3% p.a. has been used.

The outcome is a total demand for the period 2009 to 2041 of 150 million tonnes.

Selwyn District Council Area.

The area's population is projected to increase from a present approximate 37,000 to 63,000 by 2041. This rate of population increase is greater than long term national trends to date. Accordingly this report's "best estimate" has been based on the long term national demand increase plus an allowance for the locally greater population increases.

However as noted previously the ongoing urbanisation of parts of the district will tend to lead to a reduction in the district's overall average consumption per head.

The combined impact of these effects, together with an allowance of 2 million tonnes for one-off projects result in a "best estimate" demand average increase rate of approximately 3.5% p.a. In turn this will produce a total demand over the period of approximately 25 million tonnes.

Waimakariri District Council Area.

The area's population is projected to increase from a present approximate 48,000 to 69,000 by 2041. This rate of population increase approximately equates to long term national trends to date. Accordingly this report's "best estimate" has been based on the long term national demand increase less an allowance for ongoing urbanisation within the district.

This results in a total demand, over the period 2009 to 2041 of also approximately 25 million tonnes.

Future Demand Summary.

Area	Total Demand (tonnes)	
	2009 - 2026	2009 - 2041
Christchurch City Council	75,000,000	150,000,000
Selwyn District Council	12,000,000	25,000,000
Waimakariri District Council	10,000,000	25,000,000
Study Area	100,000,000	200,000,000

(All figures rounded)

Future Demand – UDS Area.

The quantum of demand for aggregates depends in part on the type of housing being used to accommodate increases in population. For example green-field sub-divisional developments require a greater input of aggregates per head, in the main due to the construction of new roading, than is the case where population growth is accommodated through increased population densities within existing urban areas.

UDS data has therefore been used to identify specific areas of population growth and its form with respect to potential aggregate demand. Four basic development growth forms have been assumed for the purposes of this report:

- Type A: Predominantly Sub-divisional.
- Type B: Predominantly Intensification.
- Type C: Status quo growth patterns – urban.
- Type D: Status quo growth patterns – rural.

Seventeen nominal areas have been identified, each of which has been assigned an assumed growth type.

Estimates were made of the existing consumption per head for each sub-area taking into account its general nature and, in particular, its notional population density. This data was adjusted, where necessary, to take into account the proposed future mix of accommodation types

Projections have then been made based on the predicted population increase for each sub-area and the assumed GDP to provide demand totals for each sub-area.

Demands from one-off projects (e.g. the Southern Motorway extension) have been added in, where known, to the sub-area, and in the time scale, in which they are anticipated to occur.

It can be seen that whilst the urban areas of Christchurch will continue to dominate demand, demands from the south western and northern sectors of the city, and their immediate environs, will be significant.

Resources.

Central Plains Water Enhancement Scheme.

The Central Plains Water Enhancement Scheme (CPW) is predicted to raise groundwater levels above those previously recorded. As a consequence potential sites located in the areas where groundwater levels are already relatively high could be adversely impacted and in the worst cases rendered uneconomic. These impacts have however not been directly included in the resource size assessment.

Christchurch City - Land Based.

It is estimated that there are approximately 50,000,000 tonnes of material remaining available for extraction within the City's present RuQ and ICP/Q zones.

Selwyn District - Land Based.

A recent investigation concluded that the SDC owned, land based, resource presently totals approximately 7 million tonnes. It should be noted however that this total is made up from a significant number of quite small lots. The resource is not distributed uniformly over the district, there being few potential pit sites east of SH 1 north of the Selwyn River for example. Very few of these sites are likely to be suitable to supply materials to satisfy demand from either larger infrastructural or private projects.

Private pits are relatively small although it is understood that there are presently tentative proposals to establish several larger private quarries.

Waimakariri District - Land Based.

There is a resource within consented gravel reserves of approximately 900,000 tonnes This equates to a remaining pit "life" approaching twenty years provided that production is limited to satisfying Council roading aggregate demand only.

The remaining resource within the privately owned quarry is thought to be small. (i.e. There are no pits in the District capable of supplying materials for either larger infrastructure or private projects.)

Rivers within Study Area.

"Minimum Bed Level" conditions attached to the majority of resource consents limit the volume that can be extracted. Under these circumstances it is estimated that there is total one-off extractable quantity of 17 million tonnes available together with a supply of approximately 700,000 tonnes, carried annually downstream by the rivers in the area, available for extraction.

Summary Total Available Resource within Study Area.

Area	Resource (tonnes)	Notes
Christchurch City	50,000,000	----
Selwyn District	7,000,000	Small pits for Council use only
Waimakariri District	1,000,000 (figure rounded)	Council use only
Rivers	17,000,000 (?)	700,000 annually (figure rounded)
TOTALS	75,000,000 (?)	700,000 annually from rivers

"Life" of Existing Available Resource.

Christchurch City – Land Based.

In theory the presently zoned areas for quarrying will be exhausted by approximately 2024 however this may not occur as some operators are beginning to source materials from the Waimakariri River in order to augment their land based resources.

It should be noted that there is an uneven distribution of land holdings between the quarry owners. Anecdotally this problem is being compounded by a resistance from non–quarry landowners within the Ru Q zone to sell their properties for quarry purposes. This is in turn leading to pressure on quarry owners with low resource reserves to seek to move to areas outside the RuQ zone.

Selwyn District – Land Based.

The majority of the existing SDC owned pits are likely be exhausted by approximately 2012. The Council are, however, presently preparing to utilise some of their existing resource of quarry lots to alleviate the situation with respect to the demand created by their own activities. Apart from an area east of SH 1 north of the Selwyn River, these pits are capable of supplying most of the Council's own demand in the medium and, in some areas of the district, in the longer term. It has been assumed that these lots will be brought into production during the time horizons used in this study.

However a demand created by private and larger infrastructural projects will remain unsatisfied unless new quarries are established locally and / or increasing quantities of materials are drawn from resources from within the Christchurch City area.

Waimakariri District – Land Based.

Provided WDC continue with their existing policy of restricting extraction from their pits to their own use then the resource has been estimated to last until 2026. The life of the privately owned quarry is unknown but is unlikely to extend beyond 2020.

No quarries exist within the district capable of supplying private demand or demand generated by larger infrastructural projects although none of the latter are forecast within the next seven years.

Rivers within Study Area.

The rivers are coming under increasing pressure to counter the shortfall beginning to be experienced from land based quarry reserves. It is difficult therefore to place a definite individual "life" on the present resource. It is possible that overall demand will outstrip total supply within the next 15 years.

Resource Requirements to Fulfil Demand.

The overall quantity of material required (i.e. additional to that already available) to fulfil demand until 2026, without regard to location, is approximately 15 million tonnes. An additional 85 million tonnes will be required to satisfy demand during the period 2026 to 2041. (i.e. A total of approximately 100 million tonnes out to 2041.)

This latter quantity is approximately equal to the combined total quantity of material originally contained in the CCC Rural Q zones at Miners and Pound Roads before quarrying began.

Resource Requirement Summary.

Area	Existing Resource	Additional Reserves Required	
		2009 - 2026	2009 - 2041
Christchurch	57,000,000 + 300,000 p.a.	10,000,000	80,000,000
Selwyn	7,000,000+ 100,000 p.a.	5,000,000	15,000,000
Waimakariri	11,000,000+ 300,000. p.a.	(0)	5,000,000
Rivers*	Included above	N / A	N / A
Total	75,000,000 + 700,000 p.a.	15,000,000	100,000,000

(All figures tonnes & rounded)

Efficiency of Use and Recycling.

A component of local aggregate demand may be driven by the relative cheapness of materials in the area. Given that transport is a major component of aggregate pricing, and that it is likely that new extraction sites will be further from the demand than is presently the case, it is almost inevitable that aggregate prices will rise at a rate greater than general inflation. It is possible that this may drive an increase in efficiency of use. Allowance however has not been made at this stage for this factor other than where specifically stated in the future demand scenarios.

Neither has allowance been made for the recycling of materials. Present volumes of locally recycled materials are probably in the 2 to 5% range of overall production. Anticipated volumes of potentially, ultimately recyclable materials are of the order of 10% of production.

Conclusions and Recommendations

It is projected that the land based quarries within the CCC area will effectively be exhausted by approximately 2024 and that river based resources will be under severe pressure throughout the time horizons of the study.

It can be seen that whilst the urban areas of Christchurch will continue to dominate demand, demands from the south western and northern sectors of the city and their immediate environs will be significant.

Total demand for aggregates within the Selwyn and Waimakariri districts is already outstripping local supply. This shortfall in supply is presently generally sourced from quarries within the Christchurch City Council area.

In the case of the Selwyn district, without provision of new resources, the situation will soon be reached when most of the required materials will have to be imported from outside the district's borders. It is understood that the Council are presently preparing to utilise some of their existing resource of quarry lots to alleviate the situation with respect to the demand created by their own activities.

However a demand created by private and larger infrastructural projects will remain unsatisfied unless new quarries are established locally and / or increasing quantities of materials are drawn from resources from within the Christchurch City area.

Whilst Waimakariri District Council have sufficient resources to satisfy their own requirements, in at least the medium term, there are no quarries in the District capable of supplying materials for either private or larger infrastructure projects.

River resources are presently supplying approximately one third of the study area's total demand. However, even at present rates, these resources are being utilised faster than is sustainable on a long term basis. This situation will only be alleviated if additional suitable land based areas are made available for quarrying purposes in a timely fashion.

Demands generated by large infrastructural projects (e.g. the Southern Motorway extensions) will place significant additional demands upon local gravel resources. It is possible that over half the identified one-off demand will seek to utilise materials sourced predominantly from the Waimakariri River. This will inevitably place further pressure on that resource.

Within the UDS area, increases in demand will be driven predominantly by the expanding populations in those areas identified for growth. Whilst demands in these areas will continue to grow at rates greater than those for the remaining areas of Christchurch, overall the city's demands will still dominate the local aggregate scene.

Within the wider study area the "best estimate" is for the existing resources to be exhausted by approximately 2024. (i.e. significantly short of the time horizon of this study.) The volumes of materials required to fill this gap are significant and will require careful planning to ensure a continuing supply of local aggregates. The present co-operative approach being taken between the local and territorial authorities to meet this challenge is to be commended.

It is recommended therefore that this report be used as a basis for ongoing discussions between SDC, WDC, CCC and ECan and between those councils and the local aggregate production industry in order to continue the development of a coherent long term strategy for the management of the local gravel resource.

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Greater Christchurch Urban Development Strategy.

REGIONAL GRAVEL RESOURCE MANAGEMENT STUDY.

DEMANDS AND RESOURCES.

Report prepared for the Urban Development Strategy Implementation Management Group
by Twelfth Knight Consulting - December 2009

SECTION 1. BACKGROUND.

1.1 Introduction.

Until recently, demand for aggregates* within the urban Christchurch area has been increasing rapidly, driven in the main by increasing rates of economic activity and population growth.

Similar growth in demands for aggregates has occurred in the adjacent areas encompassed by the Selwyn (SDC) and Waimakariri District Councils. (WDC) Both Districts were experiencing a sustained period of growth - primarily residential - and, in the case of Selwyn in particular, in activities involving the use of heavy transport associated with the expanding dairying industry. These latter activities have in turn been increasing demand for aggregates for roading network maintenance purposes. Approximately 10 - 15% of the aggregates produced from land based resources located within the Christchurch City Council (CCC) boundaries are used to satisfy demands generated from within the SDC and WDC areas.

The constituent members of the Urban Development Strategy (UDS) have determined that continued access to a supply of suitable aggregates is required both to satisfy demand for their own projects but also to satisfy demands from central government for infrastructural asset development and maintenance and from local private sector projects. In the light of these changes in demand it is prudent therefore that a re-assessment be undertaken of the area wide management of quarrying activities so that regional demands for aggregates may be met throughout the time horizons adopted by the UDS.

In the first phase of this project Twelfth Knight Consulting has therefore been engaged to:-

- Provide an overall assessment of the sub-regional aggregate resource and its locations.
- Determine the demand for aggregates to 2026 and if possible to 2041.
- In conjunction with the Focus Group, identify and prioritise location criteria and constraints for sites for new resources.

This report determines demand and provides an assessment of existing resources.

* **Note:** For the purposes of this report the definition of 'aggregates' includes all coarse and fine materials sourced predominantly, but not exclusively, from alluvial deposits. Materials produced solely for rip-rap, agricultural or industrial purposes are not included.

1.2 The Study Area.

The overall study area encompassed by the member Councils of the UDS is effectively self-contained from an aggregate production and demand perspective. (i.e. there is little or no export out of, nor import of aggregates into the area.) Hence production equates to demand. There is however evidence to show that there is a transfer of materials out of the CCC area into the SDC and WDC areas.

Whilst this report provides detailed information on demand from those areas specifically within the area encompassed by the UDS it is important to remember that demand is also generated from the remaining areas that fall within the overall local authority boundaries. Any allocation of resources must therefore take this demand into account.

Accordingly this part of the overall study has been undertaken and reported on two bases:

- Regional (i.e. WDC, CCC, and SDC areas combined) and
- Sub regional for areas falling specifically within the UDS boundaries.

1.3 Earlier Reports.

Information for this report has been drawn from the following previous reports by Twelfth Knight Consulting up-dated, wherever possible to include the latest aggregate production figures and other relevant statistics.

- Environment Canterbury - Christchurch Land Based Aggregate Resource Survey - December 2006
- Selwyn District Council - Historical and Projected Demands - September 2007
- Christchurch City Council Gravel Management Strategy - Historical and Projected Demands - December 2007
- Selwyn District Council – Satisfying Demands - April 2008
- Geological Investigation of Potential Aggregate Resources – August 2009 (in conjunction with Geotech Consulting for Urban Development Strategy Implementation Management Group.)

Extracts from these reports have been included in order to provide a more complete picture of the local aggregate industry to those readers who may not have had access to the earlier reports.

The following sections describe the historic, present and projected future demands for aggregates originating from within the study area; the resources presently allocated to fulfil these demands and the quantum of resources that will be necessary to meet any shortfalls.

SECTION 2. DEMAND.

2.1 Past and Present Extraction Rates.

2.1.1 Data Sources.

Past and Present Extraction Rates have been compiled from:

- Local land based quarry production data assembled in 1992, 2002 and 2007/8/9.
- Extracted volumes from rivers within the study area (data supplied by ECan)
- National and regional aggregate production returns as reported by the Crown Minerals section of the Ministry for Economic Development;
- Population data from Statistics New Zealand, Selwyn and Waimakariri District Councils and the Urban Development Strategy team.
- Christchurch City Council Cleanfill Bylaw returns.
- "Planning for Growth? The Determinants of Aggregates Demand in New Zealand" by J. O'Brien published in IPENZ *engineering TreNz*. Dec 06
- ECan / MWH "Regional Gravel Management Report" (Report No. R06/1 January 2006)

2.1.2 Total Production within the Study Area.

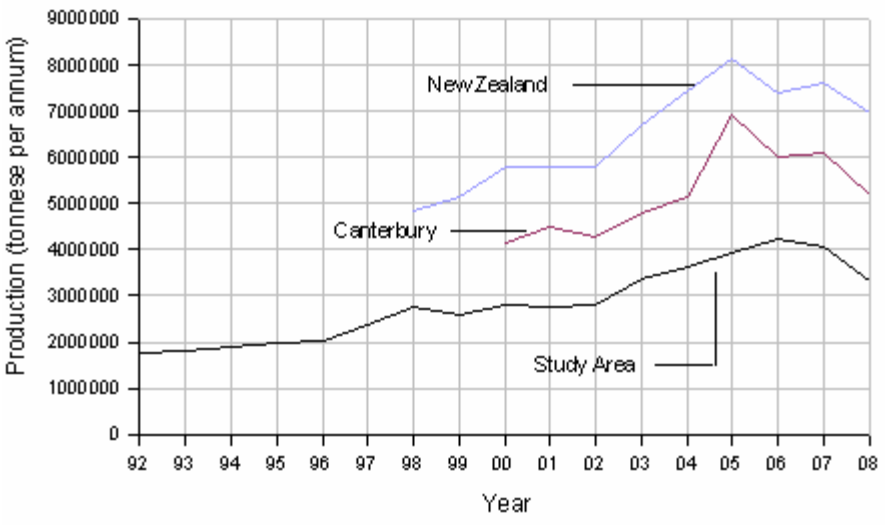
Data from the above sources was used to compile time sequences which enabled comparisons to be made between national and local trends in both total production* and consumption on a tonnage per head basis. A base line of 1992 was chosen as this is the earliest point for which potentially reliable local data is available. (Detailed local information on extraction rates prior to 1992 is difficult, if not impossible, to obtain.)

Aggregate production from all sources (i.e. rivers and local authority and privately owned quarries) from within the area encompassed by CCC, WDC, and SDC has the following history:

Production 1992:	1,800,000 tonnes
2002:	2,800,000 tonnes
2006:	4,000,000 tonnes
2008:	3,400,000 tonnes

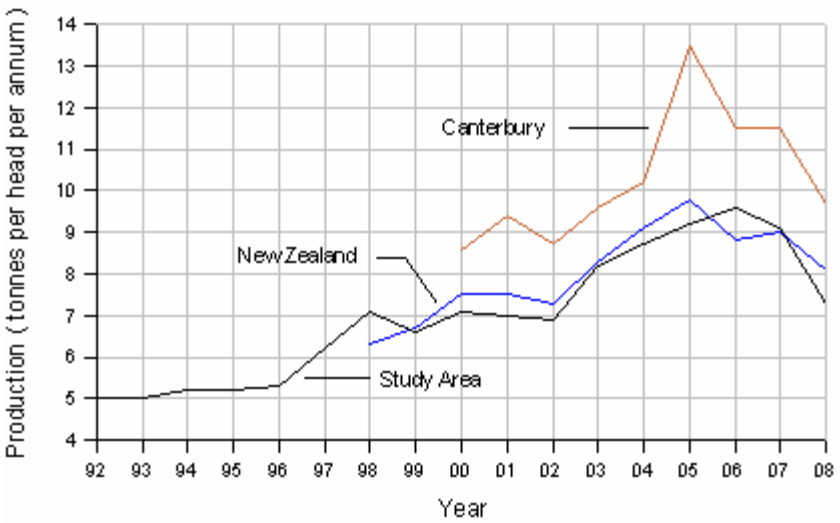
The following charts illustrate the increases in production over the study period and compares local data with data, where available, for the wider Canterbury area and nationally on both a total tonnage and tonnes per head basis. (refer Appendices for further data.)

***Note:** Tonnages have been quoted throughout this report to avoid confusion between "Solid" and "Loose" (or "Bulk") measured volumes.



(Note: New Zealand data scaled to 20% of actual for comparison purposes.)

Graph 1: Aggregate Production (tonnes per annum)

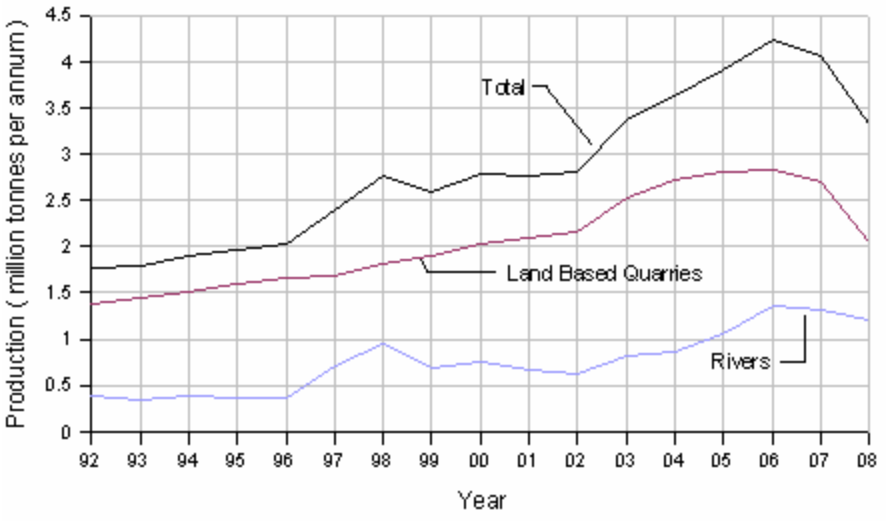


Graph 2: Aggregate Production (tonnes per head per annum)

The demand for aggregates within New Zealand is dominated by construction and maintenance activities in the roading and building sectors, with the former being the significantly larger of the two. (Approximately split 65% roading, 25% building, 10% filling.) As a consequence the average demand per head of population varies between rural areas, where building activity is low but road construction and maintenance expenditure may be relatively high on a per head basis, and urban areas where demands generated by roading and building activities are more evenly split.

Not unexpectedly therefore the per head demand figures reported for the wider Canterbury area are higher than those for the area under study in this report, where demand is largely determined by activity in the urban areas of Christchurch and its immediate environs.

A comparison between land based production and river sourced material shows that the proportion of the total being sourced from the rivers has increased over the same timescale (i.e. from approximately 20% of the total in 1992 to greater than 35% in 2008.)



Graph 3: Study Area Land based, River Sourced and Total Aggregate Production (million tonnes per annum)

2.1.3 Land Based Quarrying within Christchurch City Council Area.

Seven alluvial quarry operators produce aggregates from within the present Ru Q zones and two hard rock quarries operate on Banks Peninsula. (The production volumes from the latter are small in relative terms.) Aggregate production within the area from land based quarries has increased approximately as follows:

Production 1992:	1,200,000 tonnes
2002:	1,900,000 tonnes
2006:	2.600,000 tonnes
2008:	2,000,000 tonnes

This output constitutes approximately 60% of the aggregates sold within the study area.

In order to preserve their land based resources, there has been an increasing trend for the quarries to import river sourced materials for processing through their existing plants. In order to avoid "double counting" the figures quoted above therefore do not include materials imported from river sources.

2.1.4 Extractions from Rivers within Christchurch City Council Area.

Materials are generally extracted from the lower sections of the Waimakariri River. Some of these materials are utilised for bulk filling (e.g. establishment of building platforms at the Clearwater development) whilst others are used for the production of concrete and crushed aggregates. Data as to the ultimate destination of these materials is limited.

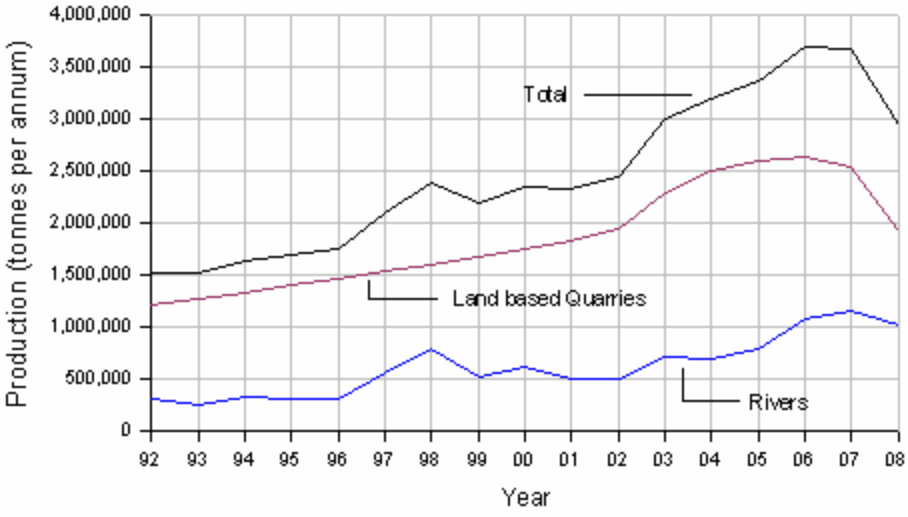
Whilst the local authority boundary between WDC and CCC falls approximately along the physical centre line of the Waimakariri River (i.e. the production from the river could theoretically be distributed equally to the production profiles of CCC and WDC) for the purposes of this study all production has been assumed to occur on the river's south bank (i.e. within the CCC area.)

Approximately 15 companies hold resource consents for extraction from the Waimakariri. The consented extraction volumes may presently be in excess of the materials available. (Refer Section 3.5 for additional comments)

It should be noted that not all of the materials from the rivers are considered satisfactory for some types of roading aggregates.

2.1.5 Total Aggregate Production within Christchurch City Council Area.

The following graph illustrates the individual component tonnages of aggregate production in the area.



Graph 4: Aggregate Production within Christchurch City (tonnes per annum)

2.1.6 Land based Quarrying within Selwyn District.

Selwyn District Council owns approximately 200 lots designated for aggregate production. These properties are generally relatively small and are scattered across the District in order to minimise haul distances. Approximately thirty of these areas are currently or were recently operational. Many are however worked out or are close to the end of their life. (Less than half have any reserves and of these 4 have 5 or less years of "life" remaining.)

SICON Ltd manage the pits on behalf of the Council. On site crushing is undertaken by sub-contract using mobile plant to provide materials predominantly used for roading construction and maintenance purposes within the District. The pits are also accessed by other private companies on a royalty permit system – often, but not exclusively for the production of materials also used for SDC roading contracts.

There are presently four privately owned pits / quarries in the district. Several others are anticipated to become operational in the near future. The present production tonnages from these pits / quarries are relatively small in the context of this study.

2.1.7 Extractions from Rivers within Selwyn District .

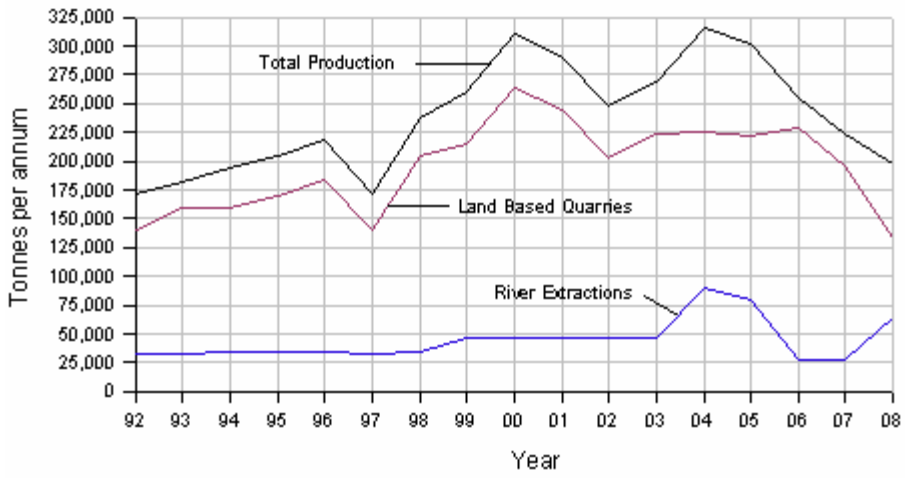
In addition to the land based quarries, materials are extracted primarily from the Waimakariri and Selwyn Rivers with lesser quantities being taken from the Cass, Kowai No's 1 & 2 and Hawkins and Rakaia Rivers. Total extractions from these rivers equates to approximately 20% of total aggregate output in the district.

As with the Waimakariri River, not all of the materials from the rivers are considered satisfactory for some types of roading aggregates.

Approximately 10 companies hold resource consents for extraction from the rivers. The consented extraction volumes may presently be in excess of the materials available. (Refer Section 3.5 for additional comments)

2.1.8 Total Aggregate Production within Selwyn District.

The following graph illustrates the individual component tonnages of aggregate production in the area.



Graph 5: Aggregate Production within Selwyn District (tonnes per annum)

2.1.9 Land based Quarrying within Waimakariri District.

Waimakariri District Council owns four resource consented pits which are also operated on their behalf by SICON Ltd. (One pit is now exhausted.)

As with SDC, on site crushing is undertaken by sub-contract using mobile plant. The aggregate is used solely for Council purposes; mainly for the supply of roading maintenance metal.

Pit life is reported as being of the order of twenty years

One small privately owned pit operates at North End supplying materials predominantly to Christchurch Ready Mix. It is understood that the majority of aggregates sold are produced from materials imported from the Ashley River. The reserves within the quarry itself are thought to be small

2.1.10 Extractions from Rivers within Waimakariri District .

In addition to the land based quarries, the Ashley, Eyre, and Waimakariri Rivers are also used as sources for aggregates. In recent years extractions from the Ashley and Eyre Rivers have equated, on occasions, to greater than 75% of total aggregate output in the District. (refer also note under 2.1.4)

As with the Waimakariri River, not all of the materials from the rivers are considered satisfactory for some types of roading aggregates.

Approximately 20 companies hold resource consents for extraction from the Ashley and Eyre Rivers. The consented extraction volumes may presently be in excess of the materials available. (Refer Section 3.5 for additional comments)

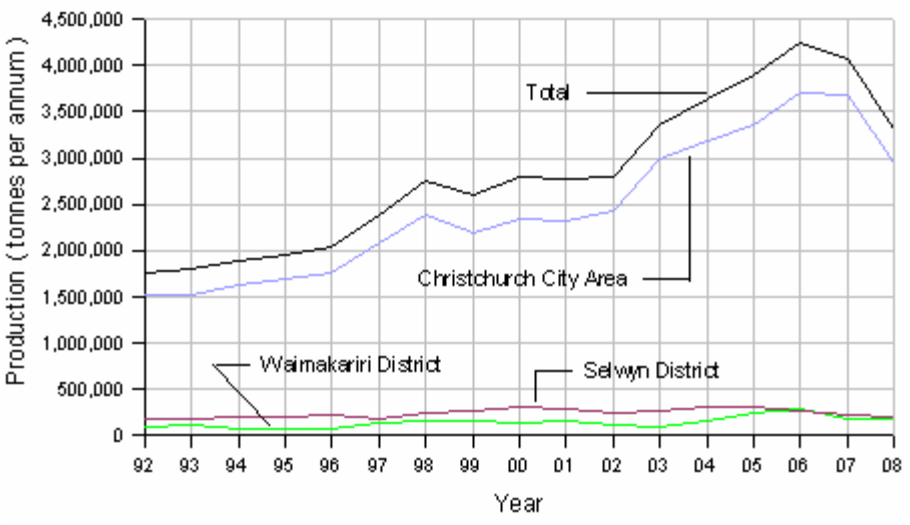
2.1.11 Total Aggregate Production within Waimakariri District.

The following graph illustrates the individual component tonnages of aggregate production in the area.

Graph 6: Aggregate Production within Waimakariri District. (tonnes per annum)

2.1.12 Study Area Aggregate Production Summary.

The following graph and table illustrate and summarise the production statistics outlined in the sub-sections above.



Graph 7: Aggregate Production within Christchurch City, Selwyn & Waimakariri Districts.

Area	Annual Production @ 2008 (tonnes)		
	Land Based Quarries	Rivers	Totals
Waimakariri District	45,000	140,000	185,000
Christchurch City Council	1,985,000	1,015,000	3,000,000
Selwyn District	130,000	65,000	195,000
Totals	2,160,000	1,220,000	3,380,000

Table 1: Study Area Aggregate Production Summary.

2.1.13 Data Uncertainty.

The following table lists the potential levels of uncertainty associated with each data set.

UNCERTAINTY	VALUE	NOTES
Past	-10% / +10%	A base-line of 1992 has been used. Detailed information on extraction rates prior to 1992 will be difficult, if not impossible, to collect.
Present	< -10% / +10%	Volumes extracted in 2002 and 2006 / 7 & 8 are known with a reasonable degree of accuracy. (I.E. better than +/- 10%) Where detailed data is not available land based volumes for 2003, 4, 5, and 6 have been estimated from 2002 and 2006 / 7 data (with an allowance for increased production in line with national trends) and production data from one of the larger Christchurch quarries
Conversion of 'Loose' volume to Weight	- 10% / + 10%	Local industry accepts an average general density of 1.5 tonnes per cubic metre for excavated / loose material.
Population	< - 5% / +5%	Population data has been extracted from national census's in 1996, 2001 and 2006. Populations in the intervening years have been estimated from these figures.
Combined	- 10% / +10%	(I.E. Probable range.)

Table 2: Data Uncertainty - Study Area Aggregate Production.

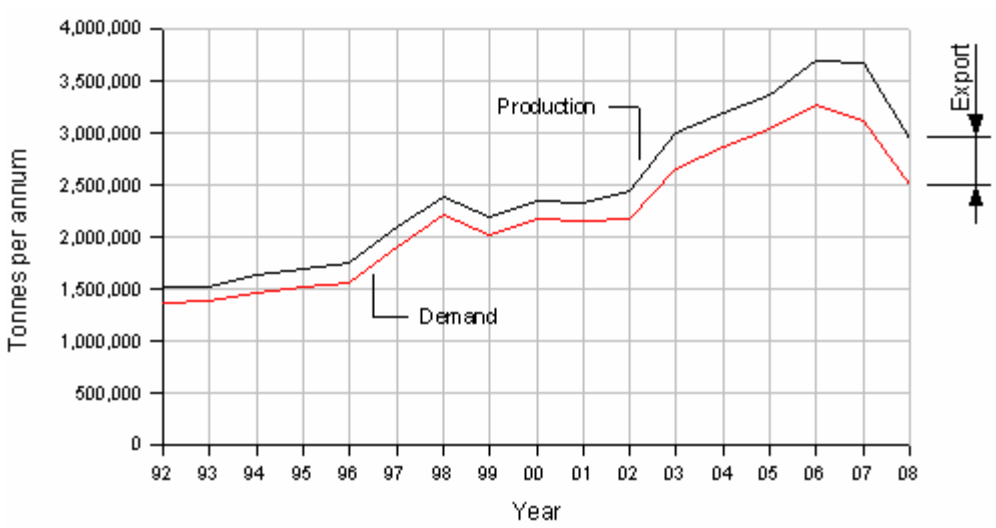
2.2 Past and Present Demands.

2.2.1 Christchurch City (including Banks Peninsula).

There is anecdotal evidence that there is a transfer of materials out of the CCC area into the SDC and WDC areas. However specific data is not readily available as to the quantum of these 'cross border' transfers. Overall demand within the CCC area has therefore been determined by undertaking estimates for each sub-area (i.e. SDC, WDC and CCC) on a tonnage demand per head basis, with due allowance for the varying natures of these areas (i.e. the "urban" nature of the city versus the "rural" nature of much of the SDC, WDC and Banks Peninsula areas) and one-off projects, where known.

Balances between these sub-area demands and, sub-area and total production have then been used to estimate the size of the cross border transfers and hence the demand within the CCC area.

Whilst the derived demand data should be treated as indicative only, it can be seen that there is an increasing disparity between demand and production. This disparity represents the "export" element of production from within the CCC boundaries to the WDC and SDC areas and is presently equivalent to approximately 10 - 15% of total production from within Christchurch City.



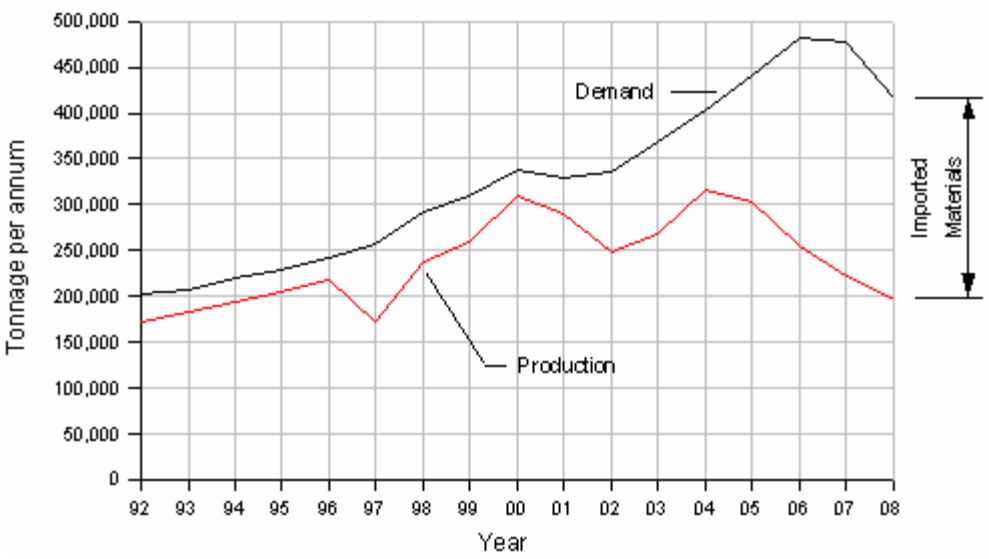
Graph 8: Aggregate Demand and Production within Christchurch City Council Area (tonnes per annum).

2.2.2 Selwyn District.

Although detailed data is not readily available it is clear that a significant proportion of the aggregates used within the District originates from outside its borders (specifically from the quarries within the CCC area.) The only method to determine overall demand within the District is therefore to undertake estimates on a tonnage per head basis with due allowance for the "rural" nature of much of the District. (refer Section 2.1.8 for production details)

* **Note:** (Production CCC area - Demand CCC area) = Total Export Quantity to SDC and WDC areas

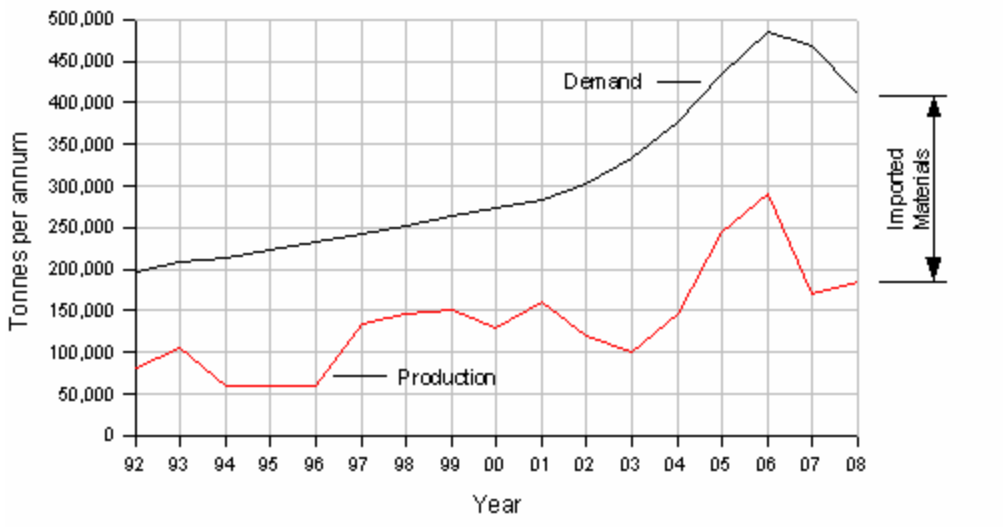
The following graph illustrates the increasing disparity between demand and production. This trend has been accelerating particularly since 2001.



Graph 9: Aggregate Demand and Production within Selwyn District (tonnes per annum).

2.2.3 Waimakariri District.

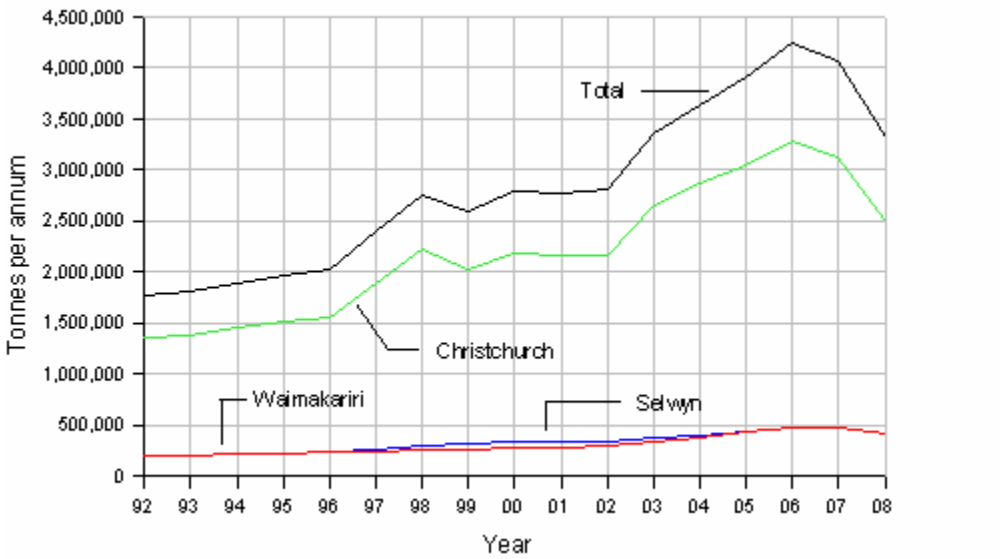
As with the demands generated from within the Selwyn District, detailed data is not readily available. However also as with Selwyn, it is clear that a significant proportion of the aggregates used within the District originates from outside its borders; specifically from the quarries within the CCC area and the lower Waimakariri River. Demand estimates on a tonnage per head basis have therefore been made with due allowance for the mix of urban and rural areas of the District. (refer Section 2.1.11 for production details)



Graph 10: Aggregate Demand and Production within Waimakariri District (tonnes per annum).

2.2.4 Study Area.

The following graph illustrates the total study area demand and its the component parts. It can be seen that demand generated from within the CCC boundaries is the largest by a very significant margin.



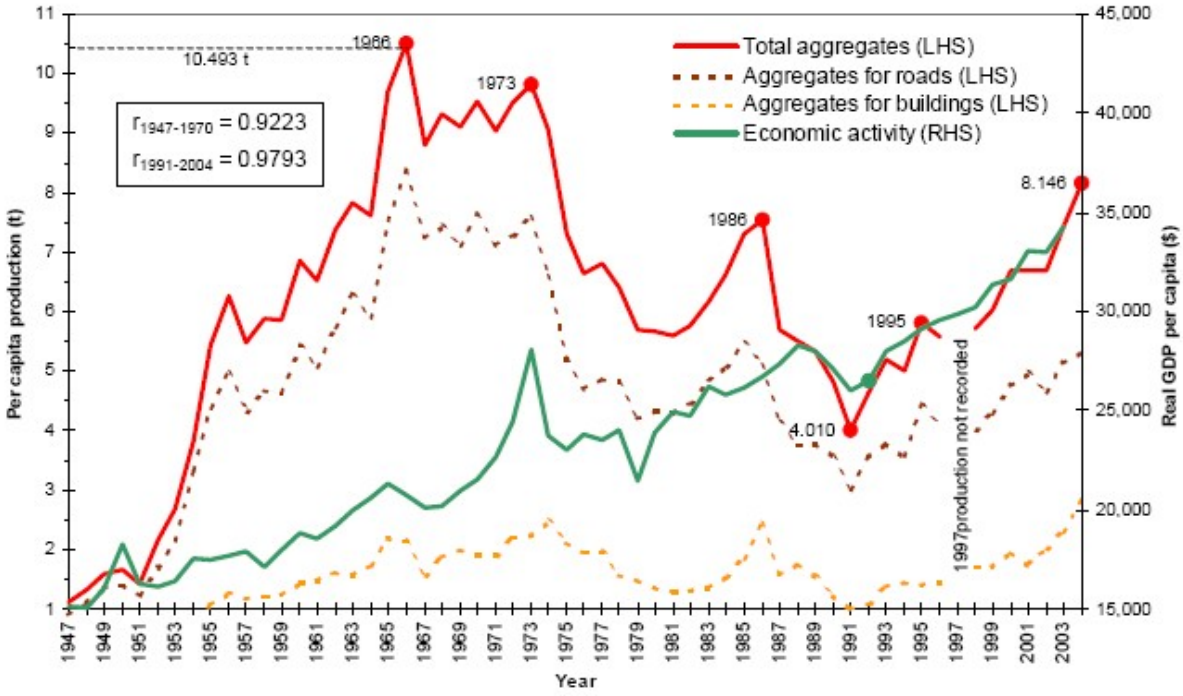
Graph 11: CCC, SDC, WDC & Study Area Demand (tonnes per annum).

2.3 Future Demand to 2026 – Study Area.

2.3.1 Background to Future Demand.

Prediction of future demand for aggregates is difficult to complete accurately as demand is often subject to wide swings. (The reasons for these fluctuations are discussed in depth in the Environment Canterbury Gravel Management Report - Report No. R06/1 January 2006 - and in the paper by J. O'Brien - "Planning for Growth. The Determinants of Aggregates Demand in New Zealand" - This subject is therefore not covered in detail by this report.)

For example the following graph, taken from the O'Brien report, illustrates the fluctuations in national demand (on a tonnes per head basis) over the period 1947 to 2004 and relates it to real GDP per capita.



As can be seen, over the O'Brien study period national aggregate production* on a tonnes per head (t.p.h.) basis has varied from a high of 10.5 (in 1966) to a low of 4.0 (in 1991).

2.3.2 Potential Impact of Larger "One-off" Projects.

Accurate predictions at a regional and sub-regional level are further hindered by the potentially significant impacts of larger individual projects.

For example it appears that over the last few years there have been at least three projects that have placed significant "one–off" demands on aggregate production locally (i.e. fill material for building platforms at Clearwater Resort, the Pegasus Township development and cover material for rehabilitation purposes at the now closed CCC Burwood Landfill.) The demand from the Clearwater and Landfill projects for example - the materials for which were sourced from the Waimakariri River - over one twelve month period alone amounted to approximately 350,000 tonnes. This represented approximately 10% of total underlying local demand at that time.

The following "one-off" projects are predicted to occur within the study area over the next ten year period: (All figures tentative only)

* **Note:** O'Brien uses production figures taken from Crown Minerals categories "Rock, Sand and Gravel for Building", and "Rock, Sand and Gravel for Roading." This report however also includes production under the category "Rock, Sand, Gravel and Clay for Fill" as much of the fill material used within the study area is drawn from the local quarries and rivers under discussion. Accordingly this report's equivalent t.p.h. figures are approximately 11.6 and 4.4 respectively.

Project	Demand (tonnes)	Notes
Christchurch Southern Motorway Extension. (TNZ)	1,500,000	Anticipated demand 2010 / 12
Southern Motorway Extension (Springs Rd -Templeton)	800,000	Possibly 2013 / 2016
Wigram – Magdala Link and Wigram Rd (CCC)	100,000	Anticipated demand 2009 / 11
Christchurch Northern Arterial. (TNZ)	1,500,000	Possibly in period 2012 / 16
Western Belfast Bypass. (TNZ)	700,000	Possibly in period 2012 / 16
Miscellaneous 4 Laning Projects	300,000	Allowance for various projects in period 2009 / 2016
Lower Waimakariri River Stopbanks (ECan).	1,500,000	Period 2010 / 16 (Further 500,000 required between 2017 and 2020?)
Building platforms in Kaiapoi.	100,000	Platforms required for housing through UDS study. Period 2012 / 2014 (?)
Building Platforms for I Zone at Rolleston	100,000	Assumed. (Period ?)
Pegasus Township Development. (Ongoing)	General sub-divisional demand accounted for in predicted general area population increases.	All cut and fill balanced on site.
Central Plains Water Scheme.	100,000	Materials will be won from project sites. Demand quoted for concrete aggregates only. Period 2012 / 2014
TOTAL	7 million tonnes (Figure rounded)	I.E. Approx 1 million tonnes per year in period 2010 to 2016

Table 3: Identified Future, Larger One-Off Projects in Study Area in period 2009 - 2016

The total figure represents an average annual "one-off" project demand of approximately 1,000,000 tonnes per annum over the period 2010 to 2016. However as noted above, the actual study area production for 2006, for example already includes approximately 350,000 tonnes of demand from "one-off" projects. It is important therefore that, when making projections, the impacts of these demands are not "double counted".

2.3.3 Study Area Scenarios.

Given the numbers of varying factors influencing future demand and therefore the difficulty in making accurate predictions a number of scenarios have been tested to provide potential upper and lower bounds for demand.

The major scenarios tested are as follows*:

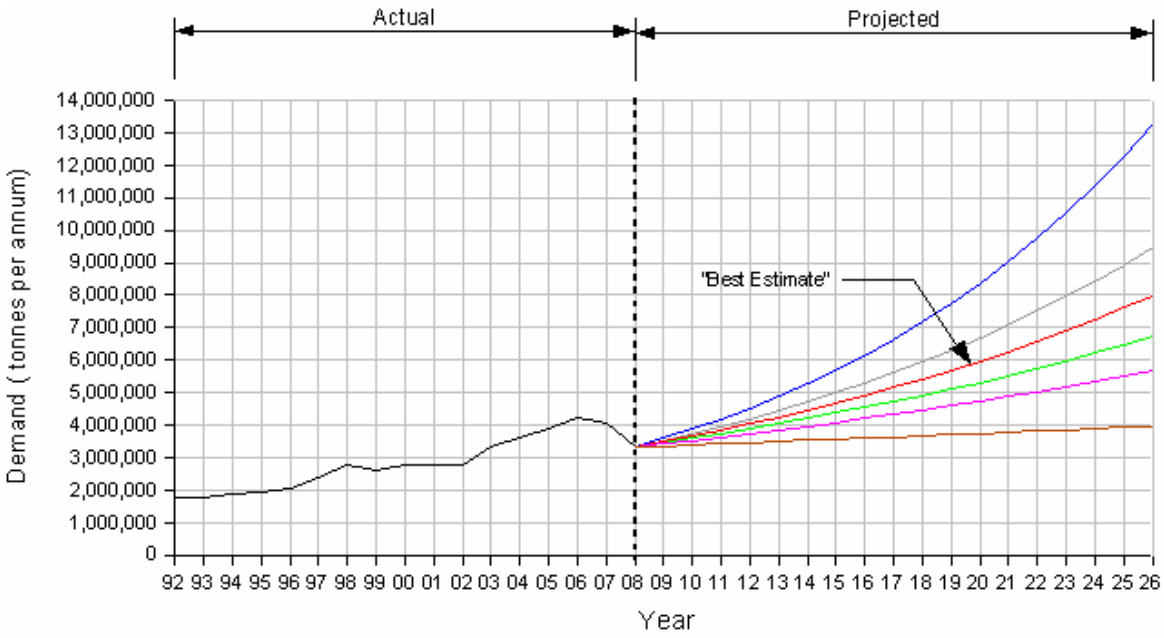
Scenario	Notes
8% per annum on total	Upper bound equivalent to:- • ECan Gravel Management Report growth assumption, • O'Brien High Growth scenario, • Approximately as per average annual local production increases between 2001 and 2006 – *Blue*
6% per annum on total	As per local production increase 1992 to 2006 – *Grey*
5% per annum on total	As per long term national demand growth with allowance for local population growth, impacts of urbanisation and one-off projects – *Red*
4% per annum on total	As per local production increase 1992 to 2008 – *Green*
3% per annum on total	Approximately equivalent to: Long term national demand growth with allowance for local population growth and one-off projects less potential impacts of urbanisation, locally increasing aggregate costs and increasing public awareness of sustainability issues - *Purple*
1% per annum on total	Approximately local population growth only. Lower bound - *Brown*

Table 4: Demand Growth Scenarios.

The first and latter of these options are considered to provide the upper and lower bounds of possible demand respectively.

The following graphs illustrate the annual predicted demands both as annual totals and on a tonnes per head basis.

* **Note:** A number of sub-scenarios were also tested but have been omitted for clarity.



Graph 12: Actual and Predicted Demand within Study Area (tonnes per annum)

2.3.4 Scenarios Commentary.

Long term trends have shown that production increases have correlated with both population increases and Gross Domestic Product. (i.e. Overall long term production increases have approximated to the sum of increases in population and GDP.) It is unlikely therefore that production increases will fall below population increases alone and accordingly this scenario is anticipated to form a lower bound to predictions. Its use is considered to be too conservative for long term planning purposes.

As noted earlier, tonnage per head (tph) figures are generally higher in rural than in urban areas. Not unexpectedly therefore the per head demand figures reported for 2004 in the Environment Canterbury Gravel Management Report for the wider Canterbury area (i.e. 10.2 tonnes) are higher than those for the area under study in this report (i.e. 8.7 in 2004), where demand is largely determined by activity in the urban areas of Christchurch and its immediate environs.

However the growth rate used in the ECan report (i.e. approximately 8% p.a.) would result in a demand figure approximately equivalent nationally to 26 tph by 2026. (c.f. a recent national demand peak of approximately 9.8 tph in 2005 and a historical maximum of approximately 11.6 tph in 1966) This growth in demand is considered unlikely as it would require very large increases in roading expenditure – for example to levels considerably greater than in the period in the 1960's and early 70's when much of the local motorway construction was undertaken - to become a reality. (i.e. The upper bound is considered to be unlikely to occur.)

It is of course feasible that the downturn in quarrying activity as just witnessed and as experienced from the mid 1970's to the end of the 1980's, could occur and that overall production could fall below present levels. However in order to take a conservative approach towards the estimates of the life of the remaining local resource and for determining future demand for planning purposes this possibility has been discounted.

These scenarios do not purport to provide detail of demands at an annual level but rather to portray general trends based on predicted population and economic data. For example for the period 2009 to 2012, economic activity is predicted by the Reserve Bank of New Zealand to be below recent short term levels (i.e. pre the "financial crisis") before rising to levels more akin to those experienced in the medium to long term past. (For the purposes of this report the Canterbury economy has been assumed to be in line with national trends.) The combined result of these impacts has been incorporated into single growth figures for the periods under study. (i.e. either 2009 to 2026 and / or 2009 to 2041)

This methodology will, and particularly when large infrastructural projects are included, tend to under estimate annual demand in the short term and over estimate annual demand towards the end of each period. However the total demand over the period, which is the key figure for this study, will be the same as if the demands for the individual years were modelled separately were sufficient data available to do so.

An additional complication is added locally to the prediction matrix in that the study area is a mix of urban and rural areas. As noted earlier demand on a per head basis is higher in rural areas than in urban areas. Therefore as the rural areas become increasingly urbanised (on a relative basis) so will the average consumption per head in those areas decrease. Gross growth demand data for the study area and for each local authority area has therefore been adjusted to cater for the effects of continuing urbanisation of the rural areas.

Twelve million tonnes of demand from one-off projects (i.e. 7 million tonnes identified in the period 2010 to 2016 and an additional allowance of 5 million tonnes for the remainder of the period to 2026) have been included into predictions where noted. Although the total demand from these projects will be accounted for by this methodology it is important to recognise that it will tend to underestimate demand in the early part of the study period and overestimate it towards the end of the period.

The most likely scenario is considered to be for a step change in demand in late 2010, as a result of demand driven by the construction of the Southern Motorway Extension, underlain by slower than average growth until 2012. Growth is then anticipated to continue approximately in line with longer term national trends, with due allowance for a reduced rate of population growth. In terms of overall demand this is best described by an average, equivalent growth rate of 5% p.a.

The scenarios for the individual local authority areas have accordingly been based on the study area's "best estimate" growth scenario (i.e. 5%) adjusted for each areas predicted population growth rates, urbanisation and one-off projects.

* **Note:** Whilst care has been taken when compiling the figures quoted in this report, it should be borne in mind that the base data may be lacking in accuracy and that, given the scope of the project, not every minor element of demand and / or production may presently be accounted for.

2.3.5 Study Area Demand.

The "best estimate" for planning purposes is a demand of 8 million tonnes per annum, at a rate of 15.0 tph in 2026. Total production required over the period would be approximately 100 million tonnes.

2.3.6 Christchurch City Council Area.

The City Council area population is projected to increase from a present approximate 372,000 to 417,000 by 2026 (i.e. approximately 0.7% per annum over the study period.) This rate of population increase is less than both long term national trends to date and that predicted for the overall study area. (i.e. 0.9%) However the majority of the larger infrastructural projects over the period will be constructed within the city's boundaries. The combined impact of these two factors will, based on the study area's "best estimate", result in a demand growth rate best represented by 5% p.a.

Accordingly the best estimate for planning purposes is a demand of 6 million tonnes per annum in 2026. Total production required over the period would be approximately 75 million tonnes.

2.3.7 Selwyn District.

The district's population is projected to increase from a present approximate 37,000 to 55,000 by 2026 (i.e. approximately 2.4% per annum over the study period.) This rate of population increase is greater than that for the overall study area and long term national trends to date.

However tonnage per head figures are generally higher in rural than in urban areas. Therefore as the district becomes increasingly urbanised (in a relative sense) so will the average consumption per head decrease.

Identified larger infrastructural projects within the district are limited to the second Southern Motorway extension to the vicinity of Templeton, some four laning of State Highway 1 and building platforms for the IZone at Rolleston.

The combined impact of these effects are a best estimate area demand of 1 million tonnes per annum in 2026 (based on an equivalent overall increase rate of 4.5% p.a.) and a total demand over the period of approximately 12 million tonnes.

2.3.8 Waimakariri District.

The area's population is projected to increase from a present approximate 48,000 to 60,000 by 2026 (i.e. approximately 1.4% per annum over the study period.) This rate of population increase is greater than that for the overall study area but is more in line with long term national trends to date than are the predictions for the CCC and SDC areas.

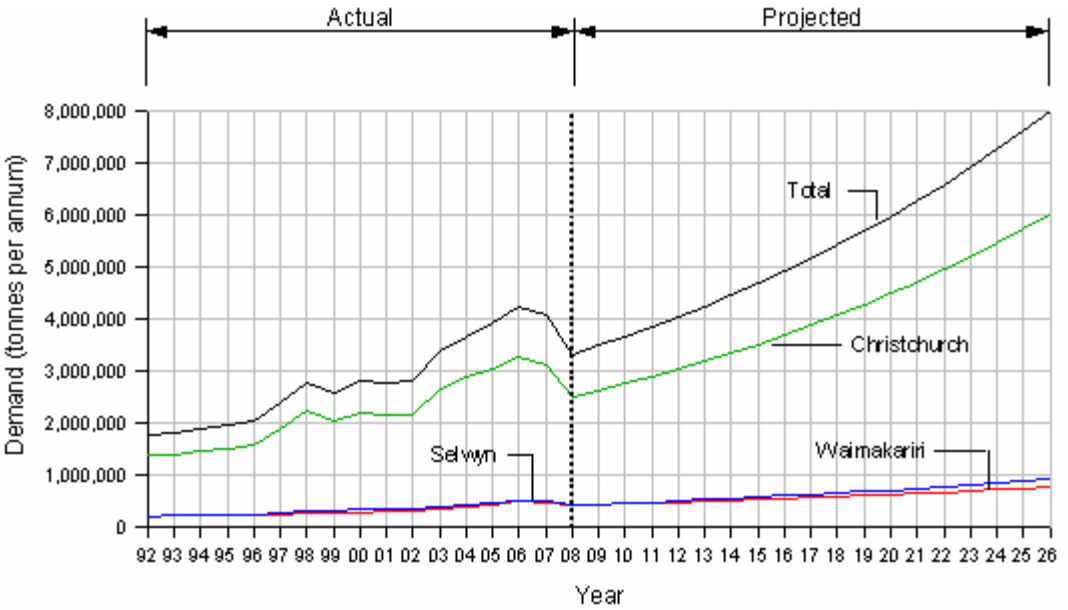
As noted under 2.3.7, tonnage per head figures are generally higher in rural than in urban areas. Accordingly as the district's population density increases so will the average consumption per head decrease although this impact will be less marked than in the SDC area.

No large infrastructural projects have been identified in the area.

The combined impact of these effects result in a best estimate area demand of 750,000 tonnes per annum in 2026 (based on an equivalent overall increase rate of 3.5% p.a.) and a total demand over the period of approximately 10 million tonnes.

2.3.9 Demand Summary to 2026.

The following graph illustrates the component parts of the overall study area demand.



Graph 13: Aggregate Demand within Christchurch City, Selwyn & Waimakariri Districts to 2026.

2.3.10 Data Uncertainty.

The following table lists the potential levels of uncertainty associated with each data set..

UNCERTAINTY	VALUE	NOTES
Population	-10% / +10%	Local population increases are based on data provided by the Urban Development Strategy team.
Production per Head	-50% / +50%	Whilst production per head has been generally in line with national trends, localised activity has the potential to markedly alter the relationship. A range of scenarios have therefore been studied using the present t.p.h. rate as a base for calculations.
Economic Activity (General)	-50% / +50%	Production is related to the general levels of economic activity both nationally and regionally (refer ECan GMR and O'Brien report)
Economic Activity (Construction)	Not directly used in calculations	Construction activity is related to general economic activity. However in the case of roading construction and maintenance, which constitutes a significant proportion of demand for local quarry products, demand is determined by central and local government policies which are sometimes out of phase with general economic activity. (refer ECan GMR and O'Brien report)
TOTAL	-50% / +50%	Potential variance in predicted demands

Table 5: Data Uncertainty - Study Area Future Demand (2009 – 2026).

2.4 Future Demand to 2041 – Study Area.

2.4.1 Study Area.

As noted earlier, the O'Brien report demonstrates that the long run increases in demand - for the period 1947 to 2004 – have approximately correlated with the increases in population and GDP over that period. This has been despite a range of influences relating to economic cycles and changes in methods of aggregate use. It has been assumed that these overall trends will continue. (i.e. demand will continue in general to correlate with population increases and GDP.)

Statistics New Zealand and Urban Development Strategy population projections* indicate that the study area population may increase from the present approximate 458,000 to a total of 585,000 by 2041 (i.e. approximately 0.8% per annum.) This rate of population increase is less than long term national trends to date. (i.e. 1.3% p.a. between 1953 and 2008) Accordingly an estimate has been based on the long term national demand increase (i.e. 3.3% per annum between 1953 and 2008) plus an allowance for potential one-off projects (of say 20 million tonnes) less an allowance for the locally lower population increases – i.e. a base of approximately 4% per annum.

However these figures correlate to a potentially implausible annual consumption per head in 2041 of approximately 21 tonnes. It is the report author's opinion that economic factors, relating in particular to the escalating cost of aggregates, and the recently rapidly growing public awareness of sustainability issues are likely to reduce or even cap the recent increases in demand per head. It is felt that a more realistic increase rate, but still potentially conservative from a planning standpoint, would be of the order of 3% p.a.

Therefore using a demand increase of approximately 3 % per annum, total aggregate demand may increase from its present value of approximately 3.5 million tonnes per annum to 9 million tonnes per annum. This equates to a total demand over the period 2009 to 2041 of approximately 200 million tonnes.

Whilst effort has been made to provide a realistic estimate of future demand it is important to note that these, and the following figures are very tentative given the long term nature of the projections. It should also be remembered that the methodology will under estimate annual demand at the beginning of the period and overestimate it at the end of the period

2.4.2 Christchurch City Council Area.

The area's population is projected to increase from a present approximate 372,000 to 453,000 by 2041 (i.e. approximately 0.6% per annum over the study period.) This rate of population increase is also less than long term national trends to date. Accordingly this report's "best estimate" could be based on the long term national demand increase (i.e. 3.3% per annum) plus an allowance for infrastructural projects but less an allowance for the locally lower population increases – i.e. a base of as per the general study area of approximately 4% per annum.

However as with the study area, such a rate of increase would lead to potentially fanciful per head consumption figures. Accordingly a demand increase of approximately 3% p.a. has been used. (refer 2.4.1 for further discussion on the underlying assumptions from which this figure is derived.) The outcome is a total demand for the period 2009 to 2041 of 150 million tonnes at a rate in 2041 of 15 tph.

* **Note:** Based on SNZ data to June 2008 extrapolated to June 2009

2.4.3 Selwyn District.

The area's population is projected to increase from a present approximate 37,000 to 63,000 by 2041 (i.e. approximately 1.6% per annum over the study period.) This rate of population increase is greater than long term national trends to date. Accordingly this report's "best estimate" has been based on the long term national demand increase (i.e. 3.3% per annum) plus an allowance for the locally greater population increases.

However, as noted in 2.3.7, the ongoing urbanisation of parts of the district will tend to lead to a reduction in the district's overall average consumption per head.

The combined impact of these effects, together with an allowance for one-off projects result in a "best estimate" demand average increase rate of approximately 3.5% p.a. In turn this will produce a total demand over the period of approximately 25 million tonnes, at a rate of approximately 20 tph in 2041.

2.4.4 Waimakariri District.

The area's population is projected to increase from a present approximate 48,000 to 69,000 by 2041 (i.e. approximately 1.2% per annum over the study period.) This rate of population increase approximately equates to long term national trends to date. Accordingly this report's "best estimate" has been based on the long term national demand increase less an allowance for ongoing urbanisation within the district.

This results in an annual area demand in 2041 of approximately 18 tph and a total demand over the period of approximately 25 million tonnes.

2.4.5 Data Uncertainty.

The table below lists the potential levels of uncertainty associated with each data set.

UNCERTAINTY	VALUE	NOTES
Population	-10% / +10%	Local population increases are based on data provided by the Urban Development Strategy.
Production per Head	-100% / +100%	Whilst production per head has been generally in line with national trends, localised activity has the potential to markedly alter the relationship. A range of scenarios have therefore been studied using the present t.p.h. rate as a base for calculations.
Economic Activity (General)	-50% / +50%	Production is related to the general levels of economic activity both nationally and regionally (refer ECan GMR)
Economic Activity (Construction)	Not directly used in calculations	Construction activity is related to general economic activity, although in the case of roading construction and maintenance, which constitutes a significant proportion of demand for local quarry products, demand is determined by central and local government sometimes out of phase with general economic activity. (refer ECan GMR)
TOTAL	-100% / +100%	Potential variance in predicted demand.

Table 6: Data Uncertainty - Study Area Future Demand (2009 – 2041).

2.5 Future Demand Summary – Study Area.

Area	Total Demand (tonnes)	
	2009 - 2026	2009 - 2041
Christchurch City Council	73,000,000	145,000,000
Selwyn District Council	12,000,000	25,000,000
Waimakariri District Council	10,000,000	25,000,000
Study Area	100,000,000	200,000,000

(All figures rounded)

Table 7: Future Demand Summary (2009 - 2026 & 2009 - 2041).

2.6 Future Demand – UDS Area.

2.6.1 Identified Areas of Growth.

The quantum of demand for aggregates depends in part on the type of housing being used to accommodate increases in population. For example green-field sub-divisional developments require a greater input of aggregates per head, in the main due to the construction of new roading, than is the case where population growth is accommodated through increased population densities within existing urban areas.

2.6.2 Sub – Area Demand Types.

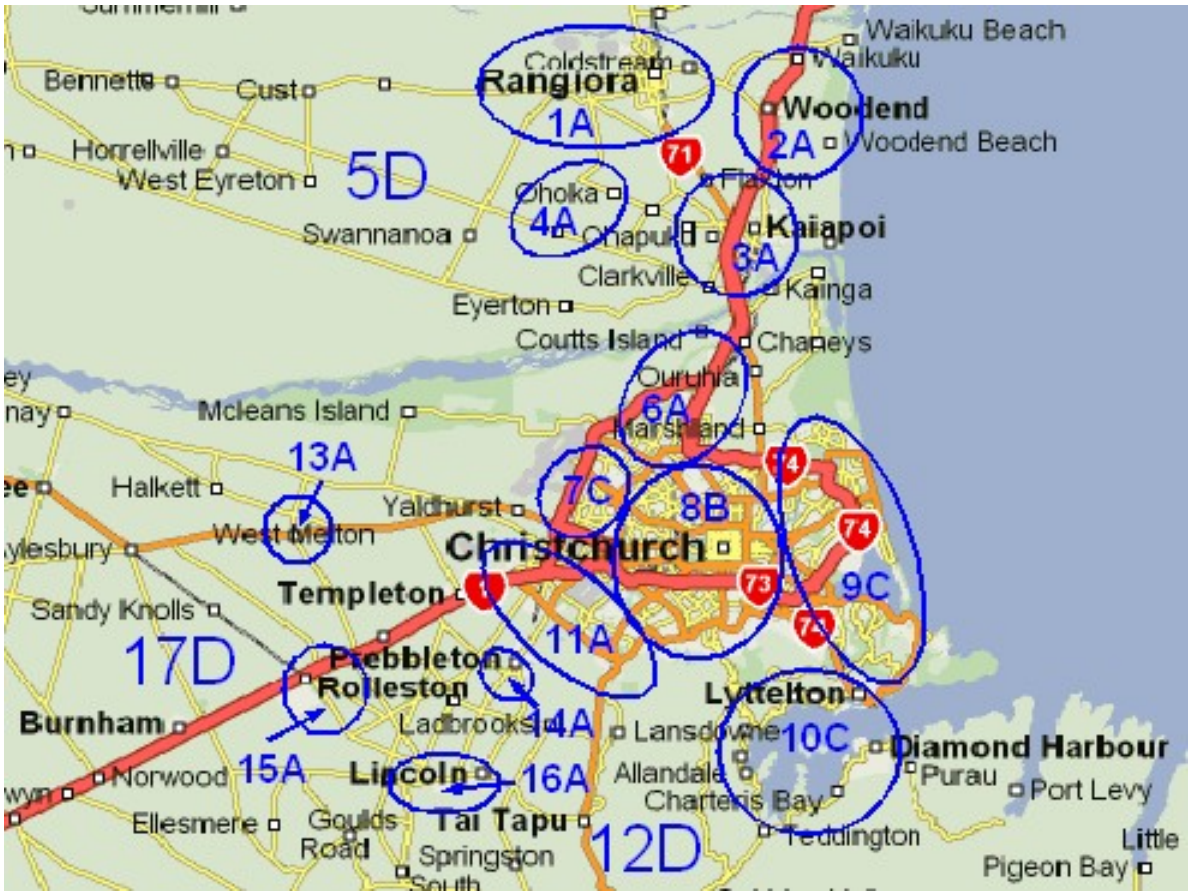
UDS data* has therefore been used to identify specific areas of population growth and its form with respect to potential aggregate demand. Four basic development growth forms have been assumed for the purposes of this report:

- Type A: Predominantly Sub-divisional.
- Type B: Predominantly Intensification.
- Type C: Status quo growth patterns – urban.
- Type D: Status quo growth patterns – rural.

* Greater Christchurch Urban Development Strategy and Action Plan 2007

2.6.3 Summary of Sub-Areas.

Seventeen areas have been identified, the boundaries of which are shown pictorially on the following map together with an area identifier number and an alpha suffix indicating the assumed predominant growth type within the area. It should be noted that these boundaries are nominal only. They do not relate to territorial boundaries and are only intended for use in determining demands for aggregates in relation to this report



The following table provides a summary of the population growth* for each sub-area and its assumed form with respect to aggregate demand.

*__Note:__ Underlying population data taken from UDS Base Growth Model: April 2009 supplied by D. Price, UDS Team June 2009 (*pers. com.*)

No.	Area	Type	Population		
			2009	2026	2041
Waimakariri District					
1	Rangiora	A	14,800	18,700	19,500
2	Woodend	A	6,400	11,300	12,500
3	Kaiapoi	A	12,600	14,500	15,300
4	Manderville / Ohoka	A	3,200	4,200	4,700
5	WDC other	D	1,600	1,500	1,400
Sub Total			*38,600*	*50,200*	*53,500*
Christchurch City					
6	Northern	A	32,200	38,300	40,800
7	Western	C	52,600	51,400	51,400
8	Central	B	121,400	136,900	155,500
9	Eastern	C	112,700	116,000	119,900
10	Lyttelton Harbour	C	5,500	6,500	7,000
11	South West	A	42,200	64,600	75,400
12	Christchurch - rural	D	0	0	0
Sub Total			*366,600*	*413,700*	*450,000*
Selwyn District					
13	West Melton	A	5,700	8,400	9,900
14	Prebbleton	A	3,200	4,300	4,800
15	Rolleston	A	4,100	5,900	6,500
16	Lincoln / Springston	A	7,400	16,300	21,300
17	SDC Other	D	2,200	2,400	2,500
Sub Total			*22,600*	*37,300*	*45,000*
TOTALS			**427,800**	**501,300**	**548,500**

Table 8: UDS Population and Sub-Area Details.

2.6.4 Demands.

As far as can be ascertained no previous attempt has been made within New Zealand to quantify aggregate demand at this level of detail. Accordingly a methodology has been developed specifically for this project.

Estimates were made of the existing consumption per head for each sub-area taking into account its general nature and in particular its notional population density. This data was adjusted, where necessary, to take into account the proposed mix of future accommodation types* (i.e. sub-divisional or intensification.)

These figures were used to provide estimates of the existing sub-area demands which were then projected forward to produce total demands based on the predicted population increase for each sub-area and the assumed GDP (The latter was assumed to be in line with national trends.) These quantities have then been summed and cross checked against quantities based on broader brush data relating to overall consumption per head and total demands.

*__Note:__ Refer Appendices for further assumption details.

Demands from one-off projects (e.g. the Southern Motorway extension) have been added in, where known, to the sub-area, and in the time scale, in which they are anticipated to occur.

The outcome of these calculations are shown in the table below and are illustrated by the following map (refer following page) for the period 2009 to 2026.

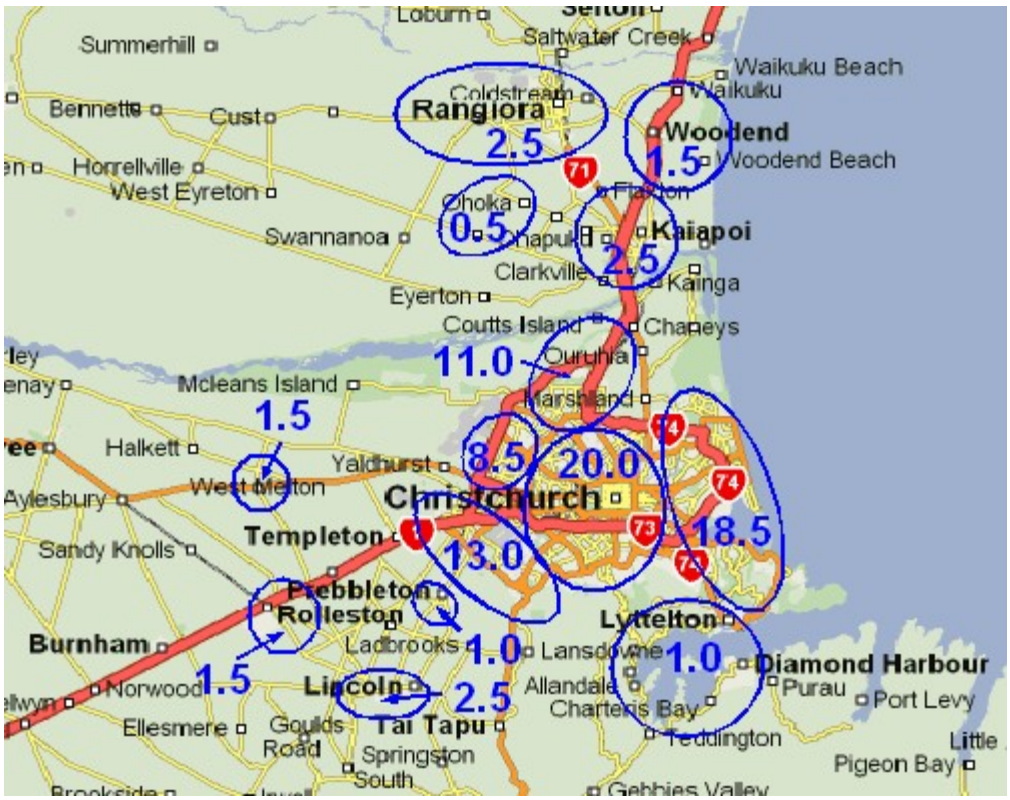
No.	Area	Type	Demand 2009 – 2026 (tonnes)
Waimakariri District			
1	Rangiora	A	2,500,000
2	Woodend	A	1,500,000
3	Kaiapoi	A	2,500,000
4	Manderville / Ohoka	A	500,000
5	WDC other	D	500,000
Sub Total			*7,500,000*
Christchurch City			
6	Northern	A	11,000,000
7	Western	C	8,500,000
8	Central	B	20,000,000
9	Eastern	C	18,500,000
10	Lyttelton Harbour	C	1,000,000
11	South Western	A	13,000,000
12	Christchurch - rural	D	0
Sub Total			*72,000,000*
Selwyn District			
13	West Melton	A	1,500,000
14	Prebbleton	A	1,000,000
15	Rolleston	A	1,500,000
16	Lincoln / Springston	A	2,500,000
17	SDC Other	D	1,000,000
Sub Total			*7,500,000*
TOTALS			**87,000,000**

Table 9: UDS Sub-Area Demands 2009 - 2026.

Whilst it is likely that the results are not entirely accurate the derived data is felt to be sufficiently robust for the purposes of the overall UDS Focus Group project. (i.e. *the development of an area wide strategy for the management of quarrying activities……..)*

However the level of uncertainty with respect in particular to the location, timing and quantum of larger "one-off" projects beyond 2026 becomes so great that it is unlikely that projections at sub-area level would be useful. Consequently UDS sub-area demand data relating to the period 2026 to 2041 has been omitted from this report.

Total demand (million tonnes) for Sub-Areas for Period 2009 – 2026.



(*It can be seen that whilst the urban areas of Christchurch will continue to dominate demand, demands from the south western and northern sectors of the city and their immediate environs will be significant*.)

SECTION 3. RESOURCES.

3.1 Central Plains Water Enhancement Scheme.

It should be noted that the Central Plains Water Enhancement Scheme (CPW) is predicted to raise groundwater levels above those previously recorded. Levels are predicted to rise significantly in areas to the west of State Highway 1 (SH 1) and to a lesser extent towards the coast. As a consequence potential sites located, in the following general areas, where groundwater levels are already relatively high, could be adversely impacted and in the worst cases rendered uneconomic*:*

- Close to the Selwyn River.
- To the east of SH 1
- The north eastern sector of Selwyn district west of SH 1
- Existing RuQ zones and adjoining areas within Christchurch City.

These impacts are not however directly included in this resource size assessment.

3.2 Christchurch City - Land Based.

It is estimated that there are approximately 50,000,000 tonnes* of material available for extraction remaining within the City's present RuQ and ICP/Q zones.

3.3 Selwyn District - Land Based.

A recent investigation concluded that the SDC owned, land based, resource (i.e. including existing pits) presently totals approximately 7 million tonnes. (Note that this total is made up from a significant number of quite small lots.) The resource is however not distributed uniformly over the district, there being few potential pit sites in the area north of the Selwyn River and east of SH 1. Very few of the sites are likely to be suitable to supply materials to satisfy either larger infrastructure projects or private demand.

The private pits are relatively small although it is understood that there are existing proposals to potentially establish several larger quarries in the near future.

3.4 Waimakariri District - Land Based.

Waimakariri District Council have supplied data that indicates that there is a resource consented gravel reserve of approximately 900,000 tonnes within the district. This equates to a remaining pit "life" approaching twenty years provided that production is limited to present levels.

The life of the privately owned quarry is thought to be limited. (i.e. there are no pits in the District capable of supplying materials for either larger infrastructure or private projects.)

* **Note:** Base data from "Christchurch Land Based Aggregate Resource Survey", TKC for ECan – Dec 06

3.5 Rivers within Study Area.

Data with respect to all the rivers within the study area is not complete however ECan have been able to supply the following:

River	Tonnes above min bed level*	Annual Supply Rate (tonnes)**
Ashley	3,500,000	7,000
Eyre	Not surveyed (Bed probably degrading)	<1,000?
Waimakariri	13,000,000	550,000
Selwyn	Not surveyed (Bed probably degrading)	4,000
Rakaia	Not surveyed	85,000
Kowai, Cass, Lower Farm Stream, Hawkins River.	n / a	Quantities small in context of study
TOTALS	17,000,000 (?)	650,000

Table 10: River Resources in Study Area.

The total presently consented extraction volumes may be in excess of the materials available. However, "Minimum Bed Level" conditions attached to the majority of these consents limits the volume that can be extracted.

There are also a number of extraction consent applications being processed by ECan. These applications will be determined with regards to the availability of gravel in relation to the outcome of ongoing river bed level investigations and, if granted, are likely to have conditions imposed restricting the area and depth of excavation, thereby limiting the volume available to those indicated in the Table above.

**Note: ***Estimated volume above minimum bed levels (No allowance for areas of deficit)

** Estimated volume supplied annually by rivers. Half of annual Rakaia supply allocated to study area.

3.6 Total Available Resource within Study Area.

3.6.1 Summary.

Area	Resource (tonnes)	Notes
Christchurch City	50,000,000	----
Selwyn District	7,000,000	Small pits for Council use only
Waimakariri District	1,000,000 (figure rounded)	Council use only
Rivers	17,000,000 (?)	700,000 annually (figure rounded)
TOTALS	75,000,000 (?)	700,000 annually from rivers

Table 11: Summary Study Area Resources.

3.6.2 Data Uncertainty

UNCERTAINTY	VALUE	NOTES
Conversion of 'Solid' to 'Loose' Measure	- 10% / + 10%	Little technical data exists on the "in-situ" (or 'Solid') density of local alluvial, land based quarry deposits. A density of 2.1 tonnes per cubic metre (for 'solid' or 'unexcavated') land based material has been used in the calculations. (Note: Production figures are generally reported on a "loose" volume basis.)
Conversion of 'Loose' volume to Weight	- 10% / + 10%	Local industry accepts a general density of 1.5 tonnes per cubic metre of excavated /" loose material".
Excavation Depths	- 5% / + 0%	A conservative approach has been taken. It has been assumed that all disturbed areas have been excavated to full depth.
Access	< - 5% / +0%	All material presently assumed physically accessible however obstructions (e.g. power pylons) may exist which prevent excavation. (Potential land ownership access issues have not been addressed in this report.)
Quality	<- 5% / +0%	All material assumed usable. Occasional pockets of unusable material have been encountered in the past. Minor allowance made at Pound Road Block for known clay pan.
Permissible Excavation Depth	< - 5% / + 5%	A conservative approach has been taken. Some uncertainty exists over depths at Mcleans Island block
Area	< - 5% / + 5%	Derived from ECan and web based documents.
River Extraction volumes	-20% / +20%	Data ex ECan
SDC and WDC Quantities	-20% / +20%	Volumes not formally measured.
TOTAL	-20% /+20%	Subject to accuracy of SDC, WDC and ECan data.

Table 12: Data Uncertainty - Resources.

3.7 "Life" of Existing Available Resource.

3.7.1 Christchurch City.

In theory the presently zoned areas for quarrying will be exhausted by approximately 2024 however this may not occur as:

- Some operators are increasingly sourcing materials from the Waimakariri River to augment their existing land based resources. (This may result in a shortened "life" for the resources presently held in the Waimakariri River.)

- There is an uneven distribution of land holdings between the quarry owners. (i.e. some operators have significant land holdings whilst others are nearing the end of their present reserves.)

- There is anecdotal evidence that there is resistance from non–quarry landowners in the Rural Q zone to sell their properties for quarry purposes (i.e. this reduces the volumes of material actually available.) Pressure to establish new quarries adjacent to existing zone boundaries is therefore increasing.

The overall impact of these issues are difficult to determine at present. (It is proposed that a more detailed study of this issue should be undertaken.)

3.7.2 Selwyn District.

On the assumption that the extraction of materials from the SDC owned pits will be restricted in the future for use on SDC roading maintenance and construction projects only, the existing pits will be exhausted by approximately 2012. However three of the pits are likely to be empty within the next two years, whilst the life of the remainder will be dependant on their location and demand within the immediately adjacent areas.

It is understood however that the Council are presently preparing to utilise some of their existing resource of quarry lots to alleviate the situation with respect to the demand created by their own activities. Apart from an area east of SH 1, north of the Selwyn River, these pits are capable of supplying most of the Council's demand in the medium and, in some areas of the district, in the longer term. It has been assumed that these lots will be brought into production during the time horizons used in this study.

However a demand created by private and larger infrastructural projects will remain unsatisfied unless new quarries are established locally and / or increasing quantities of materials are drawn from resources from within the Christchurch City area.

3.7.3 Waimakariri District.

Provided WDC continue with their existing policy of restricting extraction from their pits to their own use then their resource has been estimated to last until 2026. The life of the privately owned quarry is unknown but is unlikely to extend beyond 2020.

However no quarries exist within the district capable of supplying private demand or demand generated by larger infrastructural projects, although none of the latter are forecast within the next seven years. Increasing quantities of materials are likely therefore to be drawn from resources from within the Christchurch City area unless new quarries are established in the district.

3.7.4 Rivers within Study Area.

The rivers are coming under increasing pressure to counter the shortfall beginning to be experienced from land based quarry reserves. It is difficult therefore to place a definite individual "life" on the present resource. It is possible that overall demand will outstrip total supply within the next 15 years.

Other than for minor quantities, additional gravel that may be physically available from the Rakaia has, for the purposes of this report, been discounted as a source of aggregates given its distance from Christchurch - from where the majority of demand originates.

3.7.5 Total in Study Area.

If the existing resources prove to be of equal suitability to fulfil demand – that is are ideally located and produce materials of the requisite quality – then, in theory, the overall resource would be exhausted by approximately 2024. (i.e. 2 years short of the first study period.)

3.8 Resource Requirements to Fulfil Demand.

3.8.1 Study Area to 2026.

The overall quantity of material required (i.e. additional to that already available) to fulfil demand until 2026, without regard to location, is approximately 15 million tonnes.

3.8.2 Study Area to 2041.

The overall quantity of material required (i.e. additional to that already available) to fulfil demand between 2009 and 2041, again without regard to location, is approximately 100 million tonnes

This is approximately equal to the combined total quantity of material originally contained in the CCC Rural Q zones at Miners and Pound Roads before quarrying began.

3.9 Resource Requirement Summary.

Area	Existing Resource	Total Demand		Additional Reserves Required	
		2009 - 2026	2009 - 2041	2009 - 2026	2009 - 2041
Christchurch	57,000,000 + 300,000 p.a.	73,000,000	145,000,000	11,000,000	78,000,000
Selwyn	7,000,000+ 100,000 p.a.	12,000,000	25,000,000	3,000,000	15,000,000
Waimakariri	11,000,000+ 300,000. p.a.	10,000,000	25,000,000	(0)	4,000,000
Rivers*	Included above	N / A	N / A	N / A	N / A
Total	75,000,000 + 700,000 p.a.	100,000,000	200,000,000	15,000,000	100,000,000

(All figures tonnes & rounded)

Table 13: Resource Requirement Summary.

Note: Given the physical location of the CCC / WDC local authority boundary approximately along the centreline of the Waimakariri River, resources ex the river have been assumed to be allocated on the basis of half to each of CCC and WDC.

SECTION 4. EFFICIENCY OF USE AND RECYCLING.

There is a possibility that a component of local aggregate demand is driven by the relative cheapness of materials in the area. (It is reported that aggregate prices in Canterbury are approximately half that of Auckland for example.) Given that transport is a major component of aggregate pricing, and that it is likely that new extraction sites will be further from demand than is presently the case, it is almost inevitable that aggregate prices will rise at a rate greater than general inflation.

It is not known how price sensitive the market may be to these increases but it is possible that it may drive an increase in efficiency of use. For example newer construction methodologies, which utilise fewer aggregate resources, but which are presently not, or are only marginally cost competitive with traditional methods, may become viable in the face of rising aggregate prices.

Allowance however has not been made at this stage for this potential demand determinant other than where specifically stated in the future demand scenarios.

Neither has allowance been made for the recycling of materials. Present volumes of locally recycled materials are probably in the 2 to 5% range of overall production. Anticipated volumes of potentially, ultimately recyclable materials are of the order of 10% of production. (Recycling rates for aggregates in the UK have now reached approximately 25% of total production.)

SECTION 5. CONCLUSIONS AND RECOMMENDATIONS.

It is projected that the land based quarries within the CCC area will effectively be exhausted by approximately 2024.

It should be noted that this date varies from that projected in the report to Christchurch City Council in December 2007 (i.e. 2020) because:

- Some quarries have begun to draw potentially significant quantities of gravels from the Waimakariri River to augment their land based resource.
- There has been a significant downturn in production over the past eighteen months. This has lead to a lower baseline from which projections are made.
- Underlying growth rates in output are now expected to remain below the long term average for approximately two to three years.
- Selwyn District Council are preparing to open up a resource which in the earlier report was assumed to have been supplied from the CCC area quarries.

It should be borne in mind that the 2024 date may also be impacted upon by, amongst other matters:

- The on-going quantum of gravels brought into the land based quarries from the Waimakariri River for production purposes.
- The refusal of non-quarry land owners in the CCC RuQ Zones to sell land for quarrying purposes.
- The establishment of new quarries outside the existing RuQ Zones.

Given these variables, the 2024 date should be treated with some caution.

It can be seen that whilst the urban areas of Christchurch will continue to dominate demand within the study area, demands from the south western and northern sectors of the city and their immediate environs will be particularly significant.

Total demand for aggregates within the Selwyn and Waimakariri districts is already outstripping local supply. This shortfall in supply is presently generally sourced from quarries within the Christchurch City Council area.

In the case of the Selwyn district, without provision of new resources, the situation will soon be reached when most of the required materials will have to be imported from outside the district's borders. It is understood that the Council are presently preparing to utilise some of their existing resource of quarry lots to alleviate the situation with respect to the demand created by their own activities.

However a demand created by private and larger infrastructural projects will remain unsatisfied unless new quarries are established locally and / or increasing quantities of materials are drawn from resources from within the Christchurch City area.

Whilst Waimakariri District Council have sufficient resources to satisfy their own requirements, in at least the medium term, there are no quarries in the District capable of supplying materials for either private or larger infrastructure projects. Increasing quantities of materials are likely therefore to be drawn from resources from within the Christchurch City area unless new quarries are established in the district.

River resources are presently supplying approximately one third of the study area's total demand. However, even at present rates, these resources are being utilised faster than is sustainable on a long term basis. As a consequence, river based resources will be under severe pressure throughout the time horizons of the study. This situation will only be alleviated if additional suitable land based areas are made available, in a timely fashion.

Demands generated by large infrastructural projects (e.g. the Southern Motorway extensions) will place significant additional demands upon local gravel resources. It is possible that over half the identified one-off demand will seek to utilise materials sourced predominantly from the Waimakariri River. This will inevitably place further pressure on that resource.

Within the UDS area, increases in demand will be driven predominantly by the expanding populations in those areas identified for growth. Whilst demands in these areas will continue to grow at rates greater than those for the remaining areas of Christchurch, overall the city's demands will still dominate the local aggregate scene.

Within the wider study area the "best estimate" is for the existing resources to be exhausted by approximately 2024. (i.e. significantly short of the time horizon of this study.) The volumes of materials required to fill this gap are significant and will require careful planning to ensure a continuing supply of economically viable local aggregates. The present co-operative approach being taken between the local and territorial authorities to meet this challenge is to be commended.

It is recommended therefore that this report be used as a basis for ongoing discussions between SDC, WDC, CCC and ECan and between those councils and the local aggregate production industry in order to develop a coherent long term strategy for the management of the local gravel resource.

APPENDICES.

- Demand Projection Statistics.
- Population Projections.
- UDS Growth Projection Assumptions.

UDS REGIONAL GRAVEL RESOURCE STUDY.

DEMAND PROJECTION STATISTICS.

NOTE: Factors impacting on demand for aggregates are extensively discussed in "Planning for Growth. The Determinants of Aggregate Demand in New Zealand" by J.O'Brien – IPENZ Engineering TreNZ, Dec 2006 and "Regional Gravel Management Report" by ECan / MWH – January 2006

1. Past Demand and Population Patterns - Some Basic Statistics.

Statistic	Annual Per - Cent Increase			Notes
	1953 – 2008	1992 - 2008	2001 - 2005	1992 – 2008 represents the longest period for which relatively reliable statistics are available for local production. 2001 – 2005 represents the maximum annual rate of increase in the recent past
Average national increase in total production.	3.3	4.2	8.8	Average 2001 to 2008 = 2.6%
Average national increase in population.	1.3	1.2	1.5	
Variance in national consumption per head. (t.p.h.)	11.6 (max) 1966 4.4 (min) 1991	10.2 (max) 2005 5.5 (min) 1992	10.2 (max) 2005 7.8 (min) 2001	(t.p.h. = tonnes per head)
Average study area increase in total production	Data not available	4.0	9.0	Local data not available for period prior to 1992 Average less one-off projects 1992 – 2006 = 5.4% Average 2001 to 2008 = 2.6%
Average study area increase in population	N / A	1.6	2.2	
Study area consumption per head (tph)	Data not available	9.6 (max) 2006 5.0 (min) 1992	9.6 (max) 2006 6.9 (min) 2002	Local data not available for period prior to 1992

2. Predicted Population Increases.

Area	Average Annual Per - Cent Increase			Notes
	2009 - 2026	2026 - 2041	2009 - 2041	
Overall Study Area.	0.9	0.6	0.8	
Christchurch City Council	0.7	0.5	0.6	Includes Banks Peninsula
Selwyn District.	2.4	0.9	1.7	
Waimakariri District.	1.4	0.9	1.2	

UDS GRAVEL RESOURCE MANAGEMENT STUDY.

POPULATION PROJECTIONS.

1. Study Area.

AREA	09	10	11
Christchurch	360,660	363,347	365,924
SDC	36,730	37,985	39,266
WDC	47,426	48,626	49,899
Banks Peninsula	8,753	8,905	9,061
Area Total	**453,569**	**458,863**	**464,310**

AREA	12	13	14	15	16
Christchurch	368,303	370,697	373,106	375,531	378,036
SDC	40,491	41,754	43,059	44,404	45,826
WDC	50,884	51,892	52,920	53,973	55,144
Banks Peninsula	9,282	9,344	9,404	9,466	9,529
Area Total	**468,960**	**473,687**	**478,489**	**483,374**	**488,535**

AREA	17	18	19	20	21
Christchurch	380,833	383,652	386,490	389,351	392,232
SDC	46,651	47,494	48,358	49,241	50,146
WDC	55,613	56,085	56,562	57,043	57,528
Banks Peninsula	9,578	9,627	9,678	9,727	9,744
Area Total	**492,675**	**496,858**	**501,088**	**505,362**	**509,650**

AREA	22	23	24	25	26	41
Christchurch	395,134	398,058	401,004	403971	406,886	443,000
SDC	51,072	52,021	52,991	53,984	55,117	63,000
WDC	58,017	58,511	59,009	59,511	59,972	69,000
Banks Peninsula	9,827	9,878	9,930	9,980	10,032	10,000
Area Total	**514,050**	**518,468**	**522,934**	**527,446**	**532,007**	**585,000**

Base data for 2011, 2016, 2026 and 2041 taken from SNZ Census data and UDS Greater Christchurch Urban Development Study Medium High Population Projections produced by Statistics New Zealand in September 2006 using the assumptions specified by the UDS Project Team.

2 Details by Area

A. Waimakariri District Council.

AREA	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
UDS	38,488	39,643	40,871*	41,811	42,773	43,756	44,763	45,888*	46,310	46,736	47,166	47,600	48,038	48,480	48,926	49,376	49,830	50,243*
UDS % total	81	81	82	82	83	83	83	84	84	84	84	84	85	85	85	85	85	85
Non – UDS**	8,938	8,983	9,028	9,073	9,119	9,164	9,210	9,256	9,303	9,349	9,396	9,443	9,490	9,537	9,585	9,633	9,681	9,729
TOTAL	**47,426**	**48,626**	**49,899**	**50,884**	**51,892**	**52,920**	**53,973**	**55,144**	**55,613**	**56,085**	**56,562**	**57,043**	**57,528**	**58,017**	**58,511**	**59,009**	**59,511**	**59,972**

* Taken from UDS Medium High Scenario as at September 2006
** Non - UDS growth at 0.5% p.a. Ratio UDS / Non-UDS from pers. comm. M.Sparrow WDC 2/8/07

B. Selwyn District Council.

AREA	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
UDS	22,487	23,386	24,302*	25,153	26,033	26,944	27,887	28,896*	29,636	30,394	31,173	31,970	32,789	33,628	34,489	35,372	36,277	37,321*
UDS % total	61	61	61	61	62	62	62	63	63	63	64	64	64	64	65	65	65	65
Non – UDS**	14,243	14,599	14,964	15,338	15,721	16,115	16,517	16,930	17,015	17,100	17,185	17,271	17,357	17,444	17,532	17,619	17,707	17,796
TOTAL	**36,730**	**37,985**	**39,266**	**40,491**	**41,754**	**43,059**	**44,404**	**45826**	**46,651**	**47,494**	**48,358**	**49,241**	**50,146**	**51,072**	**52,021**	**52,991**	**53,984**	**55,117**

** Non - UDS growth at 2.5% p.a. to 2016, then 0.5% to 2026
Census 2006 UDS / non UDS ratio :- 61%

C. Banks Peninsula.

AREA	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
UDS	5,986	6,127	6,272*	6,318	6,366	6,411	6,458	6,506*	6,540	6,574	6,609	6,643	6,678	6,713	6,748	6,784	6,819	6,855*
UDS % total	69	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Non – UDS**	2,919	2,934	2,949	2,964	2,979	2,993	3,008	3,023	3,038	3,053	3,069	3,084	3,099	3,114	3,130	3,146	3,161	3,177
TOTAL	**8,905**	**9,061**	**9,221**	**9,282**	**9,344**	**9,404**	**9,466**	**9,529**	**9,578**	**9,627**	**9,678**	**9,727**	**9,744**	**9,827**	**9,878**	**9,930**	**9,980**	**10,032**

** Non - UDS growth at 0.5% to 2026
Census 2006 UDS / non UDS ratio :- 65%

D. Christchurch.

AREA	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Ch ' ch	360,660	363,347	365,924*	368,303	370,697	373,106	375,531	378,036*	380,833	383,652	386,490	389,351	392,232	395,134	398,058	401,004	403971	406,886*

* Taken from UDS Medium High Scenario as at September 2006

UDS Growth Projection Assumptions.*

The following density assumptions for households per hectare (hh/ha) - taken from the UDS Strategy - refers to a net residential density, including roads and open space:

- Christchurch central city intensification areas - 50 hh/ha
- Other Christchurch city intensification areas- 30 hh/ha
- Christchurch greenfields areas – 15 hh/ha
- Selwyn and Waimakariri greenfields areas – 10 hh/ha

The UDS Strategy proposes that for the first 20 years, approximately 40% of all new housing will occur in intensification areas within Christchurch. The balance will be provided in new development areas with housing at increased densities. Intensification would increase to approximately 55% over the following 15 years. Overall, 45% of growth over the 35 year period (i.e. 2006 – 20041) is predicted to be in intensification, including a small but declining amount of infill.

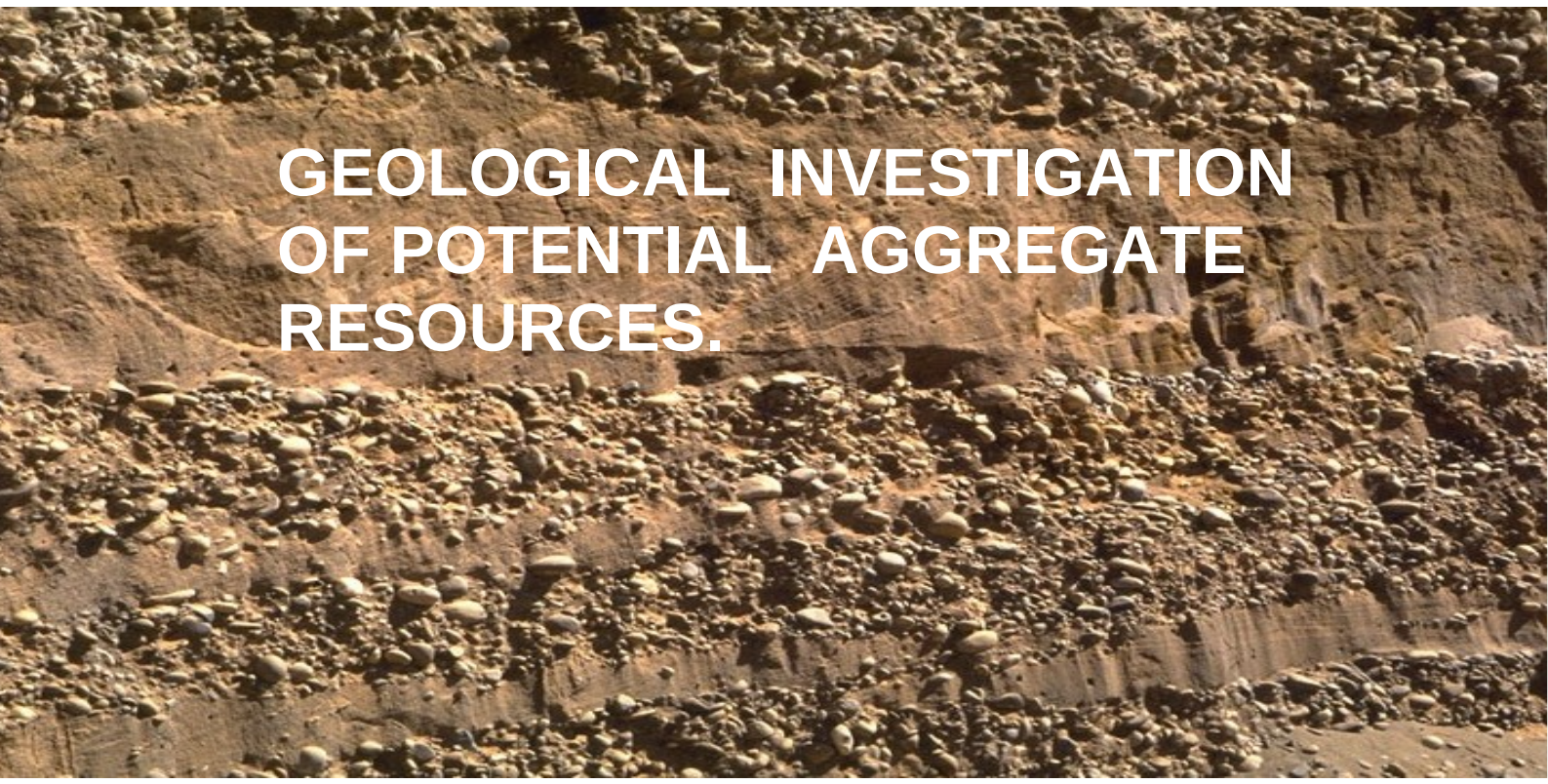
Average household size is predicted by the UDS Strategy to fall from 2.54 in 2006 to 2.36 in 2041

* Greater Christchurch Urban Development Strategy and Action Plan 2007

Report No: UDS010809

Greater Christchurch Urban Development Strategy

REGIONAL GRAVEL RESOURCE MANAGEMENT STUDY.



GEOLOGICAL INVESTIGATION OF POTENTIAL AGGREGATE RESOURCES.

GEOTECH

TWELFTH KNIGHT CONSULTING

Geotech Consulting Ltd in conjunction with Twelfth Knight Consulting.
- August 2009.

The information in this report is accurate to the best of the knowledge and belief of Twelfth Knight Consulting, acting on behalf of Christchurch City Council and the Urban Development Strategy Implementation Management Group. Whilst Twelfth Knight Consulting has exercised all reasonable skill and care in the preparation of information in this report, Twelfth Knight Consulting does not accept any liability in contract, tort, or otherwise for any loss, damage, injury or expense, whether direct, indirect, or consequential, arising out of the provision of information in this report.

Acknowledgement and many thanks for the provision of information are due to the following:

- Gordon Strowger, Civil Training and Assessment Ltd.
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- Ken Avant, Waimakariri District Council.
- Brendon Ryder, SICON Ltd.
- Brett Swain, Southern Screenworks Ltd.
- Paul McIlraith, Fulton Hogan Ltd.

TWELFTH KNIGHT CONSULTING

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Section 1. Background

Section 2. Geological Investigation.

(refer body of Geotech report for detailed contents page and Executive Summary.)

Greater Christchurch Urban Development Strategy.

REGIONAL GRAVEL MANAGEMENT RESOURCE STUDY.

GEOLOGICAL INVESTIGATION OF POTENTIAL AGGREGATE RESOURCES.

Report prepared by Geotech Consulting Ltd in conjunction with Twelfth Knight Consulting – August 2009

SECTION 1. BACKGROUND.

1.1 Introduction.

Until recently demand for aggregates* within the urban Christchurch area has been increasing rapidly driven in the main by increasing rates of economic activity and population growth.

Similar growth in demands for aggregates has occurred in the adjacent areas encompassed by the Selwyn (SDC) and Waimakariri District Councils (WDC). Both Districts were experiencing a sustained period of growth - primarily residential - and, in the case of Selwyn in particular, in activities involving the use of heavy transport associated with the expanding dairying industry. These latter activities have in turn been increasing demand for aggregates for roading network maintenance purposes. Approximately ten to fifteen percent of the aggregates produced from land based resources located within the Christchurch City Council (CCC) boundaries are used to satisfy demands generated from within the SDC and WDC areas.

The constituent members of the Urban Development Strategy (UDS) have determined that continued access to a supply of suitable aggregates is required both to satisfy demand for their own projects but also to satisfy demands from central government for infrastructural asset development and maintenance and from local private sector projects. In the light of these changes in demand it is prudent therefore that a re-assessment be undertaken of the area wide management of quarrying activities in order that regional demands for aggregates may be met throughout the time horizons adopted by the UDS.

In the first phase of this project Twelfth Knight Consulting has therefore been engaged to:-

- Provide an overall assessment of the sub-regional aggregate resource and its locations.
- Determine the demand for aggregates to 2026 and if possible to 2041.
- In conjunction with the Focus Group, identify and prioritise location criteria and constraints for sites for new resources.

This report addresses the geological aspects of the first of these tasks.

* **Note:** For the purposes of this report the definition of 'aggregates' includes all coarse and fine materials sourced predominantly, but not exclusively, from alluvial deposits. Materials produced solely for rip-rap, agricultural or industrial purposes are not included.

The area encompassed by the member Councils of the UDS is effectively self-contained from an aggregate production and demand perspective. (i.e. there is little or no export out of, nor import of aggregates into the area.) The following sub-sections describe the present sources of aggregates that are used within the study area. (Production sites for agricultural and / or industrial minerals are not included.)

A report on the outcomes of a detailed geological investigation of potential aggregate resources follows in Section 2.

1.2 Land Based Aggregate Production.

In general terms, the extent of the land based aggregate resource within the study area, with the exception of Banks Peninsula, is such that suitable material for all types of aggregate production is physically available to be quarried over wide areas of the Plains.

The method of extraction generally consists of layer mining to a point above or, in some past cases, to the level of the ground water depending on the physical and planning constraints at the time the quarry was established. Because of the relatively high water table on the Canterbury Plains close to the coast, and in particular close to Christchurch City, the excavations tend to be relatively shallow.

Ready availability of aggregates has historically resulted in a large number of small pits being scattered across the region. More recent practice has been to set large areas aside which are zoned for “Quarry” purposes.

1.2.1 Christchurch City.

Three distinct areas within the Christchurch City Council boundaries are presently used for quarrying purposes. These are generally known as:

- Miners Road Block - 340 Ha approximately. Approximately $^1/_3$ of this area has been worked.
- Pound Road Block - 100 Ha approximately. Largely owned and operated by Fulton Hogan The area is almost completely worked out.
- McLeans Island Block - 630 Ha approximately. Owned and operated by Isaac Construction.

The Christchurch City Plan designation for these areas is “Rural (Q) Quarry Zone”, or in the case of the Mcleans Island Block – “Isaac Conservation Park / Quarry” (ICP/Q)

The quarries are operated by Fulton Hogan, Road Metals, K B Construction, Winstone Aggregates, Taggarts Earthmoving, Blakely Construction and The Isaac Construction Company. In combination these quarries produce approximately 60% of the aggregates sold in the study area. (i.e. the areas of CCC, SDC and WDC.) Total gravel reserves in these areas are estimated to last until approximately 2024.

In addition Peninsula Quarries operate two hard rock quarries on Banks Peninsula – at Teddington and Duvauchelle – and Burnside Contracting operate out of the Port Lyttelton quarry. The volumes produced from these quarries are small in the context of the study.

1.2.2 Selwyn District.

Selwyn District Council owns approximately 200 relatively small lots, designated for aggregate production. These properties are scattered across the District in order to minimise haul distances. Only are small number are presently used for aggregate production.

SICON Ltd operate the pits on behalf of the Council. On site crushing is undertaken by sub-contract using mobile plant. The materials produced are used mainly for construction and maintenance of the Council's extensive rural roading network.

The pits are also accessed by other private companies on a royalty permit system, generally, but not exclusively, for the production of materials also used for SDC roading contracts.

There are presently four privately owned pits / quarries in the district. These operations are relatively small in the context of this report.

1.2.3 Waimakariri District.

Waimakariri District Council owns 4 resource consented pits which are also operated on their behalf by SICON Ltd. (One pit is exhausted.)

As with SDC, on site crushing is undertaken by sub-contract using mobile plant. The aggregate is used solely for Council purposes – mainly for the supply of roading maintenance metal. Pit life is estimated as being of the order of twenty years.

There is one privately owned quarry in the district which, in addition to providing materials for retail sales, also provides aggregates to the Christchurch Readymix plants for concrete production. It is understood that the majority of the shingle used to produce aggregates at the site is drawn from the Ashley River. The remaining reserves within the quarry itself are thought to be small.

(Environment Canterbury operate a hard rock quarry at View Hill for the production of larger rocks which are used as rip-rap for river stopbank protection.)

1.3 Extractions from Rivers.

In addition to the land based quarries, the Ashley, Eyre, Waimakariri, Selwyn, Hawkins, Kowai No. 1 & 2, Cass and Rakaia Rivers are also used as sources for aggregates. Total extractions from these rivers equates to approximately 30 - 35% of total aggregate output in the study area. (The Waimakariri River provides approximately 80% of the total materials from river sources.)

Not all of the materials from the rivers are considered by the local councils to be satisfactory for use for some types of roading materials.

Approximately 15 companies hold resource consents for extraction from the rivers. In some cases the consented extraction volumes are in excess of the materials available. (There are also a number of new extraction consent applications presently being processed by Environment Canterbury.)

SECTION 2. GEOLOGICAL INVESTIGATION.

The following section contains a report by Geotech Consulting Ltd, on behalf of Twelfth Knight Consulting, describing the:

- General geological setting of the central Canterbury Plains and Banks Peninsula.
- Aggregate sources. (i.e. hard rock quarries, gravel pits and rivers.)
- Groundwater constraints on possible extraction sites.
- Evaluation of identified geological formations against required aggregate criteria.
- Target Areas (i.e. the areas which are most likely to be a potential source of future aggregate supply.)

Please note that specific sites for new resources have not been identified or evaluated during this stage of the overall project.

GEOTECH

Urban Development Strategy
Regional Gravel Resource Management Study:-

Geological Identification of Potential Aggregate Resources.

Client: Twelfth Knight Consulting

Date: July 2009

Reference: 1794

Compiled by:

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EXECUTIVE SUMMARY.

Previous studies have identified that there is a forthcoming shortfall in accessible aggregate resources to satisfy demand from within the area encompassed by the Urban Development Strategy. This report addresses the overall geological assessment of the aggregate resource and its location with the intention of identifying areas within the sub region that may be geologically suitable for the provision of aggregate resources.

Aggregate materials must be stable, strong, un-weathered and joint free, have low porosity and permeability, be chemically inert, and be generally clean of clay and excessive fine silt. We have obtained relevant and up to date geological information to provide a context for the location and categorisation of existing aggregate operations and compiled and compared the relative aggregate quality ratings of existing pits with the geological information.

Although there are a few bedrock quarries in the central Canterbury and Christchurch area most are in Lyttelton or Akaroa Harbour and tend to be for specialist or localised supply. The great majority of aggregate for construction and road maintenance comes from aggregate pits that have been developed in the relatively young sediments that underlie the central Canterbury Plains.

The plains have formed mainly by the combined accumulation of sediment from rivers that drain hard greywacke bedrock such as the Rakaia and Waimakariri Rivers, with lesser sediment contributions from the Selwyn, Eyre and Ashley Rivers. The river fans have moved laterally back and forth and in doing so have intersected and mutually overlapped to form a thick sedimentary sequence connecting the volcanic rocks of Banks Peninsula with the greywacke dominated rocks of the foothills and Southern Alps.

The great majority of the sediment thickness and area of the Canterbury Plains was formed during the glacial period when very large volumes of sediment were generated by the unique erosive power of extensive valley glaciers. Glaciers can grind rock that has become frozen in place in the glacier base under high pressure against the bedrock over which the glacier slowly moves. As a result a glacier produces a larger volume of very fine sediment than a river system, at a time when there is relatively little water compared to sediment, and the river system has been shortened by the glaciers extension down the valley.

As a result sediment deposited during and immediately following glaciations is less well sorted and contains more fine material and greater range of particle hardness than material from the same catchments when glaciers have fully receded. Once the glaciers recede the sediment supply compared to river water volume greatly reduces and the rivers cut down into the glacial era fans. As a result they form smaller fans of younger sedimentary material that has largely been derived from the reworking of the hardest and most resistant of the glacial era sediment.

The comparison of aggregate quality from existing pits clearly shows that the strongest and best aggregate most often comes from post glacial sediments relatively close to Christchurch that form the post glacial fans of the Waimakariri and Rakaia Rivers. The sediments being quarried in these locations are most consistently the highest quality because:

- The rivers have broken down and removed the softer materials present during two cycles of erosion and deposition.
- The Waimakariri River catchment is far enough inland to avoid many of the weaker areas of greywacke bedrock in the immediate foothills.
- The rivers have had two opportunities to sort the sediment into general size categories and have had sufficient carrying capacity to bring relatively large rock sizes all the way to State Highway1 and Christchurch.
- The rocks in the sediment have been cleaned of adhering clay and silt.
- The rocks have been well rounded.
- The sediments are still relatively young (in most cases at the surface no more than 3000 years old) and thus the rock and constituent finer sediment particles are little weathered and had only minor silt and clay washed down into them during subsequent periods of rainfall.
- The windblown fine sediment capping the river gravel is relatively thin.

It is important to note that due to variability of sediment size both laterally and vertically in any braided river channel not every area of the post glacial river fans will be suitable for aggregate production. This is particularly the case lowest down the fans where the river sediments approach the finer coastal cover sediments that exist along the fringes of Lake Ellesmere and Christchurch urban boundary.

The next best aggregate areas are the most recent glacial outwash gravels that form a wide area of the central plains. In these locations there is generally more silt in the gravel (both interbedded and washed down into the voids between rocks), the constituent rock and finer particles are more weathered, and there is a thicker overburden cover. Most of the existing aggregate pits scattered across the glacial outwash areas are of modest quality but at least two pits are known to rate as highly as the aggregate pits in the post glacial areas. The variation in quality may simply be due to random lateral and vertical variations in the sediment as it is being deposited but it is also possible that within the glacial era sediments there are more suitable areas that can be systematically identified by further investigation.

There are also potential groundwater constraints on aggregate source location. Most pits must be operated above the water table and many pits are 5-10m deep. We have plotted the 6m groundwater depth contour across the area of interest and this considerably narrows down the potentially suitable areas. (Refer Figure 6, page 28) There is also the groundwater recharge area for Christchurch within the Waimakariri River post glacial fan. Most of the large aggregate pits that currently supply Christchurch lie within this zone.

Based on the sediment ages and various constraints we have identified areas potentially suitable for future aggregate production and subdivided these into two categories.(Refer figure on following page) Class A areas are underlain by post glacial sediment and fall outside of the areas of known coastal sediments, and the areas where the water table is closer than 6m to surface. Class B areas are the older glacial sediments excluded from these same potential constraint zones. We emphasise that not all of the areas thus defined will ultimately prove suitable for aggregate production due to natural lateral and vertical variations in both the original sediments and the younger overburden. However, the zones that we have identified are the most obvious targets for more detailed future assessment and investigation.

1. INTRODUCTION AND BRIEF.

Previous studies have identified that there is a forthcoming shortfall in accessible aggregate resources to satisfy demand from within the area encompassed by the Urban Development Strategy. Accordingly a focus group has been established from the constituent members of the Urban Development Strategy Implementation Management Group (UDSIMG) to complete a comprehensive review of aggregate supply and demand across the Christchurch, Selwyn and Waimakariri Council areas.

This review will provide a detailed picture of the regional situation to determine the implications and provide certainty of resource. The overall purpose of the project is therefore to:

- provide for the efficient management of the use of quarry resources
- protect potential future aggregate resources from inappropriate development
- avoid or manage the environmental impacts of quarrying
- establish a consistent planning framework for quarrying across the region
- provide efficient and effective planning for all stakeholders

The focus group have requested that an initial report should be completed in order to:

- determine the quality of the aggregate resource available in the sub-region
- provide a certainty of aggregate location and availability
- identify a sustainable supply for at least twenty years

This report addresses the overall geological assessment of the aggregate resource and its location with the intention of identifying areas within the sub region that may be geologically suitable for the provision of aggregate resources.

2. WORK UNDERTAKEN AND THE METHODOLOGY ADOPTED.

We have:

- Obtained relevant and up to date geological information to provide a context for the location and categorisation of existing aggregate operations.
- Compiled relative aggregate quality ratings of known pits by Twelfth Knight Consulting and Civil Training and Assessment Ltd and compared these to the geological information.
- Reviewed the pattern of aggregate quality in relation to the geology to identify those areas most likely to generate the best quality aggregates in the future.
- Considered potential geological and groundwater constraints.
- Undertaken the preparation of the figures and report while striving to keep the text as clear and free of technical jargon as possible.

To our knowledge no systematic assessment of this type has previously been carried out in the Christchurch and Central Canterbury area.

3. LOCATION AND RATING OF PITS INCLUDED IN THIS ASSESSMENT.

Table 1 lists the details and rates the usefulness of the aggregate available at each location. Figure 1 shows the location and basic categories of the various aggregate sources included in this assessment (sediment pits, bedrock quarries, river source.)

Pit Name	Area (ha)	Depth (m)	Material	Use	Category
Wrights	2	5	Occasional silt seams but generally clean. Stone up to 200mm.	Reasonable for C & M	3
Waddington	4	4	Occasional silt seams but generally clean. Stone up to 200mm.	Reasonable for C & M.	3
Racecourse Hill	2	6	Slight silt/clay throughout. Stone up to 200mm.	Reasonable for C , good for M	3
Reids, Darfield	2	6	Slight silt/clay throughout. Stone up to 200mm. More clay at lower depth.	Reasonable for C, good for M	3
Gallaghers	4	6	Showing more clay at depth. Top layer clean. Stone up to 200mm. Damp in base	Good C & M	2
Thomsons	2	6	As above	Good C & M	2
Miles/Bealey	2	5	As above	Reasonable for C & M	3
Two Chain	4	5	Some silt throughout but generally clean. More silt and clay at depth. Damp at base	Good C & M	2
Pankhurst	2	4	Some silt throughout but generally clean	Good for C	1
Charing Cross	2	4	Occasional silt seams but generally clean	Good for C	1
Broughtons	2	5	Occasional silt seams but generally clean	Good for C	1
Reids, Ellesmere	4	6	Presence of clay throughout	Good for M	5
Wheatsheaf	3	4	Silt throughout but generally clean. Stone up to 150-200mm.	Good for C	1
Robinsons	8	5	Frequent silt seams. Stone up to 100mm.	Good for M, lack of stone for C	4
Cemetery	23	5	Occasional silt seams but generally clean. Stone up to 150-200mm.	Reasonable for C	2
Locheads	10	5	Occasional silt seams but generally clean. Stone up to 150mm.	Good C & M	2
Gardiners	4	4	Slight clay colour throughout. Stone up to 150-200mm.	Good C & M	2
Jarmans	3	6	Some silt but generally clean. Stone up to 150-200mm	Reasonable for C & M	3
Morgans	2	5	Slight clay colour throughout. Stone up to 150-200mm	Good for C & M	2
Doyles	2	3.5	Fairly clean. Stone up to 150 – 200mm.	Reasonable for C & M	3
Coxs, Springfield	5	3	Clay throughout. Wet at base.	Good for M.	5
Greys	4	3	Clay throughout. Wet at base	Good for M.	5
Bells	2	?	Very little clay or silt. Stone up to 150-200mm.	Good for C.	1
Miners Road.	340	10	Very little clay or silt. Stone up to 150-200mm.	Good for C.	1
Pound Road	100	11	Very little clay or silt. Stone up to 150-200mm.	Good for C.	1
McLeans Island	250	Av 3	Very little clay or silt. Stone up to 150-200mm	Good for C.	1
Stony Flat	?	?	High clay content	Good for M	4
Woodstock	2	5	High clay content	Good for M	4
Garterys	6	7	High clay content	Good for M	4
Sutherlands	8	7	High clay content	Good for M	4
Hewitts	2	?	Fairly clean	Reasonable for C & M	3
Browns	2	?	High clay content	Good for M	4
Widows	2	?	High clay content	Good for M	4

Table 1: Location, comments and ratings for aggregates pits in the central Canterbury and Christchurch areas.

Key to Rankings and Abbreviations in Table 1.

C: Construction materials and concrete aggregates.

M: Roading Maintenance materials

The following ranking has been adopted for the work to date:

1: Excellent to good for construction materials and concrete aggregates.
Poor for roading maintenance material.

2: Good for construction and roading maintenance materials

3: Reasonable for construction and roading maintenance materials

4: Good for roading maintenance. Marginal for construction materials

5: Excellent for roading maintenance materials. Not suitable for construction materials.

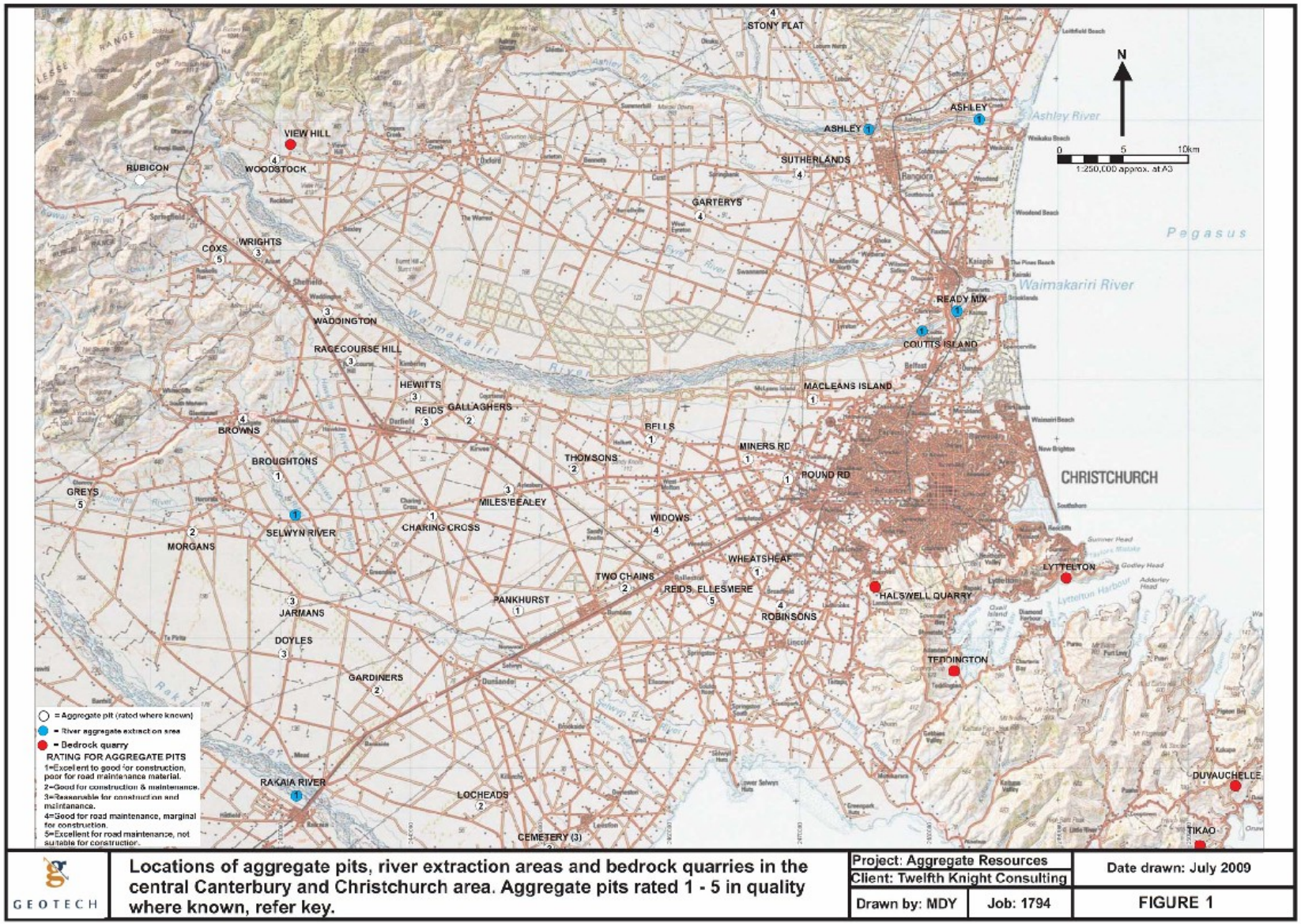

Figure 1: Locations of aggregates pits, river extraction areas and bedrock quarries.

Aggregate materials must be stable against breakdown in use and in stockpiles; free from joint flaws and micro-cracking; strong enough to withstand loading applied in use (both tensile and compressive);of low porosity and permeability in individual particles and chips; be non-plastic; chemically inert in use, not susceptible to polishing, not coated with any substance nor polished to a degree where adhesion of bitumen or cement is adversely affected; and not deeply weathered (Christie et al, 2001;Dolar-Mantanui,1983; Grant-Taylor & Waters, 1976).

The following ranking has been adopted for the work to date:

1: Excellent to good for both general construction (including concrete) and road construction, poor for roading maintenance material.

2: Good for construction and roading maintenance.

3: Reasonable for construction and roading maintenance material.

4: Good for roading maintenance, marginal for construction material.

5: Excellent for roading maintenance materials, not suitable for construction material.

These are subjective ratings by Twelfth Knight Consulting and Civil Training and Assessment Ltd based on their previous experience with aggregates. They are intended for this preliminary assessment to help narrow the range of suitable resources. Ideally ratings such as these would be based on a standardised suite of physical, mechanical and chemical tests that are the same for each location. However, at present no such data is available for enough sites to make a meaningful comparison possible.

4. GEOLOGY OF THE CANTERBURY PLAINS AND BANKS PENINSULA.

In the section that follows we provide a basic description of the geological setting and formation of the Christchurch and surrounding central and northern Canterbury Plains area where relevant to gravel and aggregate resources. Later on page 17 & 18 we introduce as Figures 2 & 3 the geological map.

Gravel and aggregate in the area comes either from hard rock quarries (i.e. quarries in bedrock) or pits and rivers where the material is obtained from geologically young sediments derived from the past erosion of hard rock. The areas of hard rock relevant to the region fall crudely into two groups.

Greywacke of the Southern Alps and foothills.

The elevated inland areas of Canterbury are dominated by old hard sedimentary rocks formed more than 140 million years ago. Referred to collectively for simplicity as “greywacke.” in detail the rock consists of hard, mainly quartz cemented, sandstone (true greywacke) and mudstone (argillite) which are bedded together in layers that have been folded and faulted into complex patterns. While the greywacke sandstone is generally an ideal material for aggregate the associated argillite is brittle and unstable and breaks down rapidly in the atmosphere into small fine gravel or coarse sand sized angular cubes.

The burial, compression and deformation of the greywacke and argillite during the folding and faulting process has also introduced some new minerals that are generally not good in aggregate. Calcite is a relatively soft vein mineral in some greywacke that is easily attacked by chemical weathering and the veins can later break open with exposure, chemical weathering and load. Zeolite is a second more serious vein mineral in greywacke that weathers and breaks down very quickly after exposure to the atmosphere. We discuss the distribution of zeolite later in Section 4.3.

There are smaller areas of younger rocks fringing the greywacke rocks and infilling some of the mountain basins including limestones, softer sandstones, weak mudstones and volcanic rocks. While the limestones can have uses for agricultural lime, and decorative aggregate, they are composed almost entirely of relatively soft calcite and are generally not suitable for normal aggregate. One significant hard rock quarry exists in old volcanic rocks of the foothills (View Hills quarry, Oxford area) which is used for rip rap (large rocks for river and coastal protection) but this type of rock has different requirements in comparison to concrete and roading aggregates, mainly to do with block size.

With the exception of Teddington Quarry in Lyttelton Harbour there are no significant greywacke rock quarries in the Canterbury area, and as discussed in the next section, the greywacke rock in the Teddington Quarry is not typical greywacke because of the volcanic history of the area.

Younger volcanic rocks of Banks Peninsula.

Approximately 12 million years ago major volcanic activity developed in the area now known as Banks Peninsula. The Lyttelton Volcano developed and uplifted some of the older sedimentary rocks including a small area of greywacke. Further volcanic eruptions continued from 12 million years to approximately 6 million years producing rocks of the Akaroa, Mt Herbert and Diamond Harbour Volcanic groups respectively all composed mainly of basaltic materials.

Volcanic action produces two main products, lava and ash. Only the lava becomes a hard rock of potential use in aggregate, and where the ash is mixed regularly with the lava it tends to become an impurity and weakness. Most of the volcanic groups of Banks Peninsula, with the general exception of the youngest Diamond Harbour Group, generally have too much ash included to make a good aggregate quarry. The youngest Diamond Harbour Group rocks are cleaner basalts. Halswell Quarry was developed in rock of this group which also had a unique flaggy jointing that made an ideal building stone. Halswell Quarry basalt was crushed and used for roading construction throughout the 20th Century but winning and crushing rock was a relatively expensive process.

The Teddington Quarry on Banks Peninsula extracts greywacke but the combination of approximately 6 million years of baking by volcanic activity and alteration of the rock by hot volcanic water has reduced the rock material strength significantly and introduced clay and other relatively soft minerals. The resulting rock has many commercial uses but it is generally not suitable for concrete or top quality road aggregate.

***Young sediments*.**

By far the greatest volume of aggregate in Canterbury comes from the geologically young sediments of the Canterbury Plains. Up until approximately 1 million years ago Banks Peninsula was an island well offshore of the Southern Alps at which time there was a critical change in the climate pattern that initiated the transition to the ice age period (Pleistocene). Over this approximately one million year period there has been a series of very large glacial advances in the mainly greywacke landscape of the Southern Alps with interglacial intervals between each colder glacial period.

Glacial action differs in a very important way from river erosion. In a river the breakdown of rocks occurs mainly by the impact between the gravel as it bumps and skips along the bed of the river. After a while the size of the material moving in this way reduces to the point where there is not enough energy to keep breaking on impact and therefore the size stops reducing at about medium silt size (0.01mm). Clay sized material (defined as less than 0.002mm) is hardly ever produced by river action. A glacier in contrast carries a significant amount of rock frozen into the glacier base where it is ground under very large compressive force against other bedrock over which the glacier passes to produce abundant very fine sizes, including clay.

Thus a sediment derived from a moderate to large river under normal non-glacial conditions (such as the modern Waimakariri River) is typically free of clay material, and while some silt is present, this tends to be coarser silt (i.e. closer to sand size) and the proportion compared to sand and gravel is relatively low. By contrast a river that is clearing a catchment of sediment trapped and stored during an earlier glacial advance contains proportionally much more silt and significant amounts of clay sized material. The fine material is carried in suspension during high and moderate flows and is trapped between the gravel bedload as it is deposited.

The silt and clay that temporarily accumulates in the river bed as river water levels drop is easily blown out of the active river bed by the wind and often coats adjacent areas that will later be flooded by gravel, thereby forming clayey silt inter-beds within glacial era river sediments. In addition the sheer volume of sediment relative to the water available to carry it during glacial and immediate post glacial times is very high, so the ability of the river to sort the material into sediment sizes is also compromised.

The final key factor is that during glacial times the river bed lengths (relative to the Christchurch area) in which the river can winnow and sort the material we much shorter because ice, as opposed to water, filled the catchments as far east as the foothills.

Because of the enormous volumes of sediment eroded and transported by the Pleistocene glaciers the seaway between Banks Island and the Southern Alps progressively filled in as the main rivers (the Waimakariri and Rakia) quickly washed out the glacial sediments during the wetter warmer weather at the initiation of each glacial retreat. The period required to “clear” the catchments was still likely to be of the order of several thousand years.

The sediment deposited by the two main rivers formed very large fans that at their maximum extent (maximum aggradation) joined and overlapped to extend around and past Banks Island (making it Banks Peninsula).

The last glacial advance ended approximately 12,000 years ago. Once the catchments cleared the relative absence of sediment load has allowed the major rivers to cut back down (entrench) into the glacial aggradation fans, thereby reworking the older glacial material by bed scour and bank erosion to form post glacial degradational fans within and forward of the original fans.

The Waimakariri River makes the transition from entrenchment within its former fan, to spilling out across the post glacial fan in the area near Halkett. By far the great majority of aggregate pits in the Christchurch area are located within the post glacial fan of the Waimakariri River.

At approximately 6000 years ago sea levels were 1- 2m higher than present and a cover of fine grained sands, silts and peats accumulated over most of the near coastal area now occupied by the city of Christchurch, Kaiapoi, and the areas further south bordering Lake Ellesmere.

In most places the fine material has covered the older pre-glacial river sediments, but the Waimakariri and other rivers have flooding periodically until European colonisation so there are some narrow local corridors of gravel dominated sediments that inter-finger with the fine coastal sediment. Most of the early gravel pits in Christchurch are located in such narrow fingers of gravel (Brown and Weeber, 1992).

Geological map of Christchurch and the surrounding area.

In order to review the aggregate quality information in relation to geology we have adapted the latest 1:250,000 geological map of the region (Figures 2 [map] & 3 [key]) and plotted on these the aggregate source information presented in Figure 1. The geological base map has just been released by GNS Science [(1)] and follows the standard conventions of geological maps by having the oldest rocks in darker colours (greywacke of the foothills and Southern Alps in blue, volcanic rocks of Banks Peninsula in red) and youngest glacial sediments is shades of dark yellow. In contrast the post glacial materials are shown in a shade of the lightest yellow.

(1) Geologic data sourced from Institute of Geological & Nuclear Sciences (Copyright Reserved)

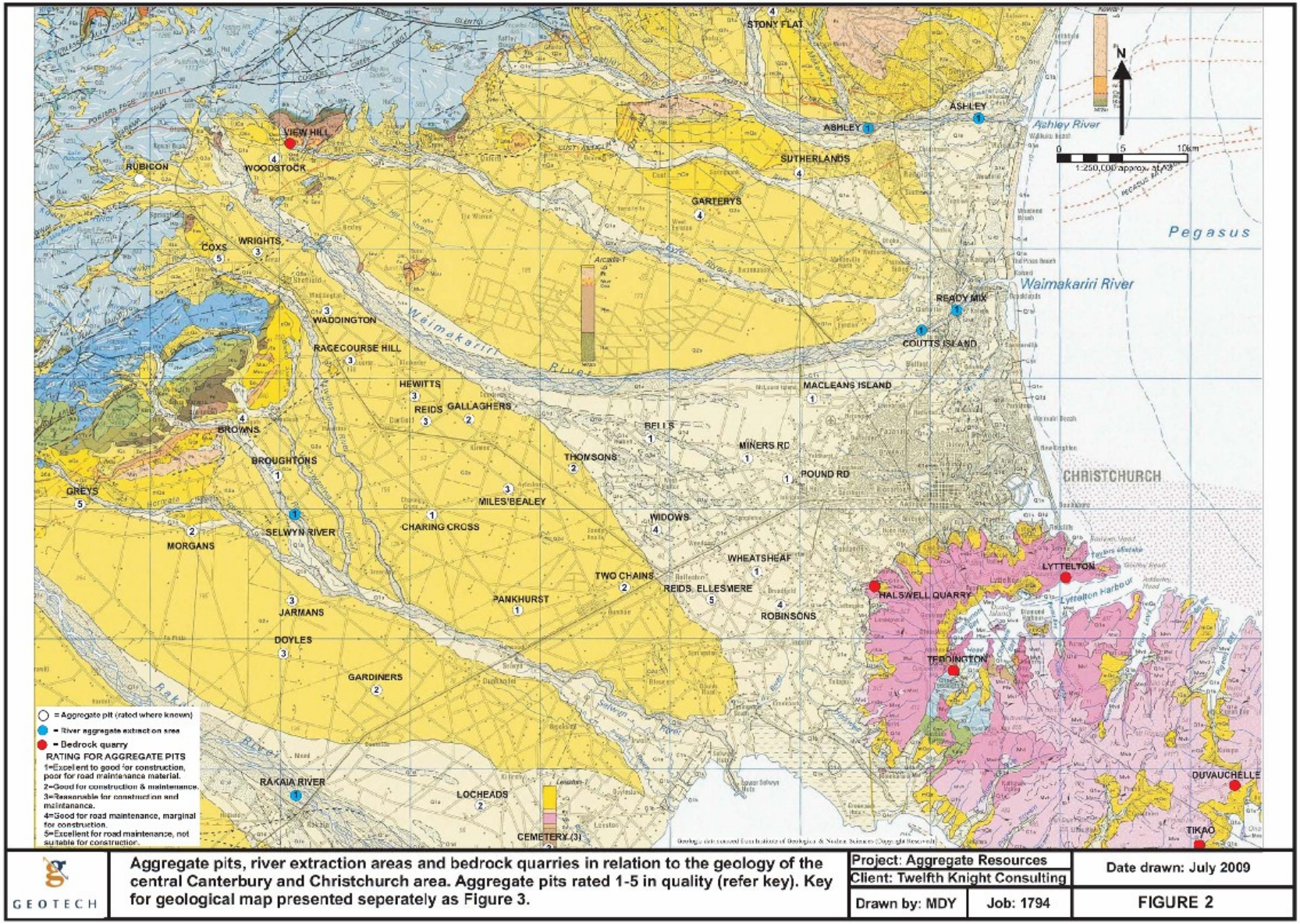

Figure 2: Geological map of central Canterbury and Christchurch areas.

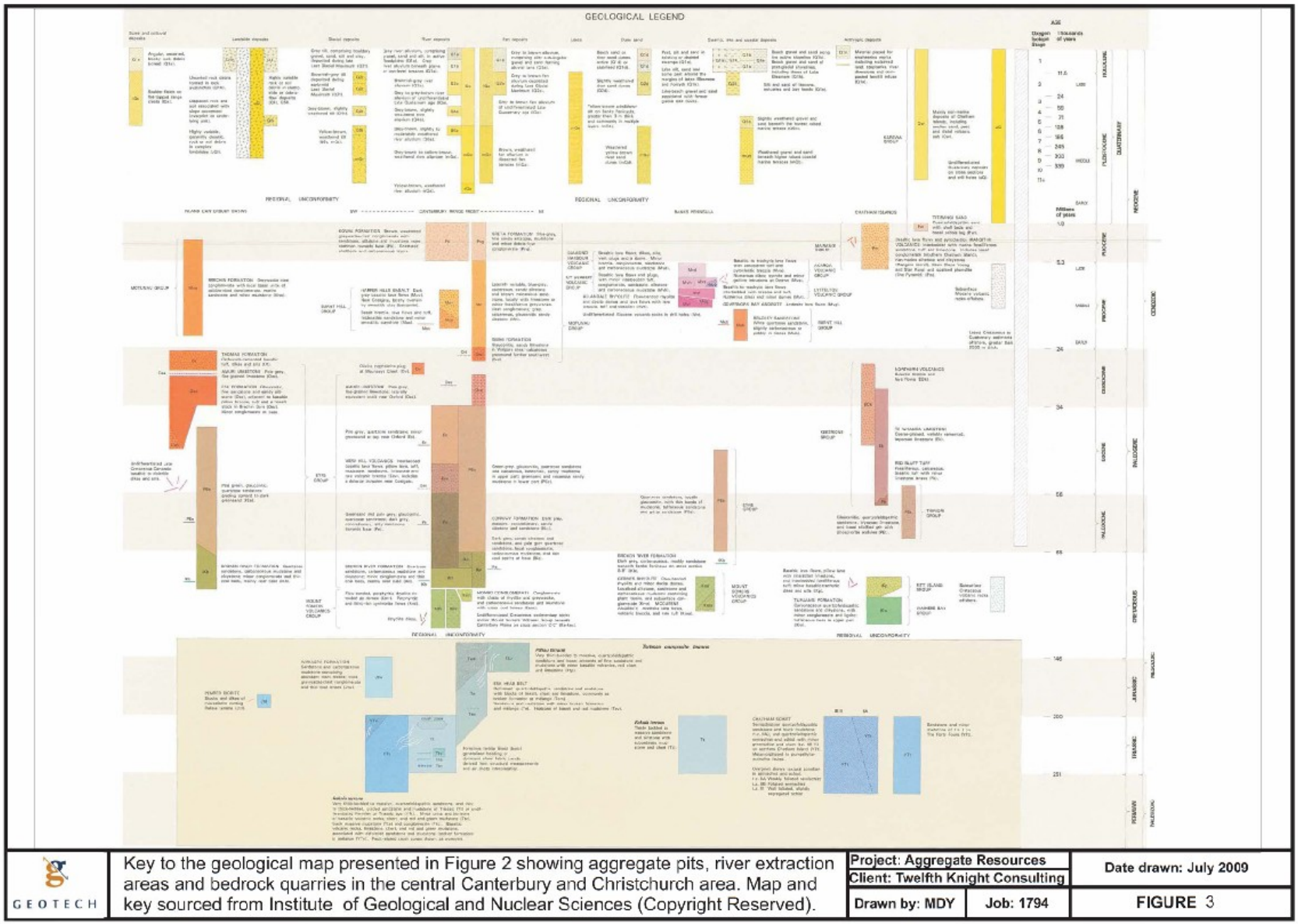

Figure 3: Key to geological map presented in figure 2.

5 BEDROCK AND PIT AGGREGATE SOURCES IN RELATION TO GEOLOGY.

5.1 Areas where the aggregate most consistently rates the highest.

Figure 2 shows that the great majority of the top rated sites are located in the post glacial fan of the Waimakariri River inland of the current Christchurch urban boundary. The sediments being quarried in this area are most consistently the highest quality because:

- The Waimakariri River has broken down and removed the softer materials present (argillite, jointed material, calcite and zeolite veins and coatings, weathered material etc) during two cycles of erosion and deposition (the second most recent cycle being incision and bank erosion of the older glacial era sediments by post glacial river action).

- Fortuitously the Waimakariri catchment extends far enough inland to avoid most of the weakest and most zeolite rich greywacke (see later Section 5.3).

- The river has had two opportunities to sort the sediment into general size categories and has had enough carrying capacity to bring sufficient amounts of large rock all the way to Christchurch.

- The rocks have been cleaned of adhering clay and silt.

- The rocks have been well rounded, making the material more easily worked as concrete (though sometimes this is not desirable in road construction applications).

- The sediments are the youngest possible (apart from those in the active river bed i.e. are post glacial and in most cases no more than 3000 years old) and thus the particles making up the sediment are the least weathered and have had only minor silt and clay washed down into them by infiltrating rainfall.

- Because the sediments are post glacial they are not always covered by dunes or loess derived from wind action from the glacial river systems so the thickness of overburden is generally at a minimum (though still present in most areas).

- The post glacial Waimakariri river is on such a scale (both in bed width and river length) that there are relatively large areas of consistently sized material thus improving pit uniformity and making planning much easier.

- The post glacial river has a much longer bed length relative to Christchurch than its glacial predecessor so the winnowing of weak material, sorting, rounding etc can be more effective.

Not all of the pits in the post glacial Waimakariri River fan rate highly. In particular Reids at Ellesmere (rated 5), Robinsons near Lincoln (rated 4) and Widows (rated 4) near Sandy Knolls have much lower ratings. These pits are reported as having frequent silt seams, small rock, or “clay” (probably silt) throughout. Reids and Robinsons are very close to the coastal sediment fringe (Section 5.4) and are also the lowest pits down the fan, so the river carrying capacity and sorting capacity will have been lower in comparison to the higher fan areas with the better ratings further upstream.

Given that Widows (located further up gradient) also rates only 4, an alternative explanation may northerly wind action off river areas to north concentrating silt in the south of the area during the long period of intermittent river gravel accumulation.

However, it is also very important to note that due to the migrating and braided nature of our rivers at any point on the fan there will always be some variability in sediment type both laterally and vertically, which could also explain the low ratings of some of the pits. In this regard we note the Wheatsheaf Pit which is rated as a "1" is only 4km away from Reids (rated 5) and Robinsons (rated 4).

Other post glacial river fan or floodplain sediment that rate highly includes Locheads and Gardiner pits near Bankside, which are in the Rakaia River post glacial fan (both "2") and Broughtons Pit near Coalgate within post glacial sediments of the upper Selwyn River (rated "1"). The lower gradient and carrying capacity of the Selwyn River mean that gravel sizes occasionally up to 150 – 200mm, which can be found near Christchurch in the Waimakariri fan 50km from the foothills, are only present for the first 10 – 15km once the Selwyn River reaches the plains. Thus the Selwyn River post glacial fan sediment and active river bed sediment near Christchurch is generally too fine for many applications.

5.2 The next best aggregate pit areas.

Areas where pits generally rate 2 – 3 (but sometimes 1) include outwash sediments associated with the most recent glacial advance that form the old and more elevated glacial fan surface formed by the coalescing fans of the Rakaia and Waimakariri Rivers.

The new geological map shows the elevated central plains area as being essentially of one formation (designated Q2) with a narrow general age range (11,500 – 24,000 years i.e. the most recent Otiran glacial period). Prior to this work the previous more detailed scale mapping had established two formations (the Burnham Formation and the Windwhistle Formation [Suggate, 1965; Wilson, 1988; Brown & Weeber, 1992]) the oldest thought to extend back to approximately 70,000 years. Regardless of their actual age these gravels are often significantly more weathered than the post glacial material; almost always contain higher levels of inter-bedded silt and clay; have had much longer for more fine material to be washed down into them by infiltrating rainfall; and have a thicker overburden of loess and fine dune sands.

Of particular note are two pits in this general setting that rate "1", both located between Norwood and Darfield (Pankhurst and Charing Cross). It is possible that there is some systematic difference within the area mapped simply as Q2 on the new geological map that explains the relatively high rating of two sites in comparison to the others (which are more typically 2 – 3), but this could also be the result of chance. During the glacial outwash period there would still have been some local areas within the aggrading fan with cleaner less silt rich gravel of an optimum size, and out of a total of 10 - 12 pits in the Central Plains area, two may have been fortuitously located within such materials.

An alternative explanation is the possible presence of an old buried channel of the Waimakariri River cutting through the area which may contain more reworked and cleaner material. Broadbent (1978) and Wilson (1988) both postulated a channel formerly ran from Gorge Hill (at the upper Waimakariri SH 72 bridge) to Lake Ellesmere. Bal (1996) developed this concept further and analysed the distribution of well permeability to infer and map former valleys infilled with higher permeability material.

We have compared the location of the high rating pits with his work. One pit (Pankhurst) falls into a higher permeability corridor as defined by Bal (1996) but the other (Charing Cross) does not, despite a wealth of permeability data nearby. The likely explanation is the depth of the permeability data which comes from deeper buried horizons while the existing pits have been developed in the near surface (< 10m). Further site specific investigations are required to better assess the quality patterns in the area.

The four pits located in Waimakariri District consistently rate lower than pits in equivalent age materials south of the Waimakariri River i.e. all rating 4 in the north in comparisons to 1 – 3 in the south. Two of the pits (Woodstock and Stony Flat) are so close to the foothills that it is no surprise that the material is relatively silt rich. The other two (Garterys and Sutherlands) are within the current catchments of the Eyre, Cust and Ashley Rivers and the material in the pits is most likely to have come from even smaller scale rivers during the glacial era.

It is possible that the extensive area of glacial era sediment immediately north of the Waimakariri River is a better grade of material. It is more likely to have been deposited by the Waimakariri and thus be more comparable to the better rated pits further to the south. This area does have considerable forestry at present and it is relevant to note that deep root penetration can sometimes be an issue for aggregate production quality from the near surface. Tree lucerne infestations also cause a similar problems.

Despite the variability in quality of some of the pits located on the Canterbury Plains, in general the physical reserves of post glacial sediment, and particularly the glacial sediments, are very large. Obviously important issues such as planning constraints, distance of travel, groundwater protection etc will effectively reduce the areas available in the future but the physical reserves themselves are virtually limitless.

5.3 Potential Contaminants in greywacke aggregates in pits (and rivers).

We noted earlier that zeolite is a potential contaminant that can occur within greywacke bedrock areas. While river action preferentially removes the weaker zeolite rich material this can take many kilometres of transport, particularly in smaller river systems.

We show in Figure 4 the known distribution of zeolite in the hills around central Canterbury. Zeolite is present in the hills south of Springfield mainly drained by the Hawkins and Selwyn Rivers. There is also zeolite in the foothills near Oxford drained by the Ashley River. However, in all cases these rivers extend back further inland to regions of zeolite free rock and it is this stronger material that is likely to be making up the larger sizes in these smaller riverbeds.

While the Waimakariri middle catchment shown in Figure 4 does not contain much zeolite, there are significant areas of zeolite outside of the map area further inland in the upper headwaters above Bealey. However, because of the high energy, velocity and bed length (travel distance) the Waimakariri River is better able to remove this type of weaker material than the smaller local rivers. Similarly under most circumstances the relatively large Rakaia River can efficiently remove zeolite rock where present in the middle and upper catchments.

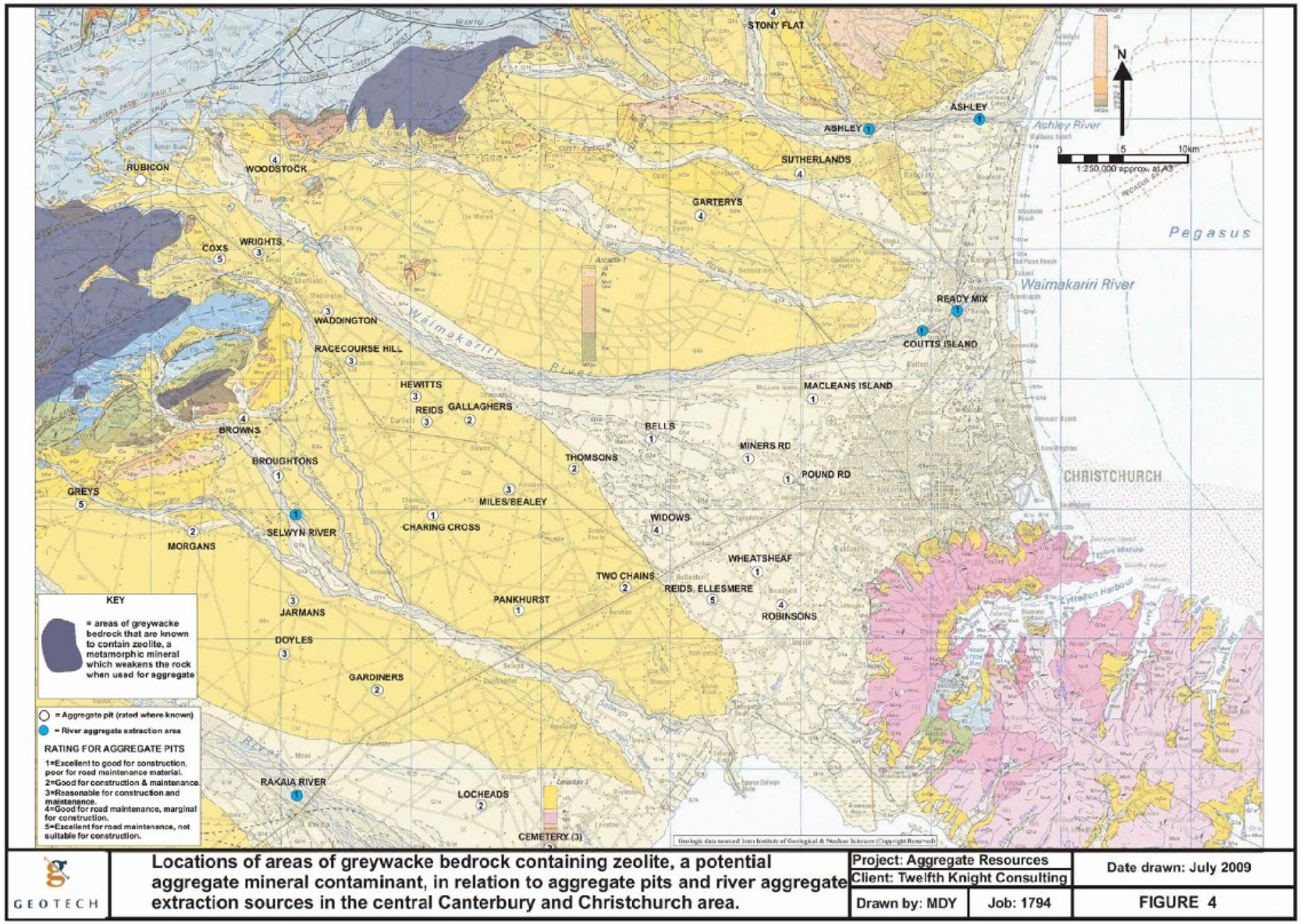

Figure 4: Locations of areas of greywacke bedrock containing zeolite.

5.4 Coastal cover sediments.

From the time of the highest sea level stands approximately 6500 years ago, and continuing to the present day, there has been accumulation and accretion of fine coastal sediments (sands, silts, peat etc) over the seaward margins of the post glacial fans of the Ashley, Waimakariri, Selwyn Rivers and parts of the north Rakaia River area. We show in Figure 5 the westward extent of these materials as defined approximately by the 1m isopach (thickness)[2] and these generally increase in thickness significantly to the east. These cover sediments are matched at depth by similar deposits that interfinger with the alluvial gravels and sands of the post glacial and older river systems. While there are tongues of younger gravel that have cut through the cover sediments in recent pre-historic flood events near Christchurch urbanisation has generally made aggregate extraction in such areas no longer feasible. There may still be local areas within the cover sediments southwest of Halswell that have suitable localised areas of gravel but in general we do not expect this to be promising future aggregate extraction area.

(2) Data courtesy of Environment Canterbury (John Weeber)

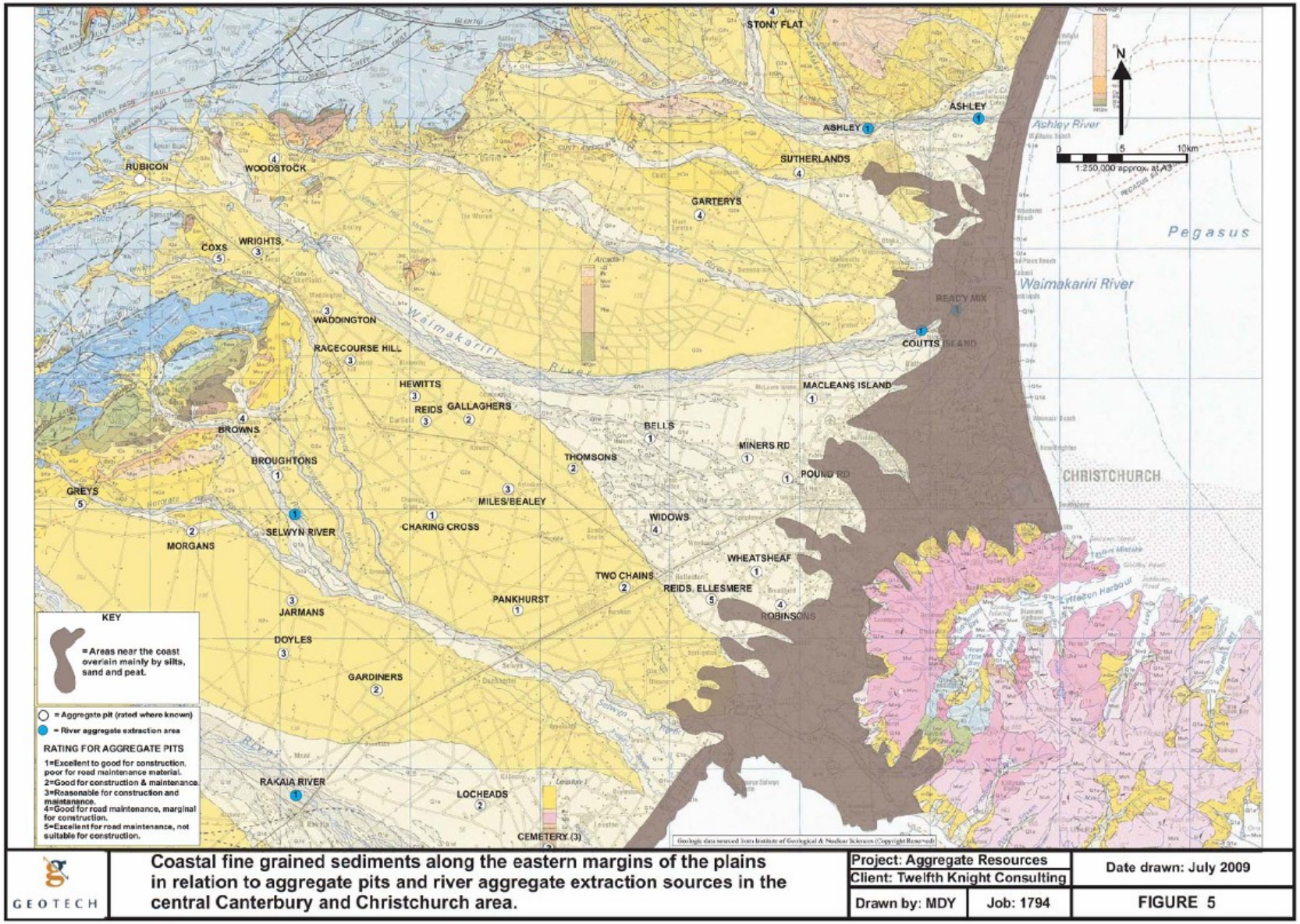

Figure 5: Coastal fine grained sediments along the eastern margin of the central Plains.

5.5 Bedrock Quarries.

We have not ranked bedrock quarries against themselves, or the sediment aggregate sources, because each quarry has generally been developed for its own specialist application to which it is well suited. There are also different constraints on the land suitable for bedrock quarries and in Canterbury their relatively low production volumes puts much less pressure on the potential reserves, which are noted briefly in relation to each quarry below.

Halswell Quarry.

Halswell Quarry began as a building stone quarry that exploited a unique flow jointing pattern within a local dome of relatively young and hard Diamond Harbour Group basaltic rock. The jointing produced a natural flagstone shape that was unique to the quarry. The quarry, which began life in the 1850's, was purchased by Christchurch City Council in 1925 and was subsequently modernised to increase the production of crushed rock for aggregates. The quarry was finally closed in 1990.

However, we understand there are limited stockpiles of building stone still present at the quarry but no significant in situ reserves of the unique flaggy basalt that made the quarry site so special. To date attempts to locate flaggy basalt rock in other areas of Banks Peninsula have not been successful.

***Teddington Quarry*.**

Teddington Quarry is operated by Peninsula Quarries (formerly Governors Bay Transport) and continues to produce a range of rock that does include some larger boulder sizes, but is mainly material suitable for maintenance and applications where the abundant fine binding material that is associated with the rock is an asset. Material from the quarry has recently been used for cattle races on dairy farms, walkways for Christchurch City Council, and for various bike tracks including Macleans Island and the Motukarara – Little River rail trail. Rock of a similar type to that quarried is relatively abundant nearby so reserves are not a problem.

***Duvauchelle and Tikao Quarries*.**

These two quarries have been developed in basaltic rocks of the Akaroa Volcanic Group and provide crushed volcanic rock for general fill, maintenance and construction in the local Akaroa area. Although Tikao Quarry is essentially worked out, there are abundant reserves at the nearby Duvauchelle Quarry, and there are likely to be other areas with equivalent suitable rock in Akaroa Harbour that are also well suited for the current applications.

***Lyttelton Quarry*.**

Lyttelton Quarry was developed in the 1960's to build Cashin Quay, and is intermittently still operated by the Lyttelton Port Company. The quarry has been developed within basalt flows and ash of the Lyttelton Volcanic Group and produces a wide range of rock sizes, with some material large enough for use as rip rap to protect against wave attack. Considerable reserves are still available.

***View Hill Quarry*.**

View Hill Quarry is located near Oxford and has been recently developed to supply Environment Canterbury with rip rap for use in the Waimakariri River and other North Canterbury Rivers. The quarry has been developed within basalt of the Harper Hills Volcanics that is of a similar age to the main Banks Peninsula volcanic units (the Lyttelton and Akaroa Volcanic Groups). Rock block size ranges from 200 - 300mm up to 2-3m (mode around 1m) and there are considerable reserves available.

6 RIVER SOURCES.

6.1 General.

River extraction provides considerable material for concrete and roading applications, particularly from the Waimakariri and Rakaia Rivers, which are capable of transporting rock in useful sizes as far downstream as State Highway 1 in the case of the former and the coast by the latter. Generally river extraction is keeping pace with gravel deposition rates in the areas where extraction is allowed, so, apart from some limited areas of previous aggradation, there is little opportunity to expand river extraction in the future without undesirable impacts on river bed level and associated bank stability.

6.2 Ratings and comments.

Table 2 summarises the various river sources and available comments on the aggregate quality. All the river locations are rated 1 in comparison to the aggregate pits, in part because the extraction location can often be adapted to meet the desired aggregate specification, and in general the rock quality is extremely fresh. For some applications there can be issues with the fine sand, silt and clay free nature of some of the river aggregate due to the intrinsic nature of the materials and/or to the washing that may occur if the material is being extracted under water. The absence of fines reduces the cohesiveness when later compacted which can affect some road construction applications.

River System	General Extraction Location	Comments
Waimakariri	Majority between Crossbank and SH 1 and latterly above Crossbank.	Top quality concrete and roading construction aggregates. Too clean for roading maintenance materials.
Rakaia	Each side of SH 1 Bridge.	Top quality concrete and roading construction aggregates. Too clean for roading maintenance materials.
Selwyn	Bealy Bridge (nr Hororata) and downstream of McGregors Ford	Very good for roading construction and reasonable for roading maintenance materials but too fine below bridge. Reasonable for concrete aggregates.
Ashley	In the vicinity of SH 1 bridge to approx 8km upstream of Rangiora bridge.	Good for roading construction, but too fine below the bridge. Good for concrete aggregates. Too clean for roading maintenance materials.
Eyre	In vicinity of Waimakariri River and Oxford township.	Generally very small material downstream of Warrens Road Ford otherwise reasonable for roading construction.

Table 2: River aggregate source locations and comment.

Potential reserves in relation to river sources are summarised in the Table 3 below.

River	Tonnes above min bed level	Annual Supply Rate (tonnes)
Ashley	3,500,000	7,000
Eyre	Not known (small?)	< 1,000
Waimakariri	13,000,000	550,000
Selwyn	Not surveyed (Bed probably degrading)	4,000
Rakaia	Not surveyed	85,000
TOTALS	17,000,000 + (?)	650,000

Note: No allowance made for possible areas of deficit below minimum bed level in resource calculation. Half of annual Rakaia supply allocated to study area. (Base data courtesy ECan - Matt Surman.)

Table 3: River aggregate material reserves.

7 POTENTIAL CONSTRAINTS IMPOSED BY GROUNDWATER ISSUES.

It is generally not desirable from an operational perspective to run an aggregate extraction operation below the watertable. Furthermore, there are significant issues in relation to potential groundwater contamination. Groundwater is present throughout the Canterbury Plains in two main interrelated aquifer systems. There is a widespread unconfined aquifer system under virtually all of the plains where groundwater exists at depth and can be abstracted by pumped wells. Water of this type is shallowest adjacent to the active river beds but relatively deep (50m plus) in the more elevated upper areas of the plains distant from the main rivers, although there is also the possibility of unrecorded, occasional, isolated, perched water tables above the main aquifers. For example in Figure 6 we show the areas where groundwater is shallower than 6 metres (3) below the general ground surface during the wettest recorded periods. The depths we have plotted allow are based on the recorded maximum groundwater levels but water depth fluctuations at many locations have not been measured for long in comparison to the duration of typical climate cycles so the plot near the margins should be considered an approximation.

The depth of 6 metres has been selected because:

- Plots of these data are currently available,
- Pits to around this depth are common, and
- 6m is likely to be the general order of depth shallower than which Environment Canterbury may become concerned about the potential impacts of aggregate extraction on groundwater quality.

While the various areas shown in Figure 6 will shrink or expand somewhat for other arbitrary groundwater depths, the general pattern is likely to remain broadly similar, and the available plot helps to define those areas that are best suited to aggregate extraction.

(3) Data courtesy of Environment Canterbury (John Weeber)

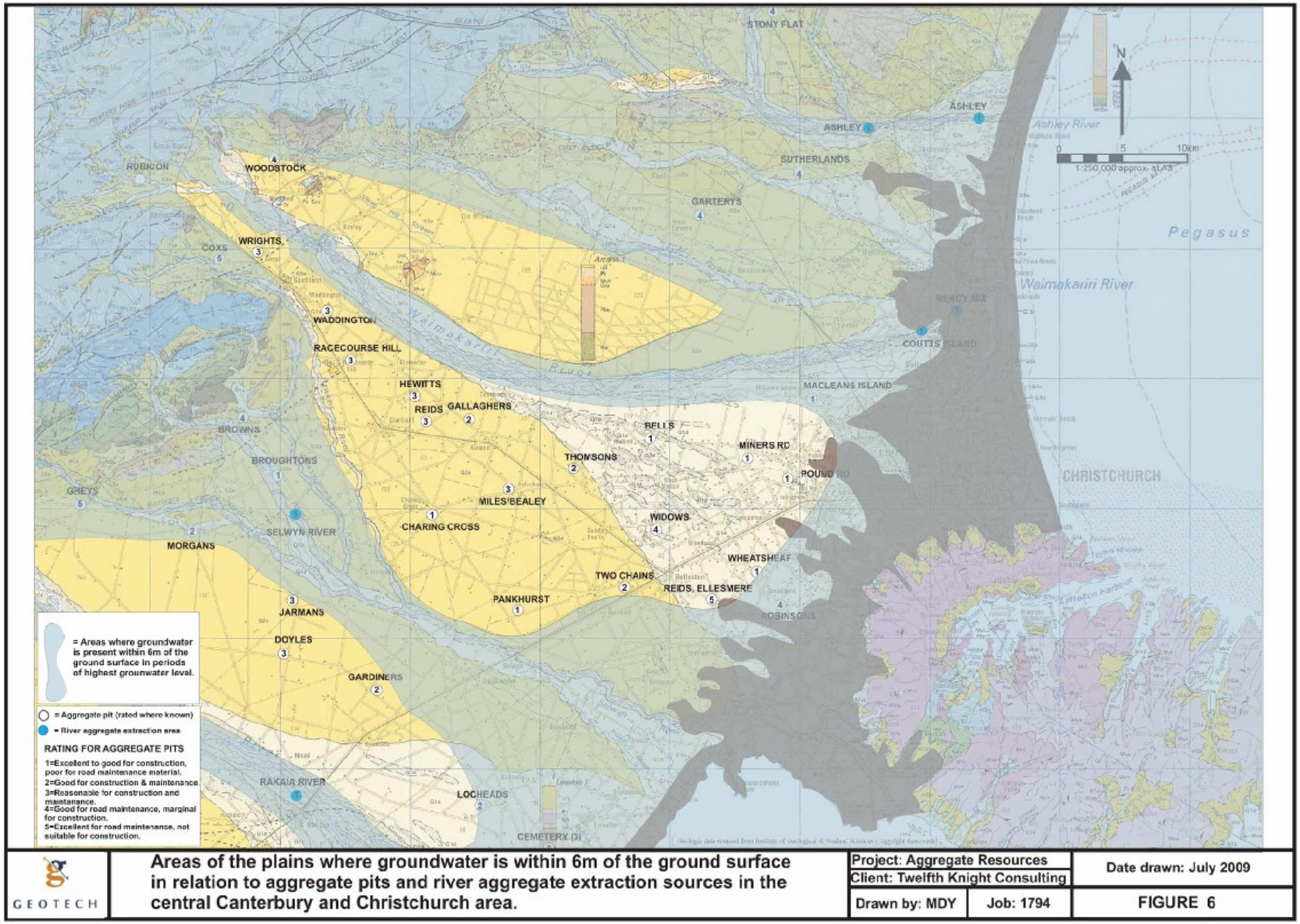

Figure 6: Areas of central Plains where groundwater is within 6m of the ground surface.

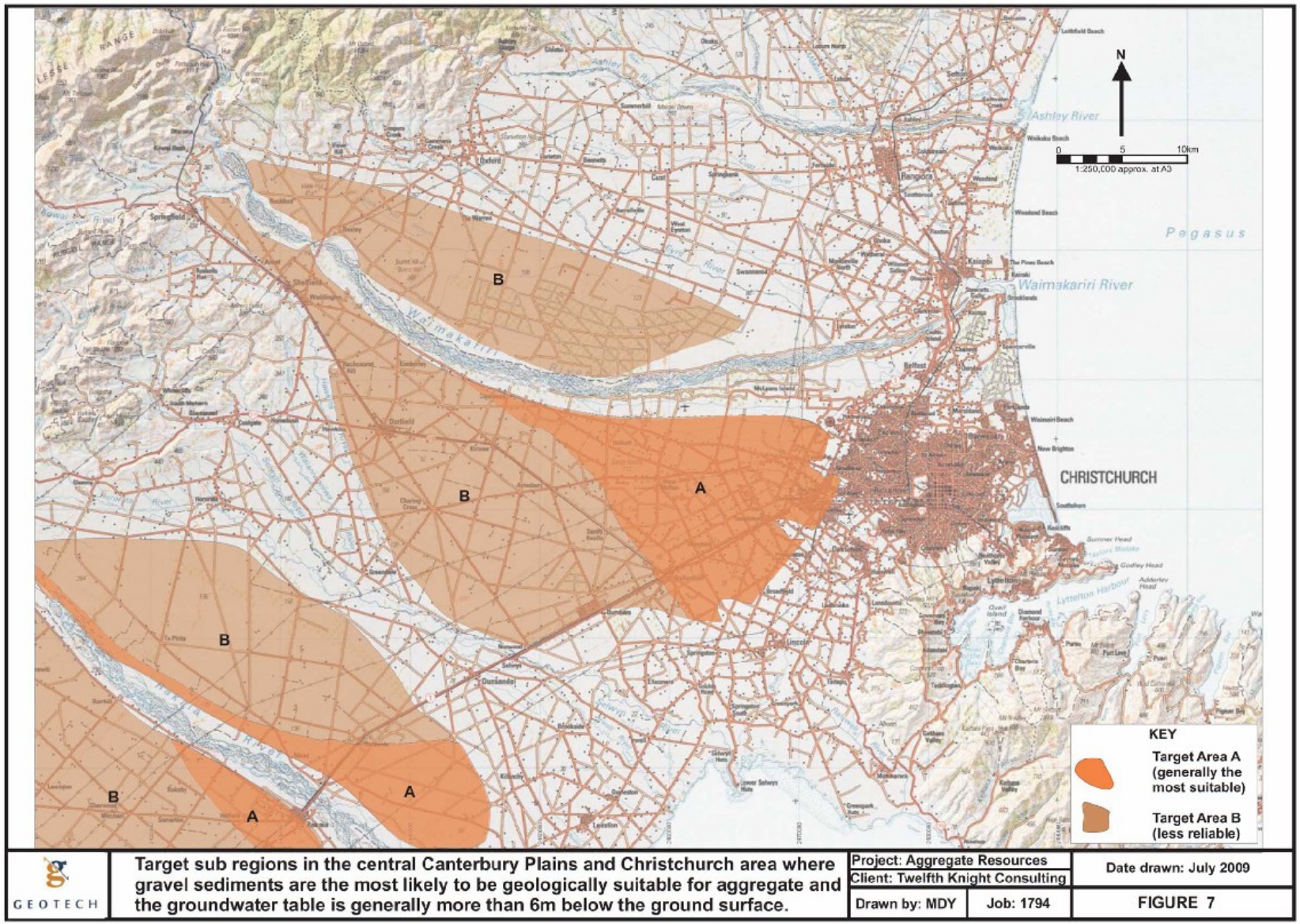

Figure 7: Target areas in the central Canterbury Plains and Christchurch areas.

8 DEFINITION OF TARGET AREAS.

Figure 7 presents the target areas for further more detailed evaluation and investigations. We have defined Area A as the most likely to be suitable. This includes the areas of post glacial fan sediment of the Waimakariri River near Christchurch and the Rakaia River near SH1 that are elevated more than 6m above the maximum recorded groundwater levels. These are the sub regions that will most often contain
areas of good quality aggregate.

Area B defines glacial era sediment that is elevated more than 6m above the maximum recorded groundwater level. Aggregates from this area will more often be silty and the overburden generally thicker however the pits to date suggest there are likely to be some areas of good quality aggregate comparable to the best material from Area A.

9 RECOMMENDED FUTURE WORK.

This assessment has narrowed down the broad areas that past practical experience and the general geology suggest are the most likely to be suitable for future aggregate extraction. Within these general areas it is still likely there will be considerable variation in quality and suitability due to local lateral and vertical variations in the original depositional environment, as well as variations in the patterns of subsequent overburden development. The pits to date have not been systematically inspected or logged by a geologist and considerable additional useful information may be exposed in the pits that can help to define and narrow the future target areas.

We recommend further more detailed pit logging, mapping, and assessment work be carried out of the most promising areas. This work should be based initially on pit inspections and geomorphological mapping (i.e. air photo analysis, surface mapping, lidar data) with the ultimate aim of a subsequent phase of subsurface investigation by geophysical methods and/or test-pit investigations to better target the most suitable local areas.

10 CONCLUSIONS.

Previous studies have identified that there is a forthcoming shortfall in accessible aggregate resources to satisfy local demand from and within Greater Christchurch. This report addresses the overall geological assessment of the aggregate resource and its location with the intention of identifying areas within the sub region that may be geologically suitable for the provision of aggregate resources.

Although there are a few bedrock quarries in the central Canterbury and Christchurch area, most are in Lyttelton or Akaroa Harbour, and the bedrock quarries tend to be for specialist or localised supply. The great majority of aggregate for construction and road maintenance comes from aggregate pits that have been developed in the relatively young sediments that underlie the central Canterbury Plains.

We have ranked existing aggregate pits and compared the variations in aggregate quality with the geology of the area. Although there are always random natural variations in sediment size and quality, the best quality aggregates most often come from the post glacial sediments of the Waimakariri and Rakaia Rivers. These materials are generally the best suited because:

- The rivers have broken down and removed the softer materials present during two cycles of erosion and deposition.
- The Waimakariri River catchment is far enough inland to avoid many of the weaker areas of greywacke bedrock in the immediate foothills.
- The rivers have had two opportunities to sort the sediment into general size categories and have had sufficient carrying capacity to bring relatively large rock sizes all the way to SH1 and Christchurch.
- The rocks in the sediment have been cleaned of adhering clay and silt.
- The rocks have been well rounded.
- The sediments are still relatively young
- The windblown fine sediment capping the river gravel is relatively thin.

We have defined as Target Area A those sub regions where post glacial river fan sediment is present and is elevated more than 6m above the maximum recorded water levels allowing pit development above the watertable. The areas are large and the potential resource from a purely geological perspective is virtually limitless.

In contrast to the post glacial sediments the older glacial sediments accumulated under conditions where silt and clay were much more prevalent in the local river systems and the rivers themselves were less capable of cleaning and sorting the sediments. The gravel rock in these sediments is also more weathered from long exposure to the atmosphere, and fluctuating moisture conditions, and there has been more time for silt and clay to be washed down into the matrix between the gravel rock.

In addition the overburden of windblown silt and sand is generally thicker than the surface cover that has formed over post glacial sediments. Despite these less favourable general attributes the glacial sediments show a range of quality from the highest to medium rating and at least some areas will prove very suitable for future supply. There are four main sub regions we define as Target Area B with glacial era sediments that are more than 6m above the water and which are located in the more elevated areas of the middle Canterbury Plains.

This assessment has narrowed down the broad areas which past practical experience and the general geology suggest are the most likely to be suitable for future aggregate extraction. Within these general areas it is still likely there will be considerable variation in quality and suitability due to local lateral and vertical variations in the original depositional environment, as well as variations in the patterns of younger overburden development. We recommend further more detailed pit logging, mapping, and assessment work be carried out of the most promising areas, and particular Target Area A. This work should be based initially on pit inspections and geomorphological mapping with the ultimate aim of a subsequent phase of subsurface investigation by geophysical methods and/or test-pit investigations to better target the most suitable local areas.

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Standard Limitations.

This report has been prepared for the benefit of, and under specific instruction from, Twelfth Knight Consulting as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall be at such parties' sole risk.

Technical recommendations and opinions in this report are based on published information and the ranking and comments by others. No field inspections have been carried out by Geotech Consulting Ltd. The nature and continuity of subsurface conditions are inferred from maps and the work of others and it must be appreciated that actual conditions could vary from the assumed model.

General opinions and judgements made in this report are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on they should be independently verified with appropriate legal advice.

Report No: UDS020909

Greater Christchurch Urban Development Strategy

REGIONAL GRAVEL RESOURCE MANAGEMENT STUDY.

RESOURCE ACCESS CONSTRAINTS.

TWELFTH KNIGHT CONSULTING

Prepared for UDSIMG by Twelfth Knight Consulting – September 2009

The information in this report is accurate to the best of the knowledge and belief of Twelfth Knight Consulting, acting on behalf of Christchurch City Council and the Urban Development Strategy Implementation Management Group. Whilst Twelfth Knight Consulting has exercised all reasonable skill and care in the preparation of information in this report, Twelfth Knight Consulting does not accept any liability in contract, tort, or otherwise for any loss, damage, injury or expense, whether direct, indirect, or consequential, arising out of the provision of information in this report.

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REGIONAL GRAVEL RESOURCE MANAGEMENT STUDY.

RESOURCE ACCESS CONSTRAINTS.

Report prepared for the Urban Development Strategy Implementation Management Group
by Twelfth Knight Consulting - September 2009

1. Introduction.

The constituent members of the Urban Development Strategy (UDS) have determined that continued access to a supply of suitable aggregates is required both to satisfy demand for their own projects but also to satisfy demands from the private sector and from central government for infrastructural asset development and maintenance. In the light of recent changes in demand patterns it is prudent that a re-assessment be undertaken of the area wide management of quarrying activities so that regional demands for aggregates may be met throughout the time horizons adopted by the UDS.

In the first phase of this project Twelfth Knight Consulting has therefore been engaged to:-

- Provide an assessment of the sub-regional aggregate resource and its locations.
- Determine the demand for aggregates to 2026 and if possible to 2041.
- In conjunction with the Focus Group, identify and prioritise location criteria and constraints for sites for new resources.

This report provides background information to enable the third task to be undertaken.

2. Constraints on new Resource Locations - General.

The interplay of the following major factors will influence the locations and sizes of the new quarries and river extraction sites that will be required if future demand is to be met:-.

- Resource Quality.
- Excavation Depths particularly in Relation to Groundwater.
- Sustainable Yield from Rivers.
- Environmental Impacts of Quarrying and Impacts on Adjoining Land Uses.
- Existing Land Use, Quality and Value
- Distance from Demand.
- Access.
- Land Holdings.
- Local and Territorial Authority planning requirements.
- Quarry Rehabilitation and End Use

These items are discussed in greater detail in the following sub – sections.

3. Resource Quality.

3.1 Land Based.

The greywacke parent rock, which constitutes the bulk of the source of the shingle materials in the central Canterbury Plains area, is of a high quality. However the composition and grading of the alluvial deposits is very variable. Deposits may be also be intermixed with varying quantities of unsuitable clays and / or silts.

A preliminary analysis of local alluvial deposits was undertaken by Geotech Consulting Ltd, in conjunction with Twelfth Knight Consulting, in August 2009 for the UDSIMG. The resultant report* details those areas of central Canterbury that are more likely to contain suitable resources for the production of aggregates. Accordingly the reader is directed to that report for further more detailed information.

It should be noted that otherwise suitable areas that are / have been used for forestry purposes or are / have been infested with yellow tree lupin may prove to be unsuitable, or be of reduced value, as a result of root contamination of the resource.

3.2. Rivers.

Whilst the underlying quality of the resource is generally very good, materials extracted from the rivers are often deficient in silts and boulders which consequently have to imported from land based sources. Materials, may on occasions, also potentially be contaminated with organic matter.

Preliminary details of river based resources are provided in the Geotech report referred to in Section 3.1.

4. Excavation Depths.

4.1 In Relation to Groundwater.

Christchurch City Plan requirements stipulate that "*No extraction of sands, gravels or other material shall take place to a depth greater than 1 m above the maximum recorded groundwater level*." Whilst neither SDC nor WDC presently have such specific requirements in their District Plans it is likely that such constraints would be imposed as a condition of any new quarrying resource consent. (Refer also Section 11.3 for further constraints relating to planning matters in relation to groundwater.)

It should be noted that the consultants acting for the Central Plains Water Enhancement Scheme are predicting, that should the scheme become operative, aquifer levels in the central and upper Canterbury Plains in particular will rise significantly. Fortuitously, from a quarrying standpoint, the aquifers over this area are relatively deep. However further down the Plains the aquifers are much shallower. It is therefore conceivable that, although the predicted rises in aquifer levels in the lower Plains are smaller, the water table may rise sufficiently to effectively reduce the available gravel resources in some areas and hence influence the number and location of new quarries required to fulfill demand.

* "Geological Investigation of Potential Aggregate Resources" – Geotech Consulting Ltd in conjunction with Twelfth Knight Consulting ; August 2009 for UDSIMG.

In exceptional circumstances, where it is considered feasible to excavate to or below the water table, consideration should be given to the impacts of ponding, and the subsequent attraction of water fowl on the operations of Christchurch International Airport.

4.2 Within River Courses.

An earlier Environment Canterbury report on fluvial gravel management* notes that, historically, gravel resource management has only been an adjunct to flood risk management rather than being a management issue in its own right. The report goes on to say:-

"*The design bed levels against which cross section surveys are assessed are set for flood management purposes (i.e. based on design bed levels associated with flood carrying capacity of river channel and stop-banks etc), and the objectives of gravel resource management (and to some extent, river engineering) have generally not been integrated into the design bed levels….*"

"This means that for the purposes of gravel management, there are likely to be gaps within the monitoring data, and existing data will not necessarily answer management questions for the gravel resource."

It is understood that Environment Canterbury are presently undertaking a detailed study of all of the rivers within central Canterbury however this work is not expected to be completed for several years. The allowable excavation depths, and hence total volumes of materials available, are therefore not yet completely known.

5. Sustainable Yield from Rivers.

As noted in the section above, Environment Canterbury are yet to complete their studies however permissible long term extraction volumes (i.e. approximately equivalent to the annual rates at which a river transports materials through its length) are known for the Waimakariri and Ashley Rivers. (Sustainable yields from the other rivers within the study area, apart from the Rakaia, are thought to be small.)

6. Environmental Impacts and Adjoining Land Uses.

6.1 General.

Quarrying has the potential to generate a range of adverse environmental impacts relating to:

- Dust.
- Noise.
- Groundwater Contamination
- Ground vibration.
- Visual Amenities.
- Traffic.

* "ECan / MWH "Regional Gravel Management Report" (Report No. R06/1 January 2006)

6.2 Dust.

Quarries have the potential to create fugitive dust through on and off-site activities, the predominant generating activities being crushing and screening of aggregate, stockpiling and movement of machinery in, around and outside the site. Although unlikely to have direct health impacts, dust is potentially primarily a 'nuisance' for neighbouring properties, that reduces amenity values such as by the soiling of crops, clean surfaces and outdoor living areas, reduced visual quality and irritation. However implementation of simple, best practice control methods, such as the use of some or all of the following, can reduce the potential problem to within acceptable limits:

- Mimimising exposed areas of bare materials and revegetating areas as soon as is practicable once excavation and / or filling has been completed.
- Water sprinklers at discharge points in the crushing and screening plant.
- Spray misting aggregate piles and/or protecting stockpiles from winds.
- Enclosed conveyor systems.
- Use of water carts on haul roads.
- Sealed roadways and hard-standing areas.
- Reduced vehicle speeds.
- Wheel wash facilities.
- Covered loads.

6.3 Noise.

As with dust, noise has the potential to impact noticeably on adjoining properties. Modern machinery design and operating practices (e.g. effective motor enclosures), restrictions on hours of operation and careful siting of fixed plant can help to minimise noise intrusion. The addition of suitable perimeter bunding and the effects resultant on most operations being below surrounding ground levels serve to further reduce potential noise impacts. However despite this, the location of sensitive noise receptors (e.g. residential dwellings) should be carefully considered when establishing a new quarry.

6.4 Groundwater Contamination.

Management of land use activities over groundwater recharge zones is the key to effective groundwater protection. Both the quantity and quality of groundwater supplies rely, to varying extents, on the recharge water that filters down through the soil and underlying sediments. Any chemicals or pathogens disposed of at the ground surface may therefore become groundwater contaminants if this recharge water carries them down to the aquifer system.

Groundwater contamination is possible from quarrying operations where the groundwater is unconfined. (i.e. there is no impermeable layer, between the surface and the aquifer, that would otherwise prevent the ingress of contaminants into the groundwater.) In reality modern practice (i.e. the siting of most operations with a potential for contamination to occur) away from sensitive areas and/or the provision of hardstandings with suitable contaminant containment systems significantly reduce this potential.

Fuel and hydraulic fluid spillages resultant on accidents or equipment failure are rare with modern mobile machinery. Potential volumes of spillages are low and are generally readily contained if suitable emergency contingency plans are in place.

Product wash water is filtered through silt holding ponds before disposal. Volumes are low

The disposal of inappropriate materials into quarries is an additional source of potential groundwater contamination. The inception of the Christchurch City Cleanfill By-law in 2004 and the conditions attached to the more recent resource consents have however significantly reduced the potential for contamination from this activity.

6.5 Ground Vibration.

Issues pertaining to ground vibration are normally confined to hard rock quarrying activities. Vibration problems associated with alluvial quarrying are rare.

6.6 Visual Amenities.

Due to the scale of their operations, quarrying and certain associated activities (e.g. aggregate stockpiling, ancillary structures / machinery and buildings) may have a visual impact that is inconsistent with the surrounding areas. Damaging visual effects on the landscape may be minimised by the appropriate use of mound screening, well maintained landscape planting and other simple management methods.

6.7 Traffic.

Issues with respect to traffic are generally often more a matter of perception than reality in the local context. The absolute quantum of traffic movements associated with quarrying in relation to overall traffic volumes is low except in the immediate vicinity of a quarry if access to the site is gained from a quieter rural road. New sites with direct access to major local roads or State Highways are therefore preferable.

In the case of the former situation issues may be reduced by the use of appropriate site layout, restrictions on dispatch times and controls over vehicle noise emissions.

6.8 Adjoining Land Uses.

Obviously some adjoining land uses are more sensitive than others to their location adjacent to quarrying operations although often, as noted previously, this is more a matter of perception than reality given the environmental practices utilised in modern quarrying operations. However these perceptions need to be managed appropriately if a new quarry is to establish successfully and to be accepted by the local community.

7. Existing Land Use, Quality and Value.

Member Councils of the UDS have enacted strategic policies to preserve high quality agricultural land wherever possible. Both the present and future strategic value of an existing land use therefore needs to be considered as part of the decision process. This value is however usually, but not always, reflected in its potential purchase price. Should this purchase price be too high it may render its use uneconomic for quarrying purposes.

8. Distance from Demand.

Locally transport costs – from the quarry to an aggregate's end use destination - constitute a significant proportion of an aggregate's total cost. Accordingly the further quarries are from demand the greater the overall aggregate cost will be to the end user.

The present average delivery cost for local aggregates is of the order of $0.3/tonne/km. As an example, given an average delivery distance of say 15km and an average product price at the quarry gate of say $10 / tonne then the product delivered price to site will be of the order of $14.50/tonne (i.e. in this case the transport component of the cost is approximately 50% of the total delivered cost. It is not surprising therefore that it is industry practice, wherever possible, to co-ordinate the transport and disposal of hardfill in the co-located cleanfill sites / quarries with the purchase and delivery of aggregates.)

From an economic standpoint this is liable to be one of the most important factors when deciding upon the locations of new sites. For example, before taking into account the potentially rapidly inflating price of transport fuels, and given that the study area demand is presently of the order of 4 million tonnes per annum, every additional kilometre that supply moves away from demand could cost the local economy an additional $1 million annually.

It should be noted that the quoted costs do not include those that might be associated with transport related greenhouse gas emissions.

9. Access.

Accessibility to a resource may be limited by physical factors (e.g. power lines, river channels, inadequate roading, etc) and / or the willingness of landowners to allow access through their properties. (e.g. to rivers.)

(Refer also Section 6.7)

10. Land Holdings.

The size and distribution of land holdings may:-

- Influence or even restrict the establishment of quarries of an economically viable size where land is held in multiple, small parcels. (e.g. the extensive areas of "life-style" blocks on the western fringes of Christchurch.) Large, individually owned blocks, which are likely to pose fewer establishment problems particularly with respect to adjoining land uses, are therefore preferable as potential sites for new quarries.

- Create pressure for new quarries to be developed outside areas presently zoned for quarrying purposes where there is an uneven distribution of land holdings between the quarry owners within the existing zones. (e.g. the recent Road Metals resource consent application to quarry outside the Miners Road RuQ zone block.)

- Result in a resistance from non-quarry owners, within a quarry zone, to selling to others for the purpose of quarrying.

11. Planning Constraints.

11.1 Strategic Development Plans

Consideration of existing local authority strategic development plans needs to be made at an early stage to ensure that quarrying would not conflict with the authorities overall long term development plans for the area.(Refer also Section 12: Quarry Rehabilitation and End Use.)

11.2 Sites of Ecological and Historical Significance

Areas of special ecological and historical value have been identified in the planning documents of each of the constituent UDS member Councils. The level of protection afforded to these areas is dependent upon the assumed societal value of each site. In general, and where feasible, these areas should be discounted from initial consideration. (Scarcity of resources may not however preclude them from eventual consideration.)

11.3 Christchurch City Council.

City Plan rules with respect to the "Rural Quarry" (RuQ) and "Isaac Conservation Park / Quarry" (ICP/Q) Zones cover items pertaining to:

- Protection of properties adjoining quarrying operations.
- Landscape and visual amenities.
- Boundary distances, particularly with reference to noise generation from quarrying activities.
- Slope stability and safety
- Rehabilitation to encourage alternative end uses*
- Protection of groundwater

These rules have the potential to have a marked impact on the viability of the smaller areas available for quarrying and therefore also contain specific conditions for sites less than 4Ha in extent.

11.4 Selwyn and Waimakariri District Councils.

Both Council's District Plans have requirements, amongst others, with respect to noise, earthworks volumes, set-backs from waterways and vehicle movements. It is likely that under both Plans all, but the smallest quarries, would be required to obtain resource consents through a publicly notified process.

However SDC own several hundred small lots "designated" for quarrying purposes. It is understood that it may be possible to establish pits in these areas without the requirement for specific resource consents to be obtained.

*In order to protect groundwater from contamination, back-fill for rehabilitation purposes is restricted to those materials seen as being 'inert'

11.5 Environment Canterbury.

In order to establish a quarry, resource consents are required from Environment Canterbury for both discharges to air - generally dust – and to land. In practice a well managed modern quarry should have little or no difficulty meeting the required standards.

Environment Canterbury have however notified Variation 6 of the “Proposed Natural Resources Regional Plan” (PNRRP) with respect to Chapter 4 – “Water Quality”

Groundwater protection requires the establishment of a land use management regime that reflects the variable degree of protection provided by the natural hydrogeological conditions. This "Variation" therefore proposes the establishment of a number of “aquifer protection” zones within and in the immediate area to the west of the city where there is no confining later protecting the aquifer.

The highest level of protection is afforded to those areas that are considered to be directly above the unconfined aquifer that supplies much of Christchurch city’s potable water. These zones encompass all of the areas presently zoned Rural Q and ICP/Q by the Christchurch City Plan (i.e. including all of the larger existing operating quarries close to the city.)

Whilst provision has been made for the existing quarries to remain operative and for the remaining areas of the Rural Q and ICP/Q zones to be quarried, other potentially suitable areas that may have been considered as a source of future aggregate supply may not be available unless Environment Canterbury can be assured that aquifer contamination will not occur as a result of quarrying.

12. Rehabilitation and End Use

Early consideration needs to be given to the end use of land once quarrying has been completed if significant areas are not to be permanently alienated from any future constructive use. End use selection should, amongst other considerations, take into account:

- Surrounding land forms.
- Surrounding land use.
- The availability of suitable fill and its timing*.

* The amounts of materials returning to the quarries in the Christchurch area for use in rehabilitation equates to approximately only one fifth of a quarries output. (Future recycling initiatives may reduce these volumes.) It is considered unlikely that filling would continue economically once quarrying has been completed. Unless specific resources are utilised it is unlikely therefore that ground levels will be returned to those pre-existing before quarrying began.

Appendix B – Road Metals Decision

BEFORE THE ENVIRONMENT COURT

Decision No. [2012] NZEnvC 214

IN THE MATTER	of a direct referral under Section 87G of the Resource Management Act 1991 **(the Act)**
BETWEEN	ROAD METALS COMPANY LIMITED (ENV-2011-CHC-000078) Applicant
AND	SELWYN DISTRICT COUNCIL CANTERBURY REGIONAL COUNCIL Respondents

Hearing:	At Lincoln, 2 - 5 April, 23 & 24 April, 26 & 27 April, 30 April – 4 May, 6 – 7 August 2012
Court:	Environment Judge J A Smith Environment Commissioner A C E Leijnen Environment Commissioner A J Sutherland
Submissions:	E J Chapman and S R Goodall for Road Metals Company Limited **(Road Metals)** C O Carranceja and J D Silcock for Selwyn District Council **(the District Council)** P A Maw and M K Prendergast for Canterbury Regional Council **(the Regional Council)** P A Steven for A A & J L Georgeson A J Schulte and A Prebble for Rolleston Rural Residents Association Incorporated **(the Residents Association)** M A Alexander, R C Bishop and others (Section 274 parties as per Appendix **A**)

INTERIM DECISION OF THE ENVIRONMENT COURT

A. **The Notice of Motion by Road Metals Company Limited (Road Metals) for a direct referral is granted.**

B. **Under Sections 87G and 291 of the Act the applications to the Canterbury Regional Council: CRC110671, CRC110672, CRC110673, CRC110675, CRC110676, CRC110678 and CRC110680, and the land use application to the Selwyn District Council Reference 105334, made by Road Metals relating to quarrying and an aggregate processing facility, concrete batching plant and the deposition of clean fill should be granted upon Conditions still to be settled.**

C. **Road Metals is directed to enter into discussions with parties and serve all parties with amended sets of Conditions within 40 working days of this decision, addressing issues raised in this decision.**

D. **If the parties agree on final wording of Conditions within a further 20 working days, the same is to be filed in Court with a joint memorandum.**

E. **If the parties cannot agree on conditions, the applicant is to file within a further 10 working days, memorandum with the Court setting out:**

1. **The applicant's preferred sets of Conditions;**

2. **Identify any Conditions that are still in dispute; and**

3. **Its position on such Conditions in dispute.**

Within a further 15 working days all other parties are to file their comments on memorandum, in particular:

1. **Whether there are any other Conditions they dispute; and**

2. **Their position on Conditions they dispute.**

The Court will then proceed to make directions, or issue a final decision.

F. Costs are reserved. Any application for costs is to be filed within 70 working days; replies within a further 10 working days. Final replies, if any, 10 working days thereafter.

REASONS FOR THE INTERIM DECISION

[1] Road Metals Company Limited (**Road Metals**) seek a Consent to establish and operate a quarry involving surface extraction of river metals from a property in Burnham adjacent to Rolleston.

[2] They have made application for direct referral under Section87G of the Act. This application was processed and heard on that basis. Under Section 87F of the Act it is necessary for councils to undertake reporting processes, and in particular, address issues set out in Sections 104 – 112 of the Act to the extent that they are:

[a] relevant to the application; and

[b] suggest Conditions that the Council considers should be imposed if the Environment Court determines to advance the application.

[3] Sections 87D – 87I of the Act set out the procedure where an applicant wishes an application to be determined by the Environment Court rather than the consent authority.

[4] In this case:

[a] The applicant made a request within the relevant period for the matter to be referred to the Environment Court (Section 87D). In this case the consent authorities decided to notify the application for consent (Section 87E(3));

[b] Subsequently, under Section 87F of the Act, the consent authorities continued to process the application by preparing reports which were served upon the applicant and the other parties;

[c] After receiving the Council report and pursuant to Section 87G of the Act, the applicant advised that it still wished to proceed with the hearing before the Environment Court and lodged the Notice of Motion with attached affidavits;

[d] The Court subsequently received from the two consent authorities (the District Council and the Regional Council) the application, the authorities' reports, and all the submissions that the authorities had received, together with a Notice of Motion;

[e] We note from Section 87G:

> (4) Section 274 applies to the notice of motion
> (5) Part 11 applies to proceedings under this section
> (6) ... the court must apply sections 104 to 112 and 138A as if it were a consent authority.

The process adopted by the Court

[5] There is still some difference between divisions of the Environment Court as to the purpose and effect of the Notice of Motion under Section 87G(2) of the Act. In Section 87G(2) the Act notes:

> (2) The applicant must,—
>
> (a) ... lodge with the Environment Court a notice of motion in the prescribed form specifying the orders sought and the grounds upon which the application is made, and a supporting affidavit as to the matters giving rise to the application; ...

[6] The Notice of Motion in this case was filed on 14 July 2012.

[7] This division has concluded on this matter that there is no discretion available to the Court regarding acceptance of the Direct Referral. The application is processed in accordance with requirements of Part 11 of the Act[1]. The Notice of Motion simply sets out and formally seeks the consents required. Other divisions have concluded that there is broader discretion as to whether the Court should hear the Notice of Motion. This Court simply notes that Section 87G(6) of the Act does not provide for the situation where the Notice of Motion may be refused by the Court. Even where it

[1] See Section 87G(5)

has been held there is residual discretion, the Court has nevertheless concluded that it can hear the Notice of Motion at the same time as the substantive case. This Court has taken that step in any event. Should we conclude that a consent should be granted we would also grant the Notice of Motion out of caution.

[8] In November 2011, the Court set out in a detailed Minute to the parties the process it intended to adopt, and called a pre-hearing conference to address the Minute. Subsequently, as a result of pre-hearing conference, the Court by consent, made directions towards hearing, which were complied with by the parties, leading to the commencement of hearing in this matter in April 2012.

[9] Relevantly, for current purposes, the opposition to the application included a residents association represented by counsel. In addition, a number of the residents in that group sought to give evidence on their own behalf and were also given permission, where they wished to do so, to make an opening statement (by way of submission) to the Court. Although arguably it was a cumbersome process, the parties were well organized and co-operated both in the presentation of the case and the order of witnesses to ensure that the matter was then dealt with as expeditiously as possible. The Court is grateful to all counsel and residents for their assistance in this regard.

[10] A delay was occasioned by lack of evidence as to the availability of ground water from a proposed bore on the site at appropriate rates. Although the Regional Council requested this information, it was not provided. The Court issued interim directions requiring that pump testing be undertaken. On 6 – 7 August, the Court then recommenced addressing this pump testing evidence.

THE CONSENTS REQUIRED

[11] In broad terms it can be said that the consents seek low impact mineral extraction on the site by virtue of using diggers to remove river metals and rehabilitating the site as the quarry progresses. The proposal also involves associated sorting, washing and crushing of the metals, and the range of consents required for the activity is not inconsiderable. District consents are required for works such as the establishment of plant, buildings and earthworks, and a significant suite of regional consents is required relating to water take and the discharges to air and ground. Some of the consents are required because of the necessity for mitigation of other affects of

the activity. One of the significant focuses of this case was the need for an extensive requirement for water to mitigate dust.

District Consents

[12] We set out firstly the full range of district consents required. The extraction activity itself required four District Council consents under the Operative District Plan:

[a] Earthworks consent (based upon Rule 1.6.1 of the Plan) exceeds 2m vertical cut and 5,000m^3, and the land will not be re-contoured to the same state as the surrounding land;

[b] Diesel storage exceeds 5,000 litres (Rule 7.1, Appendix 15);

[c] Built storage and waste areas exceed 100m^2 and more than two full-time employees for a non-residential and non-rural activity (Rule 9.4.1); and

[d] Traffic exceeds 60 equivalent car movements per day (Rule 9.13.1)

[13] It was the District Council's view that all of these activities were discretionary activities under the Operative District Plan.

[14] Aggregate crushing and processing and concrete batching require consents. There was some dispute as to whether these were all discretionary activities, which we will come to later.

[15] The District Council has combined all the above into one consent (RC105334), the purpose of which is to enable:

[a] the establishment and operation of a quarry including site establishment;

[b] the extraction of up to 160,000m^3 of aggregate per year;

[c] processing of aggregate, stockpiling, concrete batching, loading and transportation of material;

[d] the backfilling of selected parts of the quarry with cleanfill, site rehabilitation; and

[e] a workshop, office and administration facilities.

Regional Consents

[16] The following regional consents are required:

[a] The use of land for mineral extraction (CRC110671);

[b] Discharge of contaminants to land from hardfill (CRC110672);

[c] Storage of hazard substances (CRC110673);

[d] Discharge to air (CRC110675);

[e] Discharge of washwaters and silt settlement waters to ground (CRC110676);

[f] Discharge of stormwater to land (CRC110678); and

[g] Take and use of groundwater (CRC110680).

[17] The site is situated within an allocation block (as determined by the relevant Regional Plan) where current water allocation from it exceeds the Plan's maximum. Thus the allocation block is said to be over-allocated. The consequence of this is that the proposed new water take is classified as non-complying[2]. This consent is fundamental to the bundle of consents sought from the Regional Council and relies on:

[2] NRRP, Rule WQN13

[a] The washdown water used on-site will (after treatment) recharge the aquifer and will therefore not constitute a consumptive use;

[b] The clearing of land (through clearance of topsoil and vegetation) to undertake the activity will increase the natural recharge of the groundwater when it rains;

[c] Although water will be used for irrigation, dust suppression and concrete making, these volumes are small considering the overall volumes abstracted, and are compensated for by extra rainfall penetrating the aquifer;

[d] Overall when a balancing of the water take is considered relative to the characteristics of this site, the existing consent, and intended use of the water, the proposal will be non-consumptive; and

[e] Even if consumptive, irrigation and dust suppression water (consumptive uses) can currently be supplied from one existing consented bore on the former Selwyn Plantation Board land (**SPB land**).

[18] In respect of [e] above, we note for completeness, that the consent for use of water from the SPB land has now been amended so that it can be utilised for dust suppression and irrigation on the Road Metals site. However, the parties are in agreement that the use of this water on the subject site is limited and cannot be used for gravel washing or in concrete production.

[19] The reason we mention this issue so early in the case is that it became a critical issue whether there was sufficient water available for the proposed operation. The requisite water pump testing usually required by the Regional Council had not been undertaken when we heard the matter, notwithstanding the significant delay between the filing of the original application and the hearing of this matter.

[20] The practical availability of water and its potential impact on neighbouring bores seemed to the Court to be of such importance that it adjourned the hearing for three months to enable the applicant to complete the tests to ascertain whether the required water was available with little or no adverse effects on neighbouring bores.

Thus the hearing of the matter was substantially completed during the allocated hearing schedule in April/May (including closing submissions) save for final conclusions relative to the outstanding water testing. The Court reconvened for two days in August to hear the outcome of the water testing and then concluded the hearing.

THE SITE

[21] The site constitutes almost all of the large triangle of land between three roads; Wards, Sandy Knolls and Kerrs Roads, Rolleston, containing an area of some 214ha. There are several small rural properties near the apex of Kerrs Road and Sandy Knolls Road, which are not owned by the applicant. It is approximately 3.5km northwest of the Rolleston Township and 2km north of Burnham[3] and is zoned Rural Outer Plains under the Selwyn District Plan.

[22] The land is generally flat with gentle undulations reflecting ancient river channel and bar formations which is fairly typical for this part of the Canterbury Plains[4]. An irrigation canal crosses the site at its southern end in an east/west direction. The land is set out in large paddocks with several lines of shelter trees dividing the overall area up into larger sections. The site is currently used as a piggery and for livestock grazing. It is intended that the majority of the farm will continue to be used for those purposes during the quarrying and after quarrying ceases on the rehabilitated site. Given the size of the site it is likely that quarrying and farming will coexist for as long as 100 years.

[23] The site is set back from Kerrs Road by a long strip of land, approximately 250m wide, which formerly belonged to the Selwyn Plantation Board (**SPB**) but has been acquired by the applicant. While formally not part of the application site the SPB land is the location of the existing water supply bore referred to above and is offered as a buffer arrangement by the applicant. This is to be achieved by way of a proposed Condition to covenant the existing planted shelter belt within it and to ensure no quarrying activities are to take place on it. However, the access drive to the quarry will traverse this land. The accessway entrance is proposed to be located on Wards Road, approximately half way from the eastern corner of the quarry site to the

[3] Selwyn District Council, Section 87F Report Section 2, *Site and Locality*
[4] Selwyn District Council, Section 87F Report - Appendix G

intersection of Kerrs and Wards Roads. Annexed hereto and marked **A** is a copy of a map showing the proposed general layout of the site.

[24] The SPB land was covered in pine trees, but these were felled several years ago and the site has remained fallow since. It appears that there may have been some work to upgrade this area for grazing in the recent past, but no particular details were given to the Court.

The neighbourhood/existing environment

[25] Several kilometres from Rolleston, the subject locality contains a number of non rural activities in the form of the Burnham Military Camp and the Rolleston Prison. There are several designated (Selwyn District Council) quarry reserves in the wider locality, the closest being at the intersection of Sandy Knolls and Wards Road near the north-western corner of the site. A few kilometres to the east is the new iZone Industrial Park of Rolleston which has been the subject of a plan change which zoned rural land for business/industrial purposes.

[26] Rolleston itself has been an area of significant growth, spurred in part by the recent earthquakes, its proximity to major rail and roads, and the Selwyn District Plan providing for it as both an industrial and residential area. Given its rapid expansion, we were told of there being clearly a demand for building materials, including aggregate. Consistent with the applicant's advice to us, Selwyn District Council anticipates that the area will continue to grow rapidly in the next few decades.

[27] Both the site and the immediate surrounds are not seen as being part of the residential area of Rolleston. Given the Burnham Military Camp and the prison, we expect that residential development in this area would lead to reverse sensitivity issues.

[28] Although many witnesses describe this area as a quiet rural area, many acknowledged that they were able to hear the sounds of gunfire at the Burnham Camp and the Council officer described significant numbers of complaints relating to army operations.

[29] In addition, a number of witnesses described being able to hear the loud speakers at the prison, although those properties were significantly closer to the prison than the intended quarry site or Kerrs Road.

[30] The southern side of Kerrs Road is zoned Rural Inner Plains under the Selwyn District Plan. This part of the Inner Plains zoned land is a triangular shape which is contained on two of its sides by Outer Plains rural zoned land which we will discuss later. Of note though is that this arrangement does constitute a somewhat unusual zoning characteristic and is reflective of the size of the landholdings. This wedge of Inner Plains rural land is contained by Kerrs Road (southern side) and Two Chain Road (northern side) and Walkers Road. Many of the sites in this block are long and thin in shape and some are under the minimum lot size permitted within the Rural area. This pattern of subdivision appears to have been both an outcome of historical subdivision and more recent applications for consent granted by the Council.

[31] There are also a number of rural industrial activities for example Freshpork Farms Ltd (a pig production farm) and Santa Rosa (a chicken manufacturing plant); both located in Kerrs Road and within the Inner Plains zoned wedge.

[32] The land to the north of the subject site, across Wards Road, comprises larger lifestyle blocks around 10ha in area, 10 of which are part of a development known as Tresillian Drive. Right across from the site on Wards Road is the Craw's property (37ha) on which is the closest dwelling to the proposed quarry operation. In spite of this rather mixed palate of activities the immediate area has a strong rural character.

[33] Although many witnesses described this as an idyllic *rural residential* area, our inspection of the site and immediate neighbourhood showed a far more diverse area. We noted, for example, an informal contractor's depot established on Wards Road less than 1km from the site, and there were several other smaller quarries which operated intermittently. We would describe this as a mixed rural area, although we do not consider it to be in transition to another zone. As we have described, it includes areas that are similar to rural residential with small allotments. There are a number of lifestyle industries, the prison, army, quarries, and large farming enterprises including a large dairy farm, all contributing to the character of the area.

[34] We have concluded that primary production is still a significant aspect of this area. Although the other activities, including mineral extraction, army base and

prison constitute impacts on the character of that environment we conclude they do not lead it to be other than rural in overall character.

[35] We now address:

[a] The application and operation;

[b] Key issues

[c] The relevant national, regional and district documents; and

[d] The actual and potential environmental effects.

[36] We will then evaluate the proposal under the Act to reach a conclusion under Part 2.

THE APPLICATION AND OPERATION

[37] The consents sought from the District Council cover the following activities:

[a] Site establishment

[b] Extraction of aggregate by loader

[c] Transportation of aggregate by loader to hopper and conveyor to processing plant

[d] Plant for the crushing and screening of aggregate

[e] Stockpiling for processed aggregate

[f] Loading of road trucks

[g] Transport of aggregate from the site

[h] Concrete batching

[i] Transport of concrete (Some raw materials in and manufactured product out)

[j] Settlement ponds, stormwater and wastewater management facilities

[k] Workshop, office and administration facilities

[l] Some backfilling of excavated quarry with hardfill and

[m] Site rehabilitation

[38] The consents sought from the Regional Council cover the following activities:

[a] Mineral extraction (160,000m^3 cap per annum)

[b] Excavation of basins

[c] Storage of hazardous substances

[d] Discharge of contaminants and deposition of material onto or into ground

[e] Discharge of washwater and stormwater to ground

[f] Discharge of dust to air

[g] Taking and use of groundwater

[39] The proposal is for staged development, through initial establishment to a progressive managed route for quarrying through the site with follow up rehabilitation to spent parts of the site once the face has moved on.

[40] Beginning in the first sector "*Area 1A*", quarry establishment will firstly involve removal of 6ha of topsoil from the north east corner of the site (part of the approximately 9ha shown as Area 1A on the map annexed hereto as **B**). The topsoil will be used to form 3m high bunds along approximately 450m of the Wards Road boundary, around the proposed access road and along the site's eastern boundary as

shown on the plan Alternative Entrance.[5] The bunds will be grassed following construction.

[41] It appears the construction of the access over the adjoining SPB land is a permitted activity. The accessway intersection with Wards Road would need to be constructed in accordance with Council requirements (and is proposed to include a deceleration lane). It is clear that the entry point would be far enough from the intersection of Wards Road and Kerrs Road to comply with Council standards. There are more than sufficient sightlines in each direction. Planting will be undertaken to reduce visibility from nearby houses and passers-by of the quarry entrance. The applicant's Conditions propose that the consent include the establishment of a Community Liaison Group which will be consulted in the design of this planting. The access way will be sealed along its length.

[42] The permanent office and weighbridge will be constructed at ground level close to where the access way crosses the site boundary. It is proposed that this immediate area and any adjacent parking area will be sealed. The top of the office may be visible beyond the site, but bunding will avoid wider views of the site. The first stage of the quarry excavation (using mobile plant) will then lower approximately 2ha to 4m below ground level.

[43] The access road will need to drop to the new level (platform). The new platform, or depot area, will accommodate the aggregate processing plant, stockpiles of crushed and screened aggregate, workshop, storage of hazardous substances including diesel, ready mix concrete plant and machine storage. Processing plant and stockpiles will be at ground level for approximately six months (establishment phase) until this platform is constructed.

[44] A number of witnesses considered the depot area should be entirely sealed primarily to manage dust as this would be a high vehicle use area in terms of product handling and movement of vehicles. It could then be subject to stormwater control and washdown facilities, if necessary, together with other forms of dust removal from the sealed surface. We think it is now the applicant's intention to seal this area. However, we address this matter when we come to consider dust issues. We note that

[5] Kelcher, Rebuttal Evidence, Appendix A, 12 March 2012

this area will be bunded along the SPB land boundary and along Wards Road and likely to be fenced for security.

[45] The next phase will see the excavation proceed to 10m below ground level over 3ha to the west of the depot area. During this phase two 10m deep settlement ponds will be constructed adjacent to the SPB land and approximately 300m from Wards Road. Each will have a capacity of 20,000m^3 and a surface area of approximately 0.5ha.

[46] The 3ha at 10m below ground level will then be backfilled with hardfill material to 4m below ground level. This area then completes the depot and will be used for stockpiling of processed material.

[47] The remaining 3ha of Area 1A will then be stripped of topsoil and excavated to 10m below ground level. A 3H:1V batter will be constructed along the northern edge of the excavation using hardfill. This together with the base of the excavation will be rehabilitated with topsoil and grass to be used for grazing purposes.

[48] Stripping of top soil, excavation to 10m below ground level, and rehabilitation at that level, construction of batters using hardfill at the edge of the site and rehabilitation of the batters, will then proceed westward to the site's western boundary in stages each of approximately 3ha. It is estimated that it will take 20 years to reach this point. The process will then be repeated working in an easterly direction back to the depot area. This zigzag pattern will be repeated three times to cover the whole site. This could take up to 100 years. It is intended that no more than 9.4ha will be open at any one time.

[49] During excavation front end loaders will remove material from the quarry face and place it on an electrically powered conveyor system for transport to the processing plant. The conveyor system will be moved, extended and shortened as required to follow the movement of the working face. The material could be wetted while on the conveyor system and in the plant to minimise dust generation.

[50] The loaders will be stored with all other machinery and equipment in the depot area each night and may be refuelled there. Nevertheless, as required, mobile refuelling plant could be used to refuel machinery throughout the quarry and returned to the depot area when not in use.

[51] Quarry operation will require water for washing of aggregate, gravel trucks and concrete trucks, for concrete production, dust suppression and use in the office building and workshop. The estimated quantity is some 3.54 x $10^5 m^3$ annually (average rate 11.1*l*/s). Water is to be provided from a new bore on-site and from an existing bore on the adjacent SPB land. Of the total water abstracted the applicant contends 95.1% will be returned to groundwater by the settling ponds. It is also contended that the natural groundwater resource will be boosted by an annual average of 1.18*l*/s by the removal of the topsoil layer during the quarrying process. The supply, use and discharge of water for the quarry operation are major issues in this decision. We consider them in a later section.

KEY ISSUES ON APPEAL

[52] The key issues which we need to address in simple terms can be summarized (in no particular order) thus:

[a] What are the environmental effects of the proposal relative to:

[i] Ground Water issues (availability, interference and discharges)

[ii] Dust

[iii] Noise

[iv] Traffic

[v] Site rehabilitation – sustainable use

[vi] Rural character and amenity

[b] The relevant planning and statutory framework

[c] Part 2

RELEVANT PLANNING FRAMEWORK

Introduction

[53] We were provided with a joint witness statement from the planning witnesses but this document provided little assistance other than to determine the agreed (or otherwise) status of various activities. It pre-dated other expert witness conferencing such that it would seem the planners were unable to provide any narrowing of the issues and the potential adverse effects.

[54] It would have been helpful for the statement to have provided an agreed reference to the relevant planning documents and relevant policies to guide the Court. This information is something the Court would expect to be contained within the joint statement as a matter of course to ensure that these matters are teased out and clearly set out for our reference as well as any points of disagreement clearly identified.[6] In this case the situation has not been assisted by the fact that at the regional level at least, there have been changes to the regional plan as it has evolved since the Council Section 87F reports and evidence preparation of witnesses at the hearing. The Planners' Joint Statement provided little assistance to the Court.

[55] We have spent an inordinate amount of time investigating the various references that were provided by individual witnesses and getting to the bottom of policy numbering which appears to have changed at least in the case of the Canterbury Natural Resources Regional Plan. It is common place to have an agreed bundle and that would have assisted the Court immensely. Being a first instance hearing there is a higher level of information required as the process has not enabled the teasing out of the issues as usually occurs by the time it reaches this Court on appeal. The contextual regulatory framework is fundamental to the process and it should be possible for the parties to provide that in a succinct manner as a common bundle for the Court.

National Policy – General

[56] While the National Standards for sources of human drinking water and for assessing and managing contaminated soil for the protection of human health were

[6] Environment Court of New Zealand Practice Note 2011, Clause 5.6.2

brought to our attention[7] as being relevant, there was no discussion on these documents and they are not critical to our determination.

[57] The National Environmental Standard for Air Quality (NES) is relevant. In so far as the PM_{10} is the primary contaminant to be considered in this case with regard to the NES. There has been no ambient PM_{10} monitoring in the local area but typical background concentrations are expected to be well below NES 50µg/m^3 (24 hr average) and the air shed would not be defined as polluted. The experts agreed that any dust discharge from the quarry is unlikely to cause PM_{10} concentrations at neighbouring properties that exceed the NES.[8] This was dependent on adoption of control methods proposed through the draft Consent Conditions and a draft Dust Management Plan. This result will rely in part upon the applicant's access to water for dust suppression.

Key documents

[58] Thus the most relevant planning documents we took to be:

[a] National Policy Statement for Freshwater Management 2011

[b] The Canterbury Regional Policy Statement (1998)

[c] The Proposed Canterbury Regional Policy Statement (notified June 2011)

[d] Canterbury Natural Resources Regional Plan (June 2011) being:

[i] Chapter 3: Air Quality

[ii] Chapter 4: Water Quality

[iii] Chapter 5: Water Quantity

[e] Selwyn District Plan, being more specifically Volume 2: Rural

[7] Timms, EIC, page 16
[8] Joint Air Quality Witness Statement, at [25] – [28]

National Policy Statement for Freshwater Management (NPS)

[59] The starting point for this proposal which relies on water to be taken from a groundwater resource and will involve discharges to the ground, is the NPS. The NPS provides the following statement which is helpful in understanding the relative values of freshwater and understanding that all of these values are important:[9]

> ### Preamble
>
> ...
>
> This national policy statement sets out objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits. The national policy statement is a first step to improve freshwater management at a national level.
>
> ...
>
> ### National values of fresh water
>
> Water is valued for the following uses:
>
> - domestic drinking and washing water
> - animal drinking water
> - community water supply
> - fire fighting
> - electricity generation
> - commercial and industrial processes
> - irrigation
> - recreational activities (including waka ama)
> - food production and harvesting eg, fish farms and mahinga kai
> - transport and access (including tauranga waka)
> - cleaning, dilution and disposal of waste.
>
> There are also values that relate to recognising and respecting fresh water's intrinsic values for: safeguarding the life-supporting capacity of water and associated ecosystems; and sustaining its potential to meet the reasonably foreseeable needs of future generations. Examples of these values include:
>
> - the interdependency of the elements of the freshwater cycle
> - the natural form, character, functioning and natural processes of water bodies and margins, including natural flows, velocities, levels, variability and connections
> - the natural conditions of fresh water, free from biological or chemical alterations resulting from human activity, so that it is fit for all aspects of its intrinsic values

[9] National Policy Statement for Freshwater Management 2011, pages 3 - 4

- healthy ecosystem processes functioning naturally
- healthy ecosystems supporting the diversity of indigenous species in sustainable populations
- cultural and traditional relationships of Māori with fresh water
- historic heritage associations with fresh water
- providing a sense of place for people and communities.

All the values in both lists are important national values of fresh water.

(Our emphasis)

[60] The NPS sets the context for one of the key issues in this case. The proposed activities require water for a number of activities and importantly to mitigate dust effects. The impact caused by the extraction of water from the groundwater resource should avoid further over allocation of a resource which is already over allocated and should align with the policy to improve and maximise efficient allocation and use of water.[10]

[61] The proposal also involves discharges to ground for example around the washing of trucks (including concrete trucks), and processing of the extracted material (e.g. washing and crushing), and for dust suppression. There is also the possibility of accidental discharges through spillage of hazardous material (e.g. motor fuel). The NPS provides unequivocal direction to *safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the use and development of land, and of discharges of contaminants.*[11] It requires that the overall quality of fresh water within a region is maintained or improved and specifically at Objective A2 (c) refers to improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated. The water resource in this case is considered to be over allocated.

[62] We note that while the NPS indicates a range of values which are not provided with any hierarchal ranking, Section 14(3)(b) of the Act accords specific importance to fresh water required to be:

(b) ... taken or used for –

[10] NPS Section B Water Quantity Objectives B1 - B3 and Policy 5
[11] NPS Section A Water Quality Objectives A1 and A2

> (i) an individual's reasonable domestic needs; or
>
> (ii) the reasonable needs of an individual's animals for drinking water, -
>
> and the taking or use does not or is not likely to have an adverse effect on the environment; ...

[63] This seems to us to indicate a directive by implication towards avoidance of any use which might impact upon domestic drinking water supply and has relevance in this case to private bore interference. A key issue in this case is whether some or all of the water taken is used consumptively given the recharge that will occur to ground.

[64] Further the interconnectedness of these values is apparent to us and thus the importance of the clear direction espoused by the policy. The need for avoidance of contamination or degradation underlies a number of elements of this proposal. There is thus a need to show that the proposal is likely to achieve these objectives.

Operative and Proposed Canterbury Regional Policy Statements (RPS and PRPS)

[65] The RMA requires that regional policy statements, proposed regional policy statements, plans, proposed plans, and variations give effect to any provision in an NPS. Both the RPS and the PRPS have been promulgated before the national policy statement for freshwater management. At the time we held the substantive hearing on this proposal the PRPS was still undergoing assessment as decisions on submissions had yet to be issued. By the time we reconvened the hearing to consider the results of the water testing, the decisions on submissions to the document had been released. This document is thus operative for the purposes of our determination. While we note the timing of these listed regional documents is not particularly helpful in terms of the national policy directive that does not mean they do not already accord with much of the national policy directive. The elements of these documents which we were referred to were certainly consistent with the NPS.

[66] Ms Torgerson, an environmental engineer for the applicant, summarised for us the relevant parts of the regional policy documents and there was general agreement as to these references[12]. In summary we note that:

[12] Torgerson, EIC, pages 39 - 42

A. Operative Policies indicate:

[a] Land uses should not result in contamination of land (Chapter 7 *Soils and Land Use* – Policy 7).

[b] Water quality and quantity should be protected (Chapter 9 *Water*[13] - we were specifically directed to Objective 1 and Policies 1, 2, 3, 5 and 6).

[i] The allocation methods in this case relate to the *Selwyn-Waimakariri* Groundwater Allocation Zone.

[ii] Efficient use of water is encouraged both in terms of technical efficiency (avoidance of waste) and allocative efficiency (using water where it has greatest value).

[iii] Prevention of adverse effects upon existing (lawful) users except with agreement of those affected. In particular we note Policy 6.

[iv] Importantly, we note Objective 2 of this Plan which deals with the flows and levels of Canterbury's water bodies (i.e. quantity) and Objective 3 which deals with quality and amongst other matters safeguarding their existing value for efficiently providing sources of drinking water for people and safeguarding the life-supporting capacity of the water. We were specifically directed to Policies 9, 11 and 12 we would also include 8 which requires that land use should not have the effect of reducing levels and flows to below those necessary to achieve Objective 2.

[v] Policies address land use practices which maintain and where appropriate enhance water quality.

[vi] Policy 12 states:

[13] RPS Chapter 9 Objective 1

> Activities which could result in a release of hazardous substances should not be located in areas where water resources are vulnerable to contamination unless adequate precautionary measures are implemented to avoid that contamination.

[vii] Manage storage or use of hazardous substances (Chapter 17 *Hazardous Substances*).

B. Newly decided Policies:

[a] As we have indicated the circumstances surrounding the relevance of the PRPS changed at the very last minute relative to the hearing of this matter. We were left with submissions only from Mr Maw as to the relevancy of any changes to the document as now determined. The consensus of the parties was that we could rely on the evidence we had heard in respect of this instrument and we were advised that the changes do not result in substantial amendments relative to the proposal. Mr Maw summarised the changes he saw as relevant in Chapters 5, 7 and 12 and we have relied upon that advice and dove-tailed that in to the advice we received in evidence from the planning witnesses.

[b] Freshwater management is addressed in Chapter 7 *Freshwater*. Particular reference was made to Objective 7.2.1 and Policies 7.3.3, 7.3.4, 7.3.5.

[c] Objective 7.2.1 is concerned with *Sustainable Management of Freshwater* so that amongst other things, freshwater will be managed so that:

> (3) any actual or reasonably foreseeable requirements for community and stockwater supplies and customary uses, are provided for.

Particularly relevant to this proposal, is Policy 7.3.4 *Water Quantity* which sets a directive for the priority for water allocation. Specifically, we were referred to Policy 7.3.4(2) which states[14]:

> (2) Where the quantum of water allocated for abstraction from a water body is at or exceeds the maximum amount provided for in an environmental flow and water allocation regime:
>
> (a) avoid any additional allocation of water for abstraction or any other action which would result in further over-allocation, unless it is provided for under clause (2)(b); (sub 35.36 Irrigation NZ, 44.19 Genesis Power, 58.18 Mackenzie Irrigation Co, 59.8 Hurunui Water Project, 81.11 Fonterra, 95.12 Dairy Holdings) and
>
> (b) set a timeframe for identifying and undertaking actions to effectively phase out over-allocation; and
>
> (c) effectively addresses [*sic*] any adverse effects of over-allocation in the interim.

[d] The *Explanation* to this Policy[15] includes the following:

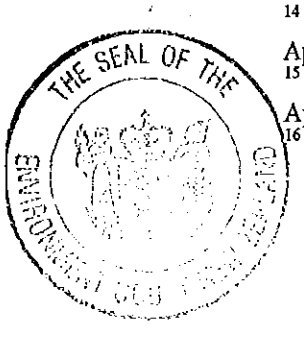
> Policy 7.3.4(2) deals with the management of water quantity in catchments where allocation has reached the maximum allocation allowable under an environmental flow and water allocation regime. The policy indicates no additional abstraction is allowed, and measures must be put in place to try and reduce the effects of the over-allocation over time . [16]

[e] Policy 7.3.5 *Water quantity and land uses* addresses management of recharge and Policy 7.3.6 *Fresh water quality* addresses water quality, including maintenance and avoidance of further adverse effects on quality.

Conclusion on the RPS

[67] There are common themes between the RPS and the general direction which indicates priority for water-take to essentially human consumption and that of

[14] Report of the Hearing Commissioners on the Proposed Canterbury Regional Policy Statement 2011 Appendix 2
[15] Report of the Hearing Commissioners on the Proposed Canterbury Regional Policy Statement 2011 Appendix 2
[16] PRPS Policy 7.3.4 – Water quantity, Principal Reasons and Explanation, page 61



animals. In the case of the proposed water take and discharges to ground, the policies set the basis for the more detailed methods contained in the Canterbury Natural Resources Regional Plan (NRRP) Chapters 4 and 5. There is a precautionary and protective approach taking into account the freshwater resources as a whole and how land use activities integrate with this resource.

[68] In addition to the matters surrounding water take, discharges to ground and to air, there is a concern with the sustainable outcome of the proposal in terms of use of the land once quarrying has ceased. Rehabilitation is proposed but in order to meet the above directives, the land will need to be rehabilitated to a sustainable standard that will provide for land use which maintains water quality.

[69] We consider the proposal does accord with these higher order instruments provided there are adequate mitigation measures. Fundamental to this is a conclusion that any new take is not a consumptive use. This in turn requires us to conclude that the existing consented take can be used for consumptive purposes (particularly dust suppression). We set out our findings when we consider the directly applicable instruments of the Regional Plan and the District Plan below. This will also allow us to assess the mitigation proposal and conclude whether they or some other condition can adequately mitigate effects to achieve the higher order objectives and policies.

[70] The detail for assessment of water take, and the discharge consents is considered under the NRRP which we now address. (The detail for assessment of the land use of quarrying and the concrete batching plant is in the Selwyn District Plan).

Canterbury Natural Resources Regional Plan (NRRP)

Chapter 3 Air Quality

[71] We received very little evidence on the provisions of Chapter 3 of the NRRP as the consensus was generally that provided dust was suppressed there would be minimal nuisance or significant effects and thus the focus of the parties was on the availability of water to achieve the dust suppression. However, given the concern of the Georgesons we feel obliged to note Objective AQL1 concerning localised air quality and the directive to ensure localised contaminant discharges into air either on their own or in combination with other discharges do not result in *significant* adverse effects on the environment including amongst other things: human health and safety, diminished visibility as a consequence of human activities, soiling of structures not

being property owned by those causing the discharge and adverse effects on plants and animals.

[72] Policy AQL6 refers to the avoidance of dust nuisance. It requires amongst other things, the discharge to air of dust to not be dangerous or objectionable or offensive:

> (a) ... to the extent that it has or is likely to cause an adverse effect on the environment beyond the boundary of the site where the discharge originates.

[73] Policy AQL6(b) also addresses reverse sensitivity where there is a direction to avoid encroachment of sensitive activities on *existing* activities discharging dust into air unless the effects can be mitigated by the encroaching activity. This is not the case here because this is a proposal for a new activity.

[74] The planning experts agreed that under the NRRP fugitive dust to air (as in this case) would be a discretionary activity. We did not have the relevant rule cited to us but we anticipate that it is Rule AQL57. Given general agreement on this point we accept the parties' determination as to status.

Conclusion Air Quality

[75] While dust remained a live issue during the course of the hearing, the technical witnesses in respect of this matter had reached agreement in their joint statement submitted to the Court that if appropriately managed dust emissions would be appropriately mitigated. We do note that the concerns raised by the submitters and the Messrs Georgeson were matters anticipated in the plan and require appropriate mitigation to accord with it. We accept that the resolution of dust management is dependent on adequate water availability and its managed application at time of risk. If that issue is resolved dust as a potential adverse effect can be mitigated as proposed and clarified through Conditions. This position is strengthened by the control of the SPB land by the applicant. Nevertheless, we conclude that this 250m separation is not sufficient of itself to achieve the requisite attenuation of fugitive dust. Both volume of water necessary and how it was to be applied and when, remained in contention at hearing.

Chapter 4 Water Quality

[76] The principal directives related to water quality relevant in this case stem from Objective WQL2.1 and in particular part (2) of this objective which sets a number of environmental quality standards.[17] The relevant Policies are found at WQL7 for point source discharges onto or into land which affect soil or groundwater quality. There are a number of standards set in the policy directives in subsection (1) of this policy which stipulate how such a discharge is to be managed. Subsection (2) seeks to avoid effects on water quality from cumulative effects of wastewater treatment and disposal systems[18] particularly in terms of water quality associated with bores used for drinking water or other purposes requiring potable water. This subsection of the policy offers methods of avoiding adverse effects by either treatment or essentially natural processes through natural attenuation or limitations[19].

[77] Policy WQL8 deals with minor point source discharges (such as de-watering from spreading of silt) and Policy WQL9 addresses the prevention of hazardous contaminants to ground water which includes accidental contamination from storage or use of hazardous substances for example the fuel used for the machinery employed in the quarry operation. In particular, WQL9(3) *prohibits* the discharge of contaminants into groundwater in this case including hazardous substances and wastes from industrial or trade processes.

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[17] NRRP Chapter 4 WQL2.1. These include:

(2) In semi-confined, unconfined, or other confined aquifers manage groundwater quality to meet the following:

(a) If, during the life of the NRRP, the overall maximum nitrate-nitrogen concentration exceeds 5.6 milligrams per litre in any aquifer, any increase in nitrate-nitrogen concentration shall not exceed a rate of 1.5 milligrams per litre every ten years. This rate shall be based on the overall maximum concentration measured or reasonably deduced in an aquifer in the three years prior to 1 November 2010;

(b) Notwithstanding (a) above, the overall maximum nitrate-nitrogen concentration in any aquifer shall not exceed 11.3 milligrams per litre;

(c) The water quality shall remain within the Guideline Value for any aesthetic determinand listed in the Drinking-water Standards for New Zealand 2005, except for natural exceedances of the Guideline Value. If the water quality does not meet the Guideline Value, as a result of human activities, the water quality shall be improved so that the Guideline Value is achieved;

(d) The median concentration of *Escherichia coli* shall be less than one colony forming unit per 100 millilitres of water; and

(e) Any other inorganic or organic determinand of health significance or pesticide (excluding nitrate-nitrogen or *Escherichia coli*) listed in the Drinking-water Standards for New Zealand 2005 shall not be detected at a concentration greater than one half of the Maximum Acceptable Value for that determinand.

[18] NRRP Chapter 4 WQL7(2)(a)(i)

[19] NRRP Chapter 4 WQL7(2)(a)(ii) and (iii)

[78] These policy directives come into play in terms of both the operational characteristics of the activity (e.g. hardfill, storage, truck and shingle washing, the settling basins and stormwater management) as well as the rehabilitation of the site after quarrying. We were satisfied (subject to the availability of adequate water) that Conditions could be applied to the proposal from an operational point of view that would address sustainable management of the ground water quality. It seemed that the parties were generally in agreement with this approach.

[79] However, the issue of a sustainable outcome relative to use of the rehabilitated land remains of concern to the Court. We are not satisfied that an approach which would result in limitations on the end use of the land is appropriate either in terms of the regional plan imperatives, the district plan zoned purpose or perhaps more fundamentally, the purpose of the Act. Conditions curtailing the long term use of the land do not in this instance present a sustainable outcome. Nor is the risk of groundwater contamination by virtue of inadequate soil and subsoil depth acceptable. We prefer the approach taken in the Yaldhurst Road Metals[20] decision where the ground water was protected by the application of a protective cover to the retained gravel separation above the water table.

[80] If a similar clause was utilised in this case we are satisfied that the purpose of the Act could be achieved in respect of water quality with appropriate conditions.

Chapter 5 Water Quantity

[81] The relevant objective is Objective WQN3 *Groundwater Management*[21] which seeks to enable present and future generations to gain access to the region's groundwater resources for *social, economic, cultural and other benefits* while ensuring amongst other things:

> [a] that there are no adverse effects from abstraction from hydraulically connected groundwater to surface water;

[20] C73/07, Christchurch
[21] NRRP Chapter 5 Objective WQN3

[b] that the cumulative effects of groundwater abstractions do not cause a significant long-term decline in groundwater levels and artesian pressures in each aquifer; and

[c] that there is no deterioration in water quality and water loss from one aquifer to another as a result of cross-connection between aquifers.

Most relevant to this proposal is Policy WQN8[22] which flows from this objective.

[82] Objective WQN4 and Policy WQN13 set up the allocation regimes through a system of allocation blocks. The relevant groundwater allocation regime is specifically addressed in subsection (8) of this policy. This policy refers to Schedule WQN4 which sets an allocation limit for the Selwyn-Waimakariri groundwater zone (being the relevant zone in this case) at 121.3 million m^3/yr.

[83] Policy WQN13.2 deals with the *Implementing and managing allocation regimes*. Subsection (2)(d)(iii) of this Policy was cited as a key policy in respect of this proposal. The allocation regime is complex and in an effort to provide some context to (d)(iii) we set out the full subsection below. We note in particular (f) :

(2) To manage allocation regimes established under Policy WQN13.1 by:

(a) providing for the taking of a small rate or amount of surface water or groundwater to be a permitted activity, where singly and cumulatively with other permitted activity takes, the amounts are so small that they do not need to be included in any allocation block;

(b) authorising, through resource consents, the taking of a rate or amount of surface or groundwater to be excluded from an allocation block, providing these avoid or mitigate any effect on the relevant allocation block; or

(c) authorising, through resource consents, the taking or diverting of surface or groundwater, for specified periods of the year, and average rates of abstraction and/or annual volumes up to the allocation block limit;

(d) authorising through resource consents:

(i) the taking or diverting of surface water or groundwater in excess of the A allocation block limit determined under Schedules WQN1, WQN2, WQN3 or WQN4, where the water sought is for no more than

[22] NRRP Chapter 5 Policy WQN8

the amount authorised by an existing water permit that was issued prior to 1 January 2002, which is expiring or has expired by no more than six months at the time the resource consent application is lodged, and the amount is reasonable (see Policy WQN16); and

(ii) the taking or diverting of surface water, or the taking of groundwater that has a stream depletion effect that is to be managed within a surface water allocation block, that is in excess of an interim allocation block determined using Schedule WQN2, only where it can be demonstrated that the proposal, in combination with all other takes from the water body that are to be summed to determine the effective allocation, will not compromise the environmental values sustained by the flows and levels in the river, lake, springs or wetlands, and that the take will not compromise the reliability of supply provided for in Policy WQN13.1(5)(a) and (b); or

(iii) the taking of groundwater in excess of an interim allocation block, where the groundwater allocation limit has been determined using Schedule WQN4, only where it can be demonstrated that the proposal, in combination with all other takes from the water body that are to be summed to determine the effective allocation, will not compromise the environmental values sustained by groundwater levels, such as flows and levels in rivers, lakes springs or wetlands, or seawater intrusion of coastal aquifers, and will not compromise the reliability of supply provided for in Policy WQN13.1(7)(a)(i) and WQN13.1(7)(a)(ii);

(e) where there is no reserve or the reserve water has been allocated, Environment Canterbury may still authorise the taking of water for individual or community stockwater supply, group drinking water supply or community drinking water supply that is not otherwise provided for in Policy WQN13.2(2)(d) above, where it can be demonstrated:

(i) that the take is for essential stock water use that is required due to a change from open race or stream access, to a piped alternative; or

(ii) that having considered alternatives it is the most practicable option: or

(iii) the take is for group or community drinking water supply use; and

(iv) that the take will not compromise the reliability of supply of existing water permits holders;

(f) except as allowed by Policy WQN13.2(2)(a), WQN13.2(2)(b), WQN13.2(2)(c), WQN13.2(2)(d) or WQN13.2(2)(e) above, prohibiting the taking or diverting of water where the amount of water that is being sought, when taken in combination with all other existing authorised takes in the same allocation block that are to be summed to determine the effective allocation, is in excess of the allocation block limit.

(Our emphasis)

[84] The Explanation for this Policy includes the following statement:

> Policy WQN13.2(2) sets out how takes will be managed in relation to the allocation regimes that are established. The policy recognises that some very small-scale takes will have no, or minimal effect on an allocation regime and will not need to be counted as part of the allocation regime. Takes for use for an individual's domestic or stockwater supply or for road construction are examples of these. Other takes that will not impact on the allocation regimes because they are very minor, temporary, are from a water race supplied from a water body, will return the same amount of water downstream or are mitigated by augmentation, or are takes for an individual's stockwater use that are greater than what is permitted, may also be authorised and not be counted as part of the allocation block. Generally, takes will be required to be authorised via a resource consent and will only be granted if there is water available within the allocation block. The consent process will allow assessment of this.
>
> The policy establishes that once an allocation regime is established it is important to maintain its integrity. In particular, there should be no continuing allocation of water from an allocation block once the allocation limit has been reached. However, distinction has been made between allocation regimes that have been fixed in Schedules WQN1 or WQN3, and the interim allocation regimes determined via the approaches set out in Schedules WQN2 and WQN4. Where the allocation regime is fixed in Schedules WQN1 or WQN3, it is a prohibited activity to take water once an allocation block has been fully allocated. Where the allocation regime is determined via the approaches set out in Schedules WQN2 and WQN4, it is a non-complying activity to take water once an allocation block has been fully allocated. This allows for an application to be made for water but Policy WQN13.2(2)(d)(ii) and WQN13.2(2)(d)(iii) requires that the applicant demonstrate that the take, in combination with all the other takes from the water resource, will not compromise the reliability of supply targeted by the earlier parts of the policy.
>
> (Our emphasis)

[85] Policy WQN16 *Reasonable and efficient use of water* is relevant here and we note in particular the first subsection of this policy. Much of the policy refers to use of water for irrigation purposes which would be relevant in the rehabilitation stage. We have not included those references. However, we do note references at subsections (9) and (10) which relate to management efficiencies including storage and recycling which we consider are relevant here.

> Policy WQN16 Reasonable and efficient use of water
>
> (1) When assessing water permit applications to take, divert and use water, ensure that:
>
> (a) the instantaneous rate of abstraction, the return period and the annual volume are specified as conditions of water permits and are no more than reasonable for the intended end use;
>
> (b) significant wastage of water is avoided; and

(c) any adverse effect on water quality is avoided or limited to meet the requirements of Policies WQL5.1, WQL5.2, WQL10 and WQL13[23].

...

(9) Promote the use of water audits for agricultural, industrial, hydroelectricity and community water supply activities to identify areas for improvements in water use efficiency.

(10) Promote the capture and use of stormwater, and the re-use of water and greywater to improve water use efficiency.

[86] Finally the last more relevant objective to this proposal is Objective WQN7 *Interference effects between bores* and the related Policy WQN19 which deal with bore interference:

Objective WQN7 Interference effects between bores

Ensure that groundwater abstractions from new bores, in conjunction with all other abstraction from existing bores, do not significantly affect the yield from neighbouring bores that are adequately penetrating the aquifer

...

Policy WQN19 Managing the effects of interference between bores

(1) Where a new bore is proposed to be installed and used, the direct cumulative interference effects should be limited to no more than 20% of the available drawdown in any other bore with an existing authorisation that is within two kilometres, unless the effect is mitigated.

(2) For the purposes of this policy:

(a) where an existing bore inadequately penetrates an aquifer (see Policy WQN14), the direct cumulative interference effects of abstracting from the new bore and all other bores will be assessed as if the existing bore is adequately penetrating the aquifer;

(b) not withstanding Policy WQN19(2)(a) above, where a new bore is installed six months or more following this policy becoming operative, and the bore inadequately penetrates the aquifer, the yield from the bore shall not be protected under this policy;

(c) where an application is made, prior to the expiry date, to replace an existing water permit to continue to take groundwater in the same manner and volume as previously authorised, interference effects between bores as per this policy need not be considered, but such applications will need to meet all the other requirements of the plan including policies WQN13 and WQN16;

(d) the "protected available drawdown" shall be determined as 80% of the drawdown available, as shown in Schedule

[23] Note: WQN10 *Confined/semi confined aquifer management* and WQL13 *Establishing allocation regimes* are relevant here

WQN10, at a groundwater level that is exceeded 80% of the time during the period of proposed water use, having taken into account individual bore and pump installation details;

(e) the "direct cumulative interference effect" on a bore shall be the combined interference of abstractions from all bores (including the new bore):

(i) that are authorised to take groundwater for abstractive purposes via a resource consent (but excluding those that are authorised to take groundwater through an operative permitted activity rule); and

(ii) that are located within two kilometres of the bore, and have a calculated interference effect on that bore of more than 0.1 metres, when abstracting at either the authorised rate of abstraction over 150 days to deliver their seasonal volume, or pumping at the authorised average daily rate over seven continuous days, whichever is the greater; and

(f) "bores with an existing authorisation" will include:

(i) bores used for the taking of groundwater for which there are existing water permits, either through an operative permitted activity rule or a resource consent for the taking of groundwater for any abstractive use; and

(ii) bores used for which no water permit to take groundwater is required, but which are intended to be used for water level observations.

The water balance approach to allocation

[87] The amount of water currently allocated in the Selwyn-Waimakariri Groundwater Allocation Zone is considered to be 161.3 million m^3/yr.[24] There is no dispute that this Groundwater Allocation Zone is currently over-allocated. The parties agreed that any consumptive takes above the current allocated water level are unlikely to be supported by the various policy directives. We conclude that further consumptive takes are contrary to the Objectives and Policies as a whole. Thus the success or otherwise of the proposal relies on it being determined that the amount of water taken will be returned to the aquifer; that this is a non-consumptive take.

[88] The applicant has thus adopted a *water balance* approach. The information requirements for applications made under Chapter 5 of the NRRP, include in addition to a number of other requirements, the following requirement:

[24] Collie, EIC, at [24]

5.7.3.2 The taking and use of groundwater

...

(h) an assessment of the effect of the take and use of groundwater on the groundwater resource. The techniques used to assess effects may include some or all of the following:

(i) use of water balance estimates based on estimated recharge and through flow to show the proposal will not result in unacceptable stress to the groundwater resource;

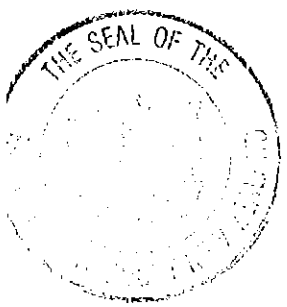
(ii) use of quantitative tools such as numerical modelling to show the proposal will not result in unacceptable stress to the groundwater resource;[25]

(Our emphasis)

[89] We accept that the *water balance* approach is an appropriate assessment methodology and that it is an expected technique in the list of assessment undertakings which are outlined in the NRRP. This approach is consistent with obtaining an understanding of the proposal relative to WQN13.2(2)(d)(iii) and the explanation of those provisions.

[90] The key to such an approach is the assumption that a proportion of the water falling on the subject land is taken as part of the overall volume available within the relevant catchment. The Plan is silent on this issue, but it is clear that the available water of 161.3Mm^3/yr is a general calculation including the subject site. Accordingly, that water volume has already been included in calculating the volume available in the catchment but using standardized assumptions as to absorption etc. In this case, the applicant gives evidence of an increase in water being absorbed into the ground after stripping the topsoils. It is only that increase that could be relied upon by the landowner as additional recharge.

[91] The Plan approach relies upon the general recharge calculation assuming that the top root zone of the soils will utilise a proportion of the rainfall, and only a proportion will penetrate to ground water. All parties agreed that the Plan uses this approach and that removal of the topsoil and pasture would increase the rainfall reaching groundwater. It is the applicant's case that any additional rainfall reaching groundwater should be available as a credit against abstraction (water balance).



[25] NRRP Chapter 5 Clause 5.7.3.2

[92] Whether there is an adverse effect on other bores remained an issue, even after pump testing, and we will discuss that later in this decision.

[93] Finally, we should note that no evidence relying on recycling of wastewater or storage ponds for rainfall or abstracted water was given or relied upon to achieve water balance. There was also no proposal in relation to potable water which might address Policy WQN16(10) which to us seems a relatively simple initiative to address with use of a rainwater tank and re-use of greywater in toilets.

Status NRRP

[94] The Joint Planners' Witness Statement confirmed the status relative to consents under the NRRP which we summarise for convenience in the following table:

Regional Plan		
Activity	**Status**	**Council Application Reference**
Excavation of land	Discretionary	CRC110671
Filling and discharge of contaminants to land (Cleanfill)	Discretionary	CRC110672
Use and storage of hazardous substances	Non-complying (subject to Rule WQL38[26])	CRC110673
Discharge of contaminates to Air (dust)	Discretionary	CRC110675
Discharge wash water to land (truck and shingle wash water, settlement basins)	Discretionary	CRC110676
Discharge stormwater to land	Discretionary	CRC110678
Take and use groundwater	Non-complying	CRC110680

[95] This list bundles various activities in groups. Most of the activities listed as discretionary have within them other activities requiring restricted discretionary consent.

[96] In relation to the *take and use* consents, the take is non-complying, while the use is discretionary. Given the need to examine the use to establish whether the take

[26] Timms, EIC, at [28] – [32], Section 87F, Report of Neil Whitaker

is consumptive or minimal, the NRRP categorisation of activities is difficult to follow. Not even the Regional Council planner suggested we consider the 14 Consents involved, but rather grouped them as shown in the table. This weakness in the Plan is likely to cause confusion and dispute in the future.

[97] The consequence of the status of *use and storage of hazardous substances* and *take and use of groundwater* is that as non-complying activities they must pass the threshold tests of Section 104D of the Act before the Court has a discretion to grant consent under Section 104(1).

[98] From our analysis of the relevant documents, it can be seen that the proposal is not contrary to the hazardous substances policies and objectives provided conditions avoiding contamination of groundwater are adopted.

[99] On the other hand, we are in no doubt that an abstraction of water that is a consumptive take is contrary to the objectives and policies of the NRRP, and also to the National Policy Statement on Freshwater. The take will thus need to be non-consumptive and/or its effects minimal:

Timing of lodgement and plans, Section 88A(1A) and Consent bundling

[100] The applications before the Canterbury Regional Council were received in December 2010 and post notification of the annotated Chapter 4 Water Quality chapter of the NRRP. As we understand it, the rule as drafted at that time rendered the proposed use and storage of hazardous substances as a restricted discretionary activity. However, since then the operative version of the NRRP has split the rule into two parts (WQ38A and WQ38B). It is WQ38A which is relevant here (as the site is not located within the Christchurch Groundwater Protection Zones) and this rule (due to the quantum and proximity of the storage to groundwater) renders this activity non-complying.[27] We agree with Mr Maw[28] that once operative it is that provision which prevails and Section 88A(1A) of the Act ceases to have effect. However, we also agree that in the end this is irrelevant as the status of this particular activity does not affect the evaluation of it. All relevant experts agreed it would pass through both gateways in Section 104D of the Act and generally agreed that effects could be

[27] Torgerson, EIC, at [7.17] – [7.26]
[28] Counsel for the Regional Council

managed by appropriate conditions. Mr Maw also considered that the status became irrelevant when the applications before the CRC were bundled as overall the water take consent renders the proposal non-complying under the Regional Plans. We agree.

Selwyn District Plan

[101] The Selwyn District Plan (**SDP**) is in two volumes: *Township Volume* and *Rural Volume*. Land within the District is zoned as Living, Business or Rural. Land in Living and Business zones forms townships, and is covered in the Township Volume of the Plan (Volume 1). The remaining land is zoned Rural and is covered in Rural Volume (Volume 2).

[102] Part A Clause A4.5 of Volume 2 provides a description of the rural area. While noting the dominant land use as farming in the Rural Zone it explains the evolving diversity of this activity and:

> **The Rural Area**
>
> ... There are many other activities, which also occur in the Rural zone which need to be recognised and provided for as part of promoting sustainable management of natural and physical resources. They include (but are not limited to):
>
> - Forestry
> - Mining and quarrying (gravel, bentonite and limestone)
> - Community facilities
> - A variety of business activities
> - Outdoor recreation
> - Residential activities, and
> - Conservation and preservation of wildlife and natural features.

[103] It is explained in Section A4.5 that:

> **Use of Zones**
>
> There is only one zone in the rural area, though the zone is split into areas to manage specific activities, for example subdivision and residential density, plantations and outstanding landscapes. The boundaries of these areas are shown on the Planning Maps.

[104] The subject site is identified as *Outer Plains* (OP). The wedge of land immediately across Kerrs Road and contained by OP land on the southern side of Two

Chain Road, is identified as *Inner Plains* (IP). All the remaining land around the perimeter of the subject site is included in the OP. This wedge of IP contained by the south side of Kerrs Road, the north side of Two Chain Road and Walkers Road, is an anomaly in that it juts into the OP and is thus surrounded by OP land apart from its eastern boundary which meets the consolidated area of the IP.[29]

[105] The difference between the IP and OP areas is explained in the same part of the Plan under the heading *The Plains*. Here it is noted that:

> **The Plains**
>
> ... The different characteristics of the Plains have resulted in different land uses and intensity of subdivision and settlement. These differences are reflected in the division of the Plains into Inner and Outer Plains for the management of subdivision and residential density in the Plan.
>
> The single most significant resource management issue on the Plains is the demand for small allotments (less than 4 hectares) for residential development. The demand is greatest within an area up to 30km from Christchurch City. This demand affects:
>
> - Natural resources such as groundwater and soil;
> - Farming activities and potential 'reverse sensitivity' issues;
> - The character of the rural area.
>
> These issues are addressed in Part B, Sections: 1.1, 1.2, 3.4 and 4.1 of the Plan.
>
> (*Our emphasis*)

[106] Part B of Volume 2 addresses Natural Resources. We were directed to Objective B1.1.1 which addresses adverse effects on the land and soil resources and more importantly Objective B1.1.3 which seeks to promote sustainable management of the soils resources of the District. Policies which flow from these objectives seek to ensure activities involving hazardous substances are managed in a way that reduces risk of contamination. [30]

[107] Of particular relevance to this proposal are two policies (Policy B1.1.6 and Policy B1.1.7) which address the adverse effects of activities on soil structure and the removal of topsoil. Specifically Policy B1.1.7 seeks to avoid the removal of topsoil unless the site will be covered in *hardstanding* or the topsoil will be replaced and the

[29] SDP, Planning Map 013 Sheet 2
[30] SDP Volume 2 - Policy B1.1.1

site replanted when the activity ceases. In the Explanation and Reasons for Policy B1.1.7 it is explained that:

> **Explanation and Reasons**
>
> ...
>
> Policy B1.1.7 allows topsoil to be removed from sites for other activities, as long as it is replaced and the site rehabilitated when the activity ceases. The site should be restored to the condition it was prior to the activity or better.

[108] Part B1.3 of Volume 2 of SDP addresses ground and surface water. Objectives B1.3.2 and B1.3.4 relevantly require that contamination of groundwater (in terms of relevance to this case) is avoided and/or mitigated and water quality improved in degraded water bodies. We also note that the section of the Plan dealing with *People's Health, Safety and Values* contains specific objectives and policies which seek to avoid, remedy or mitigate adverse effects to human health from the storage of hazardous substances and in particular to ensure the risk of any leaks or spills which contaminate land or water is reduced.

[109] The relevant objectives and policies which address transport networks and roads in particular are found under the section of Part B dealing with *Physical Resources*. The relevant objectives were provided to us in the Section 87 report. The most relevant Objective B2.1.1 seeks that new land uses do not compromise the safe and efficient operation of roads.

[110] Part B3.4 of Volume 2 deals with the *Quality of the Environment*. It is this section which is most relevant to this proposal. This section sets out a description of Amenity Values/Rural Character[31] which includes the following statement:

> The rural area has a character which is distinct from townships. There are common perceptions which many people share about the character of the rural area. These include:
>
> - Predominance of vegetation cover.
> - Dominant land uses (but not all land uses) are associated with primary production: agriculture, horticulture, forestry, pastoralism.
> - Views of mountains, basins and river valleys which are not modified by structures.
> - Being able to see, hear and smell animals and birds.
>
> Rural character can also mean different things to different people.

[31] SDP Volume 2 Part B, B3.4

- People who live in the rural area as an alternative to living in a town may value a sense of open space, panoramic views and their perception of a rural outlook.
- People carrying out farming and other business activities may share some of these values. They also perceive the rural area as a business area and expect to be able to carry out existing activities; adopt new technology and practices; and to diversify activities as markets change.
- Some people value the rural area as a place to locate activities that need lots of space. These people may value large areas of land and distance from neighbours.

...

... This District Plan has policies and rules to maintain a generally pleasant living and working environment. However, residents should not expect an environment which is as conducive to residential activities as Living zones. The Rural zone is principally a business area and the policies and rules are designed to allow people to undertake farming and other business activities relatively freely.

(Our emphasis)

[111] The more relevant objectives are found at B3.4.1 and B3.4.2:

[a] Relating to quality of environment:

Objective B3.4.1

The District's rural area is a pleasant place to live and work in.

...

Objective B3.4.2

A variety of activities are provided for in the rural area, while maintaining rural character and avoiding reverse sensitivity effects.

[b] Relating to rural character:

Policy B3.4.1

Recognise the Rural zone as an area where a variety of activities occur and maintain environmental standards that allows [*sic*] for primary production and other business activities to operate.

...

Explanation and Reasons

Policy B3.4.1 recognises that the Rural zone is principally a business area. Farms, forests and other rural activities are businesses and they need to be able to operate efficiently and with as few restrictions as practical. Residential activities occur in the Rural zone, both ancillary to farming and other business activities, and as the principal use of the site. The Plan provisions, coupled with the distance between houses and activities in the Rural zone, should combine to

maintain a pleasant living environment. However, the rules will not be as stringent as those in Living zones and residents can expect to tolerate mild effects associated with 'day-to-day' farming activities and temporary effects associated with seasonal activities.

...

Policy B3.4.3

Avoid, remedy or mitigate significant adverse effects of activities on the amenity values of the rural area.

(Our emphasis)

[112] Perhaps the most significant policy which was brought to our attention is Policy B3.4.4 which we set out below.

Policy B3.4.4

Ensure that any adverse effects arising from "rural based" industrial activities in the Rural (Inner Plains) Zone of a size and scale beyond what is permitted by the District Plan and "other" types of industrial activities in all Rural zones are avoided, remedied or mitigated to the extent that the adverse effects are no more than minor.

(Our emphasis)

[113] The explanation which follows this particular policy attracted much debate and we set it out in full so that it may be examined in detail as to its relevance to this proposal.

Explanation and Reasons

While the Rural zone may be able to better accommodate the potential adverse effects associated with industrial activities than Living or Business 1 Zones due to a lower population density and larger allotment sizes, certain types and scales of industrial activities are unlikely to be appropriate in all parts of the Rural zone. For the purposes of the Rural Volume, industrial activities have therefore been categorised into either a "rural-based" or an "other" type of industrial activity. Rural-based industrial activities are those that involve a raw material or product that is derived directly from the rural area (e.g. timber yard, winery or dairy factory), as opposed to other types of industrial activities (e.g. panel beating, dry cleaning or spray painting)

The effects associated with permitted small scale rural-based industrial activities are appropriate in all rural areas. Where these activities are of a scale and size beyond what is permitted by the District Plan there is a potential for their effects to impact on aspects of the rural environment such as visual amenity, rural outlook, spaciousness and quietness. There is also likely to be a higher demand for servicing requirements, such as water supply and stormwater disposal, which may be constrained in some parts of the rural area. Overall, the Council recognises that it may be necessary

> for an industrial activity that relies on a raw material or primary product derived from the rural environment to locate in proximity to its source.
>
> However, the potential adverse effects of rural-based industrial activities that are of a size and scale beyond that which is permitted by the District Plan may be avoided by locating in a Business 2 Zone or in the Rural (Outer Plains) Zone where larger allotment sizes and lower population densities provide greater opportunity for internalising adverse effects. The smaller allotment size and higher population density of the Rural (Inner Plains) Zone means that rural based industrial activities of a size and scale beyond that which is permitted by the District Plan are unlikely to be able to locate in this area without generating significant adverse amenity effects.
>
> The effects associated with other types of industrial activities (i.e. those that are not defined as "rural-based" industrial activities) are considered to be generally inappropriate in all parts of the Rural Zone, except for industrial activities involving the use or extraction of natural resources in the Port Hills, Malvern Hills or High Country. While there is a degree of acceptance for rural-based industrial activities within parts of the rural area, other types of industry are likely to detract from the quality of the rural environment resulting in significant adverse visual effects, increased traffic generation and noise, and a reduction in rural outlook and openness. As such, it is appropriate that these types of industrial activities are directed to locate within Business 2 Zones, unless significant adverse effects can be avoided, remedied or mitigated.

[114] At this point it is necessary for us to consider the definition of the activities proposed so that the relevant directives cited above can be interpreted. *Quarrying* is defined in the Plan as:[32]

> **Quarrying**: means to take, mine or extract, by whatever means, any rock, stone, gravel or sand existing in its natural state in land. "To quarry" has a corresponding meaning.

[115] The term *Industrial Activity* is also defined in the Plan. Quarrying is specifically excluded from the definition of an Industry.

[116] *Rural Based Industrial Activity* and *Other Industrial Activity* are defined terms within the definition of *Industrial Activity*. These subsets are reproduced below:[33]

> **Industrial Activity**: ... For the purpose of this definition an industrial activity is further defined as being either of the following:
>
> (a) Rural Based Industrial Activity: means an Industrial Activity that involves the use of raw materials or primary products which are

[32] SDP Vol 2 Part D Definitions Page D009
[33] SDP Vol 2 Part D Definitions Page D007

> derived directly from the rural environment, including agricultural, pastoral, horticultural, forestry, viticultural and crops.
>
> Or
>
> (b) Other Industrial Activity: means any other Industrial Activity that is not defined as a "rural based industrial activity", as stated in (a) above.
>
> (Our emphasis)

[117] Based on these definitions the concrete batching plant is either a Rural Based Industrial Activity or an Other Industrial Activity. We heard argument for both views.

[118] Ms Flynn in her S87F report also appraised us of other policies which address mitigation of effects from noise and dust. There are also standards and rules which apply to these effects. The parties were however, generally in agreement that the noise standards could be met (we noted the noise exemptions)[34] and the dust could be suppressed provided water was available to do so. We therefore take these particular references in the Plan no further.

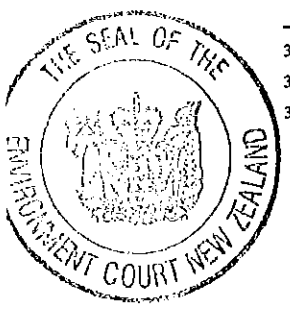
[119] More significantly in terms of the land use consent, traffic matters are triggered by Rule 9.13.2 (they would of course, also be considered under the discretionary activity status of the proposal generally).

[120] The rule provides for 60 ecm/d per site (averaged over any one week period)[35] as a permitted activity. By definition in the Plan, 1 truck movement to and from the property is equal to 6 equivalent car movements and 1 truck and trailer to and from the property is equal to 12 equivalent car movements. On the basis of vehicle movements as agreed by the traffic witnesses[36] the range per day is likely to be between 100 and 200 vehicles comprising:

[a] 26 light vehicles;

[b] 107 single trucks; and

[c] 39 truck and trailers.



[34] SDP Vol 2 Rule 9.16.6.1
[35] Equivalent Car Movement per Day
[36] Joint statement of Andrew Alan Metherell & Rhys Andrew Chesterman [5] & [6]

[121] Thus this element of the proposal would trigger Restricted Discretionary Consent on any basis of calculation of movements.

[122] There are criteria set out in the Plan to assess such activities at Rule 9.13.3. We set these out below:

> 9.13.3 Under Rule 9.13.2, the Council shall restrict its discretion to consideration of:
>
> 9.13.3.1 Any works required to the road to upgrade it to the standards set out in the Council's Engineering Design Guidelines 2001;
>
> 9.13.3.2 Any potential adverse effects of traffic on the amenity values of surrounding residents and on other uses of the road, including (but not limited to) stock droving;
>
> 9.13.3.3 The position and design of any vehicle crossing or vehicle access and egress;
>
> 9.13.3.4 Any positive effects which may offset any adverse effects; and
>
> 9.13.3.5 Any monitoring or review conditions.

Concrete Batching Status

[123] There was argument as to whether the concrete batching plant is in fact an activity specifically identified in the zone or falls into the definition of *Other industry*. We agree with Mr Chapman's view (one would have to effectively put their thumb over the words *raw material* to consider that Rural Based Industrial Activity did not apply), that the concrete batching plant uses raw materials (washed and crushed gravels) directly derived from the rural environment (the site) – it is thus a Rural Based Industry. Thus in terms of the explanation which accompanies Policy B3.4.4 it could be considered appropriate for Outer Plains parts of the Rural Zone.

[124] The consequence of Quarrying being excluded from the definition of an industry is that it is thus an *Other* Activity in the Rural Zone but we note that it is an expected activity by reference to Clause A4.5.

[125] We agree that there is confusion in the plan under the explanation relevant to this policy as Other Industrial Activities are generally considered inappropriate for the

Rural Zone. However, such activities which involve the use or extraction of natural resources have been identified as suitable in some identified locations. The subject site is not within those specified locations. We note though, that in the last sentence the explanation contained in the Plan envisages that in circumstances where significant adverse effects can be avoided, remedied or mitigated, even *Other* types of industries may be considered acceptable.

Dust

[126] We accept that dust is an accepted consequence of many permitted rural activities and this was referred to by many Section 274 party witnesses as intermittent for example associated with the ploughing of fields. The district plan envisages farm tracks formation and maintenance undertaken as of right and allows for a maximum volume of earthworks per project of 5000m^3. The dust rule[37] does require dust associated with stockpiling to be contained within the same site. Thus we anticipate that some dust associated with the use of farm tracks and unsealed roads are accepted parts of the rural environment. However, there is an expectation that more likely dust generators should be managed to protect neighbouring dwellings. We accept that it would be possible for the applicant to manage dust to achieve the usual expectation experienced in the rural zone.

Rehabilitation

[127] The proposal does not meet Policy B1.1.7 in that the land will not be rehabilitated in a sustainable manner as the applicant proposed to us. We have concluded that the land should be rehabilitated in a sustainable manner to meet this policy and avoid contamination of groundwater. By imposing Conditions to achieve appropriate soil depth and permeability, a Consent would not offend these policies.

Groundwater Quality

[128] We consider that the proposal is supportive of policies to protect groundwater through the application of various mitigation measures. For instance, the holding sump for cleaning of concrete truck washwater to manage pH levels and the various Conditions and operational initiatives to manage the storage and use of hazardous

[37] SDP Vol 2 Rule 9.19

materials. We note the rehabilitated soils discussed above would overcome long-term adverse impacts on groundwater.

Expectations in the Plains Zones

[129] Generally there is little distinction identified between the Outer Plains and Inner Plains Rural Zone in the Plan. However, there is an understanding that the Inner Plains generally is a *closer* environment with smaller sized land holdings and that the Outer Plains consists of larger and more spacious landholdings and is thus more likely to be capable of absorbing *Other* types of activities.

[130] This quarry proposal is located entirely within the Outer Plains subset of the Rural Zone but Inner Plains land is proximate to it across the SPB land and Kerrs Road. There are no special controls or buffer yards or any expectations that we can find or that were identified to us, that make any recognition for this characteristic in the District Plan. In fact when we asked witnesses about the general methods used in the Plan for addressing inter-zone boundaries, we were informed the Plan does not tend to address this issue.

[131] The Outer Plains and Inner Plains subsets are just that; as the Plan indicates, there is just one Rural Zone. Thus we tend to agree with the applicant that nothing special can be made of the location of the boundary between these subsets other than that the Outer Plains is more favourable to the proposal than Inner Plains and in that respect the site is within the Outer Plains. We do note that the site chosen has the advantage of the creation of a buffer between the Inner and Outer Plains through the use of the SPB land as offered in Conditions by the applicant.

[132] The scope of activities identified in the Plan for the Rural Zone is broad and the business character of activities which take place in the zone has an impact on the amenity. However, the rural zone is not an Industrial zone but nor is it a Residential Zone. We find that the description provided for it in the Plan is well balanced and it is against this character that the amenity values associated with this site are to be considered. This includes the existing pig farming operation on the site, the dust from pastoral operations and local roads, the traffic character, the ambient noise levels and expected noise effects related to the business of rural activities, the landscape character of shelter belts and open space etc.

Other Plan Matters

[133] On the evidence, we agree that the safe and efficient operation of the roads will not be compromised by the proposal. The roads are capable of safely managing the additional truck movements and the location of the site does not of itself present a situation which results in an inappropriate input of trucks onto the road network.

[134] The Plan addresses quarrying in the rural area through essentially the earthworks rule. The definition of earthworks includes the excavation of earth or any other mineral derived from the ground. Quarries are thus not specifically "*planned for*" in the sense of the Yaldhurst Quarry Zone in Christchurch City.

[135] The Section 274 parties correctly noted that the SDP contains designations for quarries and this appears to be an historical characteristic when Councils operated quarries to manage roading construction and maintenance. Given that most of these designated quarries are not in operation this would tend to confirm that general observation.

[136] This District Plan is *effects based* and relies on the consideration of the generated effects of the quarry activity in relation to a number of environmental outputs (e.g. noise, dust, traffic) to ascertain its suitability. This technique is less certain and does provide the element of surprise local residents identified to us of having such a proposal pop up near them. However, that does not of itself render the activity unsuitable. If the activity can meet the assessment required of it in terms of environmental effects (which we will address shortly) it is in our view anticipated by the Plan and likely to be in accordance with the objectives and policies therein. The grant of consent is then still a matter of discretion under Section 104(1) of the Act.

[137] In relation to Objective B3.4.2 we have noted the commentary provided in the Plan under the heading of Reverse Sensitivity[38]. We perceived a real concern from the Section 274 parties that once established the Plan would protect the activity over the other existing established activities in the area. We note however, that the assessment of the proposal has included assessment against the existing environment and overall environmental amenity expected in the area. Any consent will have attached to it Conditions and Performance Standards which the activity is obliged to

[38] SDP Volume 2 Part B Page B3-043

meet. Thus there will be certainty regarding performance and generated effects which will be able to be enforced through the Consent.

[138] Overall, we do not find the proposal to be contrary or even inconsistent with the provisions of the SDP provided that Conditions we have identified and others identified by the applicant are in place.

ENVIRONMENTAL EFFECTS

Positive Effects

[139] The production of the gravel and ancillary concrete batching plant proximate to a developing area has benefits in terms of the reduction in effects caused from travel (e.g. air discharge, energy efficiencies, cost efficiencies). The proposal will also meet at least in part, the future needs of the community for building materials especially since the Canterbury earthquakes.

Potential Adverse Effects

Water Allocation Issues

[140] The application lists the following annual requirements for water:

Annual Requirements for Water		
	Cubic metres (m^3)	Average Litres per second (l/s)
Aggregate plant for washing	341,550	10.51
Concrete for mixing and washing	3,760	0.12
Truck washing	3,795	0.12
Dust suppression	4,515	0.14
TOTAL	**353,620**	**11.12**

[141] Apart from the figures for dust suppression these values were not disputed. We address the dust suppression issue later.

[142] We note the above figures do not include irrigation of shelter belts and rehabilitation areas nor water for use in the office and workshop.

Water Supply

[143] Road Metals holds Consent CRC062825.2 to take groundwater from bore M36/8125 located on the SPB land. A maximum flow of 10*l*/s is authorised. This may be used for dust suppression and irrigation on the Plantation Board land and on the site.

[144] Road Metals is seeking through Consent CRC110680 to take up to 32*l*/s but not more than 1,308m^3/day or 353,620m^3/yr from proposed bore M36/20600 on-site. The water will be used for gravel washwater, truck washwater, concrete production, dust suppression and domestic/potable supply for the office and workshop.

[145] It is acknowledged by all parties that the Selwyn-Waimakariri Zone is over allocated. In such cases Policies WQN13.2(2)(d)(ii) and WQN13.2(2)(d)(iii) of the NRRP require the applicant to demonstrate that the proposed take, in combination with all other takes from the water resource, will not compromise the reliability of supply for those with bores within 2km of the proposed bore. The explanation for Policy WQN13.2(2) states in part:

> Other takes that ... will return the same amount of water downstream ... may also be authorised and not be counted as part of the allocation block.

[146] Further, the Plan indicates that the status of the take does not change if it is considered to be non-consumptive. There is still a proposal to take water which requires consideration as a non complying activity. The character of the take being considered (overall non-consumptive), simply means that it can be considered to be consistent with the objectives and policies due to this characteristic. Thus as we have discussed earlier, the success or otherwise of the proposal relies on it being determined that the amount of water taken will be returned to the aquifer. If this is a consumptive take it would be contrary to objectives and policies of the Plan.

[147] In essence, there are two major issues for the court to consider with respect to Consent CRC110680:

[a] whether or not the take would result in a consumptive take; and

[b] any effects the bore may have on neighbouring bores when pumped at 32*l*/s.

Is the water take non-consumptive?

[148] Consent CRC110680 seeks to take water from an on-site bore that can be used, amongst other uses, for dust suppression. This bore has been shown capable of providing 32*l*/s which is ample for the applicant's envisioned on-site use (annual average rate approximately 11*l*/s).

[149] It is the applicant's contention that the amount of water lost to the groundwater system through consumptive aspects of quarry operation is more than made up for by the additional infiltration from rain water that will occur through the removal of top soil. The consumptive aspects identified were concrete-making and dust suppression. Other aspects were identified by the appellant as non-consumptive because water was returned to ground. We agree that the only water that can be taken into account in this regard is the water that is not lost to the system as it formerly was because of the removal of top soil. In this regard there seems to be a level of agreement between the parties as to the volume of water the system would gain by this mechanism. Mr Callander's estimate was an increase in annual average recharge rate of 1.18*l*/s. This was not disputed.

[150] Mr Callander estimated that on an annual basis some 95% of the water taken for use on the site would be returned to the groundwater system by way of direct soakage and through the settlement ponds. This estimate assumed various proportions of the differing water uses, including none of the estimated 4,515m^3/yr anticipated for use in dust suppression would recharge groundwater. This results in an annual average loss rate of 0.54*l*/s which is less than his estimate of 1.18*l*/s for the increase in annual average recharge rate. The take is thus non-consumptive in his view.

[151] We recall that irrigation water was not included in Mr Callander's estimates. The bore on the SPB land is consented for irrigation water used on the site. Thus provided all irrigation water is sourced from that bore it does not enter into the consumptive/non-consumptive calculation.

[152] For the annual average loss rate to equal the accepted increase in annual average recharge rate of 1.18*l*/s some 24,300m^3/yr would need to be abstracted from

the on-site bore and used for dust suppression or concrete manufacture. Such an amount is within the range of amounts suggested by the parties who challenged Mr Callander's estimate of 4,515 m^3/yr. In particular, Dr Rutter suggested 20,000m^3/yr would be required. Dr Curtis suggested 132m^3/day which if applied over, say, 190 days,[39] the annual volume required is 25,080m^3 which is somewhat larger than Dr Rutter's suggested value and more than five times that estimated by Mr Callander. To this is added some of the water for concrete washing and mixing.

[153] To ensure a non-consumptive take we have concluded that the applicant will need to source some water for dust suppression from the SPB land bore and may choose to source it all from that bore. There is sufficient flow from the bore for this. This could be done by requiring:

[a] No more than 5,000m^3/yr for dust suppression or irrigation from the on-site bore;

[b] That the applicant have at least 20,000m^3/yr available SPB for use on the quarry site for irrigation and dust suppression for 7 years from commencement of the consent.

[154] We have chosen this period to allow data to be collected on actual dust suppression requirements and to coincide with the termination of the SPB water consent. There will need to be a review clause in the Condition in order that variations based on data collected can be addressed.

[155] Thus whether the proposed take itself can be considered to be non-consumptive turns on the volume of water used for dust suppression and possibly on its source. Based on the evidence, we agree, that even allowing for the highest estimate provided to us for dust suppression, the proposal is likely to achieve a positive water balance and thus be a non-consumptive take.

[156] However, in order to ensure the take is, and can be seen to be, non-consumptive a number of conditions need to be met:

[39] Dr Williams suggests there may be between 169 and 207 dry days per year

[a] The total volume of water from each source needs to be controlled and thus measured and recorded to establish compliance;

[b] The volume used for dust suppression and concrete batching needs to be measured and recorded;

[c] Conditions need to be imposed and met to ensure the envisaged recharge occurs;

[d] An annual water balance in the form presented by Mr Callander must be prepared each July showing the actual water balance for the previous 12 months (July 1st - June 30) and submitted to the Regional Council by each August 1st. The balance must allow comparison of the average annual net abstraction rate with the increase in average annual recharge rate from rainfall on the open areas (estimated using the same methods and parameters as used by Mr Callander in preparing his evidence);[40]

[e] Should the water required for dust suppression exceed 5,000m^3 in any one 12-month period during the first 7 years the excess must be sourced from the SPB bore. During this period information as to dust generation and the associated water requirement is to be gathered; and

[f] There be provision and a mechanism for the review of the above conditions (and maybe the Consent) at the end of 7 years operation.

[157] Accordingly, should consent be granted, the Court will ensure the Conditions imposed are such as to ensure the water take from the site bore is and can be seen to be non-consumptive. The difficulty arising is that if it is consumptive, provisions would need to address the urgent review of the Conditions and even Consent. In the absence of the SPB water consent we would be looking at a risk with very high consequences. Thus, it is the ability to utilise this extra source during the set-up period which convinces us that the Consent can achieve non-consumptive status.

[40] Callender, EIC, Table 6

Effects on neighbouring bores

[158] As well as being non-consumptive, the take must have minimal effects on other bore users. Acceptable effects are dealt with in the Plan by defining acceptable drawdown in neighbouring bores.

[159] Road Metals commissioned a pump test of their proposed bore M36/20600 to determine aquifer parameters from which drawdowns in neighbouring bores could be estimated. The parties acknowledged the tests were done appropriately and the data recorded correctly. However, the interpretation of the data between the parties differed markedly. Values were agreed for Transmissivity and Storativity but there was no agreement as to the value of specific yield, σ.

[160] Mr Callander asserted a value of 0.1 which he claimed was typically used for Canterbury gravels. He cited a number of references in support and noted that a value of $\sigma = 0.1$ gave matches between calculated upper and lower bounds for drawdown curves and the measured values in five observation bores.

[161] Dr Rutter and Dr Williams fitted analytical curves to the measured data to derive σ values of between 0.01 and 0.003 depending upon the assumed value of a leakage parameter. The curves matched well along their full length and not just at the upper and lower bounds. To obtain the most conservative result (greatest drawdowns) they recommended $\sigma = 0.003$. Mr Callander feels that such a low value is not realistic given the nature of the strata at the site.

[162] The value of specific yield, σ, is important because it strongly influences the magnitude and slope of drawdown curves at neighbouring bores. Smaller values of σ result in more rapid and larger drawdowns.

[163] There is no question Road Metals bore, in combination with all other bores, will affect neighbouring bores. The NRRP does not require zero effects on neighbouring bores. It allows 20% of the available drawdown at low water levels for bores which adequately penetrate the aquifer. Adequate penetration is defined in Schedule WQN10 of the NRRP as being deeper than 50% of all bores within 2km which penetrate the aquifer and were established prior to 1 January 2002. Bores not meeting this requirement are assigned a depth equal to the median depth of all bores within 2km for the purposes of estimating drawdown effects. While this may seem an

arbitrary approach it is the one required by the NRRP and we must take cognisance of it.

[164] Using his value of $\sigma = 0.1$, Mr Callander calculates that no bores within 2km of the proposed bore will experience drawdowns in excess of that contemplated as acceptable by the NRRP. Inadequately penetrating bores in Mr Callander's analysis were all given an assumed depth in accord with Schedule WQN10 of the NRRP.

[165] Dr Rutter using a value of $\sigma = 0.003$ calculated that 61 bores would be affected. She acknowledges that the WQN10 approach does not allow for recharge to the aquifer and thus it is an overly cautious approach. We are not clear as to what Dr Rutter meant by affected, whether she meant there was some drawdown or if she meant the drawdown allowable under WQN10 was exceeded.

[166] Dr Williams was also of the view that many bores would be affected by the proposed pumping. He stated his calculations did not account for inadequately penetrating bores. Again, we are not sure exactly what Dr Williams meant by affected.

[167] Each of the above estimates of the number of bores affected assumed took no account of the recharge to the aquifer upon which the non-consumptive nature of the proposed take relies. Dr Williams acknowledged the recharge would reduce the number of affected bores but did not quantify this. Both he and Dr Rutter raised concerns about the timing and the mechanisms by which recharged water would reach the aquifer. They felt the recharge may not be as effective at particular bores as might be thought. This issue was not explored in any detail by any expert.

[168] Dr Rutter raised the possibility of there being a shallow aquifer to the south east of the site. This possibility was endorsed by Dr Williams but rejected by Mr Callander. If there is such an aquifer then ignoring it would bias the results towards fewer bores being affected.

[169] As a court we are left in the difficult, but not unusual, situation where recognised experts disagree over significant matters. Our view is that the possibility of interference in excess of that allowed by WQN10 cannot be ignored. This view is shared by the applicant who has proposed a mitigation condition viz. Condition 4 of proposed Consent CRC110680. Essentially, the condition would require Road Metals

to ensure no bore owner was affected by the cumulative effects of all bores in the area in accord with the requirements of Schedule WQN10 of the NRRP.

[170] In short, we cannot conclude that the effects are minimal. They must be taken into account in the exercise of our discretion under Section 104(1) of the Act. Moreover, we cannot be certain they will meet WQN10 as acceptable. Thus, a Condition to comply is required.

[171] The Court agrees with the intent of Condition 4 but prefers Dr Rutter's formulation as set out in her Supplementary Statement[41]. If consent is granted this formulation will be adopted. Again we note that in the event the effect is greater than permitted, the applicant and Council do have the prospect of utilising the SPB abstraction consent, at least until its expiry, and in respect of irrigation and dust suppression only.

Treatment and disposal – discharge to ground

[172] Water is used in a variety of ways during the quarry operation. Each requires appropriate treatment and subsequent disposal. We now consider how this is to be achieved.

Gravel Washing

[173] Water is used to remove unwanted fine quarried materials from the aggregate during its crushing and sieving. Some 341,550m^3/yr will be sourced for this purpose from on-site bore M36/20600. A small portion of this water will remain with the aggregate, be transported to the stockpiles and will either evaporate or leave the site with the aggregate.

[174] The major portion of gravel washwater will be conveyed to the settling basins and discharge to ground either through the base or sides of the basins. The entrained sediments and silts will be retained in the basins and removed to be spread on the quarry floor to dry and be sold or used as backfill. Mr Callander estimates 97% of the gravel washing water will infiltrate and recharge the groundwater system.

[41] Rutter, Supplementary Statement, 2 April 2012, page 3

[175] Parties expressed concern that at 10m below ground level the base of the settling basins and the quarry floor may be close to or at the groundwater surface level. If so, this would allow easy access to groundwater for contaminants. A buffer zone of 1m down to the groundwater surface was suggested by the parties.

[176] In response to this the applicant has proposed a Consent Condition (Condition 10 of CRC110671) the intent of which is to firstly monitor groundwater levels for 18 months and thus better define the maximum expected levels and then to limit excavation to those levels. We support the intent but have reservations, namely: the settling basins can be excavated to 10m below ground level during the monitoring period, and no buffer zone will be provided between the quarry floor, and possibly the settling basins, and the groundwater surface.

[177] Given the nature of the water entering the settling basins we accept the risk of groundwater contamination from them is slight. The risk is greater from the floor of the quarry. We do not accept that Condition 10 will fully address this need for a buffer zone between the ground water level and the quarry floor. At least 1m should be provided as a buffer and the Condition needs to be amended to clearly reflect this. The result after the investigations set out in Condition 10 have taken place may be that the quarry floor level cannot be excavated to -10m.

Gravel Truck Wash

[178] An estimated 10 trucks per day are to be washed using approximately $14m^3$ of water per day. A detergent will be used. Condition 2 of Consent CRC110676 requires all the gravel truck washwater to be collected and discharged to a depression sump. This is a concrete lined sump with a minimum capacity of $50m^3$. Any solids will settle out and if treatment is required it can be done. The water will then be conveyed to the settling basin for infiltration.

[179] We are satisfied that this approach is adequate to protect the groundwater system from any effects due to infiltration of gravel truck washwater and note the applicant's proposed Conditions.

Concrete Plant

[180] Water from the onsite bore is used at the concrete plant for mixing, 2,686m^3 annually, and for washing the agitator bowls, approximately 1,100m^3 annually. The former goes off site while the latter may require treatment before discharge to ground.

[181] Parties were concerned about the possibility of the washwater discharges to ground having very high pH values, possibly as high as 12. As such there is a real possibility of groundwater reaching pH values in excess of 8.5 and thus exceeding drinking water standards.

[182] The applicant proposed that through Condition 14 of the Consent CRC110676 the consent holder will be required to direct the concrete washwaters to the depression sump. There the pH will be determined and if greater than 9.0 it will be reduced to below 9.0. Failing that, the washwater will need to be disposed of in a specialist facility.

[183] If the washwater is regularly disposed of in a specialist facility, which will almost certainly be off site, it can no longer be considered in the consumptive/non-consumptive calculation. The amount involved is some 1,100m^3/yr which is 0.33% of the water which is recharged. As such its loss to the system will not change the take from non-consumptive to consumptive.

[184] We are satisfied this approach is adequate to protect the groundwater system from possible contamination by the concrete washwater.

Potable Water

[185] The volume involved here has not been quantified in evidence but will be small in comparison with that of other uses. Wastewater treatment is proposed by septic tanks: 1,800*l* for the office and 4,200*l* for the workshop. No figures for potable or wastewater were given. Although minor, we should have been supplied with these figures which have been ignored in the total consumption calculations.

Finding

[186] Apart from the lack of a buffer zone between the quarry floor and the maximum expected groundwater level, which we expect the parties to consider, we are satisfied that appropriate and sufficient measures are required by the proposed Conditions to protect the groundwater system from infiltration by waters used on-site.

Stormwater

[187] It is proposed that stormwater from the roofs of the office and workshop will be discharged to sealed soak pits which are separate from all other stormwater systems. The pits will be designed for a 10 year 1 hour storm. For larger storms the excess water will be discharged directly to ground. This regime does not take cognizance of policy in the NRRP which encourages the capture and reuse of stormwater. We suggest that such an initiative is relatively easily accommodated with a tank allowing capture and storage of roof stormwater and the reuse of greywater for flushing toilets. We consider that the applicant should give consideration to including this arrangement in its final design, or at a minimum the reuse of greywater.

[188] An infiltration swale will collect stormwater from the sealed entrance way and the weighbridge area. The swale will have a capacity of at least 299m^3, be lined with a topsoil/sand mixture at least 150 mm thick and have limits on its infiltration rate. Stormwater from compacted and unsealed areas will be discharged to adjacent gravel areas.

[189] Stormwater from the truck wash pads will be directed to the depression sump for infiltration. That from the concrete refuelling pad may contain hydrocarbons and will be directed to an API interceptor for treatment prior to disposal via a soakage chamber. Stormwater from the area surrounding the concrete batching plant will be discharged to a gravel soakage area. The area will cope with a 10 year 1 hour event, be lined with at least 150 mm of a topsoil/sand mixture and have limits on its infiltration rate.

Infiltration from placed hardfill

[190] Parts of the site are to be excavated to 10m below ground and then filled back up to 4m below ground with inert fill material most of which will be derived from

roading and demolition operations. Condition 3(a) of proposed Consent CRC110672 identifies the types of material that may be used for hardfill while Conditions 4 to 8 inclusive set out how the filling process is to be managed. Measures include supervision of receipt and acceptance of material, fencing of filling sites with one lockable entry and detailed record keeping.

[191] It is passage of stormwater down through the 6m of hardfill to the underlying gravels that is of concern. Dr Rutter listed this as a possible source of groundwater contamination but noted that with good practice the risk would be low. The Joint Statement on Stormwater and Contaminated Water from the Regional Council and the applicant did not mention this issue. The parties thus seem satisfied to rely on the control measures that will be imposed to ensure the hardfill is indeed "*cleanfill*" as it is often referred to in evidence. We are also satisfied in this regard.

[192] Proposed Conditions for Consent CRC110678 *Discharge Stormwater to Land* require the above treatments and set design parameters for each system. The concerns raised by parties have been largely addressed and thus with the possible exception of lining for the depression sump (or sumps) we see these Conditions as appropriate and sufficient to ensure safe discharge of stormwater from all areas of the site.

Monitoring

[193] The Conditions that may be imposed minimise but do not eliminate the risk of adverse effects on the groundwater system from the hardfill areas. A monitoring programme has thus been suggested by all parties and accepted by the applicant. Conditions 9 to 18 inclusive of proposed Consent CRC110672 detail the suggested programme.

[194] Three monitoring bores are to be constructed prior to the commencement of activities and at least 12 months prior to the deposition of any hardfill. Ms Torgeson notes that Consent CRC110681 allows construction of these bores. Further monitoring bores are required to be installed as the excavation proceeds in the south westerly direction across the site. Consents for these will need to be sought in due course.

[195] One bore is to be "*up gradient*" in the northwest corner of the site. Two other bores (the down gradient bores) are to be located adjacent to the boundary with the

Selwyn Plantation Board land, one approximately 300m from Wards Road, the other some 600m from Wards Road. The locations are given in detail in Condition 9(d) and by reference to Plan CRC110672C. There appear to be some words omitted from Condition 9(d) and the plan referred to does not reflect the now proposed entrance way and reconfiguration of the Depot Area.

[196] The parties are directed to confer and correct these deficiencies.

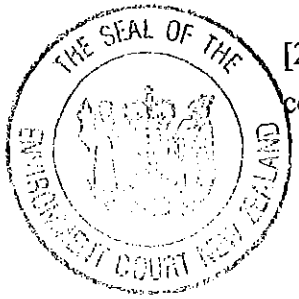
[197] Ms Scott opined that the down gradient bores should be spaced a maximum of 100m apart to increase the likelihood of intercepting a "*high velocity pathway*" which may be of limited lateral extent. Dr Rutter concurred with Ms Scott. A 100m spacing is still arbitrary and may miss the envisioned pathways. We believe a better solution is to monitor a selection of domestic bores, say biannually, in the down gradient direction as this is where the problem, if there is one, will manifest itself.

[198] Should the monitoring as proposed "*clearly demonstrate that the exceedances in concentration are attributable to discharges from the hardfill areas*" the applicant shall undertake sampling of potentially affected down gradient bores and "*implement all necessary measures to reduce the concentration of the contamination in groundwater.*"

[199] This seems to us to be insufficient. The applicant is not required to act should results of the sampling of potentially affected domestic bores be unacceptable. We have concluded that if the water in these bores is shown to be affected, then in keeping with the response to drawdowns beyond those permitted by the NRRP the applicant must provide a potable water source to any affected domestic bore owner. Drilling a deeper bore, piping water from the applicant's bore or using water tankers are all possible solutions that should be considered.

[200] The parties should confer to formulate suitable Conditions to achieve the above outcomes and provide some assurance to domestic bore users down gradient of the hardfill areas.

Dust generation and control



[201] All parties agreed that the suppression of dust generated on-site and the control of dust leaving the site were important issues. We now set out our

understanding of these issues and of the measures proposed by the applicant and the Regional Council to control them. These include a suite of Conditions on proposed Consent CRC 110675 *Discharge to Air* and the implementation of a Dust Management Plan (**DMP**)

[202] Dust will arise from the following activities:

[a] Earthworks including stripping of overburden and topsoil;

[b] Vehicle movements on unpaved surfaces;

[c] Loading, transport and unloading of materials including deposition and placement of hardfill;

[d] Wind generated dust from exposed surfaces;

[e] Rehabilitation including placement of topsoil;

[f] Crushing and screening of materials;

[g] Conveyors; and

[h] Concrete batching plant.

[203] A Joint Witness Statement addressing air quality reported on a caucusing between the three experts namely: Ms Harwood for the applicant, Mr Curtis for the Georgesons and Mr Iseli for the Regional Council. They addressed those matters over which there was disagreement as expressed in their respective briefs of evidence. The outcome was a modified DMP and an agreed set of Conditions.

[204] The Joint Witness Statement concluded:

> There are no matters with respect to the potential for effect, or effectiveness of mitigation, if appropriately implemented, which we disagree on.

[205] There are however some matters on which the court wishes to comment. We agree that the differences expressed during the hearing over wind speeds, direction and frequency and as to the number of rainy days during a year were not of

significance. The important matter was that the applicant control dust emissions at all times whatever the weather and that there be appropriate monitoring with trigger points and detailed responses. These were addressed and agreed by the experts and set out in their suggested Conditions and DMP. Should consent be granted it would be subject to the court approving this plan.

[206] The availability of sufficient water to control emissions was a concern to the experts. They were unable to "*determine the actual quantity of water that may be required on the site*" and agreed the volume suggested by the applicant would be insufficient to meet commonly used application rates over the areas expected to be open.

[207] Should Consent CRC110680 be granted, water for dust suppression could be sourced from bore M36/20600 on the site. To ensure the take from this bore is non-consumptive we will require that only 5,000m^3/yr for dust suppression can be taken from this bore. This is in excess of the applicant's estimate of the quantity required annually. Should extra water be required, as suggested by Dr Rutter and Dr Williams, it can be obtained from the bore on the SPB land. We will require the applicant to ensure 20,000m^3/yr are available from this bore.

[208] We understand that maximum need for dust controls is likely to be in the early years of the quarry when vegetation is still new and the quarry is closest to the Georgeson property. Thus, as the SPB bore is available, for some seven years at least, we are satisfied alternatives can be developed, and quantities required known, in the intervening period.

[209] There is the additional control available under the proposed Consent of chemical dust suppression and the ability of the Regional Council to review the Conditions of the Consent.

[210] Continuous monitoring is to be undertaken of wind speed and direction from one station and of total suspended particulate (TSP) from two stations. For the first two years one TSP station is to be located near the north eastern corner of the site near the Craw's property and the other on the Kerrs Road boundary within 400m of the intersection of Wards Road and Kerrs Road. After two years the locations may be changed to better cover the location of the activity at that time.

[211] Consented activities on the site, apart from dust suppression, must cease when monitoring shows stated trigger levels either of wind speed or TSP concentrations are exceeded. This only affects consented activities and thus permitted activities such as farming and ploughing on the site are correctly not included. We see this as a good approach and agree the stated trigger levels are appropriate.

[212] There are two other Conditions which if they are met will cause site activity to cease. These are if the consented activities cause "*visible suspended particulate matter beyond the boundary of the consented site*" and if consented activities cause discharge of dust "*which is offensive or objectionable beyond the boundary of the property ...*"

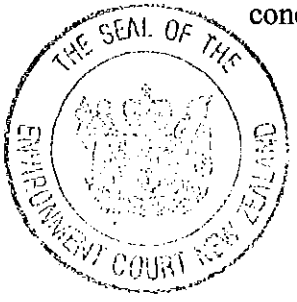
[213] The Regional Council tabled a good practice guide to controlling dust emissions which we have found helpful. In particular, we note the following statement:

> Some councils have used the term "discernible dust" in preference to "offensive or objectionable". Obviously this places a much tighter level of control on activities which may be appropriate in some urban areas. However it may be unnecessarily restrictive in industrial and rural locations.

[214] The area we are concerned with is zoned rural whether Inner Plains or Outer Plains. As noted earlier primary production is a significant aspect of the area, although other activities, including mineral extraction, a prison and an army base, all contribute to the character of the area. Accordingly, we consider that in this environment a condition based on "*visible particulate matter*", which we equate with discernible dust, is unduly restrictive and should be deleted.

[215] This leaves the control to be based on discharge of dust which is "objectionable or offensive" in keeping with the tabled Good Practice Guide and Policy AQL6 of the NRRP. It also is in line with the District Council Consent Condition 4.

[216] The Georgesons raised the issue of animal health and fugitive dust emissions. They see a risk that dust might seriously affect the health and wellbeing of racehorses and young breeding stock on their land. The concern lies principally with the concentrations of PM_{10} the finer fractions in a dust sample.



[217] Mr Curtis, for the Georgesons, stated in his evidence that, based on discussions with an expert on the topic, if dust concentrations are kept at levels which are safe for humans they will also be safe for horses. The experts agreed this was the case and further that the PM_{10} concentrations would be controlled by the limits placed on the total dust concentrations. These limits, the experts agree will ensure the site complies with the National Environmental Standard for PM_{10} emissions.

[218] The area to be sealed to prevent dust generation is addressed by a Condition in the proposed SDC Consent (Condition 36) and again in the Regional Council Consent CRC110675 (Condition 13(a)). This requires sealing from the entrance on Wards Road along the access-way to the site boundary and then along the south eastern site boundary to the processing plant. The DMP suggests the sealing will only go as far as the concrete batching plant. We endorse the extended length of the sealing and will require the DMP and Conditions to be amended accordingly.

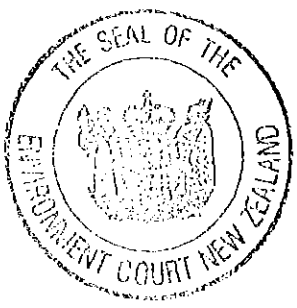
[219] The area around the office and weigh bridge, which are both at ground level, must be sealed as will the adjacent parking area. We also see advantages in providing a sealed area in the vicinity of the workshop. The refuelling pads and hazardous substances area would be part of this. A sealed access-way from the sealed area along the south eastern boundary should be provided.

[220] Neither the suggested Conditions nor the DMP refer to a wheel washing facility. It would be appropriate to install such a facility near the weigh bridge. We ask the parties to consider this and to respond on the issue.

[221] Proposed Condition 29(c) requires the DMP to be reviewed annually but does not say by whom. The words *"by the consent holder in consultation with the Regional Council and the Community Liaison Group"* should be added to the Condition.

[222] The provisions set out in the DMP for dust control are minimal. We require more detail for example:

[a] What response is expected from the person responsible for the TSP and wind monitoring systems when his/her cell phone rings?



[b] How will the automatic sprinkler system be activated and what will it cover – stock piles, currently open area?

[c] How will dust control operate at night when the site is closed?

[223] With the exception of the Conditions referred to above we are satisfied with the Conditions proposed by the experts. The thrust of the DMP is appropriate but it will need to be modified to reflect the court's discussion above and submitted to the court for approval.

Rehabilitation

[224] Rehabilitation of quarried areas serves to minimise open areas and thus dust generation and to prepare the land for post quarrying use. There are three components to the rehabilitation:

[a] Establishment of pasture on the quarry floor at 10m below ground level;

[b] Establishment of pasture on the batters reaching from ground level to the quarry floor along all boundaries of the site; and

[c] Completion of quarrying at the site and removal of the bunds around the site with the land upon which the bunds have been constructed established in pasture.

[225] The process involves covering the exposed area with topsoil and sowing with lucerne or a suitable pastoral alternative. This will be done on a progressive basis as the excavation face moves forward. Topsoil will be removed from the area in front of the face and placed in the current excavation area or on the hardfill batter slopes as required.

[226] The Application documents suggest that up to 3ha could be stripped and there may be up to 3ha of exposed quarry floor at any one time. This will require careful management to ensure the open area does not exceed the permitted 9.4ha. This must include the unsealed or not otherwise treated depot area and the stock piles.

[227] Conditions currently attached to the proposed District Council Consent require the rehabilitation to be undertaken in accordance with the method and timing specified in the application. They also require irrigation to ensure establishment of the pasture. This water will need to be sourced from the bore on the SPB land. There is ample available from this source.

[228] Condition 16 of the CRC Consent CRC110671 also addresses rehabilitation. We find this Condition most unsatisfactory, for the following reasons:

[a] The Condition begins, *"Once excavation of aggregate is complete the consent holder shall undertake the following rehabilitation works"*. Excavation of aggregate is expected to continue for some 100 years with rehabilitation occurring progressively all this time. We suggest the wording referring to the Application's description of the rehabilitation process as used in the District Council Condition be used here;

[b] Condition 16(b) requires a minimum thickness of topsoil of 0.3m. This is not in accord with the method specified in the Application, which refers to a minimum thickness of 0.35m, and thus inconsistent with the District Council Condition. However, we have concluded that a Condition similar to the Yaldhurst site Condition should be required on this site:

> Following progressive excavation to the maximum depth, the consent holder shall cover the bed of the extraction area with a layer containing silt of a minimum thickness of 500mm. This silty layer shall have an infiltration rate not exceeding 500mm/hour and shall be contoured so that infiltrating water does not run off across the top of the layer. Topsoil to a minimum depth of 300mm will be reinstated above this silt layer and planted in grass. Design plans that confirm this is achieved shall be submitted to Selwyn District Council, Canterbury Regional Council, and Community Liaison Group prior to the layer being placed.

[c] Condition 16(c) requires measures *"to prevent dust discharge from rehabilitated areas"*. One suggested measure is *"regrassing of the reshaped area within 60 days of placement of the final topsoil capping"*. This would seem to refer to the area to be rehabilitated and not to the rehabilitated area.

[229] Condition 19 of proposed Consent CRC110675 also deals with rehabilitation. It acknowledges that it will be progressive and requires completion within six months of extraction ceasing in a particular area. This contrasts with the above where 60 days are mentioned.

[230] We require the applicant and the Regional Council to consider the above and formulate more suitable Conditions for these two consents which are consistent and clear. They should also consider drafting a Condition requiring maintenance, and even watering, of the developed pasture to a standard commonly found on neighbouring pastoral properties. Dust generation within the site will thus be reduced from those areas which are currently in poor or no pasture.

Traffic

[231] While the traffic engineers were in agreement relative to the technical adequacies of the roading network (safety and efficiency) the matter of amenity effect on surrounding residents and other users of the road remained live. We heard evidence regarding horse riding, bicycle riding, school children and training military personnel using the roads. However, we found it difficult to find issue with amenity values when the road network could be expected to carry trucks irrespective of this quarry location. That is, a quarry located elsewhere serving the local Rolleston area may well utilise the same road network.

[232] We understood that much of the concern was centred on the operation of the trucks as much as which routes they might take. The Court is familiar with driver protocols being employed in other cases to manage driver behaviour. It is accepted that not all trucks driven to the site will be driven by drivers employed by the operator but it is reasonable to expect that drivers using the facility could be made aware of the protocols and required to abide by them to operate from the site. This would provide awareness for the drivers and an avenue for other local road users to report bad behaviour which could then lead to enforcement of protocols.

[233] The applicant has presented us with a draft Condition which suggests a code of conduct for drivers of vehicles where those vehicles are under the control of the consent holder. This is to be included in the Quarry Management Plan. We anticipate that there could be protocols included in the management plan which also see that code being provided to other drivers accepting the fact that their behaviour will not be

able to be managed by the operator but the information will assist in driver education. Thus we consider that there is a practical mitigation measure available to address the adverse amenity effects associated with truck movements generated by the proposal. We would require the suggested Quarry Management Plan Conditions to be amended accordingly if Consent is granted.

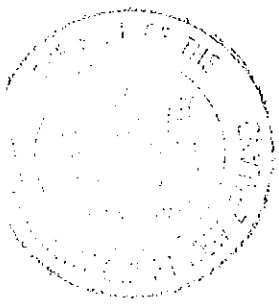
Noise

[234] The District Council requires as a Condition of its Consent that a noise management plan be prepared and sets minimum contents for the plan. This is an appropriate approach but we think it should mirror that used for the Dust Management Plan. Condition 33 of the District Council Consent should be redrafted along the lines of Condition 29 of Consent CRC110675. In particular it should specify the Council officer who will be responsible for certifying the plan and contain a provision for annual reviews. The reviews should be done by the applicant in consultation with the District Council and the Community Liaison Group.

[235] Consideration of noise effects falls into three areas: construction noise, operational noise and traffic noise on and off the site.

[236] Construction activities are to be managed in accordance with the provisions of NZS6803:1999 Acoustics-Construction noise. Any noise generated by construction activities will have to comply with the limits set out in the Standard. This is the normal approach to control construction noise and is appropriate for this site. Construction activities are defined in a District Council Condition. They are expected to last for up to 18 months. Topsoil stripping and construction of bunds are ongoing construction activities. They will be limited to periods not exceeding three weeks at any time. However there is no stipulation as to a minimum time between periods of activity.

[237] Operational noise was addressed by the experts Dr Trevathan for SDC and Mr Camp for the applicant who produced a joint statement of evidence. They noted there were no points of disagreement and made suggestions for changes to the proposed District Council Conditions.



[238] With two exceptions their suggestions have been adopted in the most recent draft Conditions. We note the hours of operation are more restrictive than proposed by

the experts namely a 06:30hr start rather than a 06:00hr start and have no problem with this. The experts suggested limiting the location of the concrete batching plant to that shown on a Marshall Day plan. This has not been brought into the Conditions. We believe it better to nominate a site for the batching plant and recommend that shown on The Alternative Entrance Plan dated 10 August 2012. This plan is referred to in Condition 1 and could well be attached to the Consent.

[239] Noise associated with traffic movement on roads is not controlled by the District Plan. The suggested code of conduct for drivers should refer to noise emanating from trucks and urge drivers to keep this to a minimum. In response to s274 parties' submissions on road noise the experts agreed that a small number of night-time heavy vehicle movements between 06:00hr and 07:30hr and also between 03:00hr and 06:00hr on a limited number of occasions per year is acceptable. Accordingly their suggestions of a limit of 4 truck movements to and from the site in any 60 minute period prior to 07:30hr and that the public not be admitted to the quarry before 07:00hr are reflected in the proposed Conditions.

[240] Noise at the point of entry and on the site can be controlled by Conditions. We note the alternative entrance location will provide reduced noise levels at the Craw's residence from trucks entering and leaving the site.

[241] Ultimately the noise control lies with the allowable limits given in the District Plan. The applicant has adopted a more stringent regime. This involves measuring noise compliance at or within the boundary of any other site not owned by the applicant. The plan requirement is for compliance at the notional boundary of any dwelling.

[242] We are satisfied that the relevant noise rules of the plan can be met and that the proposal meets the general acceptability of the noise environment in the Rural Zone.

Rural Character and Amenity

[243] We have discussed the character of the existing environment and have noted the district plan references which assist us in understanding the environmental outcome expected here. We note the Council's Section 87F report discussion on the quality of the environment and the references to the expectation for primary

production and other business activities to occur. As we have indicated, the area is rural and not residential as appeared to be a suggested focus of many of the Section 274 parties and the Rolleston Rural Residents Inc.

[244] The character of a rural area has been usefully set out in the SDP and was addressed earlier in this decision. We have considered the likely adverse generated effects of the proposal above, and these effects are generally easily measured effects which we have concluded can be mitigated through appropriate management. However, the measure of *rural character and amenity* as a concept in itself, is more difficult to assess and relies upon a number of variables. We would summarise these in broad terms to be:

[a] An assessment of the character of the existing environment.

[b] The character of activities expected in the area.

[c] The degree of compliance with environmental standards relevant to the area.

[d] An overall judgment as to the effects associated with the proposal in the context of these matters.

[245] The first point is that simply meeting the environment standards prescribed for permitted activities in the area does not mean that the proposal is necessarily consistent with the character and amenity of the area.

[246] The second point is that the existing environment may not necessarily reflect the anticipated outcome of a particular zoning regime.

[247] The key to understanding the appropriate amenity is likely to be found in the relevant parts of the district plan, bearing in mind the specific character of the immediate area in which the proposal is to locate. In other words, parts of a rural zone may differ in character due to a number of physical factors (which can be natural or man-made) such that these influence the overall character and amenity.

[248] We have found that the character and amenity of the rural zone in this case is mixed but is overall rural. This is consistent with the expectation of the district plan

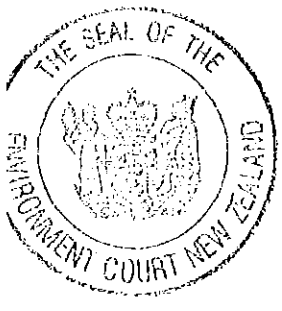
zoning. We have referred to the amenity values and rural character as described in the Plan[42] and we find that the area into which the proposal is to be located and the proposed activity have the requisite distinctive characteristics. We summarise these as follows:

[a] Predominance of vegetative cover. The site will remain predominantly in pasture. The existing vegetation includes shelter belts within the site which are a typical feature of the Canterbury Plains. Road Metals has sought to retain the ability to remove these shelter belts should farming operations require it. The contrary view was that they be retained at least until the new shelterbelt planting (at the site periphery) gains some scale. We accept that these vegetative features are not protected in the rural environment and come and go as necessary relating to normal farming/cropping requirements. However, in this case the retention of these features is useful to the retained character of this site. We accept therefore that their removal should only be predicated by a need to remove them to facilitate quarry operations when that part of the site is reached (many years from now) and as required for farming operations as is the norm. Overall, the site will retain a predominance of vegetative cover which will be enhanced by periphery planting;

[b] The proposed land uses (farming and quarrying) are associated with primary production;

[c] Views will be retained to the extent that views of the quarry operation will be screened by bunding and planting and the remainder of the site will retain its current character. As the quarry progresses, the view will be of rehabilitated pasture farmed as before but at a lower ground level. The edges of the farmed area will be transitioned in pasture and while the landform will be altered, it will not be a significant alteration to the landscape such that the rural character will be diminished;

[d] The characteristics associated with the appreciation of nature (see, hear and smell) will remain intact outside of the operational quarry area by virtue of the management systems proposed to control dust, noise and



[42] Section B3.4, *Quality of the Environment – Issues*, Selwyn District Plan

rehabilitation of the site as well as the continued operation of farming activities on the remaining parts of the site;

[e] There will remain a sense of open space;

[f] Quarrying is an established activity in the rural area so the nature of the proposed activity itself is evident within the established rural character;

[g] The Plan notes that rural zoned areas are recognised *principally as a business area rather than a residential* area in the Plan. The introduction of residential activity as has occurred in the Inner Plains area has the potential to change the balance of characteristics towards more of a township form. However, based on the evidence that has been presented to us and our own observation on our site visit, we consider that the character retains all the factors of rural character as explained in the Plan as well as some extraordinary influences resulting from the Army camp and the prison. We do not consider that the proximity of the Inner Plains part of the rural zone provides a situation where the environment is more sensitive to change than other parts of the rural area. In fact we would suggest the reverse is true; and

[h] Overall, we consider that the proposal will assimilate with the existing established character and provided certain mitigation measures are adopted as proposed, will have minimal impact upon the existing amenity in terms of both the existing situation and that anticipated by the Plan. It is unlikely that the operation of the quarry will preclude or adversely impact upon future activities establishing in accordance with the rural zone expectations.

Cumulative Effects

[249] The matter of cumulative effects was not specifically addressed by any of the planning witnesses. We note though that based on the environmental affects that were raised the single most likely cumulative adverse impact from the proposal is likely to relate to the use of ground water – either in terms of take or discharge to. We consider that these effects have now been well examined before us and we have reached conclusions. The Conditions offered to address these matters include

mechanisms to prevent cumulative effects from the proposal particularly in terms of down gradient effects resulting from the water take such that we are satisfied that any cumulative adverse effects from the proposal are fully addressed by the Conditions of Consent.

CONCLUSION AS TO EVIRONMENTAL EFFECTS

[250] We note Mr Fergusson, a Planner, appearing for the Rolleston Residents Inc, expressed concern that the local community could not have anticipated that a quarry of the scale proposed would be operating several hundred metres from their houses.[43] We feel sure that this issue has been for some a factor in their opposition of the proposal rather than a clear understanding of what the environmental impacts might be.

[251] However, in its introduction, the Plan clearly explains that there are many activities other than cropping and livestock/pastoral farming, which occur in the rural zone. It specifically lists mining and quarrying of gravel as one of these.

[252] The technique for inclusion of such activities (as we have already noted) is to deal with them as *Other* activities and this is clearly articulated in the zone provisions. Further, there are already (be it small and infrequently used) quarries within the rural area. We do not consider that the lack of understanding by some of the community of how things might work is relevant to the environmental assessment of a proposal. The environmental effects have in our view been appropriately examined and any potential adverse effects have been addressed by mitigation in the form of offered Conditions. We are satisfied that the environmental effects of the proposal can be appropriately managed such that the impact on this rural area will generally be acceptable with appropriate Conditions. Our remaining concern relates to the water take.

RELEVANT STATUTORY FRAMEWORK

[253] We are obliged in this case to make our determination in respect of two different authority jurisdictions (Regional Consents and District Consents). The Consents required from the regional authority have been individually applied for

[43] Fergusson, EIC, at [51]

whereas the Consents required under the District Plan have been combined into one land use application.

[254] There were two Regional Consents which related to non-complying activities and thus Section 104D of the Act needs to be considered.

[255] In the case of the Regional Consent concerning hazardous substances, we are satisfied, and the parties agreed, that its status as a non-complying activity is of little consequence as the relevant objectives and policies of the Plan are not threatened and the potential adverse environmental effects will be able to be appropriately managed. There was no debate that the gateway tests of Section 104D would not be met in respect of this Consent.

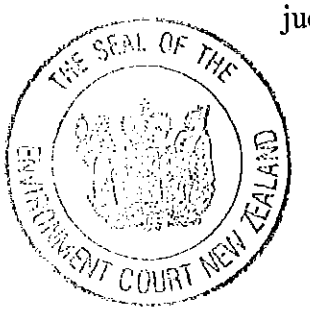
[256] In addition, we have concluded that provided the proposed water take did not constitute a consumptive one, it can be seen to not offend the regional (and higher authority planning documents). We have concluded the water take from the proposed bore can be kept non-consumptive by using the SPB bore water for dust suppression and irrigation, and have suggested a condition to ensure this.

[257] The other Regional Consents and the Land Use Consent required of the District Council do not need to be considered under Section 104D of the Act.

[258] As to the environmental effects of the proposal, we have considered it as a single proposal as the consents are all required to enable the proposal to take place. We have found that the likely adverse environmental effects can be appropriately managed and the relevant objectives and policies of the plans and higher order statutory documents will be achieved by the proposal or are not compromised by it.

Part 2 of the Act

[259] The remaining area of concern relates to the take of water. The effects may be more than minimal even if it passes the threshold test as a non-consumptive take and therefore is not contrary to the policies and objectives of the Plan. Should adverse effects occur we have suggested and will require conditions to ensure remedial action by the applicant. The issue is not a threshold one, but rather the exercise of our judgment under Section 104(1) and Part 2 of the Act.



[260] Section 5 is enabling. It seeks to enable various aspects of the community, including people in the community, to achieve their aspirations and goals. In that regard the provision of infrastructure and housing for people must be regarded as a very important outcome for their health and wellbeing. Aggregate is an essential component of that welfare, and the timely provision of this in the Rolleston area is a matter of importance. The proposal will also assist the general Canterbury region by providing aggregate for reconstruction as a result of the earthquake. We accept that part of that consequential regrowth will be centred around the Rolleston area for both residential and business activities.

[261] We consider that many of the concerns of the Residents were addressed during the course of the hearing by the more elaborate Conditions now proposed by the applicant, and by the Court's focus on availability of water and dust mitigation measures. Although Mr Georgeson still suggested that his road could be sealed to reduce another source of dust, we accept that compliance with the Conditions of this Consent will mean that no objectionable or offensive dust should reach his properties from the quarry. To do so would constitute a breach of the Conditions and would be contrary to the expectations of the experts.

[262] Similarly, we are satisfied that the Conditions of Consent suggested will enable the general community, particularly through the liaison group, to ensure that the quarry is operated in the way expected in the application and by the Court. We do not consider any particular matters under Section 6 arise. Although issues such as amenity arise, these have been discussed in the general context of character, and the expectations within this mixed rural area.

[263] Provided Conditions of Consent satisfactory to the Court are put in place, we consider that the maintenance and enhancement of amenity values and the quality of the environment can be achieved. In this context we keep in mind the need to avoid impacts both on water quality and quantity, which again we consider is addressed through the Conditions of Consent.

[264] No party suggested any of the Treaty of Waitangi principles were relevant in this particular case.

[265] We have concluded that with further Conditions the water take can be non-consumptive if it utilises the SPB Consent for dust suppression and irrigation for 7

years while data is gathered. Furthermore, although there are effects on adequately penetrating bores we consider that any drawdown in excess of that acceptable under the NRRP can be addressed by mitigation Conditions.

[266] Nevertheless, we have discretion to grant consent and must be satisfied that doing so will achieve the purpose of the Act. If this was a general application (even within the same Conditions), we doubt personal enablement would overcome our concerns to preserve the groundwater and avoid effects on neighbouring bores. However, we conclude that given the clear overall benefits and demand for aggregate in the Canterbury region, a Consent with Conditions would better achieve the sustainable management purpose of the Act.

[267] We reiterate, we see no general principle undermining the NRRP.

OVERALL CONCLUSION

[268] We have concluded that the purpose of the Act is best served by granting these consents. We acknowledge that in part the siting of quarries is self-selecting, namely, that the activity must occur where the minerals occur. Although it was suggested this was not the best possible place for such quarrying, we acknowledge that it is within the area identified as being available for such minerals and that the applicant is a company with expertise in this area. Not everywhere which has materials would be suitable for development, and we acknowledge that the activity must occur generally within the rural area because of the potential impacts on neighbours.

[269] In this case the applicant is fortunate to control an intermediate 250m wide site between the majority of neighbouring affected properties. In the end, we consider that the continuing ownership and/or control of that site by the applicant is going to be essential to ensuring that it is able to undertake its activities without breaching the Conditions of Consent, or causing adverse effects on the neighbouring properties.

[270] Overall, we have concluded that the application of the Consent Conditions to this site will yield a better environmental outcome than is currently experienced in the existing quarry area of Yaldhurst Rd. The use of a single site with a smaller open area to control enables the avoidance of cumulative effects from multiple sites. The wider use of water for dust suppression enables dust issues to be addressed before they occur. The ability to contain quarry operations below ground level within a bunded

area with a planted perimeter, will enable this quarry, in our view, to occur with minimal visibility for passers-by. Provided the trucks are properly operated, undertake wheel wash and wet-down where necessary, we are satisfied that the activity can occur.

[271] We have considered whether or not an additional wet-down facility should be required, but we acknowledge the applicant's evidence that the wet-down of the stock piles should ensure that the material, when loaded, is damp. It is of course the duty of the driver to ensure that materials do not constitute a nuisance while being transported on the roads, and in the event that there is adverse effect, we believe that there should be a general review Condition in respect of truck movements to ensure that specific Conditions should be imposed.

[272] In respect of each of the Dust Management Plans, Quarry Management Plans, Noise Management Plans, and the like, we conclude that the Plan should specify how it is going to achieve the Conditions of Consent. These will need to be checked in the Conditions of the various relevant Consents to ensure that they do set out the broad standards required i.e. that there be no objectionable or offensive dust beyond the boundary of the property, and that noise at the boundary of neighbouring sites meets the Plan standards, and in respect of traffic, for example, that there is no offensive or objectionable dust encountered on public roads or released from loads during transit.

[273] If these principles are clearly set out in the Conditions (we do not believe that they fully do so at the moment), then the Plans follow on as a methodology to achieve those outcomes.

[274] In respect of water, we believe the critical issue is that there should be an overall positive water balance, or non-consumptive use.

[275] When all these matters are incorporated into the Conditions of the various consents and reflected in the various management plans, we are satisfied that the activities can then be undertaken in a way which has minimal environmental impact and the products produced will enable the community to construct buildings and infrastructure necessary.

[276] Accordingly, we have concluded that the purpose of the Act is best achieved by granting the consents, subject to appropriate Conditions and management plans to ensure that the environmental outcomes are achieved.

DIRECTIONS

[277] We direct the applicant to reconsider its Conditions in light of this. They are then directed to:

[a] Enter into discussions with parties and serve all parties with amended sets of Conditions within 40 working days of this decision, addressing issues raised in this decision;

[b] If the parties agree on final wording of Conditions within a further 20 working days, the same is to be filed in Court with a joint memorandum;

[c] If the parties cannot agree on conditions, the applicant is to file within a further 10 working days, memorandum with the Court setting out:

[i] the applicant's preferred sets of Conditions;

[ii] any Conditions that are still in dispute; and

[iii] its position on such Conditions in dispute.

[d] Within a further 15 working days all other parties are to file their comments on memorandum, in particular:

[i] whether there are any other Conditions they dispute; and

[ii] their position on Conditions they dispute.

[278] The Court will then proceed to make directions, or issue a final decision.

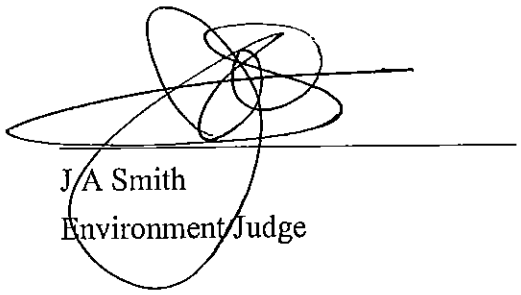
[279] The Court tentatively does not consider that this is an appropriate for an award of costs. If any party wishes to make application for costs, they are to file the same

within 70 working days. Any replies, within a further 10 working days thereafter. Final replies, if any, 10 working days thereafter.

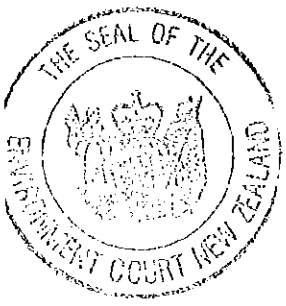
[280] Upon receipt of the submissions and/or applications for costs, the Court will determine whether to reconvene the hearing or determine the matter on the papers.

DATED at AUCKLAND this 9th day of October 2012

For The Court:



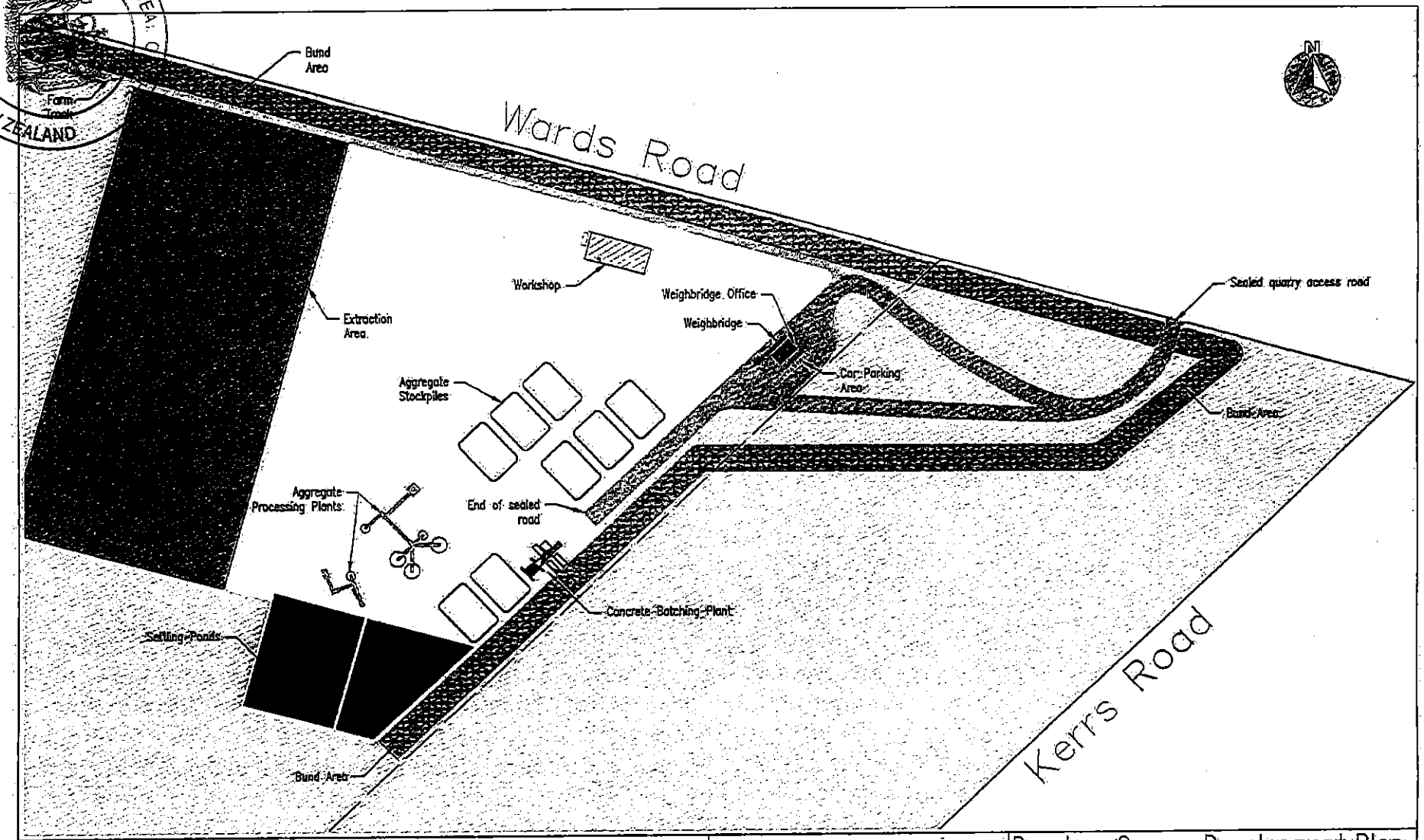
J A Smith
Environment Judge



Annexure A

SECTION 274 PARTIES

A & L Georgeson et al.
Agnew, Brian
Alexander, Mark
Archbold, Julie
Archbold, Michael
Barnes, Corrie
Barnes, Krystle
Barnes, Maria
Barnes, Michael
Bishop, Roger
Boult, Ben
Brown, Stuart
Chaney, Kevin
Chaney, Susan
Clarke, John
Cornelius, Mary
Craw, Margaret
Craw, Martin
Dalton, Carol
Dalton, Terry
Donovan, Robin
Evans, Diane
Evans, Kenneth
Fairbairn, Clayton
Farrar, Leanne
Gallavin, John
Gilroy, Fiona
Harkerss, Jennifer
Harkerss, Richard
Hill, Lisa
Horsbrugh, Andrew
Horsbrugh, Jo
Hunt, Kylie
Hunt, Shannon
Jackson, Adnenne
Jarris, Pauline
King, Adele
King, Peter
Lock, Simon
Masters, Amber
Masters, Steven
McKim, John
Meijen, Haaye
Mitchell, Geoffrey
Mitchell, Karyn
Pietzner, Anna
Pietzner, Gareth
Pinches, Byran
Pinches, Kathleen
Pinches, Roland
Pitcaithly, John
Polaschek, Karl
Rhodes, Beverley
Rolleston Rural Residents Incorporated
Santa Rosa Marketing Limited
Santa Rosa Marketing Limited
Schaap, Christopher
Schaap, Maarten
Schaap, Nicole
Schaap, Sally
Schuass, Lynette
Schwass, George
Scott, Sadie
Selwyn Central Community Board
Stroud, Susan
The Craw Partnership
Titmuss, Geoffrey
Titmuss, Susan
Todd, Christopher
Todd, Kirsten
Tresillian Farm Ltd
Watson, Colin
Williams, Sandra
Wintergerst, Karin



- Weighbridge and office to be located at existing ground level.
- Stockpiles, processing plants and workshop to be located at least 4 metres below existing ground level.

25 0 25 50 metres

ROAD METALS CO LTD

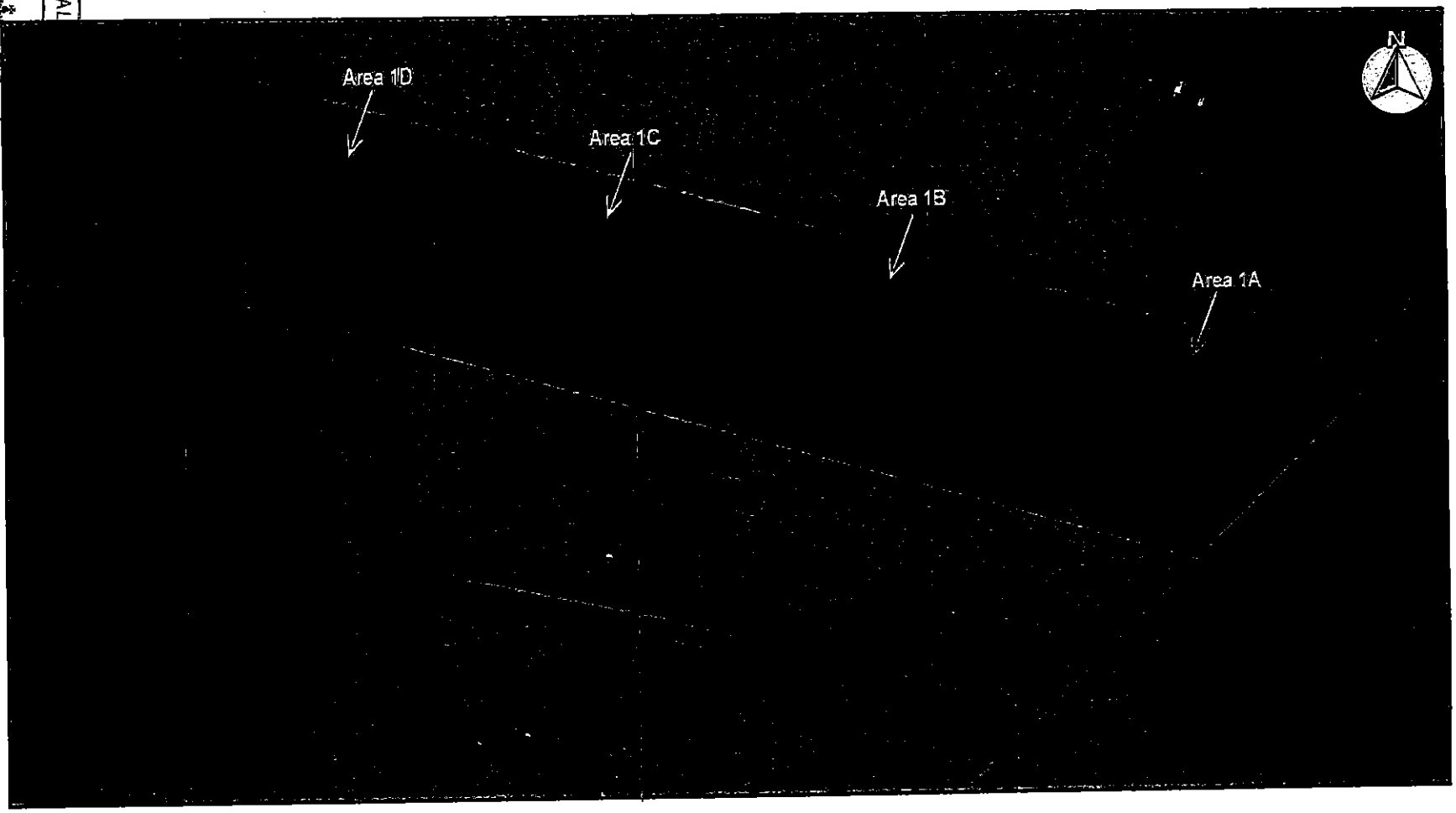
DRAWN: JF	DATE: 10/8/2012	
SCALE: 1:2000	SIZE: A3	

Burnham Quarry Development Plan

FILE NAME: Area 1A – Step 8 Alternative Entrance

PROJECT ID: RM915-01 | FIGURE No: 12 | REV: 5

Annexure B



ROAD METALS		PROJECT	Burnham Quarry Development Plan
DRAWN JF	DATE 5-11-2010	TITLE	Stage 1 Map
CHECKED	DATE		
SCALE NTS	PROJECT No RM915-01	FIGURE No 2	REV No 1 A4

Annexure C

GHD

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Final	Amy Callaghan	Janice Carter		Janice Carter		8 December 2017

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