

**Environmental Protection
Measures on NZ State
Highway Roding Projects
Volume 1: Reference Guide to
Past Practice**

Transfund New Zealand Research Report No. 224

**Environmental Protection
Measures on New Zealand State
Highway Roading Projects
Volume 1: Reference Guide to
Past Practice**

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Executive Summary

This project, *Environmental Protection Measures on New Zealand State Highway Rooding Projects*, reviews alternative methods of management of the environmental impacts of road construction projects in New Zealand. The focus of the study is on controls imposed on these projects through the Resource Management Act (RMA) process, either as conditions of consent or designation, or through mitigation measures specified in the original Assessment of Effects on the Environment (AEE).

The aim of the study was to investigate how effective the environmental protection measures have proved to be on these recently constructed projects and to find out what lessons can be learnt for the use of the same or similar methods on highway rooding projects in the future. The fact is that the majority of issues that are encountered when dealing with rooding projects are usually issues that have been encountered elsewhere before. It is valuable to know how these issues were then dealt with and the success or otherwise of the environmental protection measures that were put in place. It is also useful to know where impacts may have been overlooked or under-estimated so that on future rooding projects these impacts can be better anticipated.

The study was carried out in 2001 and is based on a sample of 35 state highway rooding projects constructed throughout the country between the years 1991 and 2001. Investigations have been based on site visits, file research, literature review and, above all, interviews with a range of people having direct on-the-ground experience in the management of environmental impacts associated with each of the 35 selected projects. Those interviewed have included the original contractors, engineers, project managers, regional council monitoring and enforcement staff, original submitters to the RMA consent process and affected landowners.

The results of the project are presented as two separate reports:

- Volume 1 : Reference Guide to Past Practice.
Transfund New Zealand Research Project No. 224.
- Volume 2 : Key Issues & Observations from the Study.
Transfund New Zealand Research Project No. 225.

This Volume 1 has been prepared in the form of a reference guide and is intended for day-to-day use by RMA practitioners involved in the management of environmental impacts of rooding. The report covers a wide scope of issues, provides examples of previously used protection measures (drawn from the case studies), and feedback and discussion on experiences with the effectiveness and/or practicality of implementing these measures in the field. The function of the guide is to provide a prompt for ideas and to share experience in the use of alternative methods for the management of environmental effects.

The Volume 2 report highlights significant issues and observations from the study. The aim of Volume 2 is to provide a focus for areas where further research may be needed and where further improvement could potentially be made to the way that the environmental management of roading projects is currently conducted. Like the study as a whole, the findings in this report are based largely on feedback from interviews with a range of people involved in or affected by previous roading projects. Further work is recommended in these areas.

The issues that are identified and discussed in the Volume 2 report are as follows:

- 1. Conditions Setting Suspended Sediment Limits:** In-stream suspended sediment limits are a type of performance standard often applied to road works as a condition of resource consent. However field experience has shown that these conditions can be difficult to monitor, of doubtful relevance, and ultimately of limited value in determining whether or not reasonable sediment control measures are actually in place. For compliance purposes it is proposed that sediment control should be judged by what is physically done on site (with reference to a pre-agreed sediment control plan), rather than by downstream measurement of suspended sediment.
- 2. A Greater Role for Sediment Control Plans:** Sediment control plans have the potential to be used more extensively as an alternative to detailed consent conditions for the management, measurement and enforcement of erosion- and sediment-related controls. This includes the use of sediment control plans as an alternative to consent conditions governing downstream limits for suspended sediment. These plans have the advantage of flexibility for ensuring that the best practical option for minimising sediment is pursued while providing flexibility during the project to deal with changing situations on the ground. The same flexibility is not possible where prescriptive consent conditions have been used. It is recommended that Transit further investigate the use of sediment control plans in this capacity as a complete package for the management of erosion and sediment control. A high quality of sediment control plan is now possible with the help of best practice guides now available (such as the Auckland Regional Council document, TP90).
- 3. Controls Limiting the Area of 'Opened Ground':** Controls on the amount of ground that can be opened up at any one time for earthmoving can potentially add significant costs to a project. In one case this control is reported to have added an extra \$2million to a project's cost. The purpose of the control is to limit the amount of soil erosion that can occur during any given storm event. There is, however, an argument that by limiting the amount of ground that can be opened up during the height of the earthmoving season (when there are optimal drying conditions), a greater proportion of earthmoving work gets carried over in to the start and end of the season when ground takes longer to dry – with the result that, on average, each hectare of opened ground is left exposed to erosion for a longer period of time. There needs to be further a investigation of this issue, in dialogue

with the councils, to accurately establish the balancing of risk factors, costs, benefits and alternatives to this kind of control.

- 4. Restrictions on the Timing of the Construction Season:** Restrictions on the start and finish of the construction season can incur significant costs (between \$500 and \$1,500 per stood-down item of machinery per day). Some contractors dispute that these restrictions are providing worthwhile environmental benefits and argue that the closure of the construction season should be self-regulating, whereby earthmoving will stop in any case once ground conditions become too wet for effective compaction. Council enforcement staff have however cited instances where they claim that earthmoving contractors have continued to work even when conditions are unsuitable – causing the ground to be excessively churned up. Further research would be useful to resolve this debate. The important point in the meantime is to ensure that there is a flexible and pragmatic enforcement of these restrictions, ensuring that extensions can be granted (and quickly and inexpensively processed) if ground and weather conditions remain suitable.
- 5. Restrictions on Earthwork during the Spawning Season:** Road construction work is often required to cease during the trout spawning season. This is a precautionary measure to reduce the risk of sediment damage to spawning beds. There is, however, little known about the actual likelihood of this kind of sediment damage in the context of a typical roading project. Nor is it clear whether the fishery is in fact any more sensitive to sediment from such activities during the spawning season than at any other time of the year (trout habitats will be adversely affected by sediment for a variety of reasons at any time, not just during spawning). Furthermore, there is currently no common agreement on the period by which the ‘spawning season’ can be defined. Further research is required to establish whether in fact there is a tangible benefit in restricting road works during the trout spawning season, and if so, then how that season should be defined. The costs to a roading project from being unable to work during this period (depending on the flexibility of the work programme) can be between \$500 and \$1,500 per item of stood-down machinery per day.
- 6. Stormwater Treatment Devices:** Stormwater treatment devices such as settling tanks are being required more often, by way of consent conditions, in the design of new sections of highway. This is despite a lack of clear evidence that the treatment devices installed around the country at the present time are actually making any significant difference to downstream water quality. The cost of installation of these units is around \$2,000 (but can be up to \$45,000) each. Further research is recommended to assess the performance of these existing units before new ones are installed.
- 7. Management of Dust Impacts:** Dust is a significant and sometimes costly issue on some projects. Existing control methods are few, and in most cases limited to spraying the ground with water. This method (water spraying) is not always completely effective, however, when conditions are extremely dry. Further research is required to see if other alternative control methods can be found.

Work is also required in the area of dust impact remediation. There are currently no clear Transit guidelines for defining 'nuisance' dust, nor protocols for cleaning up dust once problems occur.

- 8. Land Reparation Issues & Dealings with Landowners:** A number of farmers interviewed for this study whose land had been affected by roading projects complained at the standard of final restoration work on their property. The most common complaints were in relation to the standards of fencing, topsoil replacement and re-grassing. These are usually minor issues in the context of a large roading project, but if poorly handled can have serious long-term consequences for the affected farmer and for future relationships between the farmer and Transit New Zealand, to the detriment of future roading projects in the same area. The results of the study indicate that 'partnering' is proving to be a very effective way of dealing with these issues. Complaints of this nature were usually only found to arise on projects where a partnering process had not been applied. It is suggested for this reason that partnering should be more widely used on roading projects. This may require a modified form of partnering process to be developed for use on smaller works.
- 9. Timing of Re-grassing:** A minor issue with conditions on some roading projects is the requirement that grass should be "immediately" applied on completion of each area of earthwork. The problem is that "immediate" re-grassing can sometimes mean grassing in unsuitably dry conditions when the grass will not survive. The better approach is to require re-grassing "as soon as growing conditions allow".
- 10. Simplification of Resource Consents:** It would improve the comprehension of consents if these could be issued with a single comprehensive list of conditions from the relevant issuing authority. Major roading projects will frequently require several different resource consents to cover the full scope of work. These consents are usually issued separately, rather than in the form of a single comprehensive list of conditions. The result can be an unnecessarily large and complex mass of paperwork, meaning that the full intent of the conditions is difficult to understand.

Abstract

A project, *Environmental Protection Measures applied to New Zealand State Highway Rooding Projects*, was undertaken in 2001 to review environmental protection measures that have been applied through the Resource Management Act (RMA) process, to a sample of 35 state highway rooding projects constructed in New Zealand, between the years 1991 and 2001.

The results of the project are presented as two reports:

Volume 1: Reference Guide to Past Practice.

Transfund New Zealand Research Report No. 224.

Volume 2: Key Issues & Observations from the Study.

Transfund New Zealand Research Report No. 225.

The investigation takes a retrospective look at these projects to find out (using site visits, file searches and interviews with original participants) how the protection measures performed.

Volume 1 is presented in the form of a reference guide to past practice in the management of environmental impacts of rooding and contains sections dealing with such issues as sediment control, noise, effects on fish, weed control, landscaping, etc. Each section contains examples of environmental protection measures that have previously been used on rooding projects and a discussion on any feedback or findings on experiences in the implementation of these controls.

Volume 2 contains a summary of key issues and observations from the study. This volume provides a focus for areas where further research may be needed and where further improvement could potentially be made to the way that the environmental management of rooding projects is currently conducted.

Introduction

This project, *Environmental Protection Measures applied to New Zealand State Highway Rooding Projects*, was undertaken as a review of alternative methods for the management of the environmental impacts of road construction projects in New Zealand. The focus of the study is on controls imposed on these projects through the Resource Management Act (RMA) process, either as conditions of consent or designation, or through mitigation measures specified in the original Assessment of Effects on the Environment (AEE)¹.

This report, Volume 1, has been prepared as a reference guide to environmental protection measures on state highway rooding projects in New Zealand. It documents measures used for the control of environmental impacts on a selection of 35 recent or current rooding projects constructed between the years 1991 and 2001, and provides commentary on the way that these controls have been working out in practice.

Investigations have been based on site visits, file research, literature review and, above all, interviews with a range of people having direct on-the-ground experience in the management of environmental impacts associated with each of the 35 selected projects. Those interviewed have included the original contractors, engineers, project managers, regional council monitoring and enforcement staff, original submitters and affected landowners (insofar as each of these people can still be found).

The report aims to record and collate this experience and to present it in a form that will be of use to future practitioners involved in the management of the environmental impacts of rooding under the RMA.

The report has been prepared in acknowledgement of the fact that the majority of issues that are encountered when dealing with rooding projects are normally issues that have been encountered elsewhere before. It is therefore valuable to know how these issues were dealt with, and the success or otherwise of the environmental protection measures that were put in place. It is also useful to know where impacts may have been overlooked or under-estimated so that on future rooding projects these impacts can be better anticipated.

Methodology

Selection of Case Studies

The first step for this project was to select a range of case studies to be investigated. These were selected on the advice of Transit New Zealand regional planners. The aim was to find a range of different types of project throughout the country (in both the North and South Islands) that would cover as much as possible a wide variety of

¹ Mitigation measures specified in an AEE will often have the effect of a condition of resource consent in circumstances where the over-riding consent includes a standard condition in which all construction works must be "in accordance with" any plans and documents submitted in support of the consent application.

potential issues. The preference was for large projects and projects that had been completed at least within the last five years (before 2001). Completed (as opposed to “in progress”) roading projects were preferred so that the finished project could be looked on in its entirety. The preference for projects from within the last five years was to improve the chances of locating the people who were originally involved in these projects, and the chances of them remembering the events of that time.

There were some exceptions to this selection process. Two of the projects (the Pukerua Bay to Plimmerton SH1 Rural Upgrade and the Glenhope to Kawatiri Realignment) were both works in progress. These were chosen, however, to include an account of the unique issues that applied to them, and also to provide another perspective in contrast to projects where all work had been completed.

Some of the other projects selected for the study were longer than the preferred five-year historical timeframe. This meant that, in some cases, it was difficult to locate some of the original participants in order to conduct interviews. But for most projects, even those completed more than five years ago, most of the people could still be found.

A complete list of the 35 case studies is attached to this report as Appendix 1.

File Searches

Having selected the projects, the next stage of the study was to locate file information relevant to the RMA consent process that applied to each of these. The purpose of this search was to locate the original AEEs; the consent documents themselves (containing council officers reports and conditions of consent for each project); and any other accompanying information on subsequent monitoring of the project or problems that were later found to arise (often recorded on file notes). Files were also used as a source for locating the names and contact details for original participants in each project (council monitoring staff, original submitters, affected landowners, and any other people who may have been consulted at the time).

The initial search concentrated on project files kept by Transit New Zealand regional offices. However it was soon found that in most cases better information could be obtained from the regional councils who had originally been involved in the issuing of resource consents. Councils normally keep well maintained files on all of the consent applications that they deal with.

The regional councils therefore proved to be the main source of file information on each project. Other file material was however obtained from Transit New Zealand offices and some from territorial local authorities (mainly relating to designations). The information thereby obtained has been collated for inclusion in this report.

Site Visits

All the case study project sites were re-visited for this investigation. The aim of these visits was to familiarise the researcher with each site (to better understand any file comments or feedback from interviews), and to check for any remaining evidence of environmental impacts and environmental protection measures that had been implemented during and/or after the construction of the road.

These site visits were useful for the observation of such things as the measures taken to allow for fish access in streams, the collection and treatment of road surface stormwater run-off, and landscaping. There are however limits to what can be seen at a project site some years after a road has been built. Impacts on water quality during the earthmoving phase, for example, will no longer be apparent. The same applies to construction noise and dust impacts, and to land severance issues. For each of these it is necessary to rely on, or supplement with, interviews with people who were involved at the time.

Interviews

Interviews were the key to this study and were conducted with as wide a range of people as could be located, who had been directly involved in each of the projects. The focus here was on people who had been involved with each project in some capacity ‘on the ground’ (including contractors, consultant engineers, Transit New Zealand project managers, council compliance and monitoring staff, original submitters, affected landowners and neighbours). These people were selected as having had a direct experience with the implementation of measures taken to manage the environmental effects of each project.

Interviews were not normally conducted with people whose experience with a project had not actually extended in to the field. Consent officers and environmental impact assessors involved in the planning stage for each project, for example, would be able to comment on the types of impacts that had been anticipated, and the types of measures put in place to control these impacts. But unless they had been subsequently involved in on-going monitoring of the project they would not normally have a detailed knowledge of how those impacts and protection measures had actually worked out in practice. It is this outcome of the implementation of environmental protection measures that is the specific focus of the present study.

Interviews were conducted either in person or by telephone. The usual format for these interviews (after a brief explanation of the study) was to initially ask each respondent if they had any recollections from the project and anything in particular that stood out as either good or bad experience in terms of the management of environmental effects. The interview would then go through each of the environmental protection measures that had been applied to the project (either through mitigation measures specified in the AEE or through conditions of resource consent). This was to ascertain what the respondent could recall of these measures and how they had worked out in practice. This format (following a pre-prepared

summary of environmental controls) also often helped to trigger other recollections with the respondent.

A considerable amount of useful information was obtained from these interviews and is summarised in each of the ‘feedback’ sections contained in this report.

As expected, not all interview respondents had the same interpretation of events. Nor did they necessarily all share the same opinions on the success or failure of measures taken to manage environmental impacts. A contractor, for example, may have a different interpretation of events to that of a local resident affected by the same project. There was, however, a large amount of common ground. All the different arguments and interpretations of events are presented alongside each other in the ‘feedback’ sections of this report.

Format of the Report

This Volume 1 report is intended to work as a reference guide. It is expected that the report will be used for scoping purposes (that is, in the context of an environmental impact assessment, for prompting ideas on the types of issues that might need to be considered). As well it is for finding out about the types of environmental protection measures that have specifically been used in the past and the experience of those involved in their implementation.

The report is therefore set out in a reference book format. This is structured around categories of environmental issue (sediment control, noise, effects on fish and fish habitat; weed control, etc.), with the next level of reference being the various environmental protection methods used to deal with such issues. Beneath this are specific documented examples of methods that have been used.

Each of these examples is headed by a one-line summary caption and followed, where relevant, by a brief commentary on subsequent interview feedback and other findings.

For the most part, the identity of interview respondents has been kept quite general in each of the commentary sections. Respondents are usually referred to only as “a council officer”, “a resident”, “an engineer”, “a contractor” and so forth. This is deliberate, mainly for reasons of confidentiality for the respondents, but also to ensure that the focus of the report stays on issues rather than people and personalities. The identifications that are used are intended to be sufficient to enable the reader to understand the respondent’s position (and therefore potential bias) without specifically being named.

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1. Sediment Control

1.1 Performance Standards

... no change in water clarity of more than 33% ...

The resource consent for stormwater discharge from the **White Bridge**² construction site required that the discharge should not result in any conspicuous change in visual clarity of the river after reasonable mixing, with the zone of reasonable mixing extending in this case from 25 to 100 metres downstream of the discharge point. A “conspicuous change in visual clarity” was taken to mean a greater than 33% change in clarity, as measured by black disk (as described in the proposed Waimakariri Regional River Plan, Sept 1996).

Feedback

The black disk method is limited in its ability to provide accurate and consistent readings, which will vary from person to person and depending on light conditions at the time. It is, however, a relatively inexpensive method and (unlike suspended sediment sampling) provides an immediate result. Therefore, although lacking in accuracy, it can be a suitable method to use where only indicative measurements are required.

*Nevertheless, the method was practically never used on the **White Bridge** project. It soon became apparent in the field that a better and more meaningful appreciation of water discoloration could be gleaned from simply looking for plumes of suspended sediment in the river. The measurement of this suspended sediment to give it a numerical value would have been of no additional use in, for example, determining the source of the sediment or its cause. These things are best worked by just looking.*

... no change in water clarity of more than 50% ...

The standard applied to the **Glenhope*** realignment project, through resource consent conditions, was that the clarity of the water, as measured 200 metres downstream of the works by the black disc method, should not be decreased by more than 50%. Otherwise, the consent holder (Transit New Zealand) was required to “ensure that every effort is made to keep the flow of water in the river as clear as possible”.

Feedback

*Work on the **Glenhope** realignment project has taken place during a period of drought in the Nelson area, with the river adjacent to the work site running at a very low flow. This has meant relatively little run-off from the construction area, but has also meant that any sediment getting in to the river (e.g. from channel diversions) is not greatly diluted. The project manager suspects that there will have been times when the limit of a 50% change in clarity will have been exceeded. When the main river diversion was put through it is thought likely that this limit would have been exceeded for about half a day.*

² See Appendix 1 for locations of these projects (names in bold italic type).

... no “conspicuous” change in clarity ...

Regional Council consent for culvert and bridge construction work on the *Homer to Murrells* realignment project included a condition that a minimum standard for Class C waters (as described in the Regional Plan) should apply and be maintained 20 metres downstream of the point of discharge. These standards are that:

- Natural water temperature should not be changed by more than 3°C.
- The pH of the water shall be within the range 6.5 to 8.3, except when due to natural causes.
- The water shall not be tainted to make it unpalatable, nor contain toxic substances to the extent that it is unsafe for consumption by humans or farm animals, nor emit objectionable odours.
- There shall be no destruction of natural aquatic life by reasons of the concentration of toxic substances.
- The natural colour and clarity of the water shall not be changed to a conspicuous extent.
- The oxygen content in solution in the water shall not be reduced below 6mg/litre.
- Based on not fewer than 5 samples taken over a 30-day period, the median value of the faecal coliform bacteria content of the water shall not exceed 200 per 100 millilitres.

Feedback

Water quality was not, in fact, actively monitored at Homer to Murrells.

... no more than 50g/m³ of sediment ...

The standard applied to the *Twizel Bridge* widening project, as a condition of consent, was that the suspended solids concentration in the Twizel River should not increase by more than 50g/m³ of water when measured at any point more than 100 metres downstream of the work area.

Feedback

The Regional Council compliance officer for the Twizel Bridge project advised that the limit of a 50g/m³ change in suspended sediment is a standard condition of the Regional Council. In his experience a sample has never yet been taken to test whether this condition is being complied with, and would most likely only be tested if there was a clearly visible problem with sedimentation.

The Transit New Zealand project manager for the Twizel Bridge project indicated that this kind of limit would have been very difficult (and at times impossible) to comply with, where there was any kind of excavation work occurring in the river channel (including the construction of new bridge piers).

The same suspended solids limit of an increase of no more than 50g/m³ also applied as a regional council condition of consent for both the *Otira Viaduct* and *Hawkswood* deviation projects, except that in these cases the points of measurement were respectively taken to be 200 and 300 metres downstream of the construction area.

The consent condition for the *Otira Viaduct* project furthermore required that there should be a change of no more than 50 Nephelometric turbidity units at this point downstream of the site.

Feedback

As with the Twizel Bridge project, suspended sediment levels were not actually measured during construction of the Otira Viaduct. Those involved with the project (including the DOC observer) felt that these measurements would not have been very useful or meaningful considering the regularity of flooding in the Otira River and the high silt loading and natural flushing effect during each of these floods. Silt caused by the road works would have been trivial by comparison. Furthermore, the physical limitations of the site and frequently torrential rainfall in the area meant that there was little more that could have been done to actually contain sediment within the construction area. Otherwise impossibly large sediment ponds would have had to be built to contain run-off from the site (with the construction of these causing more damage than they would be likely to prevent). It therefore had to be accepted that during heavy rainfall events the sediment control systems would be overwhelmed. At these times the run-off from the site would effectively discharge directly in to the river (noting, however, that the river itself would by then already be in flood and carrying significant amounts of naturally occurring sediment at the time).

There were, in any case, some doubts over the actual degree of sensitivity to sediment of the aquatic biota in the river at the Otira Viaduct project, and whether in fact the river would be adversely affected by any increases in sediment loading likely to be caused by the road works. A study undertaken at the time found that the natural river ecosystem, influenced by regular flooding, was already adapted to this type of impact, with the ability to rapidly recover from these events.

... no more than 100g/m³ of sediment ...

For the *Kuaotunu* seal extension project, in the Coromandel, the standard was a maximum load of sediment in adjacent streams not exceeding 100g/m³, based on monthly averages, as measured at a point downstream of the construction site following reasonable mixing.

Feedback

A neighbouring resident at Kuaotunu commented that the 100g/m³ suspended sediment level was exceeded on a number of occasions during the construction project. He had personally measured levels of about 700g/m³. He was, however, critical only of the fact that the 100g/m³ limit was simply unrealistic, particularly as the limit was regardless of background sediment levels in the stream. The regional council compliance officer for the project expressed similar reservations about the practicality of this condition.

Another commentator on the Kuaotunu project pointed out that it was impossible to know, from the water quality monitoring, whether the cause of any of the high sediment load readings at any particular moment was

on account of the road works or because of natural land slips in the immediate catchment area after rain.

Despite the limitations of the maximum 100g/m³ sediment load condition at Kuaotunu, one of the supervising engineers to the project noted that it did at least encourage a greater focus on minimising sedimentation on the part of the contractor. Suspended sediment readings would be discussed at each partnering meeting and therefore helped to maintain an awareness of this issue.

... up to 500g/m³ or 5,000g/m³ of suspended sediment ...

The AEE for the **Pukerua Bay** SH1 upgrade project does not include any specific performance standards for sediment discharge, but does nevertheless make some predictions of the expected levels of suspended sediment resulting from the construction work based on data from similar or equivalent types of activities previously gathered by the Wellington Regional Council Rivers Department. These predictions acknowledge that a certain amount of increase in suspended sediment levels is inevitable during the construction phase in spite of any measures taken to reduce it. The predictions were as follows:

- *“Discharge of freshwater flows from culverts where suspended sediments could vary from background levels of less than 2g/m³ (during operation) but seldom exceeding 500g/m³ in normal flows during construction.*
- *Discharge of stream sediment to the stream during construction of culverts or other instream works, resulting in suspended solids at the discharge point of about 100g/m³, but seldom exceeding 500g/m³, with the low flow diverted around the site to minimise such discharges.*
- *Discharges of stormwater and silts as run-off from raw cuts and fills during construction, resulting in suspended solids at discharge points of about 500g/m³, but seldom exceeding 500g/m³.*
- *Discharges of washwater.*
- *Discharges of water and silts as streams are diverted into new channels, resulting in suspended solids which are expected to be high in short term (up to 5000g/m³, but rapidly reducing and settling overnight to values little above background, i.e. between 5 and 50g/m³).”*

Feedback

- ***the overall approach is wrong***

*These predictions for sediment loading were originally provided by the regional council for inclusion in the **Pukerua Bay** AEE. However, the council officer who supplied the data (and who subsequently monitored the project) has suggested that, in hind-sight, these figures were almost certainly too low, and that during times of heavy rainfall the actual sediment load could have easily been ten times more than predicted. This was not necessarily intended as a criticism of the standard of sediment control work on the construction site, but rather as an illustration of the extent to which suspended sediment levels can fluctuate, even if all reasonable control measures are in place. There is only so much that can be done to prevent significant silt run-off if heavy rainfall lands on a large earthmoving site. In these situations, where no one has control of the amount of rain that falls, it is unrealistic to expect suspended sediment*

levels to strictly conform to predetermined limits. It was suggested for this reason that consent conditions which set a maximum allowable suspended sediment level are inappropriate, and should not be used. Rather, consent conditions would be more useful if they were focused on the methods and processes for designing silt control than on fixed (and often unachievable) water quality standards.

*Similar comment was made by contractors involved in the **Eland and Laws Hill** projects, that when a very heavy rainfall event occurs there is sometimes no way that the sediment control systems will completely cope (as happened when a 200mm rainfall event occurred during construction of the Eland realignment). All parties, including local farmers, agreed that little else could have been done in the circumstances of such an extreme event.*

• ***the standards are not relevant to all situations***

The other problem with the use of suspended sediment levels as a performance standard is that, for most purposes, a suspended sediment reading provides only an indicative measure of actual effects on the environment. The main reason for collecting this information is usually because it implies degrees of effect on downstream aquatic biota, particularly macro-invertebrates. The higher the suspended sediment load, the greater the assumed effect. However, not all streams and rivers have the same naturally occurring biota, and therefore will not experience the same degree of sensitivity to suspended sediment. A naturally murky stream with a silty bed and/or high propensity for flooding will be less affected by sediment than a stream with clear water, a coarse sand or shingle bed, and low frequency of flooding. The biota in each stream will be adapted to the conditions that are present.

There is not, therefore, any one suspended sediment limit that can necessarily be defined as the critical threshold limit for adverse effects on aquatic biota in all rivers and streams. That limit will vary from one river to the next.

Possibly the only truly accurate measure of effect is by direct sampling of the aquatic macro-invertebrate populations. This is, however, a comparatively expensive process, costing about \$200 per sample, as compared with \$10 per sample for the measurement of suspended sediment.

... ***“no contaminants, including suspended sediment shall be discharged”*** ...

Regional council consent conditions for the placement of culverts as part of the **Goodwood** realignment project, in coastal Otago, included a condition that “the activity shall be conducted in such a fashion that no contaminants including suspended sediment shall be discharged” into the respective creeks. This effectively meant that, technically, the allowable suspended sediment limit was nil.

Similarly, consent conditions for the **Thames Coast** project, required that “all fill and excavated material shall be disposed of, or utilised on site, in such a way as does not cause contaminants to enter water”.

Feedback

*It is obviously practically impossible for earthmoving work to be undertaken in or adjacent to a watercourse without at least some suspended sediment escaping as run-off. These conditions on the **Goodwood and Thames Coast** projects could not have been complied with. (Note here that under the RMA the definition of “contaminant” includes suspended sediment.)*

1.2 Guidelines for Sediment Control

... Waikato Regional Council Guidelines for Earthworks ...

The regional council consent for the *Thames Coast* project required that sediment control practices should be undertaken “in general accordance with the principles outlined in the Waikato Regional Council’s *Design Guidelines for Earthworks, Tracking and Crossings* (Sept 1995)”.

... Auckland Regional Council Guidelines for Earthworks ...

Similarly, for the *Orewa Bridge, Spiral Hill, Laws Hill, Shannon* and the *Kaimatira* projects, the respective AEEs propose that all works would be undertaken in accordance with *Auckland Regional Council Guidelines No.2, 1992* [updated March 1995]. These guidelines provide ‘best practice’ advice on a wide range of erosion and sediment control methods. The same condition was also imposed, by way of consent conditions, on the *Puhoi Bridge* realignment project.

For the *Kaimatira* realignment the regional council required that these sediment control measures should remain in place at least until re-grassing was completed.

Wellington Regional Council Guidelines for Earthworks ...

The Wellington Regional Council *Guidelines for Silt Control Associated with Mass Earthworks* are referred to in the AEE for the *Pukerua Bay SH1* upgrade project. The AEE states that these guidelines will be “considered” in the final design of the silt control system.

... Nelson City Council Guidelines for Earthworks ...

Consent conditions for the *Stoke Bypass* project include a condition that all sediment control measures should be constructed and maintained in accordance with the Nelson City Council *Guidelines for Sediment Control associated with Mass Earthworks*.

Feedback

*The regional council enforcement officer for the **Thames Coast** project acknowledged that the interpretative nature of the “guidelines” means that they are difficult to police, although they serve to educate contractors, and are useful for discussing control measures with contractors on site. Care needs to be taken, however, in trying to apply the guidelines too prescriptively. There are often variations on the methods contained in the guidelines that are found to work well for specific situations. This kind of adaptation and innovation should be encouraged. Similar comments were*

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also made by the compliance officers overseeing the *Spiral Hill* and *Stoke Bypass* projects.

On the other hand, feedback from the regional council in relation to *Pukerua Bay* (and other projects) was that it is of little meaning to say that the guidelines will be “considered”. This can be widely interpreted, and is unenforceable in practice. It would be preferable that the requirement was for the guidelines to be actually followed.

1.3 Sediment Control Plans

... prepare a Sediment Control Plan ...

The AEEs for the *Shannon*, *Laws Hill*, *White Bridge* and *Oakmere* realignments plus *Orewa Bridge*, *Otira Viaduct* projects and the *Kuaotunu* seal extension project all required that the Contractor design and implement a sediment control plan (with this plan to be prepared and approved prior to construction). The same condition also appears in the AEE and conditions of the coastal permit for the *Rosebank* interchange, as well as consent conditions for the *Thames Coast* protection works and *Whangamoa North* and *Glenhope* realignment projects.

In the case of the *Pukerua Bay* SH1 upgrade project, a sediment control plan is also required by the AEE. In addition to this, the resource consent issued by the regional council for the project sets out its own requirement for the preparation of what is described as a “Water Discharge Management Plan” (to set out steps to be taken to avoid, remedy, or mitigate any discharge of contaminants to groundwater and surface water).

Feedback

- *a useful discipline*

The advantage of a sediment control plan is that the requirement to prepare a plan forces the contractor to focus on the management of sediment early on, so that it becomes a part of the management of the job right from the beginning. Those working on the Kuaotunu, White Bridge, Rosebank, Whangamoa North and Glenhope projects said that they had found it to be a useful discipline to follow for this reason.

- *flexibility is essential*

Flexibility is very important, however. Sediment control plans that are not sufficiently flexible will stifle innovation, and although a plan may “look good on paper”, it will often need to be continually adapted on the ground. An overwhelming number of respondents (from both regional councils and contracting firms) therefore have strongly advocated to ensure that, where sediment control plans have been drafted, there is a mechanism by which they are able to be changed as the project progresses.

In a number of cases (such as on the Kuaotunu, Otira Viaduct and White Bridge projects), this kind of system was set up, often based around a partnering group structure, with all parties being involved in the on-going planning and management of sediment control.

Legal and technical barriers to this kind of flexible approach to the management of sediment control can exist, however. This is particularly so where the contents of the sediment control plan are effectively regarded as conditions of consent. Where this is the case it may technically require a variation of consent condition in order to legally amend the plan. However, such a process can be clearly impractical when dealing with a fast-changing sediment control system "on the ground".

To get around this problem, some council compliance staff around the country are having to simply take the initiative (although they arguably lack the authority) of conferring with contractors and site engineers to work out and approve amendments to sediment control plans. This is pragmatic, and seems to work well, but can clearly leave the council officer and contractor exposed.

*The apparent solution, used for example by Auckland Regional Council (ARC) in respect of the **Rosebank** project, is to ensure that the sediment control plan is not completely tied in to the RMA consent process, but rather is provided with its own internal mechanisms for on-going change (in the style of a management plan). This means that although the plan may be a condition of consent (and therefore enforceable), it is not bound by the consent process for the purpose of future ongoing amendments. The ARC erosion and sediment control guidelines specifically advocates the "evolution" of sediment control plans.*

For this system to work best it does however require at least an initial consensus between the council consent authority and the contractor (or whoever drafts the sediment control plan) on the basic form of the sediment control plan, so that the two parties are agreed on the basic expectations of the methods and scale of sediment control. This basic framework needs to be established before the commencement of construction, and preferably even before the application for resource consents.

1.4 Council Discretion to Intervene

... council may direct ...

Consent conditions for the *Whangamoa North* deviation project (as these relate to a proposed spoil dump) stipulate that the regional council's Soil and Water Resources Officer "may direct [the installation of] additional stormwater treatment facilities if water containing sediment is found to leave the site and cause a conspicuous discoloration of any water body".

Feedback

This condition is essentially a statement of the normal powers of a council enforcement officer under section 322 of the RMA to issue an abatement notice where (in this case) the activity is resulting in a conspicuous discoloration of water.

1.5 Slip Control Plans

... requirement to prepare a Slip Control Plan ...

In addition to the development of a sediment control plan, the consent holder for the *Kuaotunu* seal extension project was also required, as a condition of the regional council resource consent, to prepare and submit a Slip Management Plan, setting out methods, timing and disposal sites for slip material. This condition reflects the fact that a certain amount of slippage was anticipated to occur as cut slopes settle in after construction is completed.

Feedback

The slip control plan at Kuaotunu was, in the end, a relatively simple document mostly describing the procedures for clearing up slips and for disposing of slip material. Its focus was mainly on what to do when slips occur, rather than on slip prevention.

1.6 Settling Ponds

... silt traps and settling ponds to be used ...

The AEEs for the *Oakmere* realignment and *Pukerua Bay* project specified that silt traps and settling ponds would be used to capture and settle out suspended sediment from construction site run-off. Earth bunds were to be used to direct run-off water into these silt traps and ponds. The AEE for the *Whangamoa North* project simply states that silt traps will be used “where practical”.

A settling pond (described as a “stilling basin”) was also required in the AEE for the *McArthur’s Bend* (Dunedin) realignment project, to be located immediately downstream of a proposed culvert. It was proposed that this would be a temporary structure only (for use during the construction phase), but built within the actual channel of the stream. The regional council resource consent for this project also stipulates the use of a silt trap downstream of the site.

For the *Goodwood* (Otago) realignment project, the AEE simply states that silt ponds will be constructed to prevent site run-off entering the adjacent watercourses.

Feedback

Sediment ponds are a standard and effective method of silt containment. However they are not always appropriate. On the Otira and Kuaotunu projects a conscious decision was made to specifically avoid the use of sediment ponds because the impact caused by the construction of the ponds would be more damaging than the likely generation of sediment. On both projects there was simply not the space available. The only way to create ponds of an adequate size would have been to clear and then excavate significant areas of native vegetation.

... settling ponds to be built before any other construction ...

Similar measures were specified in the AEE for the *Ngutukaka* (Otago) realignment project, with silt detention ponds to be installed at low points on site before commencing earthworks, plus drainage ditches to provide a barrier to uncontrolled run-off between the work site and the adjacent stream.

... sediment may be disposed into the river during floods ...

Silt traps were required by both the AEE and regional council consent conditions for the *Otira Viaduct* project. However, in this case it was proposed to re-release the sediment collected in the settling ponds during flood events in the Otira River. This process was intended to mimic the natural pattern of sediment loading in the river. It was also an acknowledgement that full size silt traps would be impractical to try and fit on to such a confined site.

... silt retention structures built to withstand a 5-year storm event ...

The AEE for the *Laws Hill* (Manawatu) project specifies the use of either earth bunds or straw bale control dams to retain sediment, with dams designed to hold a 5-year return rainfall event. A similar condition is also picked up in the regional council consent for this project, which specifies that stormwater should be diverted to a retention dam for settling, or that otherwise straw bale retention structures are to be used (<3m at crest), in accordance with plans submitted to the council by Transit New Zealand.

Feedback

While it is reasonable that sediment dams should be expected to withstand a 5-year return flood event (meaning that they should not collapse in such an event), it is not realistic to expect that they will continue to work very effectively under this amount of run-off.

*Design standards may also have to be compromised by the availability of space and the nature of the topography. On the *Pukerua Bay* project for example up to 40 small sediment ponds were operating at any one time (fitting in to the landscape wherever they could). It would have been inconceivable to try and design most of these small ponds to have sufficient storage to cope with even a 2-year flood event.*

... silt retention structures built to withstand a 100-year storm event ...

The AEE for the *Puhoi Bridge* realignment project recommends that “silt control systems” be installed to control run-off and reduce sediment entering the river during construction. The regional council resource consent conditions for this project more specifically required the installation of sediment retention structures able to withstand a 100-year return storm event and incorporating an emergency spillway to accommodate that event. The consent required these structures to be cleaned out no less than every time they become half full of sediment.

Feedback

*In reality it is unlikely that the silt control systems built around the **Puhoi Bridge** would have withstood a 100-year storm event. An event of this magnitude would have completely engulfed the site in a torrent of already heavily silt-laden water.*

... sediment ponds impractical to build in some circumstances ...

Sediment ponds were deliberately *not* specified in the AEE for the **Kuaotunu** seal extension project because of the difficulty in finding suitable locations for them around the construction site, and because of the high clay content in the area of work. It was predicted that a retention time of 6 to 8 days would be necessary for the clay to settle out effectively in any such pond (meaning that very large settlement ponds would need to be built to allow for such a long retention period). It was therefore proposed in the AEE that the use of sediment ponds would be at the discretion of the contract supervisor, and that these would only be expected to provide partial removal of sediment from local site run-off.

Feedback

*A neighbouring resident at **Kuaotunu** agreed that the decision not to use sediment ponds was the right one for the circumstances. There would have been insufficient flat land available in the area to build these, and to attempt to do so would have resulted in a greater adverse effect on the environment (in terms of scale of earthworks involved) than would have been caused by unrestrained run-off. Furthermore, any that were built in this area would not cope with major rainfall events of the kind sometimes experienced in the Coromandel area.*

*The same conclusion was also reached for the **Otira Viaduct** project. The original scheme for this project had been to build large settling ponds to collect run-off water from the site. However, it was soon realised that the excavations and vegetation clearance required to construct such ponds would have resulted in far more significant damage to the environment than any sedimentation would have been likely to cause. Furthermore, the intensity of rainfall in this area is such that any sediment entering the river would be unlikely to settle for long. Because of this high rainfall, the effectiveness of conventional settling ponds would also have been in doubt. Settling ponds were therefore not used on this project.*

... child-proof fencing around the silt pond ...

Sediment control conditions attached to the designation of the **Stoke Bypass** were fairly brief. The condition simply requires that “construction methods shall include the use of silt traps in areas of potentially high silt run-off”. However, more detailed conditions appear in a separate earthmoving consent for this project (issued about 4 years after the coastal permit). The consent requires the installation of two separate sediment ponds which (being next to a residential area) must have child-proof fencing built around them in accordance with the Fencing and Swimming Pools Act 1987.

Feedback

The sediment ponds on the Stoke Bypass project were fenced off as required. This was generally accepted as appropriate in the circumstances of an urban residential environment.

1.7 Floating Decants

... maintaining silt pond buffering capacity ...

Feedback

Floating decants were a method used on the Pukerua Bay project to increase the buffering capacity of the settling ponds. The floating decant is essentially a large siphon that drains water from the surface of the pond to discharge it downstream. The siphon is attached to a floating boom which means that water can keep draining out of the settling pond by this method even after the water level drops below the level of the overflow weir. Consequently the pond is left with a greater storage capacity than if only a fixed weir was in place. The pond is therefore less likely to overflow in the next rainfall event. By draining water from the surface of the pond it also effectively removes the most settled water. A sediment filter may also be fitted to the siphon.

Floating decants are estimated to cost about \$2,500 each in labour and materials. The contractor on the Pukerua Bay project felt that it had worked reasonably well.

The regional council compliance officer suggested, however, that the effectiveness of the system on this project had not been completely optimised because some kind of energy dissipater was lacking at the inlet to the pond. This meant that storm run-off could flow in to the pond at relatively high velocity, and therefore tended to stir up the silt that had previously settled on the bed.

Decants and other related structures are described in detail in the ARC erosion and sediment control guidelines (1999).

1.8 Filter Fabric & Hay Bales

... general requirement to filter stormwater discharge ...

For the *Shannon* and *Laws Hill* realignments, the AEEs stipulate that run-off water from any bare land at the construction site will be filtered prior to discharge.

... use of hay bales and filter fabric ...

The AEEs for the *Oakmere* and *McArthur's Bend* realignments, *Rosebank* interchange and *Pukerua Bay* SH1 upgrade, specify that silt fencing will be used (either filter fabric or hay bales) to filter sediment out of run-off from the site. For the Pukerua Bay project these filters were to be installed on the stormwater and culvert inlets.

Hay bales (“or other suitable material”) were proposed to be installed for the filtration of stormwater run-off for the *Kuaotunu* seal extension project. The AEE for the project specifies that these filter barriers will be placed at 20 metre intervals in the road drains; along the full length of the toes of all fill embankments; and at the entrance of any open receiver or culvert while the road remains unsealed. The bales would be staked firmly in to the ground to prevent movement and subject to regular maintenance checks.

Feedback

- ***silt fencing & hay bales have limitations***

The general consensus (from both contractors and regulatory agencies) with regard to the use of filter cloth fencing is that this works well only as long as it is in the right situation and is regularly maintained. Filter cloth is suitable for taking out sediment from very slow moving blanket overland flow, but does not work if put in a direct flow path. If placed in a direct flow path it is likely to get quickly overloaded and collapse or be undermined by the water.

Silt socks have the same limitations. Costing about \$150 each, these fit on to pipe outlets and are designed to filter out sediment from the discharge. They are effective for use in situations where flow rates are only slight, but will easily blow out if overloaded.

*The same comments apply to the use of hay bales. Indeed, the 1999 ARC guidelines for sediment control do not consider hay bales to be a sediment filter at all. Those contractors interviewed considered that they work moderately well as a filter for slow surface flow, but are not effective if placed in a flow channel. Also, in order to remain effective, hay bales need to be regularly replaced. They tend to clog up very quickly, at which point they cease to work. The regional council compliance officer for the *Kuaotunu* project estimated that hay bales would normally have an effective life of about 2 weeks.*

*A neighbouring resident interviewed for the *Kuaotunu* project commented that the hay bale sediment barriers had worked well, although the contractors were fortunate that the whole of the project was able to be completed without enduring a major rain event (rainfalls of 100–200mm/hour are known in this area). He was critical, however, that it was some time before the contractors realised that it was necessary to replace the hay bales when they became clogged up with silt. Similarly, a resident neighbouring the *Maisey’s* realignment project observed that the hay bales used on this job were more or less left unchanged, with the result that clay and silt built up behind some of the bales to the point of eventually being over-topped.*

- ***introduction of weeds in hay***

*On the *Pukerua Bay* project, hay bales could not be used because of concerns that the bales might introduce weed seeds into the area (and in particular to the adjacent Taupo Swamp reserve).*

- ***theft of bales***

Straw bales were used on the Laws Hill project, although the contractor had an on-going problem with replacing the many bales that were stolen during the course of the work.

- ***silt fabric may have to be left behind***

On the Rosebank interchange project silt fencing was used around the perimeter of the work site. This proved effective, but when the time came to remove the fencing at the end of the job it was found to have sunk so far in to the estuary muds and become so bound up with mangrove roots, that it would have been impossible to uplift them without causing significant damage. The best solution was to simply cut off the fencing at ground level and leave behind whatever remained buried beneath the mud.

- ***unsuccessful experiments with filter fabric & straw***

Some of the contractors interviewed for this study described experiments they had tried using filter fabric as a sediment filter. In one such experiment filter fabric was used to make a series of curtains across a sediment pond (with the aim of using the curtains to filter out very fine suspended sediment as it circulates in the water). This unfortunately did not work. The fabric curtains had no discernible effect on water clarity between the inlet and outlet ends of the pond.

Similarly no success was reported in the case of an experiment where filter fabric was put across the full width of a small but fast flowing stream. A sequence of three separate curtains of filter cloth were fitted across the stream in this fashion in an attempt to provide a 'triple filtering' effect. However, the filter curtains had the reverse effect – with suspended sediment levels actually increasing downstream owing to the scouring effect on the bed of the stream as the water flow was forced at greater velocity through the gap between the stream bed and the filter fabric.

On the same project (and same stream), a further experiment was attempted using hay bales loosely arranged inside gabion baskets and placed in the stream to intercept sediment. This, however, had no effect on the fine sediment in the stream, which passed straight through the hay basket filters.

... silt filtration through a natural gravel bed ...

For the *Craigieburn* bridges project, the AEE proposed that the discharge of gravel-processing water, containing sediment, should be discharged into a settling pond in a nearby dry gravel stream bed to provide effective filtration.

Feedback

This system of filtration is reported to have worked quite effectively in this situation.

... silt filtration by discharging across vegetated land ...

In the case of the *Stoke Bypass*, consent conditions required that any pumped discharge of water from the construction site should be over stable vegetated land and

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that [otherwise] every practical measure should be observed to prevent the discharge of silt into the adjacent stream channels.

Feedback

The engineer to the project advised that, in practice, the only water to be pumped from the construction site was water pumped out of the smaller stream channels during de-watering for the construction of culverts. This stream water was not normally silty anyway, so would have been pumped directly back in to the stream channel again downstream of the work. It was thought that discharging over land would have probably just introduced more sediment to this water.

1.9 Flocculation

... enhanced settlement of suspended sediment ...

Flocculents (the same as those commonly used for the treatment of drinking water) have been used in some cases on construction projects recently undertaken in the Auckland region. The flocculent is automatically added to run-off water as it enters settling ponds where it significantly increases the rate of silt settlement. The use of flocculents can mean that smaller settling ponds can be used. It is claimed that flocculents do not generally have adverse side effects on the environment.

Feedback

*Flocculation has been used on the **Alpurt** project in Auckland. The contractor for this project said that he was initially sceptical but in the end found that the system worked very well and was more cost-effective than other alternative silt control options (such as the very expensive mulching work required for this project). The cost of running a flocculation system was said to be "in the tens of thousands of dollars", including about \$3,000 to 4,000 per season for flocculation chemicals.*

Another contractor spoken to was however less convinced of the merits of flocculation, mainly because of the risk of over-dosing the ponds. He questioned whether this presents a greater risk to downstream aquatic invertebrates than would the untreated sediment. Aluminium flocculents can be toxic to aquatic life if applied in sufficiently high concentrations.

1.10 Temporary Culverts, Bunds, Contour Drains & Check Dams

... construct contour drains & check dams ...

The AEEs for the **Oakmere** realignment and **Pukerua Bay** SH1 upgrade stipulate the use of contour drains and check dams on the construction site to prevent heavily concentrated run-off. The AEE state that the drains would be re-instated after rainfall events.

Check dams (or drop structures) for the control of channel water velocities were also required as a condition of consent for earthmoving work associated with the **Stoke Bypass** project. The consent also stipulates the use of contour drains and earth bunds to control run-off and direct it to the diversion channels.

... install cut-off drains...

Consent conditions for the *Eland* realignment project required that sufficient temporary culverts and cut-offs are to be provided to prevent undue concentration of surface water flow and scour of water-tables during construction.

Cut-off or interceptor drains were also proposed in the AEE for the *Hawkswood* deviation project (near Cheviot) to prevent stormwater run-off from adjacent farmland spilling over any of the batter slopes.

The use of cut-off drains around the perimeter of the work site (to collect and direct run-off water to either settling ponds and/or sediment traps) was also proposed as a requirement in the AEE for the *Glenhope* realignment project.

... a cut-off drain for every 1000m² of construction area ...

For the *Kuaotunu* seal extension project, the AEE states that cut-off drains will be installed to prevent overland flow from entering the construction area as well as within the construction area itself. They are to service a maximum area of no greater than 1000m² for each cut-off, and the water from all of these drains then being passed through an energy dissipater, silt trap and overland flow before reaching a natural drain or stormwater channel.

Feedback

The council representative and Transit New Zealand project manager for the Kuaotunu project both agreed that the requirement for a cut-off drain for every 1000m² should at best be considered as a guide only. Ultimately, the placement of cut-off drains was dictated by what was possible within the constraints of the topography. The need for cut-offs also depended on whether the ground at any particular point was flat or sloping, and on the nature of the soil and on aspect.

1.11 Roadside Stormwater Channels

... install kerb and channelling ...

A measure proposed in the AEE for the *Hawkswood* deviation project was the installation of channelling beneath any new road edge cuttings exceeding 1.5 metres in height. (It was noted that the ground material in this area is highly erodible.) Otherwise, where cuttings would be less than 1.5 metres, the drainage would be only in the form of a normal unsealed roadside drain.

Kerb and channelling was also to be installed along the top of all major fill embankments (those greater than 2 metres high) in order to prevent pavement run-off from dispersing over the fill batters.

Feedback

According to the project manager for the Hawkswood project, the 1.5 metre and 2 metre height criteria would have been treated as only indicative. Other factors (notably the slope angle and nature of the soil) would have determined the need or otherwise for channelling to be installed.

1. Sediment Control

*Side drains have become a concern for the local regional council on the **Spiral Hill** project. The soil in this area is highly erodible and the angle of the road quite steep. There has consequently been a problem with scour down the open side channels. This has been combated by laying down a series of check dams made out of stacks of small cement-filled sand-bags at spacings of about 8 metres apart down the length of the down-hill alignment. This has worked adequately as a temporary control measure, but is now beginning to break apart.*

... dish channels and 'turn-outs' ...

For the **Otira Viaduct** project, the AEE and regional council consent conditions required that (in keeping with standard practice for this area) stormwater should be collected in dish channels alongside the road with 'turn-outs' on the down-hill side of the road at regular intervals. The turn-outs were to be located so that the water would be filtered by soil and gravels before reaching the adjacent river or side streams.

Feedback

*The 'turn-outs' referred to for the **Otira Viaduct** project were for the discharge of water from permanent stormwater drains. These were built at regular intervals, as required. However, the naturally high intensity of rainfall in this area would not have allowed much opportunity for any of the resulting run-off to filter in to soil without causing scour. The turn-outs were therefore generally directed straight into the river gravels.*

1.12 Modified Culvert Designs

... install energy dissipaters at culvert outlets ...

Energy dissipaters were stipulated as a mitigation measure for the **Eland** realignment project AEE. This measure (using rocks set in concrete at each culvert outlet) was applied to all of the 13 culverts that were constructed in conjunction with the project to help reduce the velocity of the water exiting from the culverts, and therefore reduce the likelihood of scour.

In the **Oakmere** realignment AEE is a requirement that rip-rap will be installed at the base of an existing culvert in order to minimise scour at the outlet. This measure was not specifically part of the actual realignment work, but rather was proposed as a means of improving the standard of the existing drain.

All culverts installed for the **Kuaotunu** seal extension were required by the AEE to have dissipaters fitted, with the requirement that dissipaters must first be in place before the culvert is laid. The AEE describes a number of types and configurations of dissipater that would be used.

For the **Kaimatira Road** and **White Bridge** realignments the respective regional council consents simply required that outfalls and flumes should be constructed so as not to cause river bank erosion.

Feedback

*Energy dissipaters are clearly effective. The most common method is simply to place piles of rocks in the path of the discharge. Where this method has been used (as on the **Eland** and **Hawkswood** projects) it has generally worked well.*

*A variant on this was tried successfully on the **Kuaotunu** seal extension project. Here, run-off water was piped away in to gabion basket enclosures (each enclosure measuring about 3 metres square). These were designed to act as stilling compartments for the water discharged from the drainage pipes before spilling over and through the gabion basket, and in the stream at the base of the gully.*

*Dissipaters were not as much required on the **White Bridge** project. In many situations the run-off could be channelled straight on to existing rock boulders. These existing bounders in the river bed acted as effective energy dissipaters.*

... seepage collars, debris risers & stilling basins ...

All culverts associated with the **Hawkswood** deviation, according to the AEE for this project, were to be installed with seepage collars to minimise the potential for undermining. Some of the culverts also featured a debris riser to prevent blockage by debris, a rock-lined stilling basin at the head of the intake and cobbled batter paving at the outlet.

Debris risers were also specified in consent conditions for culverts on the **Whangamoia North** deviation project, and a stilling basin was proposed in the AEE for the **Maisey's** deviation project as an erosion control measure, but with the location of the basin at the outlet rather than the inlet to the culvert.

Feedback

*Only one debris riser was installed on the **Hawkswood** project (on one particular culvert, with a bend in it, where it was thought there could be a risk of blockage).*

... reno mattress ...

For the **Potts Hill** realignment project the regional council required that inlet and outlet protection should be put on all culverts that were to be extended as part of the work. This included a requirement for reno mattress to be laid down for a distance of at least 20 metres downstream of the main multi-plate culvert on the alignment, to protect the bed and river banks of the Waioku Stream. (Reno mattresses are a flatter version of the gabion basket being a wire basket filled with rocks, in this case about 230mm high, 4m long and 2m wide.)

1.13 Channel Modifications

... channel widening to reduce flow velocities ...

To reduce channel velocities and to encourage sediment to drop out within the channel before reaching an ecologically significant swamp area downstream, the AEE for the *Pukerua Bay* project proposed that the watercourse between the construction area and the swamp would be widened out and cut to a shallow grade.

... diverting to a hard rock channel ...

The AEE for the *Belmont* realignment project states that in conjunction with this project the diversion of the Pauatahanui Stream would be cut along an alignment that would take it through a hard rock promontory. The aim of this was to produce a channel that would be less susceptible to bank erosion and therefore likely to have less adverse impact downstream. It was also proposed that the channel would be created with a reasonably rough surface finish so as to provide, as much as possible, a variety of niche habitats within the stream bed.

... rock rip-rap for stream bank protection ...

The AEE for the *Oakmere* realignment project specified that rip-rap would be installed for bank protection in the Te Pohue Stream. This protection work was to compensate for a steepening of the stream gradient resulting from a curve of the stream taken as part of the realignment.

In consent conditions for the *Glenhope* realignment project, which involved a diversion of the channel of the Hope River, Transit New Zealand was required as a condition of consent to “provide heavy rock rip-rap for at least an additional twenty metres” along the right bank downstream of the diversion.

... downhill flumes ...

For the *Laws Hill* realignment the AEE required that flumes should be provided “where necessary” to control erosion.

Feedback

Corrugated iron flumes were installed on two of the properties affected by the Laws Hill project to remove run-off water from the road.

The respective farmers were not entirely happy with the result, however, and claimed that the positioning and design of the flumes would now interfere with the use of their paddocks. They were also concerned that the sharp edges to the aluminium fluming would present a risk of injury to their cattle and were therefore seeking to have these fenced off. They felt that they had not been adequately consulted about the placement of these flumes.

A problem also occurred with scouring at the base of one of the flumes since this had been positioned where it would discharge in to a paddock rather than in to the river about 50 metres beyond. This had left a scour

hole and had caused an erosion channel to form between the flume and the river. To deal with this the contractor piled up rocks to break the velocity of the water. This went some way to reducing the scour problem but has left, as far as the landowner was concerned, an unwelcome pile of rocks in the paddock and an ongoing issue with drainage. The landowner suggested that a better solution would have been to run the flume (or a pipe) the extra distance to the river, which also would have provided a more permanent solution.

The contractor believes that this conflict would have been avoided if a more formal written agreement had been made with the landowners, at the start of the project, outlining precisely what would be done. This is a situation where some form of partnering arrangement would have probably also helped to prevent the bad feeling that resulted from this series of disagreements.

... rock drains ...

The AEE for the *Spiral Hill* project stipulated that a rock drain should be formed at a natural spring at one of the dump sites.

1.14 De-watering of Streams and Drains

... drains to be de-watered during construction ...

In respect of the construction of culverts for the *Eland* realignment project (1994), the AEE states that the relevant drains will be de-watered while construction work is taking place in the channel. The same condition was applied to the Te Pohue *Oakmere* realignment project.

... coffer dams to be made from existing channel material ...

A regional council resource consent for the *Potts Hill* realignment project required that coffer dams associated with the project should be constructed out of the same material as the channel in which they are formed. The dams should be well compacted and less than 1 metre in height.

Feedback

Contractors have generally indicated that they do not have any problem with the de-watering of channels. In most situations this is desirable anyway in order to comfortably undertake the work, although on some projects there is not always the space to do this, or a diversion may not be necessary for the amount of water involved.

1.15 Re-grassing & Topsoiling

... seed mix to be free from weeds ...

For the *Hawkswood* deviation project a condition of consent (as recommended to the council in the AEE) was that the batters and fill embankments should be re-grassed as soon as possible after earthworks are completed, and preferably during spring and early summer. The condition goes on to require that the grass seed mix should be free of weeds and that the seeded areas should be fenced off from grazing. Other consent conditions (also taken from the AEE) are that adequate nutrients, including lime, phosphate, potash and sulphur should be applied to assist plant growth.

The AEE and resource consent for the *Kaimatira* realignment specified that all fill batters should be re-grassed. The AEE also required that cut-batters should be re-vegetated where possible.

Feedback

Care was taken on the Hawkswood project to ensure that the affected farmer was consulted on the type of grass seed and fertiliser he preferred. The requirement for re-grassing to be undertaken "as soon as possible" (rather than within a fixed time period) allowed flexibility for the contractor to wait for appropriate weather conditions.

... re-grassing to be completed within 3 months ...

For the *Oakmere* realignment project the AEE required both hydro-seeding and topsoil to be applied to finished cut/fill batter slopes. The district council land use consent for this project required that the re-grassing should be completed within three months of the end of construction.

... top-soil & re-grassing 'at the earliest opportunity' ...

The AEEs for the *Shannon*, *Potts Hill* and *Laws Hill* realignment projects specify that topsoil and grass should be applied to exposed surfaces "at the earliest opportunity". A similar requirement (for topsoil and re-grassing of fill batters) also appears in the AEE for the *Ngutukaka* and *Arahura* realignments and in the AEE and consent conditions for the *Hawkswood* deviation and *Stoke Bypass*.

Feedback

- ***grass seed will only grow when conditions are right***

Both the contractor and council compliance officer for the Stoke Bypass project agreed with the requirement for grass to be sown "at the earliest opportunity", rather than (as in some other consent conditions) that the grass should be sown within a stipulated period of time. Grass is best sown when conditions are right, and then will still take a month or two to form a cohesive bed.

- ***complaints over poor quality topsoil***

Two of the farmers whose land was affected by the Potts Hill realignment project were disappointed at the quality of topsoil that was used for the rehabilitation of the former road alignment and along the new earth embankments. It was, they said, poor soil, thinly laid, and containing pieces

of wire and other rubbish. The grass did not take very well on it. Both farmers said they had to go back and apply their own grass/clover seed. There were similar sentiments from a farmer affected by the **Shannon** realignment.

There were also complaints over the thickness and quality of topsoil used for pasture reinstatement on the **Laws Hill** project. One farmer said that in some places the newly laid topsoil would be no more than an inch deep. There had been a high level of die-off and he was later obliged to re-seed the area himself.

Another farmer at **Laws Hill** claimed that the topsoil brought on to his farm was essentially just sand and rock (this is disputed by Transit New Zealand and the contractor). The farmer says that it was not topsoil at all and that he had to go back and put on his own topsoil (taken from elsewhere on the farm). A truck had to be hired to help with this, at a cost of about \$600.

- **complaint over contract specifications for topsoil**

The contractor for the **Spiral Hill** project said that he was critical of the fact that contract documents usually provide minimal detail on specifications for topsoil and re-grassing. There were consequently disputes between the contractor and some of the affected landowners over what was an appropriate standard of replacement topsoil and grass. Some of the farmers affected by this project have made it clear that they were definitely not happy with the quality of soil provided. One farmer remarked that the soil put back on at the end of the work was so full of tree trunks and rocks that it is now unable to be ploughed, disced or mowed because of the risk of damage to machinery. The local haymaking contractor refuses to go near it for fear of damage to his gear.

- **weeds in the seed mix & poor quality seed**

There was a problem at **Laws Hill** with weed seeds ('Mayweed') getting in to the grass seed mix used by the contractors on this project. One of the property owners also complained about the quality of the grass seed that was used, and found that this was not a 'certified' seed. They therefore purchased their own grass seed (on-charged to the contractor) and laid it themselves.

The **Rosebank** interchange AEE and coastal permit require that embankment berms and batters should be topsoiled and grassed or otherwise stabilised as soon as possible after their formation.

Feedback

The words "or otherwise stabilised" were essential to this condition since grass would have been mostly inappropriate in this area. Other methods were used to stabilise the slopes.

... deterioration of stockpiled topsoil ...

A word of caution from some contractors was that care should be taken not to stockpile topsoil for too long. After a while the soil at the bottom of the heap may sour. Where this happens the soil may need to be treated with lime fertiliser before it will be suitable for growing grass again.

*In anticipation of this, a contract requirement on the **Hawkswood** project was that any topsoil used on the project should be within the pH range of 5.0 to 6.5, with lime to be added to raise the pH if necessary.*

...certifiably “organic” topsoil ...

*A farmer affected by the **Spiral Hill** project was disappointed by the fact that the contractor on this project had not consulted with him on the treatment of the topsoil put on to his land. Aside from his misgivings at the overall quality of the topsoil he was also concerned that inorganic fertilisers had been then used on it to try and promote grass growth. He had been considering making a switch to organic farming and would now have to wait a period of 7 years for the now-fertilised soil to be able to be certified as ‘organic’.*

... an appropriate seed mix to be chosen ...

A recommendation in the AEE for the **Glenhope** project (on the edge of Kahurangi National Park) was that the selection of the seed mix should be determined in agreement with DOC to ensure against the introduction of new grass species in to the area.

Feedback

*There were no problems as far as DOC were concerned with the types of grass seed used on the **Glenhope** project. However, it was more of an issue for one of the affected farming properties, as they were not satisfied with the mix used on their farm (comprising two types of seed: ryegrass and clover). The farmer advised that they would normally lay a mixture of about 6 types of grass on the property. Too much straight ryegrass can be harmful to the stock. It was later agreed with the contractor that the grass would be re-sown.*

1.16 Hydro-seed

... hydro-seed to be applied to batter slopes ...

Hydro-seeding was stipulated as a method in the AEEs for the **Pukerua Bay** SH1 upgrade, the **Eland** and **Glenhope** realignments and **Kuaotunu** seal extension. For the Kuaotunu project the AEE required that fill batter slopes should be hydro-seeded or impregnated with seed within a week of completion.

Feedback

• **hydro-seed will not survive on dry slopes**

*A neighbouring resident at **Kuaotunu** suggested that the regular use of hydro-seed was one of the best measures for reducing sediment run-off from the work site for this project. However, he claimed that on slopes of 60° or more (in the Coromandel area at least), it was essentially useless because of the propensity for these slopes to dry out completely during the summer. Certainly, during site visits it was seen that hydro-seed grass had died off on a number of the naturally dry slopes.*

- ***hydro-seeding has to be timed around the weather***

An engineer on the Kuaotunu project noted that grass had come away very well in areas where there had been light rain immediately after hydro-seeding. But if the conditions were dry at the time then the hydro-seed would frequently fail. He suggested for this reason that it is not practical to try and automatically seed within a week of completion of a batter, but rather that the timing of hydro-seeding should be dictated by when weather conditions are suitable for grass growth. The timing of hydro-seeding is also dictated to some extent by the availability of the hydro-seed subcontractor, who will usually be working on a number of projects around the country at any one time.

For the Pukerua Bay project a hydro-seeder was brought in to spray any finished surfaces around the construction site every 4 to 6 weeks. The regional council compliance officer said that he was happy with this arrangement and that it seemed to be working well. However, on this project also, some of the hydro-seed applications failed because of dry weather conditions at the time. In these instances the hydro-seed (costing about 50c/m²) would have been largely wasted.

... hydro-seeding only on slopes greater than 2m ...

It was proposed for the *Glenhope* project that hydro-seeding would be limited to fill batters greater than 2 metres in height.

... hydro-seeding not permitted ...

The use of hydro-seed was specifically not permitted by DOC on the Homer to Murrells project. Hydro-seed grass would have looked out of context along this section of roadway and would have also risked the introduction of new species of exotic grass and weeds in to the Fiordland National Park.

1.17 Minimising Bare Ground

... minimal exposure of erodible soil at any one time ...

The AEEs for the *Eland*, *Kuaotunu* and *Oakmere* realignment projects state that construction work will be undertaken in stages (to minimise the extent of earthworks at any one time). For the Kuaotunu project this was interpreted in the AEE to mean that there should not be any topsoil or vegetation removed from any part of the construction area unless earthworks were due to proceed in that area within two weeks (equivalent to about 600 metres of road).

The AEE and consent conditions for the *Rosebank* interchange required that work should be scheduled to minimise the extent and duration of exposed bare earth.

Feedback

- ***area limits can be accommodated on some projects***

An engineer for the Kuaotunu project said he thought that the restriction on the amount of area that the contractor could expose at any one time was not unreasonable and had the positive result of forcing the contractor to

concentrate on one area at a time. However, he went on to make the point that had the limitation been such that the contractor would have been forced to run the project in to another construction season, then it would have been much more serious. In this case the limit (no more than 600 metres of road to be worked on at any one time) did not unduly interfere with the overall work programme.

The regional council compliance officer for Kuaotunu also supported the limitation on the amount of ground able to be opened up at any one time, and that this should be determined by the amount of machinery available to promptly get on with the job.

At Rosebank the site was already very small and involved a minimal area of earthwork. This condition therefore had little or no practical relevance to the project.

- ***area limits can add significantly to contractors' costs and risks***

Elsewhere contractors have warned that an imposition of areal limits on the amount of earthwork that can occur at any one time runs the risk of significantly increasing the cost of a project, particularly where this means that the work is likely to have to run in to two seasons. Rough estimates are that, where this was the case, the cost of earthwork on a project could potentially increase by up to 25% of the overall cost of the job.

Several of the contractors interviewed for this study considered conditions limiting the amount of opened ground on a construction site to be the most controversial and financially risky condition that they were aware of. It is known for example that in the case of the Alpurt project in Auckland (which included a requirement limiting the amount of exposed ground), at least one major contractor declined to bid for the work specifically because of this condition. It is also reported that this condition alone added about \$2million to the overall cost of the Alpurt job and incurred significant liquidated damages (due to time delays) being imposed on the contractor.

The main problem here was that the contractor was constrained during the optimum mid-summer construction period when conditions are normally at their best for drying out the ground and earthmoving. Any work that cannot be completed during this time must be deferred to a later time when conditions are not as good for drying. This has the effect of prolonging the job, not only because of the amount of ground to work on is limited at any one time, but also because a greater proportion of the work then has to be done at times when the ground is not as easy to work.

The ground is normally dried out for earthmoving by stripping away the grass and topsoil cover, then discing the ground to expose it to the air and sunshine. If rain threatens the ground will be rolled flat again to repel the water.

- ***area limits may actually increase erosion***

It has been suggested that limiting the amount of ground that can be opened may actually increase rather than decrease the amount of erosion from the site over the full term of the project. This is because restricting the amount

of work that can be done during the main part of the earthmoving season will mean that more of the earthmoving will have to be done during the less-optimal times for drying out the ground. This means that each hectare of ground on average will take longer to dry and will therefore be left exposed to the elements for longer, than if a greater proportion of the total earthwork was able to be completed at the time of year when conditions for drying and earthmoving are at their best.

1.18 Limited Construction Period

... earthworks to be completed within 8 months ...

A condition of consent originally on one of the main resource consents for the *Stoke Bypass* project was that all earthworks should be completed within a single period of no more than 8 months. The rationale for this condition was that the noise from heavy machinery would start to wear on local residents if allowed to run for much longer than this. The condition was later amended, however, to permit earthworks for no more than 8 months over one continuous period (meaning that the earthwork could run for up to 8 months, stop over the winter, then re-start in the new construction season).

Feedback

The contractor on the Stoke Bypass remarked that, had this condition not been changed from its original form, it could have ultimately 'hobbled' the project because of the uncertainty of whether or not all of the earthworks could be completed within the stipulated time. A single 8-month period would have run in to potentially marginal conditions at the start and end of the normal construction season. It was fortunate in this case that the regulatory authority (and other affected parties) were agreeable to the amendment.

... construction limited to the 'low flow period' ...

The AEEs for the *Oakmere* realignment and *Whangamoia North* project stipulate that the construction period will be limited to the summer low-flow period. Similarly, the AEE for the *Glenhope* project proposes limiting culvert construction work to the late spring / early summer period to coincide with the low flow period.

The same mitigation measure applied in respect of the timing of in-stream construction works (culvert construction, etc.) in the AEE for the *Pukerua Bay SH1* upgrade. The AEE states that these in-stream works would be carried out in times of naturally occurring low flow.

Feedback

Unexpected delays in starting the Oakmere project meant that most of the work was actually carried out in the autumn period (March – April – May). This created some difficulties because of the particular characteristics of the soil (a soft volcanic ash material, prone to slumping) which during the winter months becomes very soft and very muddy. There was consequently a greater than expected problem with slumping and with sediment run-off from the site. Extra sub-surface drains had to be provided. The project was

also hit by a flood during this period, which resulted in some significant bank erosion and resulted in much of the partly completed rip-rap being washed away.

*The **Glenhope** project in the Nelson area has taken place during a period of drought in the region, with the 'low flow' period extending well in to autumn. Channel construction has continued during this time (with no apparent adverse effects).*

... construction limited to the period 1 October to 30 May ...

For the **Kuaotunu** seal extension project the AEE states that work would cease on the project over the winter period, from June to September inclusive. The AEE also proposed that work would stop at any other time when it is deemed that conditions are unacceptably wet. It was indicated that the contractor would not be expected to count on a construction season of longer than five months.

Feedback

• **potentially significant additional costs**

*The **Kuaotunu** project was fortunate to have fine weather right through the winter, and was also fortunate that the regional council were sufficiently flexible to waive the requirement for a June–Sept closedown because of this. Had this restriction been strictly adhered to it would have imposed significant additional costs on the project for no tangible environmental benefit. This opinion was shared by all parties involved in the project (on both the operational and regulatory sides).*

*This situation at **Kuaotunu** (although fortunately resolved, thanks to the pragmatism of the council) illustrates the main failing of the determination of an arbitrary start and finish date for earth-moving.*

On this project, and on several other roading projects around the country in recent years, long dry summers have meant that earthmoving work has been able to continue well in to the autumn, and in some cases right through the winter while conditions have remained sufficiently dry.

Normally work would stop only when the ground conditions get to the point where the moisture content of the soil does not allow for adequate compaction. Typically this would be from some time in April through to some time in September, during which work would naturally have to cease. This is, however, only for a typical year. For wet years the workable construction season will be shorter, and in dry years the season it will be longer. The problem is that the length of the season can not be accurately known and specified in advance.

By imposing an arbitrary close-off date a contractor may therefore be required to withdraw machinery while earthmoving conditions are in fact still workable.

There are significant costs attached to this. Most importantly the contractor will be left with idle machinery that, at this late stage of the construction season, is unlikely to be able to be assigned to work elsewhere. Standing down large earthmoving machinery has an estimated

opportunity cost of approximately \$500 to \$1,500 per item of machinery per day. In addition to this are the costs of initiating the winter shut-down, including securing the site and standing down or laying off staff.

1.19 Mulching & Windrows

... slowing overland flow and conditioning soil ...

Mulching can be used as a method used for breaking up and filtering overland flow on shallow gradients. It also has the benefit of improving the soil as a medium for grass growth. The mulch may consist of either straw or green-waste produced on site and scattered directly on to the ground. The ARC Guidelines recommend the application of unrotted small grain straw at a rate of 6,000 kg per hectare.

Feedback

*Mulching has been used on the **Alpur** project in Auckland. The contractor for this project says, however, that he remains sceptical at the value that would have been gained from doing this, as compared against the cost. Mulching prior to each winter closedown on this project cost in the order of \$800,000.*

The contractor said that it was not necessarily a problem for his company (Transit New Zealand ultimately paid for this as an itemised cost), but he felt that, for all the expense of it, it had made very little difference to the amount of sediment run-off from the site. Whatever small amounts of extra sediment run-off that would have occurred without the mulching most likely would have been captured, in any case, by the other sediment controls set up on the job (notably the flocculent-assisted sediment ponds).

... wind-rows of slash ...

Consent conditions for the **Whangamo** North deviation specified that, as a minimum treatment, a “wind-row” of slash material should be laid down on the down-hill side of a spoil dump that was to be located on the side of a gully. The aim of the slash was to intercept and slow down the flow of any surface run-off from the dump site. It was anticipated that this wind-row would be formed by slash material cleared from off the dump site itself.

1.20 Response to Heavy Rain Warnings

... loose earth to be compacted ...

The AEE for the **Eland** realignment project states that exposed fill batters will be compacted to minimise the loss of loose soil during rainfall.

A similar mitigation measure is contained in the AEEs for the **Laws Hill**, **Potts Hill** and **Shannon** realignment projects, in which loose base material is to be either removed or compacted whenever there is a risk of heavy rain.

Feedback

Contractors have advised that it is generally regarded as good house-keeping and as standard practice for areas of recently worked earth to be rolled every night before close-up, as well as at any other time when heavy rain may be threatening, otherwise the material will get saturated.

... earth-moving to stop in the event of heavy rain ...

A condition of consent for the *Rosebank* interchange project was that all earthmoving operations should cease as soon as practicable during 'heavy rainfall events'.

Feedback

*This condition on the *Rosebank* project was never actually activated. It would have been open to interpretation as to what constituted a 'heavy rainfall event'. Work on most earthmoving projects would stop in any case in heavy rain purely for reasons of worker safety.*

... cover up exposed earth if a cyclone is threatening ...

The use of erosion cover mats is referred to in the AEE for the *Pukerua Bay* SH1 upgrade project. The AEE states that the contractor would be required to have these mats available to place on any large exposed cuts or fills in the event of a severe cyclone warning.

Feedback

*All parties involved in the *Pukerua Bay* project (including regional council staff) were agreed that erosion cover mats would be both costly and impractical to use, particularly where there may be several hectares of exposed cut and fill area on the construction site at any one time. It would be almost impossible to get these areas covered and for the covers to be securely tied down ahead of an approaching storm. There has consequently been no attempt to use (or purchase) covers for the *Pukerua Bay* project. Nor has there been any expectation on the part of the council that this should actually be done.*

1.21 Cement Stabilisation

... cement stabilisation of the edges of drains ...

For the *Eland* realignment project it was proposed to use cement stabilisation along the water tables as a measure to reduce channel scour.

Feedback

*A contractor for the *Eland* project advises that lime (rather than specifically cement) was used for the stabilisation of drains, and that this appeared to work well in the circumstances. This was dug in to the ground along the edges of the drains. Care was taken to ensure that the stabilisation work was done only during fine weather, so that the lime would be able to set ahead of any rainfall.*

Note, however, that in other cases it is quite common for the use of cement to be specifically prohibited in and around waterways (see “Other Pollutants”). Cement can be very harmful to aquatic life.

1.22 Protecting Riparian Vegetation

... riparian vegetation to be untouched / reinstated ...

The regional council consent for the *Potts Hill* realignment project required that grassed land adjacent to the stream should be left untouched, and that any riparian vegetation damaged during construction should be reinstated. The reinstatement of native riparian vegetation is also specified in the AEE for *Whangamoia North*.

Similarly, as a condition of consent for the *Arahura* realignment project, Transit New Zealand was required, in a general manner, to “minimise damage to creek bank vegetation and creek beds”.

Feedback

This was generally considered to be a sensible requirement for the Arahura project in particular, where there was some concern that this may possibly be a spawning area for whitebait. Whitebait spawn in river-side grasses, reeds etc. during high spring tides in the tidal reaches of rivers. The riparian vegetation in this case was therefore potentially of direct value as a whitebait spawning habitat. However, regrettably the contractor on this project did not pay a great deal of attention to this condition and made no particular effort to save any of the vegetation along the bank. A more clearly specified condition may have helped to prevent this or at least permitted stronger enforcement.

... riparian vegetation to be established ...

The AEE for the *Belmont* realignment stated that riparian vegetation would be established alongside the Pauatahanui Stream edge as part of the landscaping.

1.23 Machinery in Stream Beds & in Coastal Water

... machinery to be kept out of the stream beds and coastal waters ...

A mitigation measure required of the *Oakmere* realignment project, in the resource consent for that project, was that the use of machinery in the stream bed should be “minimised”.

A stricter condition appeared in the resource consent for the *Thames Coast* project. This required that machinery should not operate at all from within the coastal waters during the course of the work (laying rock protection along eroded sections of coastline beside State Highway 25). Similarly, in the AEE and consent conditions for the *Craigieburn* bridges project it was stated that work within the main flow channel would not be allowed.

Feedback

Two reasons are usually cited for not permitting machinery to work in streams or coastal waters. These are that (1) the skewing action of the tread will stir up sediment into the water, and that (2) the machinery could leak oil.

The first of these is likely, although the effects of this sediment will depend on the sensitivity of the particular receiving waters as well as on the type of machinery involved and on the care with which the machinery is operated. The worst scenario would be a repeat of earlier land clearance practices of the Forest Service era where it was not unusual for bulldozers to work right across a creek bed. However, not all machinery tasks (particularly on roading projects) are likely to be anywhere near as damaging.

Oil spillage is also a possibility, but realistically the chances of a significant oil spill occurring in most circumstances would be very remote. And while even small quantities of oil (a few drops) may not be desirable in any waterway, it has to be asked what measurable harm such amounts would actually cause.

This suggests that, while the operation of machinery in waterways should be generally discouraged, it may not be appropriate to totally prohibit this kind of activity in all circumstances.

*On the **Craigieburn** project the contractor was able, if necessary, to drive machinery across the stream channel, but was not permitted to operate a static machine there (because of the skewing of the tread of the machine on the stream bed).*

*In the case of the **Thames Coast** project, it was in any case inadvisable to take machinery in to the water because of the damage that the salt water would cause to the machines. It was also acknowledged that machinery in the water would not be a particularly "good look" in the perception of passing motorists.*

... low level culvert for construction vehicle crossings ...

Consent conditions for the **Belmont** realignment project included a requirement that, where frequent crossings of the Pauatahanui Stream by machinery are proposed, a low (bank level) base flow culvert must be installed.

1.24 General Precautions

... “precautions” will be taken ...

Resource consent conditions for the *Eland* realignment project required that “precautions” would be taken to prevent soil erosion.

... water quality “shall not be significantly affected” ...

A similarly broad condition appears in the DOC concession notice for work on the *Homer to Murrells* realignment project in Fiordland National Park, which generally requires that the water quality of any river, creek or stream “shall not be significantly affected” by the realignment construction work. Regional council consent conditions for this project are equally general: that all instream works should be “kept to a minimum to avoid as much as possible discoloration of the stream”. Where it is necessary to enter the bed of streams the consent requires that “all practical means should be used to ensure that any damage to the margins and beds of the watercourse is minor, is avoided, remedied or mitigated”. A similar condition was also applied to resource consents for the *Stoke Bypass* and in the AEE and consents for the *Whangamoa North* deviation project.

... “minimise” disturbance of the streambed ...

Likewise, in consent conditions for the *Kuaotunu* seal extension and *Makarora* bridge widening works project required that the consent holder should “minimise disturbance” to the stream bed. The AEE for Makarora required (in keeping with conditions suggested by the local Fish and Game Council) that the instream excavation works should be “carried out in a sensible manner to prevent unnecessary discoloration / siltation”.

... “good earth-moving practice” will apply ...

For the *Spiral Hill* project the AEE stated that “good earth-moving practice” was to be applied, especially regarding the removal or compaction of surface material when there is a risk of rain.

Feedback

*The definition of “good earth-moving practice”, although seemingly innocuous, later came in for considerable scrutiny on the **Spiral Hill** project after a major land-slide occurred during construction and fell on to a house in the valley below (17/5/1999).*

The conditions of resource consent for the project referred back to mitigation measures contained in the AEE (thereby effectively making these conditions of consent in their own right). Whether or not the contractor had been observing “good earth-moving practice” and whether or not a failure to do so contributed to the landslide therefore became a point of legal interest.

The official regional council report on the slip attributed the cause to the ripping up of the old abandoned road surface, which had then been covered over with slash and woody earth (to assist regeneration). This meant that a large amount of

rain water was able to infiltrate the ground along the old road alignment, which then fell away. The landslide may have also been assisted by run-off water from a newly constructed flume, causing liquefaction of the slip material.

*The contractor for the **Spiral Hill** project was critical of the vagueness of the “good earth-moving practice” consent condition because the meaning of this condition is so open to interpretation.*

For the contractor (particularly when profit margins are tight) it is always tempting to interpret this in the least cost way. The council interpretation may be quite different to this, and a likely source of conflict as the project proceeds.

*The regional council compliance officer for the **Spiral Hill** project also thought that the conditions had been too vague and that the result (when things went wrong on the project) was that the officer would be “put on the spot” trying to interpret these conditions against the opinion of the contractor. The council officer said that if the same project was to run again he would want far more specific and clearly worded conditions.*

... in accord with “best engineering practice” ...

Consent conditions for the **Pukerua Bay** project included a requirement that work (the laying of culverts) should be completed “in accord with best engineering practice and the manufacturers specifications”. In other conditions Transit New Zealand was required to take “all practical steps” to minimise sediment loading and increased turbidity of the Taupo Stream.

Feedback

*Regional council compliance staff working on the **Pukerua Bay** project acknowledged that this kind of general requirement for “best practice” to be followed was too vague and open to interpretation, and for this reason had not always worked out.*

It also turned out to be a costly condition for Transit New Zealand as the term “best engineering practice” was later interpreted by the council (and enforced on Transit) to mean that the culverts should be designed for a 100-year return flood event, which is much larger than would normally have been designed for by Transit New Zealand in this situation.

There were also long debates over what “all practical steps” should be taken to mean. Some parties argued for a while that this should require Transit New Zealand to use centrifugal separators to remove sediment from the run-off water, or that all run-off water should be pump-sprayed on to grass paddocks, or even into another catchment area.

For the **Arahura** realignment, consent conditions from the regional council included the condition that the consent holder should “minimise the discharge of sediment to waterways”, and that “where practical, during construction, sediment retention methods shall be employed for treatment of discharges prior to entry into natural watercourses”. For the water diversion permit, Transit New Zealand was required to carry out the work “in a manner that will minimise any detrimental effect to the quality and availability of natural water for any other purpose.”

... *“appropriate measures” to prevent silt run-off* ...

For the *Belmont* realignment, regional council consent conditions included a requirement that “appropriate measures” should be taken to prevent silt run-off from raw cuts and fills. The same appears in the AEE and consent conditions for the *Maisey’s* realignment project.

Feedback

No-one involved in the Maisey’s realignment project was able to recall any specific silt control measures being applied to the job.

District council consent conditions for the *Hawkswood* deviation project included a condition (as recommended in the AEE) for “appropriate stormwater management measures including drains and sediment traps for the interception and treatment of stormwater run-off”. These were to be in place for the duration of the construction period and until a suitable vegetation cover has established in restored areas. The condition requires that the exact location of these [stormwater management] measures should be determined before the commencement of construction.

2. Stormwater Treatment

2.1 Stormwater Treatment Devices

... “stormwater treatment devices”, isolation valves ...

The AEE and coastal permit for the *Rosebank* project both required that all run-off from sealed and other impervious parts of the carriageway should be passed through a “stormwater treatment device” (as specified in design plans) to help “settle any particulates and attached contaminants prior to discharge”. The consent also required that isolation valves should be installed within the drainage system to contain hazardous or contaminated spillages. These structures were to be in operation prior to the commissioning of the finished interchange.

The stormwater treatment devices are described in the *Rosebank* AEE as large rectangular chambers constructed of reinforced concrete or concrete blocks and set in the ground. The chambers are intended to allow run-off to collect and any sediment to settle before release through a screened outlet.

Feedback

The “stormwater treatment devices” at Rosebank cost approximately \$45,000 each to construct and install. Each of the four installed has a capacity of approximately 84m³ and fitted with three chambers. Recent research by Transit New Zealand³ has shown that they are working to some degree, with the removal of around 30% to 40% of suspended sediment, zinc, lead, copper and total PAH⁴ (although actual figures can vary considerably from sample to sample).

To what extent these tanks are significantly improving the water quality of the Waitemata Harbour remains to be seen however. At current rates, about 60% to 70% of contaminants are still passing straight through the tanks and in to the receiving waters. There it will join the other untreated run-off from the rest of the motorway system, plus other untreated run-off from elsewhere around the Waitemata catchment.

Some question remains, therefore, whether the treatment tanks are providing a significant benefit to the environment for their \$180,000 total cost. Further research may be needed in this area to more accurately assess the effectiveness and actual overall benefit of these treatment units in the context of the existing environment. It would seem unwise to install more units of this kind until more is known about whether they are actually making a significant difference.

³ Larcombe, M. April 2001. *Auckland Northwestern Motorway: Efficiency of Stormwater Treatment Tanks at Rosebank and Patiki Interchanges*. Report to Serco Consultancy. 27pp.

⁴ PAH – polycyclic aromatic hydrocarbons.

... “swales”, siphon sumps, dish channels ...

For the *Pukerua Bay* SH1 upgrade project, conditions in the final designation included requirements for the collection and treatment of road surface run-off. Under these conditions the run-off from the road was to be kept separate from any local farm run-off and passed through a variety of treatment systems.

“Treatment” in this case included the use of small “swales” (shallow dish-shaped depressions in the ground) at the culvert outlets, intended to spread the flow, promote the settling out of sediment, and more generally provide a “buffer” against downstream effects. It also included the installation and maintenance of siphon sumps (“incorporating a sediment debris collection sump in the base and a siphon outlet to prevent the discharge of floatable material”). The conditions then require that, if possible, the discharge from the siphon sumps should be directed into a remnant wetland area rather than directly in to the main Taupo Swamp. Transit New Zealand was also required to provide road-edge drainage channels along the full length of the alignment, with a preference expressed in the conditions for “dish channels” rather than conventional concrete curb and channelling.

Sumps were also stipulated for the *White Bridge* project. Conditions of consent for the project required that design plans for the stormwater sumps should be submitted to the regional council before the works commenced. The consent also required that a certificate, signed by the person responsible for designing the system, should be submitted to the council within one month of construction to certify that the system is constructed and installed in accordance with the design plans.

Feedback

For the Pukerua Bay project it remains to be seen how much benefit will be gained from the siphon sumps (otherwise known as grit and oil traps and costing about \$630 each plus cost of installation), and whether or not they will actually have a significant beneficial effect on downstream water quality. It can be reasonably assumed that the sumps will catch road oil as intended, but it is unknown whether the small quantities of oil intercepted by the sumps would have had any measurable effect on the environment in any case. There were no such sump units on the existing roadway and no evidence is available to indicate that this was previously causing an adverse environmental effect.

The “swales”, on the other hand, have been reasonably easy to construct, although in some places constrained by the lack of verge space. Whether these swales will really have a significant beneficial effect on the quality of run-off from the road corridor is again unknown.

The supervising engineers interviewed for the White Bridge project were equally doubtful of the likely benefits of installing sumps on this particular section of road, noting that nowhere else along the rest of the state highway, running for hundreds of kilometres in either direction of this one site, would have any such sumps. With the comparatively low levels of traffic (approx 1,000 vehicles per day (vpd)) on this road it would be difficult to imagine a significant scale of effect without them.

2.2 Sump Maintenance

... maintenance plan for stormwater treatment devices ...

Under the conditions of the *Rosebank* coastal permit Transit New Zealand was also required to prepare a maintenance and operation schedule for the “stormwater treatment devices”. The schedule was to address procedures for hazardous spill containment, as well as the inspection of the devices and removal and disposal of sediment from those devices.

... annual maintenance of sediment traps ...

Stormwater treatment chambers were also required as mitigation measures of the *Orewa Bridge* AEE. It is proposed in the AEE that the cess pits and sediments traps [for stormwater] will require annual de-sludging to ensure their effectiveness.

... visual inspection and cleaning of stormwater sumps ...

A condition of consent for the *White Bridge* project was that the stormwater sumps should be visually inspected at least once every three months once the road is built, with any visible hydrocarbon product to be removed immediately and disposed of in an authorised landfill. The consent also more generally required that all debris and sediment should be removed from the sumps whenever it occupies greater than one quarter of the storage volume of the outlet pipe or weir.

3. Other Pollutants

3.1 Fuel, Oil Changes & Plant Maintenance

... re-fuelling & oil changes shall occur away from waterways ...

The AEE for the *Eland* realignment project states that oil changes and plant maintenance will be undertaken at a nominated site away from waterways and other sensitive areas. A similar requirement also appears in the AEE for the *Waimate* realignment projects.

Likewise, the AEE for the *Oakmere* realignment required that fuel storage and re-fuelling should be conducted away from the Te Pohue stream. The resource consent for the *Thames Coast* project similarly required that refuelling and lubrication should be carried out away from any water body and that all machinery should be operated in such a manner which ensures that spillages of fuel, oil and similar contaminants is prevented.

... re-fuelling shall not occur within 20 metres of any stream ...

For the *Butts Road* realignment project the AEE specifies that, as a precautionary measure, refuelling will not take place within 20 metres of any stream.

... re-fuelling shall occur at “controlled sites” ...

With the *Homer to Murrells* realignment in Fiordland National Park, conditions from the DOC concession notice include a requirement that all refuelling and fuel storage should be at controlled sites. These sites were to be agreed with the DOC representative.

... fuel and oil shall not be released into the river ...

For the *Kaimatira* realignment project the regional council required that no contaminants, including oil, hydraulic fluid, petrol, diesel and lubricants (but excluding sediment), should be released into the Wanganui River.

Similarly, the consent conditions for the *Stoke Bypass* project required that the consent holder shall “ensure that any spillage of fuel, oil or other construction-related substance does not contaminate water or is deposited in a position where it may contaminate water”.

The regional council consent for *Potts Hill* specifically states that no fuel or oil should be permitted to leak into the stream and that [for this reason] there should be no re-fuelling in the stream.

... machinery to be maintained in good order ...

The AEEs for the *Shannon* and *Potts Hill* realignments state that contract documents for the respective projects will require the contractor to maintain reasonable standards of machine maintenance, including the servicing of machinery to prevent oil spills.

... fuel storage facility to be bunded ...

The AEE for the *Pukerua Bay* SH1 upgrade project also describes standard specifications in the construction contract. In this case, according to the AEE, the specifications would require a separate bunded on-site storage area for diesel, and for the contractor to minimise the amount of diesel stored on site at any one time. The regional council consents for this project go on to require that the final location of this fuel storage area should be to the satisfaction of the council.

Feedback

One of the farmers whose land was affected by the Pukerua Bay project was critical of the fact that a large pit had to be dug, on what he said was good farm land, to create a bunded area around the tanks. He felt that the small risk presented by the fuel tanks did not warrant this level of containment. However, another neighbour said he thought that the bunding was good and appropriate. The contractor himself had no particular problem with the requirement for bunding, but wondered if it was entirely necessary since his fuel storage tanks were all double-skinned.

The value of bunding (and of ensuring the overall security of fuel storage tanks) was, however, demonstrated on the Stoke Bypass project. The main diesel storage tank was twice vandalised during the course of the project and on one of these occasions resulted in some diesel getting in to a stream. This could have been avoided if there had been bunding provided. It appears that the main risk of spillage is not so much a tank failure (against which double-skinned tanks protect) but rather the risk of deliberate vandalism and/or tampering with the valve.

Contractors have remarked more generally on the problems with maintaining fuel storage bunds on construction sites, and in particular how to deal with the pit filling with rain water. In some cases a digger is used to scoop out water from the bund. In others cases a self-contained bunding is used which can be drained after rainfall, or the whole fuel tank and bunding is put under shelter. However, as yet there is no one easy solution. One option may be to fit bunds with a basic oil separating system (in the form of a siphon).

The AEE for the *Otira Viaduct* project likewise required that all fuel and other liquid contaminants should be confined to the laydown areas, and that the fuel storage areas should be bunded and surfaced to contain any accidental spills, with the run-off from these areas directed through interceptors of proven effectiveness.

Feedback

A sophisticated fuel storage and re-fuelling area was built for the purpose of the Otira Viaduct project. The fuel tank in this case was securely stored

inside a modified shipping container. A concrete pad was laid down next to this as a re-fuelling area, with the whole area serviced by an in-ground oil separator. All parties agreed that this was an appropriate level of fuel management for the area and for a job of this scale.

For fuel storage the AEE for *Kuaotunu* specifies that all fuel storage vessels should be located in a watertight bunding at the dedicated mobile plant storage area, with a watertight bunding large enough to contain the maximum volume of the vessel with 10% freeboard. If more than one fuel container is stored in a single bund, the AEE allows that the bund must hold the maximum volume of the largest container plus 10% freeboard.

Feedback

There were in fact no fixed fuel storage vessels on site on the Kuaotunu seal extension project. All machinery was serviced either by a mobile tank or by re-fuelling at the local store. This avoided the need for a bunded fuel storage.

4.2.2.3 ... locate fuel storage areas out of the floodway ...

In regional council consents for the *Belmont* realignment project, the main concern of the council in relation to fuel storage was that these facilities should be located away from the floodway of the Pauatahanui Stream. This appears as a condition of consent for the project, as well as a more general condition that “the risk of spillage into streams [shall be] kept to a minimum”. The AEE for the *Whangamoia North* project also requires that fuel tanks should be located clear of any floodways.

In a similar theme, the regional council consent conditions for the *Arahura* realignment project required that there should be “no re-fuelling or fuel storage in or on the creek beds”.

For the *Makarora* bridge widening project, conditions contained in the AEE also included (at the request of the local Fish and Game Council) a requirement that all refuelling and housing of vehicles, plant and other equipment and chemicals should be well away from any water course.

4.2.2.4 ... no fuel storage permitted on site ...

At *White Bridge* the AEE stipulated that no fuel would be stored on site (except for a small emergency supply). All machines were to be fuelled directly from a mini tanker fuelling service.

4.2.2.5 ... use only hand-pumps for pumping oil ...

The *White Bridge* AEE also specified that lube and hydraulic oils will be transferred by hand pump to control volumes in the event of spillage, and required that a supply of sand should be kept on site to assist with soaking up a diesel or oil spill.

... prepare a fuel management plan ...

The AEE for the *Kuaotunu* seal extension required that the contractor should submit to the Project Engineer a fuel management plan setting out:

- Likely spill scenarios,
- Provisions to be put in place to minimise the chance of each scenario, and
- A contingency plan for cleaning up any spill.

Feedback

The contractor on the Kuaotunu project acknowledged that fuel management plans are now a standard practice and sensible contingency.

... dedicated construction vehicle parking areas ...

Another requirement of the AEE for *Kuaotunu* was the establishment of a dedicated area for the overnight parking of mobile plant. The AEE stipulates that this parking area should be located well away from any natural watercourse and on ground that is not prone to flooding. It requires that the surface of the parking area should be covered with a 150-mm layer of sand, to be removed, treated and disposed of at the end of the contract.

Feedback

A neighbouring resident at Kuaotunu advises that this dedicated vehicle parking area was never built. Nor was there a layer of sand put down anywhere for vehicles to park on. He suggested, however, that any such measure would have been completely "over the top".

... drip trays for leaking vehicle oil ...

The Kuaotunu AEE also required that any construction vehicles identified as leaking oil or fuel would be parked on drip trays overnight in the dedicated park area. Any vehicles determined to be leaking excessive amounts of oil or fuel would be taken out of service and repaired immediately.

Feedback

There were never any problems with leaking oil on the Kuaotunu project. Had leaks been identified the vehicle would have been repaired immediately (if only to keep the machine operating and in good working order).

3.2 Contingency Planning for Fuel Spills

... staff to be trained in fuel handling ...

The AEE for the *Hawkswood* realignment project included a statement that appropriate storage and contingency measures would be implemented, including staff training and supervision in matters such as fuel handling and spill contingency and emergency procedures. This included the storage of fuel and machinery in a secure bunded enclosure.

... a management and contingency plan for hazardous substances ...

A contingency plan to control and dispose of construction-related contaminants was required, prior to the commencement of work, as a condition of consent for the *Stoke*

Bypass and *Glenhope* realignment projects. Similar conditions were also applied to *Kuaotunu*; and to the *Bluff Creek* project through DOC consents.

Consent conditions for the *Hawkswood* project also required (on the recommendation of the AEE) a management plan, to be prepared by the contractor, for the storage, handling, use and disposal of hazardous materials, chemicals and waste. A similar "contingency plan" was also required to be prepared for the *Otira Viaduct* project as a regional council condition of consent.

Consent conditions for the May 1997 resource consent for the *Thames Coast* rock protection project required that the consent holder (Transit New Zealand) should retain appropriately experienced persons to develop a contingency plan for the prevention and removal of spills of hydrocarbons and other illegal discharges to the coastal marine area. The consent conditions also required that all site employees should be aware of the contingency plan and should have appropriate training as to the procedures to be followed in the event of any such spill occurring.

3.3 Action to Remedy Spills

... *fuel spills are to be isolated and removed* ...

For the *Ngutukaka* realignment project, the AEE states that the construction contract will specify that any spill of oil, petroleum, etc., shall be isolated from any water course and that remedial works will be initiated to contain and remove contaminated material from the site.

With the *Homer to Murrells* realignment project the regional council consent for bridge and culvert work simply required that, in the event of any contamination of a watercourse by fuel or oil, the consent holder should "remedy or mitigate the effects of contamination at the site and notify, without undue delay, the Director of Environmental Management" at the council.

Regional Council consents issued for the *Pukerua Bay* SH1 upgrade project included a condition that, in the event that there is a release of contaminants (including suspended sediment) into the adjacent Taupo Swamp which causes, or is likely to cause, "significant adverse ecological effects on the Swamp", then the consent holder must immediately notify the Council and the QEII Trust (as administrators of the Swamp) and liaise with these parties on appropriate remediation.

3.4 Toilet Effluent

... *chemical toilets to be provided* ...

The AEE for *White Bridge* required that all toilets on site should be chemical toilets with holding tanks to be regularly cleaned out. All sewage was required to be disposed of off-site into an established sewage disposal system. The same was required by the AEE and resource consent conditions for the *Otira Viaduct* project.

3.5 Vehicle Wash-down

... wash-down facilities to be provided for trucks...

Discharge consents for the *Pukerua Bay* SH1 upgrade project included specific conditions relating to the washing down of vehicles on site. This included a requirement that the washwater should contain no additives (for example, detergents). The consent also required that an effective washwater settlement basin or treatment system should be established, in which the suspended solids content in the discharge should not exceed 20g/m³ and that suspended particles larger than 20 microns are retained in the basin and treatment system.

Feedback

Commentary on the Pukerua Bay project from the regional council suggests that there is likely to be little point in specifying allowable suspended sediment levels in discharge from the wash-down water settling basin (in this case a limit of 20g/m³), as the actual level will be very much dependant upon rainfall conditions at the time. This limit would almost certainly be exceeded in even a small rain event. It is more appropriate to specify the type of silt control measures that should be in place (which the contractor at least has some control over) than to attempt to specify suspended sediment limits that can only be known some time "after the event".

3.6 Cement & Other Contaminants

... uncured cement as a contaminant in water ...

Uncured cement is specifically identified as a contaminant that should not be permitted to enter into the waterway for the *Oakmere* realignment project (as stipulated in both the AEE and resource consent). The same or similar requirements are also specified in the *Whangamoa North* and *Potts Hill* AEEs, and in consent conditions for the *McArthur's Bend* and *Glenhope* realignments and *Makarora* bridge widening.

In conditions for the *Rosebank* interchange coastal permit Transit New Zealand was instructed to use pre-cast beams and components wherever practical in the construction design (as proposed in the AEE). The consent specifically prohibits the disposal of waste concrete, as well as wastewater and "other substances which may have an adverse environmental effect" into the coastal marine area. The consent and AEE both specify that foundation cylinders for the bridge superstructures will be required to be constructed inside a casing, with all sediment from that process to be removed and disposed off site.

Feedback

On the Glenhope project, cement float water was able to be drained away from the river and into a settling pit.

At Rosebank pre-cast beams were used as they were more suited for the construction work. Thus they would have been used irrespective of any specific requirement.

... only water to be used as a drilling lubricant ...

For foundation drilling during construction of the *Rosebank* interchange, the coastal permit also required that only seawater or fresh water should be used as a drilling lubricant, with provision made for the recycling and appropriate disposal of this fluid.

... variations on Section 171(1) RMA ...

Conditions are much more specific in the regional council resource consent for the *Potts Hill* realignment. Here the consent stipulates that discharges to the stream “shall not result in any conspicuous oil or grease films, scums or foams [etc., as per Section 107(1) RMA], nor reduce horizontal visibility by >30%, nor have a BOD₅ exceeding 2g/m³, measured 20m downstream. The reduction in light at the sediment bed (measured by standard PAR meter) is not to be more than 20% of the undisturbed value”.

Feedback

There were no measurements of water quality actually collected on the Potts Hill project.

Consent conditions for the *Pukerua Bay* SH1 upgrade project generally require that there should be no discharge of hazardous liquids or substances. However, the conditions also refer more specifically to what are in effect the performance standards of s.171(1) of the RMA (with some modification). In relation to any discharge from the spoil dumps, the consent requires that the discharge below these landfills should not result in:

- The production of any conspicuous oil or grease films, scums or foams or floatable suspended material;
- Any conspicuous change in colour or visual clarity;
- Any emission of objectionable odour;
- Any rendering of fresh water unsuitable for consumption by farm animals;
- Any significant adverse effect on aquatic life; and
- Any visible deposition of iron oxide [as an additional standard, not from s.171(1) RMA].

Another version of the s.171(1) condition appears in four of the other six regional council discharge consents for the *Pukerua Bay* project, except that for each of the other consents the consent holder (Transit New Zealand) is required only to take all practical steps to “minimise” (rather than completely avoid) the stated effects. In these consents also “visible deposition of iron oxide” is not a specific requirement. However, a new standard for “a change of no more than 3° Celsius in the natural temperature of the water” is introduced.

The standard of not rendering fresh water unsuitable for consumption by farm animals is also made stricter in each of these other consents by adding that the water should also not be rendered unsuitable for consumption by humans.

Feedback

*Some of these performance standards, based on s.171 of the RMA would be difficult or impossible to achieve with a typical roading project running next to or through a watercourse. For example, the requirement on the **Pukerua Bay** project that there should not be any conspicuous change in water clarity would effectively prohibit the run-off of any sediment into adjacent streams. There is no way that this could always be achieved.*

*It is also unlikely that the contractor on the **Pukerua Bay** project would have much control over the visible deposition of iron oxide (more a function of the local geology), and increases in the temperature of natural water (a function of the amount of sunshine).*

... acid-producing pyritic rock ...

One of the main concerns for the **Kuaotunu** seal extension project was the acid condition of the underlying pyritic rock in this part of the Coromandel. This material has the potential for significant contamination of local surface water with metal precipitates if exposed and oxidised. The AEE proposed that, where possible, this acid-producing material should be separated out and encapsulated in large compacted embankments to minimise exposure to air and water; to receive lime treatment (to increase the pH and thereby reduce leaching); and to keep the material concentrated in case further mitigation treatment should be required in the future.

The AEE also proposed that each of the encapsulations should be sited above the local water table and should be fitted with underdrains to remove surplus water; with diversion drains above and around; a cap of impermeable soil; and final covering of vegetation to enhance the stability of the mound.

... materials to be generally “uncontaminated” ...

In other conditions for the **Pukerua Bay** project, the regional council consent (for instream construction works) required that “all material placed in the beds of watercourses or in the flood path of the Taupo Stream shall be uncontaminated, suitable for the site and have no potential to produce harmful effects on the environment”.

4. Debris in Waterways

... keeping debris out of waterways ...

A requirement of the regional council for the *Eland* realignment project was that waste material (branches and other debris) should not be put in to, or in a position where it may enter into, a watercourse. The council also required that provision should be made for the removal of debris in the event that this occurred. A similar requirement also appears in the consent conditions for the *Glenhope* project, that all disturbed vegetation, soil and debris will be placed in such a manner as to prevent it from entering the river and causing either “diversion, damming, stream-bed erosion or destruction of in-stream habitat”.

In consent conditions for the *Whangamoia North* project, only vegetative debris from the construction area greater than 10cm diameter were specifically required to be removed from waterways. Soil and vegetation were however required to be placed in a position where they would not be likely to wash in to the river.

Feedback

The main concern with the Glenhope project in relation to debris in waterways was that willow cuttings would get washed away and take root elsewhere downstream (to the exclusion of native species). Nets were therefore laid out in the river to catch any loose branches while willows were being cleared. These precautions were not particularly difficult to carry out but were taken even though a large number of willow trees were known to be already established and growing on the river banks further down stream.

Consent conditions for the *Makarora* bridge widening project also required that any construction debris should be removed from the stream bed prior to completion of the works, and that excess material [spoil] should be deposited away from the bed or banks of the stream.

A mitigation measure in the AEE (later adopted as a condition of consent by the regional council) for the *Arahura* realignment was that, during the installation of culverts, the contractor should take “all practical measures” to minimise the spillage of earth into the stream running through the construction site. For all other activities on site the contractor was generally required to ensure that there was no spillage of earth material in to the stream. Similar measures were also proposed in the AEE for the *Hawkswood* deviation.

Feedback

There were no similar conditions requiring earth to be kept out of waterways on the Spiral Hill project. Nor does it appear that there was much attempt to do so. Some creek beds were actually filled in by the contractor on this job. This did not sit at all well with the local regional council.

... tarpaulins to be used to catch debris ...

For the **Potts Hill** realignment project the regional council resource consent required that any debris entering the Waioku Stream should be removed. The consent also required that spoil should be kept out of the stream and that tarpaulins should be spread over the bed of the stream to collect debris (for subsequent removal) during back-fill and removal of the coffer dams.

Feedback

A tarpaulin was used in the stream at Potts Hill as required to capture debris falling in to the water. Neighbouring farmers interviewed confirmed that this was done, but could not see the point of it. Nor could anyone else.

... temporary platforms to be used to catch debris ...

The AEE for the **Twizel Bridge** widening project proposed that, in order to prevent chips of concrete and other debris falling in to the waterway, a temporary platform would be constructed beneath the work area (also to serve as a working platform for bridge repairs).

Feedback

The “temporary platform” that was built for this project comprised, in the end, a series of tarpaulins swung beneath the work area. The project manager and contractor have questioned the actual need for this platform, considering that the work on the bridge (widening the bridge to two lanes) did not involve knocking any material off the bridge, or cleaning it down. The only thing that the platform might have caught would have been tools and equipment accidentally dropped from the work area. None of this would have been likely to actually affect the river.

5. Coastal Reclamation

5.1 Limits to the Area of Reclamation

... specific limits to the area of reclamation ...

Coastal permit consent conditions for the *Rosebank* interchange project specified a maximum area of reclamation in an area of coastal mangrove in the Waitemata Harbour for the construction of the two interchange ramps. For the first of these ramps (Ramp A) the limit was 2200m². For the second (Ramp D) the limit was 1300m² of reclamation.

Feedback

*This strict limitation on the amount of land area able to be reclaimed for construction of the **Rosebank** interchange meant that space was insufficient for an earth embankment to be built on the reclaimed area, and that the structure had to be entirely supported by concrete piers. Another few metres of reclamation would have been necessary to fit in a sloping embankment.*

The resulting structure arguably looks more attractive than would an embankment, and presumably meant that it had slightly less direct impact on the mangroves, but added about another \$1million to the overall cost of the project.

... keep encroachment “to a minimum” ...

Consent conditions for the *Thames Coast* rock protection works project simply required that the extent of encroachment of structures [the rock protection walls] onto beach areas should be “kept to a practicable minimum”.

Feedback

*Feedback from DOC on the **Thames Coast** project was that for all of the effort that was put in to working out environmental controls on the project, the actual job “on the ground” was quite low impact. All the fill material was clean, and the amount of excavation required was “trivial”.*

5.2 Bunding of the Reclamation Area

... bund off the reclamation area ...

The *Rosebank* consent required a bund to be established around the edge of the areas to be reclaimed. The bund was required to come up to at least the height of the proposed reclamation.

Feedback

A bund was not actually required in the end at Rosebank because an alternative method of reclamation was used instead. Rather than construct a bund and fill in behind it, the land was instead reclaimed in stages (using clean metal fill overlaid on top of geotextile fabric). This eliminated the need for any tracking over the soft estuary muds and avoided any potential problems with water ponding behind the bund.

As a condition of the coastal permit, a bund wall was also required to be constructed around the perimeter of the reclamation area for the *Stoke Bypass* project before any infilling.

5.3 Tidal Restrictions

... no work permitted in areas under water ...

The *Rosebank* coastal permit required that any foundation work beneath the level of the surrounding reclamation bund (for the construction of the interchange ramps) could only be undertaken when the area was not covered by tidal waters. A similar mitigation measure was proposed in the AEE for the *Thames Coast* rock protection project, with excavation work for the formation of the base of the proposed sea walls to be carried out during low tide.

The *Rosebank* consent also required that excavated materials should be removed from the intertidal area before the return of the incoming tide, with this material to be taken to an off-site disposal area approved by the regional council. Any such material that was stock-piled on site was required to be “appropriately contained” (again, to the satisfaction of the regional council).

Feedback

The immediate transportation of excavated material from the site at Rosebank made sense in any case because of the desire by the contractor to minimise double-handling.

5.4 Seasonal Restrictions

... work while the beach has a summer profile ...

For the *Thames Coast* rock protection project, it was proposed in the AEE that all of the necessary work would be carried out between late summer and early autumn when the beaches have a gentler summer profile.

Feedback

The regional council enforcement officer for the Thames Coast project suggested that this requirement for work to be undertaken while beaches were in a summer profile was not really relevant to the Thames Coast area where relatively little seasonal variation is seen in the profile of the beaches. The profiles in this area vary more between individual storms (which occur irrespective of the season).

Another question was whether a low steeper (winter) profile would have been preferable in any case, when less sand has to be cleared around work on the foundations of the walls.

5.5 Use of Geotextile Membrane

... lay down geotextile matting ...

The *Rosebank* coastal permit required that, before the placement of any fill in the construction area, a geotextile membrane should be laid down.

The use of a geotextile covering was also required as a mitigation measure in the AEE for the *Kuaotunu* seal extension project to limit the amount of surface erosion into adjoining waterbodies.

5.6 Specifications for Fill Material

...use only granular fill below high tide level ...

The *Rosebank* consent specifies that only granular fill should be used for one of the two interchange ramp reclamations (Ramp D). For the other ramp reclamation (Ramp A), the consent specifies that only granular or rock fill is to be used up to the high tide level, but that clay fill may be used above the high tide mark.

The consent also required that, at the end of each day, the fill should be graded to slope away from the harbour in order to minimise the opportunity for sediment loss caused by run-off.

Feedback

No real attempt was made to slope the fill away from the harbour on the Rosebank project because this would have resulted in ponding on the construction site in the event of rain.

5.7 Discharge of Bilge Water

... removal of sediment from bilge pump water ...

For the *Rosebank* interchange project, the AEE and coastal permit required that water pumped out of the excavation area (during pier construction) should not be discharged to bare earth. Instead “flow spreading devices”, discharge over grass, and portable tanks should be used to prevent erosion and sediment discharge from the disposal of this water back into the Waitemata Harbour.

Feedback

Novaflo drainage piping was used as the “flow-spreading” device at Rosebank to disperse the pumped-out bilge water along the rocks at the water edge. The effect of this was to reduce the velocity of the discharge water before it entered the harbour, but otherwise would have had a minimal effect on the removal of silt.

Because of the sheer quantities of water being pumped out of the excavation area it was impractical to do much more than this. The rate of water infiltration in to the excavation hole meant that a 4 – 6 inch pump would be working full time to clear the water.

At one time the contractor tried bringing in tanker trucks to load the water into but these would fill in the space of half an hour. Settling ponds would have been impractical, for the same reason, within the small confines of the site.

5.8 Access Across Mudflats

... barges, temporary working platforms ...

The *Rosebank* interchange AEE and coastal permit conditions specified that access for test drilling in the intertidal area (for foundation investigations) must be either by barge or from the existing motorway shoulder. Access for construction purposes was only permitted from the existing road. For construction of the interchange in the intertidal area, the AEE and consent required the use of temporary building platforms supported on piles (to be removed on completion of construction).

Feedback

It was later realised that barges would not work on the Rosebank project as a method for bringing in the drilling equipment. The shallow tidal nature of the mud flats in this area meant that a barge would almost certainly drag along the bottom as it was brought in to position, and would therefore cause considerable damage to any mangroves in its path.

This was, however, a specific condition of consent. So technically, despite the damage it would cause, it was something that the contractor was required to do. To deal with this situation the council provided a memorandum to Transit New Zealand stating that while the condition was still technically in effect, there would be no attempt made to enforce it. This

pragmatic action avoided the need to undertake a formal review of conditions.

The temporary platforms on the other hand were built as required, although at significant cost to the project. The contractor has estimated that the cost was in the order of \$100,000 for these to be built (having to be strong enough to handle the weight of large construction cranes plus the crane load). The equivalent cost of building earth platforms would have been \$10,000 – \$20,000. The option of building earth bunds and then simply rehabilitating the site was not allowed.

Some of the piles from these construction platforms are still in place as it would have been more damaging to remove them than to leave them behind. These were sawn off just below ground level and left.

5.9 Notifying the Naval Hydrographer

... provide plans to the Naval Hydrographer ...

On completion of the **Rosebank** interchange, Transit New Zealand were required, by conditions of consent, to provide plans of the reclamation work to the Hydrographer of the Royal NZ Navy for the up-dating of marine charts.

6. Effects on Fish & Fish Habitat

6.1 Reinstatement of Stream Bank Vegetation

... damaged stream bank vegetation to be replaced ...

The AEE for the *Spiral Hill* project required various measures to be taken to protect the trout habitat of the main stream running through the work area (in which a large culvert extension was to be constructed). This included a requirement for any stream-bank vegetation that is damaged during the construction work to be replaced.

6.2 Channel Enhancement

... reconstruct pools, riffles, bends ...

Feedback

It may be possible in some cases to reconstruct the natural form of a river where the river has to be diverted for roading purposes. An example of this is at Longslip Creek (a tributary of the Ahuriri River) on the Lindis Pass, SH8, where the stream had to be diverted to prevent undermining of the road. Reconstruction of the river channel included the creation of a low flow channel set in a wider flood bed, with riffles, pools, runs and natural sweeping bends, making ideal natural habitat for trout. The finished work has been commended by the NZ Fish & Game Council.

6.3 Cessation of Work During Trout Spawning Season

... no construction work 1st May to 30th October ...

A condition applied to the *Oakmere* realignment project (through both the AEE and regional council resource consent) was for no construction work during the trout spawning period, which was specified as running from 1st May to 30th October.

... no construction work August to September ...

The spawning season referred to in the AEE for the *Twizel Bridge* project (from consultation with the local Fish and Game Council) was between August and September. It was proposed that all work would be completed before then.

... no construction work June to November ...

A different construction period is proposed in the AEE for the *Craigieburn Bridges* project. Here the AEE recommends that to avoid the spawning and rearing period the construction work should occur in the period December to May.

... **no instream construction work April to September** ...

The AEEs for the *Glenhope* and *Spiral Hill* projects required that no work should be undertaken in the stream bed during the April – September trout spawning season.

... **no instream construction work after April** ...

For the *Makarora* bridges widening project, consent conditions included (in accordance with recommendations from the local Fish and Game Council, as set out in the AEE) a requirement that, in order to avoid the trout spawning season, all in-stream works should be carried out between the months of February and April (inclusive) and otherwise only during periods of little or no flow.

Feedback

It is apparent from the examples above that there is currently quite a wide interpretation around the country as to what should be defined as the "trout spawning season". This is presumably a reflection of the fact that, while the overall timing of the season may be known, the precise start and finish dates are open to a certain amount of interpretation. The reason for this is that while the bulk of the spawning will occur in the middle of the season, there is a gradual build up and tailing off at either end.

NZ Fish & Game Council personnel advise that for Brown Trout, spawning can happen at any time from mid April through to August, and for Rainbow trout any time from May to October. Thereafter the eggs take another 6 – 8 weeks to hatch and another 2 weeks for the juveniles to emerge from the gravel. The same timing should apply throughout the country.

This implies that the whole of the spawning, hatching and emergence period could run anywhere from mid April through to the beginning of December, with only four months (December to March) where there is not at least some phase of spawning in action.

The more important question however that remains to be answered and has direct relevance to road construction works is to what extent trout are actually susceptible to the effects of sedimentation from road construction activity during each of these phases of their life cycle.

The broader concepts of the impact of sediment on trout and their habitat are well recognised. Sedimentation can, for example, smother the spawning beds with silt and thereby suffocate the eggs. It can clog up the pores between the gravels where prey species live and therefore deprive the trout of food, or reduce light penetration in to the water and so reduce the growth of primary organisms in the food chain. By reducing visibility in the water it can also reduce the ability of trout to find their prey.

But what is not yet clearly understood is the extent to which a typical modern rooding project is actually likely to produce a sufficient amount of sedimentation to cause these effects. It is also unclear whether it is really the spawning season that is the most sensitive period, or whether it is the

period immediately after the spawning. This is when the juvenile fish are going out in search of food and when the abundance of food may be affected by the amount of sediment in the water. The spawning season therefore may be arguably no more or less important than any other time of the year.

The issue is further complicated by the fact that not all rivers and streams occupied by trout will have the same degree of sensitivity to sediment. A naturally turbid stream for example will be far less susceptible to sediment because the species of invertebrate present in the stream that are fed upon by trout are likely to be already adapted to this kind of high sediment environment.

Some research suggests that rivers and streams affected by sediment may recover in a relatively short period of time, although the rate of recovery will depend on the river in question and the amount of sediment deposited. Therefore, while a temporary impact may be caused, the river or stream will eventually return to its previous state.

A number of important questions remain unsatisfactorily answered about the actual impact of road construction works on trout fisheries: on the duration and indeed the relevance of the spawning season, and on the need to specifically avoid that period when undertaking earthmoving work.

On most roading projects where this kind of condition has been applied, fortunately the work could be successfully programmed to avoid the specified spawning periods. And because of this in most cases contractors have not been greatly concerned by the restriction. But this restriction does ultimately have the effect of reducing the length of the construction season, and therefore can impact on the efficiency and ultimate cost of the job. This being the case, the justifications for this kind of control that are so poorly understood at present should be a cause for concern.

6.4 Native Fish Spawning Season

... precautions required 1st February to 30th April / January to June ...

Mitigation conditions proposed in the AEE for the *Arahura* realignment project included a requirement that no construction work should be within 5 metres of a stream in the area of the work site during the whitebait season (1st February to 30th April). This precaution was proposed although the area was not thought to be within a whitebait spawning zone. A resource consent from the district council later took this matter up as a condition of consent, that there should be no construction work in or near the stream, or spoil dumped in to the stream, during the whitebait spawning season. However, the district council took the whitebait spawning period to be, in this case, from January through to June. The regional council consents for the project also included this condition but kept with the definition of spawning period used in the AEE (1 February to 30 April).

Feedback

This condition on the Arahura project was able to be programmed without difficulty. It is still uncertain whether this was a whitebait spawning area, but its proximity to the mouth of the Arahura River suggests that the precaution was warranted. However, it also remains unclear to what extent whitebait spawning might have been affected by sediment in the water (possibly not at all), although by prohibiting work within 5 metres of the stream during this period it was at least possible to ensure that any possible spawning areas would not be damaged among the plants on the stream bank.

... avoid instream works in May, October & November ...

A different native fish migration season is identified in the AEE for the *Maisey's* deviation. The AEE here proposed to avoid stream-bed work during the months of May, October and November when native fish are said to migrate up from the Waimea estuary. The types of fish are not specified in the AEE.

Feedback

The implication of this control on the Maisey's project (prohibiting in-stream work during certain months) was that in some cases culverts had to be put in place ahead of the surrounding earthworks in order to fit in with the time limit. Normally this would have been done the other way around.

Note that culverts normally take between 1 and 4 days to install. During this time there may be an increase in suspended sediment and a temporary barrier to fish passage. It needs to be considered whether, for channel work of such short duration prohibition on instream works during the whole of the native fish migration season is entirely necessary.

6.5 Inanga Spawning Habitat

... protect & enhance inanga spawning habitat ...

A mitigation measure proposed in the AEE for the *Stoke Bypass* project was the creation and enhancement of inanga spawning habitat at the end of a diversion channel associated with the works (discharging in to the Waimea estuary). The AEE does not set out specific details of this enhancement work, except that it was to involve riparian planting and shaping of the channel.

Feedback

DOC have indicated that they were generally pleased with the result of the spawning habitat enhancement. This included shaping the banks of the mouths of the streams to a shallow angle and planting around these areas with a mixture of overhanging flaxes and grasses, in which the inanga can lay their eggs during spring tides. Stock has also been fenced out of these areas, whereas previously they could graze down to the water's edge. The road may be said to have had an overall positive effect on the inanga.

6.6 Fish Passage (Trout)

... *ensure fish passage* ...

Resource consent conditions for the *White Bridge* and *Hawkswood* projects required that the works should not prevent the passage of fish, nor cause the stranding of fish in pools or channels.

The AEE and consent conditions for the *Twizel Bridge* widening project also required that fish passage should be maintained at all times.

... *“roughening” the base of culverts* ...

To better facilitate fish passage up through the newly extended culvert at the *Spiral Hill* project site, the AEE stipulated that small boulders should be concreted into the culvert invert to “rough up” the surface for improved fish access.

... *provide lighting for fish passage* ...

It was also proposed for the *Spiral Hill* project that “if possible” two man-holes should be put in mid-way down the culvert to provide lighting to encourage trout to swim through.

... *provide a low-flow channel* ...

An attempt was made on the Glenhope project to contour the river bed (during the diversion of the Hope River) to provide a low-flow access for trout. However, because the bed material was gravel, rather than hard rock, the low-flow channel was wiped out in a subsequent flood, leaving the channel to re-assume its original form.

6.7 Fish Passage (Native)

... *temporary water diversion pipes* ...

Native fish were understood to be present in the Ngutukaka Stream, in which a culvert was built as part of the *Ngutukaka* realignment project. On the recommendation of DOC, it was proposed in the AEE that the stream would be temporarily dammed upstream of the construction area, with a temporary diversion pipe put through to bypass the area of excavation in the stream. It was stipulated that the diversion pipe would be designed to ensure that it does not create a velocity barrier to fish passage.

Feedback

A diversion pipe was not necessary in the Ngutukaka project, in the end, because the stream was not running at the time. The contractor noted that it would have actually been quite a major task to install this diversion if it had been required because of the confined working space. It would have involved a significant amount of earthwork and sediment spill into the stream to install a diversion pipe. The contractor therefore considered that a diversion pipe would have actually caused more harm than good.

... velocity barriers ...

The AEE for the *Goodwood* realignment project included a requirement that proposed culvert extensions should be built that would not act as a velocity barrier to native fish.

... “roughening” the base of culverts ...

To facilitate native fish passage through culverts associated with the *Stoke Bypass* project, the AEE proposed that the bottom of the culvert cell boxes would be roughened during construction to leave a coarse texture. The aim was to provide a roughness, water ripples and pockets of gravel that would assist fish passage up the culvert (mainly targeting common bully, smelt and inanga).

Feedback

The engineer for the project advised that it was a reasonably simple matter to create a roughened culvert base. One of the culverts was even built to have a mud bottom. Nor was there any difficulty for the contractor in pricing this work in to the overall budget.

For the *McArthur’s Bend* project, the AEE specified the use of an “Aluflo” corrugated culvert, as this type of culvert is stated to not impede the passage of fish. The stream in which the culvert was to be placed was thought likely to contain banded kokopu and long finned eels (although a prior fish survey had found none).

... creating a sandy culvert bottom ...

Culvert design for the *Maisey’s* deviation project, as described in the AEE, also incorporated a proposal to ensure a layer of stream sediment along the bottom of the culvert to make the culvert more attractive to fish. To achieve this it was proposed to lower the base of the culvert to slightly below the natural level of the stream bed.

Feedback

Fish passage was mostly academic during the summer months on the Maisey’s project, when the creek through the construction area usually completely dries up.

A similarly well bedded-in culvert was proposed in the AEE for the *Waimate* realignment projects for the purpose of ensuring fish passage in the stream.

... fish passage on all streams during construction ...

Consents issued for the *Pukerua Bay* project included a condition that fish passage should be “maintained during any construction activities” (meaning that fish passage should be provided on all watercourses not only after the completion of the work, but also while the instream construction works are in progress). A similar condition also appears in the designation for this project.

Feedback

The fish passage condition for the Pukerua Bay project was later amended because, in the way it was drafted, the condition required that fish passage should be provided even on streams where there would not normally be

any fish, and in some cases in stream channels where there would not normally be any water. This was changed to require that fish passage would only have to be provided on certain specified streams where fish could reasonably be expected to be present.

The method used to enhance fish passage through the main culverts at Pukerua Bay was to cement square (12cm x 12cm x 6cm) concrete blocks to the floor of the inside of the culvert in an irregular pattern to break up the flow and thereby make it easier for fish to get through. Protruding rocks were also set in an open concrete drainage channel for the same purpose. It can be assumed that these measures are effective in slowing the water velocity along the channel bed although, in the case of the stream at Pukerua Bay, the normal water velocity in the channel was already very slow. It may be debatable, therefore, whether these artificial boulders were entirely necessary.

The other measure to improve fish access in the main stream at Pukerua Bay, which appears reasonably sensible, was to install a low (approximately 10cm high) flow barrier across the base of one of the two pipes in a twin culvert. The effect of this barrier was to divert all the stream water in to just one of the culvert pipes during periods of low flow. Without this barrier the low flow would be split in to two channels and therefore would be that much shallower and more difficult for fish to get through.

6.8 Passage of Aquatic Insects

... ensure passage of aquatic insects ...

For the *Bluff Creek* realignment project conditions of concession from DOC (under s.55(2) of the National Parks Act 1980) required not only that the culvert proposed for this project should be passable to fish, but also passable to invertebrate insects. The AEE for the project assured that this would be done.

Feedback

It would have been of little value making the culvert at Bluff Creek accessible to fish and invertebrate insects because with or without the culvert the narrow, steep and seasonal watercourse in question would not normally be accessible to either. It should also be noted that a substantial number of aquatic insect species migrate upstream in the airborne phase of their life cycle and therefore have no need for access via a stream.

6.9 Rescue of Stranded Fish

... rescue of stranded fish in de-watered channels ...

A concern noted in the AEE for the *Craigieburn* bridges project was the potential for fish to be stranded in the stream channel as a result of de-watering the channel for bridge construction. It was proposed that the local Fish and Game Council would be notified before the diversion was completed to allow any stranded fish to be rescued before the de-watering was complete.

The *Craigieburn* project also involved the extraction of river gravel for use as construction material. The AEE proposed that if any cut-off pools were to be inadvertently created during this exercise the Fish and Game Council would be immediately advised [to check for and recover any fish].

6.10 Fish Screens

... fish screens to be installed on the water intake ...

The *Craigieburn* Bridges project included a proposed extraction and processing of gravel, using up to 20 litres of water per second for this purpose. It was proposed in the AEE for this project that the water extraction intake should incorporate a fish screen to prevent fish from being drawn in.

6.11 General Effects on Fisheries

... fisheries shall not be significantly affected ...

Consent conditions for the *Whangamoia North* deviation project include a general requirement that “any diversion of water shall not significantly adversely affect any fisheries, wildlife habitat, or recreational values”.

7. Native Fauna

7.1 Kiwi

... maintain Kiwi feeding habitat ...

An issue for the *White Bridge* AEE was the presence of Kiwi in the vicinity. The conclusion from research and field work for the AEE was that at least one female Kiwi was in the area, and that a nearby bog was likely to be used for feeding. The requirement therefore was that there should be no interference with the hydrology of the poorly drained bog areas above and below the road. To accommodate this, a 100 metre length of cut-off wall (faced with natural stone work) was incorporated in the design of the realignment to prevent the bog from being drained.

Feedback

The measures taken to protect the bog at White Bridge were generally very successful – both ecologically and aesthetically. It is estimated that the additional cost of this work would have been in the order of \$25,000.

... check for Kiwi in the construction area ...

Another requirement in the AEE for the *White Bridge* project was that immediately before commencing construction there should be a walk-over to ensure that there are no signs of Kiwi nesting or feeding along the new alignment. Action would be taken according to the circumstances if any Kiwi sign was found.

... fence off pits ...

As a precaution, open pits around the construction site at White Bridge were fenced off to prevent wandering kiwi from falling in.

... signage, underpass tunnels for Kiwi ...

For the *Kuaotunu* seal extension project the regional council resource consent required, as a condition of consent, that if Kiwi monitoring in the area [also required as a consent condition] suggested an increased risk to Kiwi from the new road alignment, then an appropriate plan would be formed, in consultation with DOC, to minimise risk and aid the protection of Kiwi. This may include the erection of signs, Kiwi fences and underpass tunnels.

... remove birds and eggs at risk ...

Contingency measures (including the removal and re-siting of Kiwi or other threatened species, removal and incubation of eggs, and the raising and release of hatched chicks) were required to be activated at *Kuaotunu* in the event of these being found in the immediate vicinity of the construction site.

Feedback

Monitoring was undertaken at Kuaotunu as planned, using a combination of listening for night calls and transmitter tracking. During the course of the monitoring one adult female Kiwi was found to be marginally close to the work area and was re-located. Although the risks of harming any Kiwi were always likely to be very slight, the survey at least provided an assurance of this. The concerns were that either birds would be physically injured by the construction work, or that birds nesting nearby could be scared off their eggs.

The tracking and monitoring work undertaken at this time was also useful for finding out about patterns of bird movement across the road. The main concern here was that birds might be found to cross through a road "canyon" (with steep banks on either side) where they would be more vulnerable to getting run over.

7.2 Blue Duck

... construction activity confined to specified areas ...

To minimise disturbance to Blue Ducks in the area of the *Otira Viaduct* project, the AEE and consent conditions required that vehicles and workers must be confined to the specified work areas and access tracks.

Feedback

The engineering consultant, project manager and DOC observer for the Otira Viaduct project were all of the opinion that defining and marking off the construction area worked well. It was easy and inexpensive to action and almost certainly helped to minimise the extent of impacts on the area. It was also a useful way to keep workers reminded of the sensitivities of the area and to enforce a discipline of containment on the contractors.

What also helped to make this work was that the DOC observer on the project was reasonably accommodating and pragmatic in dealing with situations where the boundaries to the construction area had to be altered. This was required on a couple of occasions during the course of the project.

The DOC observer maintained a photographic record of the location of the agreed site boundaries for the purpose of enforcement.

7.3 Pukeko

An unforeseen effect of the Stoke Bypass project was that between 20 and 30 pukeko were knocked over and killed on the new road soon after it was opened. The birds had previously occupied the area and took some time to get used to the presence of the road. Some of these were later trapped and successfully re-located elsewhere in the South Island by the local Fish & Game Council. In order to successfully re-locate these birds they had to be shifted as far away as possible. Pukeko have been known to fly distances of well over 100km to return to their home territory.

7.4 Disturbance from Gravel Extraction

...disturbance of terns, gulls, dotterels ...

A regional council consent was issued for the *Homer to Murrells* realignment project to permit the extraction of gravel from the bed of the Hollyford River in Fiordland National Park. A condition of this consent was that roosting, nesting and feeding areas of black-fronted tern, black-backed gull, banded and black-fronted dotterels should not be disturbed during extraction.

8. Wildlife Predation by Dogs, Cats, Rats, etc.

... keep out dogs, cats, ferrets & vermin ...

AEE and coastal permit consent conditions for the *Rosebank* interchange project (built alongside an estuarine roosting area in the Waitemata Harbour) required that measures should be instigated to ensure that dogs, cats and vermin are excluded as much as is reasonably practical from the construction site. This included a proposal in the AEE to lay rat traps around the construction area and to prohibit dogs from being allowed onto the construction site.

AEE and consent conditions for the project also required that where temporary construction platforms were built the platforms should be provided with barriers to prevent access by predators to the intertidal area.

Feedback

*There were no problems with keeping dogs and cats off the **Rosebank** construction site, and rat poison was laid down as a matter of course for sanitary reasons. It is, however, inevitable that rats will be present in this kind of area, irrespective of the presence of a construction project. Rats would have been present before the project and will certainly still be present after the project.*

Vermin barriers were nevertheless built as required across the end of the construction platforms although all parties later agreed that these were completely ineffectual. The rats did not need the construction platforms to get to anywhere that they wanted to go

A similar prohibition on animals was put on the *White Bridge* project in Arthur's Pass. The AEE for this project specified that domestic animals or pets, in particular dogs, cats and ferrets, would not be permitted on the site or in any building, vehicle or trailer associated with the contract.

No dogs (other than certified Kiwi-locating dogs) were allowed on the site of the *Kuaotunu* seal extension project as a condition of consent, for reasons of ensuring the protection of Kiwi in the area.

9. Protection & Restoration of Native Vegetation

... protect rare plants ...

Special precautions were taken on the Glenhope project to protect a rare form of native tree daisy (Olearia polita). The five plants identified next to the alignment were screened off to prevent them from being damaged and the area where they are located was set aside for restoration. In a previous realignment project in the same area three plants had been inadvertently destroyed.

... re-planting with local genetic stock ...

The *Spiral Hill* realignment project involved a minor intrusion into a Scientific Reserve. A requirement of the AEE for the project was that the subsequent re-planting of this area in and around the reserve should be with native vegetation sourced only from local genetic stock. It was required of this project (through the AEE) that operational guidelines for vegetation removal and restoration should be developed prior to the commencement of physical works.

A similar issue arose with the *Laws Hill* realignment project where the new road alignment was to affect an area of native vegetation identified as significant by DOC. The AEE required restoration planting to be undertaken, using plants taken from local native genetic stock. This restoration planting was to be completed within one planting season, on completion of the road work. A similar condition also applied to the *Silverstream* 4-laning project in Wellington.

According to the *Otira Viaduct* AEE, all plant material would be sourced locally (either from seeds or cuttings). These plants would be raised outside the area but “hardened off” at a similar altitude prior to planting.

The use of local genetic stock for re-planting was likewise specified in the AEE for the *Craigieburn* bridges and *Kuaotunu* seal extension projects, and as a condition of consent for the *Whangamoa North* realignment project.

Similarly, for the *Stoke Bypass* project (which involved a significant area of coastal reclamation), the coastal permit required that Transit New Zealand rehabilitate the coastal margins of the reclamation. This was either by the removal and re-establishment of existing indigenous estuarine plants or by the propagation of new plant material from indigenous genetic stock sourced from the immediate area. The landscape plantings were required to be maintained by Transit New Zealand for a period of five years.

Feedback

There are a mix of opinions on the benefits of maintaining local genetic purity when undertaking restoration plantings, although expert opinion generally favours this as a precautionary practice in places where significant native vegetation exists and which would otherwise be isolated from cross-breeding with non-localised variants.

Nevertheless, consideration needs to be given in some cases to whether a condition requiring the propagation of local genetic stock can be practically achieved. In the case of the **Silverstream** 4-laning project near Wellington the contractor was required to collect a large amount of seed-containing duff material from the local forest. However, the amount required for the project was well in excess of what could be readily found in the area (with the adjacent bush growing on a semi-scrub). For this project most of the plants were eventually sourced from outside the Wellington region – with several thousand being required. The punga logs that were used to build a punga wall façade along the cut face in this project were also sourced from outside the area. It would have otherwise been practically impossible to obtain a sufficient number of these locally without causing significant damage to existing bush.

The **Silverstream** project also illustrated the problem of trying to determine what actually are the “local” genetic boundaries. It was unclear whether this meant the immediate valley, the district, the region or beyond. Obviously, the smaller the area, the more difficult it can be to gather sufficient cuttings of seed.

In most cases this is left to interpretation. However, one solution that may be available in the future is to define the collection area in terms of the extent of the local “ecological domains”. These domain areas are currently being defined and mapped for the whole of the country by Landcare Research, and will eventually see up to 200 domains created nationwide.

The other problem for implementing this kind of condition is that it will often require a lead-time of two to three years for sufficient seed and cuttings to be collected and propagated ready for planting. Locally sourced plants can not usually be bought “off the shelf” in the quantities normally required for road restoration work. There is also normally a premium paid for locally propagated plants because of the extra labour costs involved with gathering the material.

On the **Otira Viaduct** project no major problems were identified with local sourcing of plant material. In this case it was generally accepted that (with the site being in a National Park) the requirement was an appropriate one. Seeds and cuttings were collected from the area, propagated elsewhere, then hardened off again near the site. The only plant that did not do well by this method was common tutu (making up about 50% of the total planting). This, in the end, appears to have grown better from self-sown seed. It will be very interesting to compare the success of these plantings at the **Otira Viaduct** with the self-seeded regeneration at **White Bridge** in another two to three years’ time.

... re-vegetating with “existing species” ...

Revegetation was also required as a regional council consent condition for the **Makarora** bridge widening project, in this case in the bed of the stream. The condition was that “the entire area of disturbance within the bed of the river shall be re-vegetated using species that are presently on site”. The AEE for this project also

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includes a condition (inserted at the request of DOC) that DOC should be consulted over any necessary restoration work before that work has begun.

Feedback

In fact no re-vegetation was carried out on the Makarora bridges project because the areas of disturbance had not been covered in any significant amount of vegetation to begin with.

... re-vegetation procedures ...

Restoration of native vegetation was required in the AEE and contract documentation for the *White Bridge* project in Arthur's Pass. In this case vegetation restoration measures were to be applied to the remains of the old road and to cut slopes and fill batters of 1.75:1 or less [with steeper rock slopes being left as bare rock features]. The procedures for re-vegetation were described as follows:

- Any "duff" [seed-bearing leaf litter] in the project area is to be removed during initial stripping and earthshaping and stockpiled nearby.
- Any borrow material brought in to the project area is to be free of weeds, such as gorse and broom.
- Only shoulders and disturbed areas in loose rock are to be treated for revegetation.
- Incorporate salvaged duff and prepared seed for the immediate project area.
- Following construction the area is to be monitored for germination of weeds, and weeds are to be removed either manually or by approved chemical means.
- Borrow areas and spoil disposal areas, if appropriate, are to be resown with seed collected from the area adjacent to them.
- Foster natural re-vegetation by leaving disturbed areas with surface textures that will provide protected crevices that will promote re-vegetation. [Contract documentation requires ripping to create crevices of 100 to 150mm deep].
- Following construction, spread any stockpiled duff on shoulders to be re-vegetated [in a layer at least 25mm deep].
- All vegetation 75mm [diam.] or less will be mulched and mixed with the duff and spread after a period of temporary stockpiling.
- The material from the southern and northern approaches [to the bridge] will be kept separate and processed separately.
- After completion of the works and shaping of surfaces, the area is to be left fallow for at least one growing season to allow the germination of weeds that were imported, or encouraged to germinate by construction activities, and to allow the accumulation of organic matter in crevices prior to any seeding.
- In the summer, collect seed from native pioneer species presently found in the vicinity of the site. These will primarily be bird-dispersed seeds, such as tutu (*Coriaria arborea*) and wineberry (*Aristotelia serrata*). Collection will normally be in summer, but the exact collection time will be determined by monitoring. [Contract documents for the project specified the collection of 60kg of seed (30kg for each of the two species), for spreading over a total area of approximately 13,300m². The contract also requires the collected seeds to pass a 50% germination test and for the seeds to be coated in "Prillcote" with fertiliser, before sowing].
- Have the seed professionally prepared and pelleted.
- Before seeding, eradicate weeds that have germinated during the fallow period. This may be by manual means or spraying.

- From this point let nature take its course. Wind-dispersed seeds, such as those of silver akeake (*Olearia avicenniaefolia*) and rata (*Metrosideros umbellata*), will be carried into the area where the coarse texture will provide niches in which they can germinate alongside the seeds that have been broadcast.
- Carry out routine monitoring for removal of introduced weeds over a 15-month period.

Feedback

*The distinguishing feature of the **White Bridge** project is that the whole emphasis of the re-vegetation strategy was on seeding and preparing the ground for seed, rather than on planting out pre-propagated shrubs. It was thought that the hard climate and difficult soils in the area would not lend themselves well to the survival of transplanted plants. Certainly, the **Otira Viaduct** project, not far from this project, was understood to have had a significant loss rate among the transplanted tutu seedlings (making up half of the 120,000 seedlings of various species put in on this job). In contrast, the seeded or self-seeded tutu on both projects is said to have been very successful.*

*The cost advantages to seeding are obvious, as opposed to the propagation of plants. Re-vegetation can be a significant cost item (in the case of the **Otira Viaduct** project costing, altogether, about \$600,000). With seeding there are not the risks that replacement planting will be required where initial plantings do not survive.*

*The seeding strategy would not necessarily be appropriate, however, in situations where weeds could potentially take over. It is fortunate that, in the **White Bridge** area, the seed bed would have been almost exclusively native. The high rainfall environment is also likely to assist with the rapid establishment of seedlings.*

*On a matter of detail, some problems were experienced with gathering the amount of tutu and wineberry seed specified in the AEE and contract documents for the **White Bridge** project (30kg of each). Wineberry does not exist in the area and therefore had to be substituted, and tutu produces very tiny seeds. Gathering 30kg of tutu seed in the local area would have been extremely difficult. Again, it is understood that some kind of compromise had to be made.*

*Also of note on the **White Bridge** project is that some care was taken to separate the mulch materials from the northern and southern approaches to the bridge. The objective was to ensure that any subtle vegetation differences between the two areas would be taken into account in the later spreading of the mulch.*

It has been suggested by some involved on the project that this may have been overly "purist" – particularly as it meant that greater amounts of mulch at one end could not be used to make up for short-falls at the other.

A mixture of re-vegetation methods was also proposed in the AEE for the **Glenhope** realignment project (with these methods varying depending on the different conditions and circumstances encountered on site). Methods proposed included relying on natural

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re-vegetation; hydro-seeding, grass-seed broadcasting; laying of kanuka slash; the use of man-made ground-cover; and transplanting. The AEE notes that fertiliser might also be used to assist with growth.

Feedback

Another method of seeding, under trial on the Maisey's project, and elsewhere, has been to use hydro-seed kanuka. It is as yet unknown how successful or unsuccessful this has been. Hydro-seed was also to be used on the Whangamoia North project as a method for seeding with native grasses.

Kanuka has also been grown as a road-side planting for the McArthur's project, although initially with mixed success. The QEII Trust representative suggested that the high failure rate with kanuka on this project may have ironically been in part due to the generous amount of topsoil put down on the batter slopes where the kanuka was planted. This has resulted in a lush growth of grass over the batters, which has in turn tended to suppress the kanuka seedlings. The kanuka is said to have grown better in those areas where the soil is poor. Latterly, a more intensive management of the plantings has resulted in a reasonably successful take.

... let natural re-vegetation take its course ...

A simpler approach was taken with revegetation for the *Homer to Murrells* realignment in Fiordland National Park. The realignment work for this project was comparatively minor (mostly deviating only 1 to 2 metres from the original alignment, although on some sharp corners by up to 10 metres). Here the AEE proposed re-vegetation mainly by natural re-growth and natural re-seeding. To assist the re-seeding of new gabions along the alignment the AEE proposed, where possible, the placement of topsoil on the gabion baskets, with nature otherwise left to take its course.

The DOC concession notice for this project did however require re-planting along the new road batters. The method to be used for this was the transplantation of shrubs previously removed (as part of the work programme) from other sites along the alignment.

Feedback

After discussion with DOC it was agreed that, on the Homer to Murrells project, soil should not be loaded on top of the gabion baskets for trees and shrubs to grow in. The concern was that the tree roots would grow down through the baskets and eventually cause them to rupture. In spite of this it may be noted that gabion baskets have in fact been used elsewhere overseas in this way (e.g. in Switzerland), with trees and/or flowering plants being deliberately planted to grow either on or through the gabions. The transplantation of shrubs did not work particularly well on the Homer to Murrells project, however. The shrubs in this area are mostly to be found growing in and around large boulders, which made it very difficult to remove the plants, using a mechanical digger, without severely damaging them.

... plant fuchsia cuttings ...

A method of re-planting trialed on the Bluff Creek project was to simply plant out the old road scar with native tree fuchsia cuttings. These cuttings (about pencil thickness and 15cm in length) were dipped in rooting hormone and put directly in to the ground. The survival and growth of these cuttings remains to be seen. The total cost of replanting on this project (including a few conventional plantings at either end of the old road alignment) was \$3,000-\$4,000.

... restoring swamp vegetation ...

In the case of the *Pukerua Bay* project, Transit New Zealand was required, through the AEE, designation, and resource consent conditions, to restore the margins of two small remnant swamp areas on the opposite side of the road from the main Taupo Swamp. These two areas were to be slightly encroached upon by the new highway alignment. Restoration planting was only proposed within the area directly affected by the road.

... maintain adequate swamp water levels ...

A condition of the *Pukerua Bay* project (in the AEE, resource consents and designation) was that the water level in the two remnant swamp areas next to and slightly affected by the highway should be maintained at a level “sufficient to facilitate the regeneration of the flax tussockland ecosystem”.

... protecting and restoring riparian vegetation ...

Re-planting was proposed as a mitigation measure for the *Arahura* realignment, along the margins of the stream running through the construction site. The AEE proposed that flax and other native species should be planted. District council consent conditions for this project also generally required Transit New Zealand to ensure that during the construction period “the destruction of indigenous vegetation is minimised”.

Feedback

Regrettably, rough handling of flax plants by the contractor on the Aradhura project meant that these were unable to be saved for re-planting.

Similarly, for the *Hawkswood* deviation project the AEE stated that, in consultation with DOC, any stream-side vegetation lost during construction would be re-planted. This was later adopted as a condition of consent for the project (on the recommendation of the AEE).

... defining the limits of the construction zone ...

In order to contain the extent of damage to existing native vegetation during construction of the *Otira Viaduct*, the AEE proposed that the nominal “work area” should be marked out before the start of construction, using markers that are clearly visible and difficult to remove.

Feedback

*The engineering consultant for the **Otira Viaduct** project believed that defining and marking off the construction area worked very well. It was easy and inexpensive to action and almost certainly helped to minimise the extent of impacts on the area. It was also a useful way to keep workers reminded of the sensitivities of the area.*

What also helped to make this work well was that the DOC observer on the project was reasonably accommodating in situations where the boundaries to the construction area had to be altered. This was required on a couple of occasions during the course of the project. The DOC observer maintained a photographic record of the location of the agreed site boundaries.

*The same precautions were also taken on the **White Bridge** project and helped to ensure, for example, that a potentially delicate area of alpine bog right next to the new road was practically unscathed by any of the construction work.*

... “landscape & ecological principles” agreement ...

A re-vegetation programme for the *Otira Viaduct* was to be worked out with DOC. This consultation resulted in a “Landscape and Ecological Principles” agreement, which is referred to in the conditions of consent for the project from the regional council. The consent required that the re-vegetation of the site should be in accordance with this agreement.

Feedback

*The main “principle” was that there would be an adequate survival rate among plantings on the **Otira Viaduct** project. The minimum target survival rate was 60%.*

... re-planting within the current or next planting season ...

Consent conditions for the *Kuaotunu* seal extension project required that there should be re-planting of bare soil surfaces and disturbed riparian margins resulting from the road works. The consent indicates that this replanting should occur within the current or next planting season.

... re-planting during the autumn-winter period ...

The AEE for the *Silverstream* 4-laning project proposed that re-planting of the exposed cut-face created by the work should be completed during the autumn-winter period, before August. It was proposed that the overall timing of the construction work should be organised so as to allow for immediate replanting of the area during this optimal period.

Feedback

*It is understood that the planting at **Silverstream** did not actually occur until September/October, mainly because of delays in sourcing punga logs for the finished façade. However, this delay did not appear to have any significant detrimental effect on the growth and survivability of plants.*

... 10-year plant maintenance period ...

Conditions of consent for the **Silverstream** project included the requirement that all re-planting must be with locally 'eco-sourced' plant material and that a 10-year maintenance service contract should be entered in to for tending these plants (covering plant replacement, watering and weed control). Transit New Zealand was also required to ensure that re-planting of the area would result in a net gain of indigenous species (meaning a greater variety of native plant species would be planted than would be taken away).

Feedback

The 10-year maintenance period for this project is now generally looked upon as excessive, now that the re-planting has clearly become established. This is an exceptionally long period of time over which to require continued tending.

... 2-year plant maintenance period ...

The **Otira Viaduct** AEE proposed that the re-establishment of vegetation should be monitored and maintained over a period of two years.

... protection from wind ...

Another condition of consent for the **Silverstream** project was that a cloth wind-break should be set up around the perimeter of the exposed construction cut face. The intention of this measure was to protect remaining native vegetation next to the cut site while restoration planting was in progress. The condition also required that the re-planting of the cut face should include 'buffer species' to replicate the natural bush edge.

Feedback

*An original submitter on the **Silverstream** project maintains that the use of wind-break cloth was sensible, considering in particular the high winds that can affect this area. She also felt that the use of 'buffer species' along the edge of the cut face was a practical move for the same reason. The site engineer and contractor also agree that the wind-break probably helped with the re-establishment of young shrubs. The cost of installing wind-break fencing is about \$25 - \$30 per lineal metre.*

10. Weed Control

... steam-clean machinery arriving on site ...

A requirement of the AEEs for the *White Bridge* and *Twizel Bridge* projects was that all machinery brought on to the site should be steam-cleaned before delivery, with, in the case of the White Bridge project, a certificate of cleanliness to be provided to DOC before unloading.

The same steam-cleaning condition was applied to the *Homer to Murrells* realignment project through special conditions in the DOC National Park concession notice as well as the regional council consents for this project. The condition required that an appointment be made for plant and equipment to be inspected [by DOC personnel] before entry into the Park.

Machinery introduced for the *Makarora* bridge widening project was similarly required in the AEE (at the request of DOC) to be “effectively cleaned by steam or alternative means to prevent the spread of exotic weeds”. DOC also required (as referred to in the AEE) that exotic weed control should be undertaken by Transit New Zealand on an annual basis over the area of work.

Feedback

On the White Bridge project a crane was accidentally brought on site without having first been cleaned down. It then had to be hand-cleaned, which took about a week to complete. There was, however, no question of the appropriateness of ensuring that only clean machinery was brought on to this particular site. The failure to pre-clean the crane was accepted as a mistake on the part of the contractor, which had to be put right.

However, contractors have questioned whether steam cleaning (as opposed to just water blasting) is entirely necessary. Water-blasting equipment, which is almost as effective and is much more readily available to the average contractor, whereas steam cleaning gear would usually have to be specially hired in.

... water-blast machinery, eradicate new weeds ...

The cleaning of machinery before delivery on site (for weed control purposes) was also a measure included in the AEE and consent conditions for the *Hawkswood* deviation project. In this case it was proposed to use a water blaster for cleaning. Conditions from the resource consent also state that the consent holder will be responsible for the eradication of any new weed species that establish on site.

A similar requirement also appears in the AEE for the *Craigieburn* bridges project, with both vehicles and imported aggregate to require water blasting prior to arrival on site. It was a condition of consent for this project that all vehicles and, as far as practical, all gravel, sand, etc. should be free from plant or seed material. The need to prevent the spread of willows is specifically mentioned.

The cleaning of construction vehicles was also proposed in the AEE for the *Glenhope* realignment project, with vehicles to be receive a “hosing down” before coming on site.

Feedback

The Transit New Zealand project manager on the Glenhope project acknowledged that in this environment, next to conservation estate, it was entirely appropriate to ensure that all earth-moving machinery delivered to the site had been cleaned down before delivery to remove any possible gorse seeds, etc.

... 5-year weed control programme ...

The *Craigieburn* AEE undertakes to require a weed maintenance period of five years following completion of the construction work. A further requirement (requested by DOC) was that there should be an inventory taken of the species of weed present in the area, prior to construction, so that this may be later compared with the species of weed present afterwards.

The DOC concession for the *Bluff Creek* project required that all equipment must be cleaned outside the Arthur’s Pass National Park prior to entry to the construction site. The concession also required that weed control should be undertaken on the site of the old road for a period of five years after the completion of construction of the new realignment, and on an “on-going” basis along the new alignment within 10 metres of the centreline of the road.

Feedback

One of the issues with this kind of on-going maintenance requirement (for weed control and for the maintenance of landscaping) is that Transit New Zealand construction contracts will often place the responsibility for on-going maintenance on the principal contractor. However, on completion of the project, the contractor will move on to other work around the country and is therefore unlikely to sustain a great interest in weed control, etc. on a project completed up to five years before.

The eventual arrangement with DOC on the Craigieburn project was that post-construction weed control would be on a “complaints” basis only, rather than require Transit New Zealand to physically monitor and control the emergence of weeds over a 5-year period.

For the Bluff Creek project the responsibility for weed control was to be handed on to the state highway area maintenance contractor (through a variation to the maintenance contract). Before this hand-over the site would be photographed so that the standard for future weed control could be established and compared.

... 2-year weed control programme ...

In the case of the *Otira Viaduct* project, the AEE also proposed that a programme of weed control should be implemented and maintained over a period of five years, although conditions of consent for the project from the regional council ultimately limited this weed control period to the construction period plus two years. The council

consent also stipulates that earthmoving equipment should be steam-cleaned prior to delivery to the construction site.

Feedback

*For simplicity, the on-going weed control programme at the **Otira Viaduct** was contracted out entirely to DOC (as administering body for the National Park). The same was also arranged for **Homer to Murrells**.*

*The DOC observer on the **Otira Viaduct** project noted that it was generally very hard to tell which weeds were due to the construction project and which were due to natural invasion. He suspects that most of the weeds coming in to the area (in particular gorse and broom) were actually arriving with the grit that is put on the road each winter for the control of ice.*

... weed growth on stock piles ...

A condition of consent for the *Hawkswood* deviation (recommended as a condition in the AEE) was that the stockpiling of materials, particularly topsoil, should be for as short a time as possible to minimise weed growth (as well as to limit the loss of soil from stormwater run-off).

... weed growth on batter slopes ...

Conditions attached to the designation for the *Pukerua Bay* project also required Transit New Zealand to control or eradicate invasive grasses and exotic weeds along the batter slopes abutting the Taupo Swamp, and to replant the batters with locally sourced native seedlings to “encourage self-sustaining re-vegetation, suppress weeds and filter run-off”.

Feedback

*One of the farmers interviewed at **Pukerua Bay** reported that thistles were coming away on areas where the land had been disturbed by construction activity. This included on the clean-fill dump site located on his land.*

... control of specific weeds ...

For the *Stoke Bypass* project Transit New Zealand was required, as a condition of the coastal permit, to spray and kill all *Spartina* (an invasive introduced water weed) within the area of the consent prior to the commencement of any construction works.

Feedback

*There was, in the end, little or no *Spartina* found at Stoke.*

11. Landscaping

11.1 Landscape Planning

... prepare and implement a landscape plan ...

The AEEs for the *Ngutukaka*, *Goodwood*, *Pukerua Bay*, *Belmont*, *Stoke Bypass* and *Eland* projects stipulated that a landscape plan would be prepared and implemented in conjunction with the work. The requirement for a landscape plan for *Pukerua Bay* and *Stoke Bypass* also appears as a condition of designation both of these projects, along with the requirement for a “landscape management plan” to describe procedures for the on-going maintenance of landscaping.

Feedback

A lesson from the Stoke Bypass project was that the public should always be made aware that landscape plans are usually only “indicative”, and that what appears on the plan may require 8 to 10 years of growth. Some of the public had been disappointed with the landscaping on this project, expecting that it would immediately appear as shown on the landscape plan. There were similar experiences with the Maisey’s realignment project.

For the *Rosebank* interchange project the coastal permit consent conditions required landscaping to be carried out in accordance with a formal landscape plan. This landscape plan was required to be prepared, taking into account:

- The protection of existing visual and amenity values.
- The use of appropriate eco-sourced native species as far as practical.
- The removal and control of environmentally damaging species.
- The use of vegetation on embankments and berms suitable for diffuse of stormwater discharge.

11.2 Landscape Principles

... guiding principles for aesthetic design ...

The AEE for the *White Bridge* project at Arthur's Pass set out a number of basic principles to be applied to the aesthetics of all structures, including barriers and concrete. Those principles were:

For road barriers:

- Follow sharply curving alignment of the road.
- Simple, visually heavy.
- Recessive colour.
- Traditional galvanised guardrail are acceptable, unpainted, with dark grey posts.

For concrete:

- Dish or flat channels, where possible.
- Greyed, with black oxide in mix or applied after construction

11. Landscaping

For restoration of the landform:

- Exposed rock faces to be finished with a coarse, rather than smooth, surface texture.
- Rockfall areas to be left with an uneven surface.
- Any disturbed areas married sympathetically to adjacent disturbed areas.
- Any machine marks to be removed.
- If disturbed by construction, the river edges and/or surface characteristics are to be restored to original characteristics.
- Turnouts and working platforms to be ripped, shaped and married to adjacent landforms.

For restoration of structures:

- Old road to be ripped, stripped and dumped off site.
- Old road formation ripped, reshaped to a natural contour and married to adjacent landforms.
- Redundant barriers, bridges and retaining structures removed and dumped off site.
- Culverts to be as short as possible and dark in colour.
- Native rock rather than concrete to be used for energy dissipaters.
- Backs of visible structures, like guardrails, signs and netting, to be dark grey in colour.

On the *Whangamoia North* project the AEE states that landscaping will be undertaken in accordance with a "Landscape Concept Plan". The key points to this plan were to:

- Encourage re-vegetation of endemic species on any earthworked area.
- Restrict the extent of disturbance into the reserve through the identification of site boundaries.
- Ensure that DOC's management objectives and policies for the reserve are observed.
- Ensure that any sourced tree, shrub or groundcover is approved by DOC and "eco-sourced", and propagated for return to the reserve.
- Consult DOC before trimming any vegetation in the reserve.

11.3 Use of Local Stone

... incorporate the use of natural local stone ...

The *White Bridge* AEE also proposes the construction of about 80 metres of natural stone wall alongside the road for use as retaining wall. Stone walls are an historical landscape feature along this section of highway.

A similar mitigation measure also appears in the AEE and final conditions of designation for the *Gorge Creek* realignment project in Central Otago. On the recommendation of DOC it was agreed to put on a facing of local stone over the tops of the gabion baskets that would be used for bank support.

Regional council consent conditions for the *Otira Viaduct* project and mitigation measures in the AEE and resource consent for the *Craigieburn* bridges project also stipulate the use of locally sourced, or similar type of rock, for the construction of rip-rap and rock protection.

Feedback

*The use of local rock was not a problem for the **Otira Viaduct** project or on the **White Bridge** project on account of the plentiful availability of accessible rock in those areas. The use of rock for wall building was also clearly in keeping with the history of the road.*

*About 245 lineal metres of stone wall were built for the **White Bridge** project at a cost of about \$1,000 per metre (to 1.5m in height). These were generally built as a façade over top of the underlying concrete retaining walls.*

*On the **Craigieburn** project the fulfilment of the requirement for matching rock turned out to be a major obstacle to construction and effectively delayed the commencement of work on the project for 1 to 1½ years. Rock with a near colour match was available in the area, but not of a sufficiently close match to get the approval of DOC, or else was inaccessible, being within the National Park. Appropriate coloured rock was eventually sourced out of left-overs from the **Otira Viaduct** project, although with significant additional transport costs being incurred (a haulage trip of about three-quarters of an hour).*

Use of local stone was also an issue for the **Thames Coast** rock protection project. Previous coastal protection works in this area had involved the use of imported red volcanic rock which was not in keeping with the colours of the local geology. The resource consent for the project therefore specified that the erosion protection structure should be of a colour that, when weathered, will be consistent with other rock in adjacent locations. The same condition was also applied to the colour of any cement or grouting used in the construction of the rock wall.

Feedback

*The use of rock that is of a similar colour to the existing rock along the coast on the **Thames Coast** project was generally thought to be a successful measure by those consulted (particularly in comparison with the previous use of red volcanic rock). Although no one had felt that the previously used red rock was a major problem (some locals evidently liked it enough to steal for use as feature rock in their gardens), it was mostly agreed that the use of matching rock was better. The finished work has been widely commended.*

11.4 Concealment of Construction Buildings

... locate construction buildings out of sight ...

A condition of consent for the *Otira Viaduct* project was that construction buildings should be positioned in locations selected to minimise their intrusion on the surrounding landscape (in consultation with DOC).

Feedback

After some discussion with DOC it was eventually agreed not to take any great measures to conceal the construction buildings. (Painting the buildings green had also been considered.)

It was acknowledged that regardless of what attempts there might be to hide buildings, etc., the whole site would be quite clearly a major construction area, and of only a temporary nature in any case.

11.5 Protection of Feature Trees

... avoid damage to "feature trees" ...

The AEE for the *Potts Hill* project states that the survey line of the new alignment will avoid a group of "major trees" identified on one of the affected properties. Similar assurances were given in the AEE for the *Goodwood* Realignment in relation to a pair of 90 year old Californian Redwoods.

In the case of the *Belmont Road* realignment, the AEE informs that adjustments were made to the position of the alignment to avoid various specimen trees and that, through "careful management during construction", a small stand of Kahikatea trees close to the area of earthworks would avoid being damaged. The regional council consent conditions for this project also make specific mention of a mature totara tree in the construction area (on the site of a proposed batter). The condition required that information should be provided to the council on the viability of retaining this tree before it could be removed.

The *Rosebank* project involved special measures to preserve a protected copper beach tree immediately adjacent to the construction area.

A prominent matai tree was identified in the AEE for the *Maisey's* realignment project. The AEE states that the tree would be protected, with efforts to ensure that the placement of a retaining wall (as part of the construction project) would be outside the drip line of the tree.

Feedback

The 60 year old (some argue as much as 180 year old) matai tree on the Maisey's realignment project ended up costing the project somewhere in the order of an extra \$170,000. Rather than build a retaining wall it was decided to move it instead (on rails). The tree now stands not far from the realignment, with its own water tank supplying a drip-flow of water. A retaining wall to protect the tree would have cost about \$200,000.

Of the \$170,000 it finally cost to move the tree, only about \$70,000 of this was the cost of physically shifting it. The remaining costs were mainly associated with time delays (about 2 months) incurred on the project while negotiations over the tree were completed.

All those involved in the project (including the QEII Trust) agreed that the final cost of saving the tree was ultimately much more than the tree was really worth, and that, in hindsight, the cost of this would have been better directed in to other areas of mitigation and enhancement. The QEII representative later spoken to felt that even if the cost of retaining the tree had been as little as \$10,000, it would have been better to put this money in to other alternative areas of enhancement. It had not been anticipated that moving the tree would end up costing so much.

A mis-communication at Potts Hill resulted in about 25 of the "major trees" that were meant to be avoided being cut down by the contractor for the diversion of a creek. The error was only discovered when the owners of the property returned home and found the trees were gone.

On the Belmont Road project the QEII Trust put a penalty value of about \$5,000 on each of the specimen trees, in the event that any of them should be damaged.

11.6 Screen-planting

... privacy from the road ...

Screen planting was proposed in the AEE for the *Stoke Bypass* project for certain areas where the privacy of residential properties might otherwise be affected by the proximity of the road.

Screen planting was also required as a condition of designation for the *Pukerua Bay* project. In this case it was to screen off the Whenuatapu cemetery.

Feedback:

On the Stoke Bypass project the initiative was taken, at least two years in advance of the main construction work, to get some of the screen plantings in place. This allowed a reasonable period of time for the trees to grow before construction started.

... lump sum payment ...

For the *Gorge Creek* realignment project a condition of designation was that compensation would be paid to a neighbouring landowner for the reasonable costs of planting, irrigating and subsequently maintaining the establishment of landscaped screen planting between the property-owner's house and the new road.

Feedback:

A lump sum was in fact paid to the landowner for landscaping work at Gorge Creek, although it appears that not very much landscaping later

11. Landscaping

became of it. The discretion for spending this sum is entirely in the hands of the landowner.

11.7 Shading & Prevention of Ice

... shading from trees ...

The final notice of designation for the *Butts Road* realignment project included, at the recommendation of the council, a condition that the planting of a replacement shelter belt beside the highway should be with deciduous tree species. This condition was intended to reduce the potential for icing problems along the highway during winter as a result of shading on the road.

A condition of designation for the *Maisey's* deviation project required that vegetation plantings on the sides of the new road alignment should be maintained in such a way as to reduce the effects of shading during the winter months.

11.8 Separation Between Road and Trees

... 20 metre set-back from pine trees ...

A requirement of the AEE for the *Whangamoia North* deviation project was that a separation distance of 20 metres would be set aside between the new road alignment and the edge of the adjacent pine plantation (measured from the edge line of the road to the edge of the tree canopy). This was mainly for safety purposes, to provide space for logging operations and as a precaution against forest fire.

11.9 Maintaining Views

... transparent median barriers ...

A median barrier was required for safety reasons as part of the design of the *Pukerua Bay* SH1 upgrade project. An issue raised in the AEE for this project was that a solid median barrier would restrict views of the adjacent Taupo Swamp for southbound motorists. A wire barrier was therefore considered in the AEE as a method of providing the required level of safety without necessarily blocking views of the swamp.

The proposal for a wire rope barrier was later picked up as a condition in the final notice of designation for the project, with the proviso [inserted by Transit New Zealand] that this should be the case only where the use of wire rope did not compromise traffic safety.

Feedback

A wire barrier (rather than solid barrier) was incorporated in the design of the Pukerua Bay project as proposed. A special dispensation had to be obtained by Transit New Zealand to allow the use of a wire barrier in this case. Recent changes to the Transit specification and implementation standards mean that, for safety reasons, a solid barrier would have normally been required on a road of this kind.

... elevate the road ...

Another condition attached to the designation for the *Pukerua Bay* project was that Transit New Zealand should investigate, at the detailed design stage, the practicality of either raising the road or splitting it into two levels to allow motorists to get a better view of the adjacent Taupo Swamp.

Feedback

The options of raising or splitting the road were investigated by Transit New Zealand but found to be significantly more expensive and were therefore not pursued.

... build a look-out, remove trees ...

Transit New Zealand was further required, in the *Pukerua Bay* designation decision, to develop a viewing location across the Taupo Swamp and to remove existing willows from the swamp immediately adjoining the viewing area.

Feedback

The condition requiring removal of willows on the Pukerua Bay project was later amended to spraying (without physical removal of the dead trees). This work had no direct connection to the state highway realignment, but was undertaken as a concession to the QEII Trust who administer the Swamp. About 2,500 willows were poisoned.

11.10 Shaping of Batters

... round off the top of the batters ...

A landscaping mitigation measure proposed in the AEE and included in designation conditions for the *Pukerua Bay* SH1 upgrade was rounding off of the tops of the new batters to merge these in with the adjacent landform. Some of the shallower slopes would then be returned to pasture. The remainder would be planted with native plant species to create a “native theme” along this section of highway.

... build random shelves into the cut face ...

The designation conditions for the *Pukerua Bay* project went on to require that the cut batters on both sides of the highway should have “numerous small random shelves” cut into the facing, which would then be covered with soil and planted with colonising native species.

Feedback

The requirement for “small random shelves” to be cut at Pukerua Bay was ultimately not included in the construction contract and, through a variation of consent, was removed as a consent condition by the regional council. It was agreed that this condition would be too difficult to implement without incurring significant additional cost on the project.

... make the batter slopes suitable for grazing ...

For the *Maisey's* deviation and widening project it was proposed in the AEE to create batter slopes at an angle of 4:1 in pastoral areas to allow grazing. The rounding off of the tops of the cut batters was also recommended to give a softer edge.

Feedback

As it happens, the extra-long (4:1) slopes were also a convenient way of using up surplus fill from the project. This was the main reason that the long slopes were created. The fact that it also resulted in a better slope angle was simply a bonus.

11.12 Reinstatement of Stream Bed Profile

... re-establish a braided river form ...

A requirement of the AEE and consent conditions for the *Craigieburn* bridges project was that, on completion of work associated with the extraction of gravel from a stream bed (for bridge construction purposes), the extraction site would be reinstated to a level profile, whereby the natural braiding form of the stream would be able to most quickly recover.

Feedback

This condition was not hard to achieve and was considered by all parties to be entirely appropriate for the circumstances.

11.13 Replanting on Steep Cut Faces

... punga log façades ...

An unusual problem encountered with the *Silverstream* 4-laning project was the need to re-vegetate an extremely steep (70°) cut slope associated with the widening of the road and encroachment into a scenic reserve. The solution proposed through the AEE for the project (later adopted as a condition of designation) was the construction of a close-packed punga log façade over the face of the cut, underlaid with an organic matting and self-contained supporting frame. The punga surface was expected to have a lifespan of 20 years, within which time regeneration should occur.

Feedback

*The methods used to re-vegetate the cut slope for the **Silverstream** 4-laning project have been widely commended. One of the original submitters against the project said that she was now "absolutely delighted" by how it had finally turned out and only felt sorry that the job had not had as much good publicity as it deserved. The pungas provided an immediately attractive covering surface and in fact began sprouting new fronds within the first year of being laid.*

This was not a cheap solution, however, and for this reason would not be recommended for wider use. The punga logs are all that can be seen from the outside, but beneath this façade is a completely self-contained retaining

wall, incorporating a network of cells which each contain natural woollen bags stuffed with a mixture of mulch and duff material collected from the surrounding forest.

The soil nailing alone on this project (which holds the retaining wall frame in place) cost in the order to \$600,000. There were also high costs in trying to obtain "eco-sourced" local seed-containing duff material. The adjacent forest is on a semi-scrub slope with only patchy soil and leaf litter. A team of workers spent about three days there raking up leaf litter and in this time were only able to collect a small fraction of the amount required to fill in behind the punga logs. In the end the bulk of this was made up by simply mulching up plant material that had been removed from the cut face.

The punga logs were sourced, of necessity, from outside the area (from near Levin). These logs took a team of 10 workers about a week to fit in place on top of the retaining structure.

... geotextile webbing ...

The problem of re-vegetating steep (53°) batter slopes and keeping these slopes stable was also encountered with the *Kuaotunu* seal extension project. A shallower slope angle would have required substantially more earth movement and much larger cuts. The AEE for the project proposed that various alternative batter treatment methods would be trialed, including the use of a geotextile material ("Geoweb"). This could be pinned to the top of the slope and unfolded down the surface to provide an interconnected honeycomb of cells for the retention of topsoil and to assist the establishment of vegetation. It was proposed in the AEE that this covering should be applied within 24 hours of completion of the final slope.

Feedback

*There were, in the end, never any such trials on the *Kuaotunu* project (being curtailed on account of cost). Consequently no special measures were taken to provide extra stability to the slopes, with a high risk of future slippage being accepted as the cost of this.*

12. Removal & Restoration of the Old Road Surface

... rip up, topsoil, re-grass ...

The AEEs for the *Shannon, Potts Hill, Ngutukaka* and *Laws Hill* realignment projects specify that the old road surface will be scarified, topsoiled and re-grassed (to essentially return it to pasture) once the new alignment has been built.

... rip up, return to native bush ...

A similar requirement to rip up the old road surface was specified in conditions of consent for the *Kuaotunu* seal extension and AEE for *White Bridge*. In these cases the reinstatement of the old road surface was intended to return it to a covering of native bush.

... rip up, recontour, re-plant ...

For the *Pukerua Bay* project on SH1 north of Wellington, the AEE proposed not only ripping up the old road but also infilling it in some areas to re-integrate it in to the landscape. The filled in sections of road would be shaped and either hydro-seeded or planted with native species.

Ripping up the road surface and re-contouring it to integrate with the surrounding landscape was also required as a condition of concession from DOC for the *Bluff Creek* realignment project.

... rip up, re-contour, lay down slash ...

The *Glenhope* realignment AEE proposed that “in general” the old road surface would be ripped up, contoured to avoid ponding, and covered with spare fill/soil material then left to regenerate naturally, except for possible transplanting of shrubs and juvenile trees and laying of kanuka slash. The resource consent for this project simply requires that the old road should be “left in a state suitable for successful re-vegetation and/or natural re-vegetation”.

Feedback

*The ripping up of the old road surface on the **Spiral Hill** project (although not a specific condition of consent) was in part responsible for the later failure of the slope beneath the old road. This caused a landslide to fall on to a house below. In this case the removal of the old road surface allowed the free infiltration of rainwater. The same also occurred (although less dramatically) on the **Laws Hill** project where a 20m long section of the old road dropped away soon after the tar seal covering had been stripped off. There have also been concerns that the requirement to remove the old road surface left behind at the **Otira Viaduct** site will hasten its eventual collapse for the same reason.*

*Laying down slash and allowing these areas to self-seed was considered sufficient in most places away from the road on the **Glenhope** project. The bush is expected to naturally take over these areas in time. Planting was*

only considered necessary in the more visible areas next to the new alignment and as a screen across the end sections of the old road. The alternative to self-seeding would have been to plant the whole of these areas with propagated local genetic plant material. After consultation with DOC, it was agreed that this cost was not sufficiently justified.

... for the landowner to decide ...

For the *Butts Road* project the AEE proposes to leave the fate of the old road to the discretion of the landowner, with the options of either ripping up the pavement and re-grassing or simply passing it over to the landowner “as is”, to be left as a hard stand area for stock (or some kind of combination).

Feedback

*The landowner’s decision at **Butts Road** was to keep the old road as a feed-out strip for his cattle. Transit New Zealand therefore had any paint markings removed (to avoid any confusion for traffic) and left this cut-off section of the old road intact. This has allowed the farmer to make some use out it, although it is undoubtedly not a very visually attractive outcome. It has also been suggested that the seal on the old road surface will start to break up after a couple of years, particularly as a result of the corrosive effect that cattle dung has on bitumen. For Transit New Zealand the disadvantage was that the retention of the old road meant that the underlying hard fill was not available to scavenge for use on the new alignment.*

13. Spoil Dumps & Stockpiles

... dump sites to be shaped to a natural contour ...

The resource consent for the *Kaimatira* realignment and the AEEs for the *Shannon*, *Whangamoia North* and *Laws Hill* realignments require that waste spoil is evenly compacted at the dump sites, and that the spoil mound should be shaped to the natural contour of the land so as not to cause the ponding of stormwater.

... topsoil to be stripped off and set aside ...

For the *Kaimatira* realignment the regional council also required that the topsoil at the dump site should be stripped away, set aside, and placed back on top of the spoil heap at the end of the work. The same requirement also appears in the AEE for the *Hawkswood* deviation.

Similarly, for the *Pukerua Bay* project, the AEE required that topsoil should be initially stripped away from the dump areas and put aside in a separate stockpile to be re-used at the dump site on completion of the work. The finished dump sites would be topsoiled, contoured to the shape of the surrounding landscape, and re-grassed.

Topsoil was also required to be stripped and set aside as a condition of consent for the *Whangamoia North* realignment project, with this to be stockpiled on the uphill side of the spoil dump (itself located on the side of a gully).

Feedback

A good thick layer of topsoil was available for laying over the top of the dump site at Kaimatira (about 400mm thick) and was also fertilised. For some reason, however, the farmer advises that the grass on this finished dump site has never really thrived and is certainly not as lush as on other parts of the same farm. This may have possibly been caused by souring while the topsoil was in stockpiles, or by the wrong fertiliser, or poor quality grass seed.

The quality of finish on this dump site nevertheless compares very favourably with other dumping in the same area (associated with later bank protection works on the Wanganui River) and where very little topsoil has been applied. On this later dump site very little grass is to be seen at all. Mostly weeds are growing and the site is now of practically no value for grazing.

... specific wastes prohibited, dumping records to be kept ...

Regional council conditions of consent for spoil dumps associated with the *Homer to Murrells* project included a requirement for re-contouring and planting of the dump site with species appropriate to this area of the National Park. The consent also required that the material deposited at the spoil dump should not include putrescible, pollutant, inflammable or hazardous components (including a specific prohibition on the dumping of bitumen). Also that on completion of the project a report should be submitted to the council stating (1) the quantity of material deposited, (2) the specific

location of the material, (3) a description of the final re-contouring, and (4) details of species planted at the site.

Feedback

*It is unclear why bitumen should have been prohibited from the dump site on the **Homer to Murrells** project. This is obviously the same material as exists along the entire roadway. Old road-surface bitumen is not known to have any significant adverse effect on the environment.*

Unusually, the *Homer to Murrells* project also required consent from not only the regional council but also the district council for the dumping of fill. More or less the same conditions were applied to this consent, with the exception that the district council consent also required a photograph of the spoil dump area on completion of the work as verification of the completion of re-contouring and re-planting.

Regional council consent conditions for the *Pukerua Bay* SH1 upgrade project included restrictions on the types of material that may actually be put into the landfills to be used in the project for the disposal of surplus fill. The consent required that there should be no liquid waste, domestic, industrial and commercial waste, demolition fill, hazardous waste, contaminated soil, soil or clay in saturated condition, trees or garden trimmings, disposed of at any of the cleanfill sites.

Consent conditions on the dump site for the *Whangamoia North* deviation project also put restrictions on the type of material allowed to be dumped. Permitted materials included clean soil, rock, roading aggregate, vegetative debris and bituminous seal.

... dump site to be grassed / vegetated ...

Consent conditions for the *Pukerua Bay* project, and the AEE and consent conditions for the *Whangamoia North* project, required that fill material in the spoil dumps should be compacted to avoid erosion and instability. Also the cleanfill sites should be planted/vegetated as soon as practicable upon the completion, including topsoiling and hydro-seeding with native grasses.

The AEE for the *Stoke Bypass* project states that the spoil heaps will be topsoiled and grassed within 12 months of disturbance.

For the *Kuaotunu* project, if the material was not to be used or added to for any longer than 2 months the AEE required that it should be either topsoiled and grassed, or covered with some form of geotextile protection.

... stability of dump sites ...

The AEE for the *Stoke Bypass* proposed that the spoil dumps for this project would be appropriately sloped and “feather-edged” [i.e. with a tapered slope] adjacent to any waterway or estuarine zone to ensure that there were no internal instability problems with the heaps.

Feedback

*The stability of dump sites became a significant problem on the **Spiral Hill** project. A local farmer described how, because of the soggy condition of the material combined with a lack of adequate containment, one of the*

dumps sites collapsed. The resulting mud flow is said to have slipped about 200 metres down the valley. A buttress dam was later built by way of containment, but did not include any internal drainage. The long-term stability of the dump site is therefore in doubt.

... dump sites to be kept clear of the floodway ...

In the case of the *Belmont* realignment project, the main concern of the regional council with regard to spoil heaps was that these should not be placed within the floodway of the (sometimes flood-prone) Pauatahanui Stream. The consent for this project includes a condition to this effect.

... dump sites to be kept away from streams & natural slopes ...

For the *Kuaotunu* seal extension project, the AEE specified that all stockpiled material would be placed well away from any natural water course and at least 2 metres from any natural slope. Also it should be on a site where all run-off is collected and filtered before being discharged on to natural ground or waterways.

... stockpiles to be "appropriately located" ...

Earthmoving consent conditions for the *Stoke Bypass* project required that the contractor should ensure "the appropriate location and management of all topsoil stockpiles".

14. Haulage Tracks

... haulage tracks to be reinstated ...

A concern for the *Hawkswood* deviation project was the reinstatement of haulage roads constructed from the borrow areas to the construction site. One of the conditions for this project (as recommended in the AEE) was that these should be reinstated on completion of the project, with appropriate contouring and grass sowing measures.

Feedback

On the Kaimatira project a haulage track was built by enlarging an existing farm track up to the dump site. The same track was also used in conjunction with a later rooding project in the area. Some issues arose with this track, and in particular with the control of run-off from it. A fence line at the bottom of the gully below the track has been partially buried by the eroded clay (effectively reducing it from an 8-strand to a 6-strand fence). Some deep run-off scours were also left at the top of the track.

15. Public Access

... provide public access ...

An issue for the *Ngutukaka* realignment project was the existence of an old stone arch bridge (the existing state highway bridge) which was claimed by the NZ Historic Places Trust to be an historic site. The AEE proposed that after consultation with the landowner, public access would be provided to the bridge by way of a stile and a length of unsealed shoulder-widening (also to be used for parking) on the realigned state highway. Signage of the site was to be arranged by the Historic Places Trust.

Conditions of consent for the *Rosebank* interchange coastal permit required that Transit New Zealand consult with DOC and Royal Forest & Bird Protection Society (RFBPS) on public access to Pollen Island (an intertidal island in the Waitemata Harbour). Transit New Zealand was to be required to incorporate public access to the island into the final detailed design for the interchange, if recommended to do so by DOC and the RFBPS.

The uncertainty of this condition reflects that there was on-going debate at the time as to the most appropriate level of public access to Pollen Island (an area of significant ecological importance).

... prevent public access ...

There was no such uncertainty in the AEE for the *Pukerua Bay* project in respect of public access to the adjacent Taupo Swamp, a regionally significant wetland. The administering body for the wetland (QEII Trust) specifically wished to discourage direct public access from the highway to reduce the likelihood of littering and dumping of campervan effluent.

16. Land Severance

16.1 Disposal of Surplus Lands

... incorporate severed land into existing titles ...

The AEE for the *Eland* realignment project stated that all surplus lands resulting from farm severance will be incorporated into existing properties.

A condition of consent for the *Glenhope* realignment project was that, where practical, land titles severed by the realignment should be incorporated into adjoining land titles to avoid the proliferation of small substandard certificates of title.

... set aside surplus land as scenic reserve ...

A requirement of consent for the *Silverstream* 4-laning project was that Transit New Zealand should set aside surplus road reserve, containing regenerating forest, as an addition to adjacent scenic reserve land. The consent also required that Transit New Zealand should remove all of the larger exotic trees from this land and plant native ribbonwood species instead (to complement the scarce local ribbonwood tree population).

Feedback

There is some question over the appropriateness and legality of a resource consent condition such as this being used as a means for requiring Transit New Zealand (or any other party) to give up land, particularly where this land is not directly connected to the area of the consent. The land in this case was nevertheless surplus to requirements for Transit New Zealand and was gladly given to the local authority for on-going maintenance.

16.2 Land-locked Property

... provide access to land-locked property ...

An issue for the *Stoke Bypass* project was the possibility that the road would land-lock a block of land that the owners were proposing to subdivide as residential lots. The solution was for Transit New Zealand to purchase an adjoining residential property as a replacement access to the proposed subdivision.

16.3 Stock Access

... build a stock bridge ...

A problem encountered on the *Glenhope* project was that an open drain from the road had been built across a farmer's paddock. The farmer claimed that the drain effectively severed the paddock which meant that stock and farm vehicles could not readily get access because neither a bridge or culvert had been included in the design. This was later resolved by agreement that a stock bridge would be constructed.

... build a stock underpass ...

For the *Eland* realignment project the issues with stock access across the state highway were not *caused* by the realignment project. The farmer in question was already taking stock across the road about 300 times per year. Rather, the realignment provided an opportunity for an *improved* access by the installation of a stock underpass as part of the construction work. This was built on a cost-sharing basis between the farm owner and Transit New Zealand.

The same occurred with the *Butts Road* realignment project, with a stock underpass built to link two parts of a pastoral farming block on either side of the state highway. As in the case of the *Eland* project, the separated block of land had already been severed by the existing highway (meaning that there was already a history of stock being driven across the road). The construction of a stock underpass would improve this existing situation.

Stock underpasses were also proposed in the AEE for the *Ngutukaka* realignment to replace previous access for stock under the old state highway bridge, and to link the two parts of a severed farming property in the AEE for the *Pokeno Bypass*.

In the case of the *Gorge Creek* realignment project, a stock underpass to link up the two parts of a severed farming property was proposed as a condition in the district council's recommendation on Transit New Zealand's designation requirement. Although the property in question was already split by the existing highway (with stock movement therefore already occurring across the road), the council was concerned that the increased speed of traffic through the realignment would make the crossing unsafe. Transit New Zealand considered but ultimately rejected the recommendation for the reason that the increased traffic speeds would be more than adequately compensated for by increased sight distances along the new alignment. A stock underpass was therefore considered to be unjustified and was not included as a condition in the final designation for the project.

Feedback

Stock underpasses cost in the order of \$50,000 (e.g. Butts Road). A share of the cost may need to be met by the property owner. Transfund subsidies and farmer contributions for this work will depend on the relative benefits of the underpass to either party (for Transit New Zealand this will include whether the underpass is actually needed to significantly improve safety). Subsidisation will also depend on whether or not the property was already effectively divided by the existing road.

16.4 Minimising Encroachment

... build steeper batter slopes ...

To minimise encroachment onto an adjoining farm property, the AEE for the *Butts Road* realignment project proposed that slope batters along the realignment would be steepened from an originally designed angle of 4:1 to an angle of 2:1. This change to the design was at the insistence of the affected landowner.

Feedback

*The steepening of the slope angles on the **Butts Road** project actually resulted in lower overall construction costs, owing to the reduced amount of earthmoving required. It has meant, however, that the resulting batter slopes are too steep to effectively farm.*

16.5 Environmental Benefits of Land Severance

... severance serves to protect coastal habitat ...

*One of the benefits to result from the **Stoke Bypass** project was that the road has created a physical barrier between Waimea estuary and the adjacent industrial, rural and residential lands. The road has allowed a coastal buffer strip (up to 300m wide in places) to be created, now planted in native coastal plants, where previously grazing and/or industrial and residential activities had had effect right down to the water's edge. The estuary also now has a higher public profile as a result of the number of commuters who travel past it each day, with a resulting increase in public interest and concern for the area. The overall result (when compared with the previous condition of the area) is considered by all parties to be a net conservation gain.*

17. Farm Facilities

17.1 Water Supply & Fencing

... maintain or reinstate farm water supplies ...

With the *Eland* realignment project it was confirmed in the AEE that all stock water supplies would be maintained or re-instated. In this case it included the creation of a new stock watering pond on one of the farming properties.

Feedback

Stock water supplies were adequately repaired and maintained on the Eland project, according to local farmers. However, disputes occurred over the repair and replacement of fences damaged during construction work (including one fence partially buried by fill). The matter was eventually put right only after direct intervention from Transit New Zealand.

The AEE and consent conditions for the *Kuaotunu* seal extension project proposed that alternative water supplies would be set up to service properties that would be potentially affected by sediment run-off during construction of the road works.

Feedback

The drinking water supply problem at Kuaotunu was resolved by bringing in new polythene water tanks by helicopter to the affected houses, with the idea that these could be filled from the stream while water quality was good, and closed off at the intake when heavy rainfall and run-off from the construction site made the water too silty.

... maintain electric fencing ...

For the *Ngutukaka* realignment the AEE indicates that existing water supply and electric fencing will be reinstated on completion of the works and that provision will be made for temporary supply during the construction period.

... provide replacement farm fencing ...

The AEE for the *Butts Road* realignment project also proposed the temporary replacement of any existing fences removed during construction and the re-erection of permanent fences (including a shelter-belt fence to exclude stock from new shelter plantings) on completion of the work. The final designation notice for this project also included a condition that any stock water supplies disrupted during the work should be relocated “to the satisfaction of the landowner”.

Temporary stock fences were also proposed in the AEE for the *Hawkswood* deviation to keep animals out of the area during construction and re-planting.

Feedback

*A problem for one of the farmers on the **Glenhope** project was that, at one point in the project while the area was in drought, the fencing sub-contractor removed the temporary roadside stock fence but then went on holiday for a week before he had finished the replacement. This meant in effect that the farmer was unable to use two large paddocks adjoining the road for a period of about 2 weeks while the property was very short of feed. Some 20 cashmere goats died in the meantime.*

Other problems on this farm (although later resolved) concerned the specifications provided for the final boundary fences. The initial specifications were for a 7-wire fence rather than an 8 or 9-wire fence, as would be normal for a boundary. A seven-wire fence would have been inadequate, particularly for the containment of goats.

*One of the farmers interviewed at **Potts Hill** complained of the sluggishness of the contractor in setting up strong temporary stock fences. It was only after some of his cattle escaped on to the road that this was put right.*

*A similar complaint arose on the **Laws Hill** project where a farmer claimed that low-cost temporary fencing was used by the contractor to try and hold deer in an adjoining paddock over the two-year period of construction. There were a number of escapes, including two animals that disappeared permanently into some nearby bush.*

Another farmer complained that the replacement fence that had been installed on his property was not up to standard and believed that it would probably not last 10 years. He said that the line of the fence “goes up and down”. The fencer responsible for the work had been engaged by the contractor, he said, purely on the basis of lowest cost.

*Quality of fencing was also an issue for an affected landowner at the **Kaimatira** realignment project. The landowner believed that the new stock fencing was not up to scratch and, again, that it would not last long. He pointed out, in particular, that the battens on the fence had been secured to the wires with un-barbed staples from a staple gun. As a consequence the battens were loose and some of the staples were popping out.*

*Fencing was also a problem for one of the affected properties on the **Pokeno** bypass. The respondent said that good quality fencing, with concrete strainers, had been removed to make way for the bypass, but that this had been replaced with a far lower standard of materials and finished work. The new posts were not footed and have consequently been popping out. He predicted that he will have to repair and replace sections of it for years to come.*

*A landowner at **Belmont** advised that he had successfully got around all problems of ensuring a good quality of fencing by organising his own fencing contractor and on-charging the cost of the fencing contractor to Transit New Zealand. He was satisfied with this arrangement.*

A similar fencing arrangement was arrived at with farmers on the Hawkswood and Butts Road realignment projects. The farmers in this case were specifically consulted on their choice of fencing specifications and fencing contractors. This arrangement appears to have worked very well.

17.2 Shelter for Stock

... plant new shelter belts ...

An effect of the *Ngutukaka* realignment project was the removal of some existing farm hedges that would normally provide shelter to stock during the lambing season. The AEE for the project proposed the planting of a new shelter belt, as required to the satisfaction of the landowner.

The *Butts Road* realignment project also involved the removal of an existing shelter belt. In this case the mitigation method was simply for a lump sum payment to be made to the landowner for replacement plantings.

17.3 Restoration of Machine-Damaged Pasture

... restore pasture on the lay-down area ...

The AEE for the *Butts Road* realignment project identified a potential effect of ground compaction by heavy vehicles in a 1-hectare paddock to be temporarily occupied by the construction contractor. The AEE proposes that, if required by the landowner, this paddock would be ripped/aerated and re-grassed, with, if necessary, a soil scientist to be engaged to advise on the timing of this restoration work and the equipment to be used.

Feedback

The paddock at Butts Road was ripped, aerated and re-grassed. However, it was not thought necessary to engage a soil scientist on this occasion.

17.4 Reinstatement of Drains

... repair damage to underground field drains ...

A requirement of both the AEE and final designation for the *Butts Road* realignment project was that any drains damaged during the course of the construction should be reinstated.

Feedback

Drainage problems occurred at Potts Hill where the construction contractor did not realise that underground drainage tiles were under in one of the paddocks where work was taking place. The tiles were unwittingly ripped up and resulted in some long-term drainage problems for the affected landowner (for which some compensation later had to be paid). The farmer claims he has been left with some swampy patches on his land and permanent ponding in the area for the first year after construction.

17.5 General Farm Services

... maintain farm services during construction ...

The AEEs for the *Shannon* and *Potts Hill* realignment projects stated that farm services will be maintained through the construction period, in consultation with the relevant landowners.

Feedback

Although it is not mentioned in the AEE for this project, there was a separate agreement between the contractor and at least one local farming resident on the Belmont Road project that water and power supplies to the property would not be lost for more than 6 to 12 hours. This was successfully adhered to by the contractor throughout the project.

17.6 Incidental Farm Improvements

... provide improved land drainage ...

An agreement between Transit New Zealand and one of the farm owners affected by the *Laws Hill* realignment project was that, as part of the construction work, Transit New Zealand would undertake to provide an improved drain network and drainage outfall, and to provide internal stock access to an area of higher ground on the farm. This measure was stipulated in the project AEE.

Feedback

There were problems on the Laws Hill project with implementing the improved drain outfall (involving the lowering of a road culvert by about 30cm) because, according to the farmer, the drop in level was overlooked when drafting the final design plan. The contractor therefore put in the culvert at its original level.

Nevertheless drainage improvements were achieved on the farm, which the farmer acknowledges has provided him with a better paddock than before the alignment went in. However, he is critical of some of the finishing work, including the fact that a drainage flume was positioned to terminate in the paddock rather than run an extra 50metres or so to the creek. The consequence has been erosion scour in the paddock.

... provide improved farm access ...

Improved stock access was also proposed in the AEE for the *Butts Road* realignment project by constructing new farm access tracks at either end of the new road alignment, as well as seal widening on the highway (for milk tanker access), at the entrance to the property. It was also proposed to raise the level of a strip of land next to the main drain to facilitate stock access during flooding.

18. Utility Services & Signs

... relocate public utilities ...

The AEE for the *Ngutukaka* realignment project refers to the existence of a number of utility services in the locality of the proposed work, including fibre optic cables, overhead power lines, a water supply pipeline and a LINZ cadastral benchmark. These services were to require relocation before commencement of the realignment work. It was proposed in the AEE that these relocations would be negotiated directly with the service agencies concerned. A similar assurance is given in the AEE for the *Goodwood* realignment in respect of an identified fibre optic cable.

... keep utility services functioning ...

In the case of the *Butts Road* realignment project, the AEE identifies the existence of district council 125mm pressurised water pipelines and electricity supply lines. The AEE states that Transit New Zealand (or their consultant) will discuss with the council the location of these services and pass this information on to the construction contractor. The contract for the work was to include a clause to the effect that these services should be maintained during the time of construction and reinstated on completion of the project. A similar condition, relating to the maintenance of the piped rural water supply, was also included in the final notice of designation recommended by the district council and approved by Transit New Zealand.

A condition on the designation of the *Pukerua Bay* project was that construction works must not compromise the function of either the trunk sewer main or the water supply main of the Wellington Regional Council.

... replace existing signs ...

The AEEs for the *Kaimatira*, *Spiral Hill* and *Laws Hill* projects stipulate that all existing signs removed during the course of the construction project will be replaced.

19. Hours of Work

... 6.30am to 8pm, Monday to Friday ...

The AEEs for the *Kaimatira* realignment and for *Spiral Hill* set the hours of work for the projects as 6.30am – 8pm Monday to Friday, 7.30am – 6pm Saturday, with no work on Sundays or public holidays. Noise levels for these projects were to comply with New Zealand Standards for Construction Noise.

Feedback

Residents consulted for the Kaimatira project said that the contractors almost certainly worked longer hours than these but felt that this was of no importance. They appreciated that the contractor had consulted with them directly to check whether there were any concerns with noise, etc.

The contractor on the Kaimatira project thought that these restrictions on hours of work were unhelpful, and was critical in particular of the restriction on working on public holidays, noting that public attitudes to working on public holidays have changed significantly over the years. Restrictions of this kind are frustrating when only a limited number of days are available during which ground moisture conditions are suitable for earthmoving and compaction.

On the Spiral Hill project, one of the landowners said that during the summer work had sometimes gone on until 10 at night. He was not bothered by this, however, and accepted that these extended hours had to be worked in order to get the project completed within time and while the weather was holding.

... 7am to 7pm daily ...

Different hours of work were set in the AEE for the *Shannon* realignment project. In this case the hours were simply 7am to 7pm daily.

Feedback

Neighbouring farmers verified that the contractors worked within the specified hours, but generally could not see the point of this limitation. Most just wanted the work to be finished as soon as possible.

... 7am to 7pm, Monday to Saturday ...

For the *Laws Hill* realignment project, the hours of work specified in the AEE were 7am – 7pm Monday to Saturday, with restricted use of heavy/noisy machinery on Sundays and no work on public holidays.

Feedback

Farm residents affected by the Laws Hill project said that they were not concerned with the hours of operation of the contractor. As far as they were concerned the longer the hours of work that the contractor could operate the sooner the job would be done. The contractor on the project

was of the same opinion. He felt that this kind of rule may be appropriate to some urban situations, but not so in the country.

A further variant is in respect of the *Potts Hill* realignment. The AEE for this project specifies the hours of work as 7am to 7pm Monday to Saturday, with no work on Sundays or public holidays.

Feedback

A neighbouring farmer was asked about the hours of operation for the Potts Hill project and replied that he couldn't see any practical reason why the contractors should not have been allowed to work longer hours. It would not have bothered him. He would have in fact actively encouraged them to work longer hours so that the job could be finished sooner. Similar sentiments were expressed by other residents.

... 7am to 6pm, Monday to Saturday ...

Hours of work specified in the *Ngutukaka* AEE were 7am to 6pm Monday to Saturday with, again, no work on Sundays or public holidays. It was proposed that the contractor may work outside these hours, subject to the approval of the Project Engineer, and subject to the Engineer first consulting with affected parties. The same conditions appear in the AEE and consent conditions for the *Goodwood* realignment project, although the consent conditions, unlike those in the AEE, do not include any limitation on work on Sundays.

Feedback

The limitation on hours was not a problem for the Ngutukaka project, particularly as these hours could be extended, if necessary, after consultation with affected parties. For example, construction of the main culvert on this project required an extension of normal working hours. The contractor was comfortable with these restrictions but suggested that it would not be appropriate to then impose additional controls specific to noise levels.

The project supervisor for Ngutukaka believed that, for the sake of safety and the need to rest, it was important for the contractor, and everyone else involved, to generally have at least one day (Sunday) off each week, with the option of working extra time only if specific circumstances demand.

The contractor for the Goodwood realignment project was equally relaxed about this restriction on hours of work. His opinion was that the specification of hours of work sets a benchmark from which longer hours can be negotiated, if necessary, with the affected neighbours. Sometimes it suits the neighbours to allow longer hours of work so that the job can be completed sooner.

However, if the neighbours are not agreeable to any change to the hours of work, and the project needs to make up time (perhaps as a result of a period of bad weather), then a requirement to get prior landowner approval could be potentially very costly.

... "during the hours of daylight" ...

For the *Hawkswood* deviation project, the AEE simply stated that construction activities would be limited to Monday to Saturday, during the hours of daylight.

Feedback

The engineer for the Hawkswood project had no problem with the limitation on hours (citing traffic safety concerns if work was to occur outside of daylight hours), but could see no reason that these hours should not be able to be extended, in special circumstances, with the agreement of affected neighbours. The neighbours themselves likewise indicated that night-time work would not have bothered them.

... work at night to minimise traffic delays ...

The AEE for the *Pukerua Bay* project indicated that, in order to minimise the extent of delays to traffic using the state highway, some construction work would need to take place during night-time hours. According to the AEE, this would usually involve non-earthwork and smaller construction plant required to provide tie-ins to the temporary and permanent traffic lanes. However, night-time operations would not take place near dwellings in order to mitigate the likelihood of disturbance.

Feedback

No specific hours of work were stipulated for the Belmont realignment project and, in this case according to one of the residents, the contractors sometimes worked around the clock to catch up on their programme. However, he had no problem with this, mainly because the contractor had come to him beforehand to let him know what they needed to do and intended to do.

20. General Disruption

... lump sum compensation ...

For the *Butts Road* realignment project it was anticipated in the AEE that there would be a loss of production and general disruption of day-to-day farm management suffered by the affected landowner. The mitigation offered in this case was a lump sum payment in compensation for these effects.

... “all practicable measures” to minimise disturbance ...

Consent conditions for the *Twizel Bridge* and *Hawkswood* projects included a general condition that “all practicable measures shall be undertaken to minimise adverse effects on property, amenity values, wildlife, vegetation and ecological values”.

... “controls imposed through contract documents” ...

The AEE for the *Belmont* realignment simply stated that nuisances arising from construction activity (including dust, noise, vibration, temporary disruption to access and highway traffic, and the movement of heavy vehicles) would be managed by “controls imposed through contract documents for construction of the work”. The nature of these controls is not otherwise stipulated in the AEE.

... cease work during periods of heavy traffic ...

To minimise the amount of disruption to traffic during construction of the *Kuaotunu* seal extension project, the AEE proposed that construction work would cease during periods of high traffic flow (flows of greater than 200 vehicles per hour). This was considered likely to mean the closure of work from 25 December to 2 January; 4pm Friday to 10am Monday for each weekend in January, and either side of every long weekend and every public holiday. Otherwise, the AEE proposed that no significant construction activity would be carried out outside the hours of 7am to 8pm (or before sunrise or after sunset).

Feedback

This requirement for a mid-summer shut-down was imposed on the Kuaotunu project to avoid disruption during the main period of holiday traffic. Work closed down from 18 December until after Waitangi weekend.

... 1 hour maximum traffic delay ...

The *Kuaotunu* AEE also proposed a traffic delay limit of a maximum of one hour over a length of no more than 2 kilometres where certain major earthworks are required to be carried out. Each such closure was to be preceded by at least 48 hours prior public notice through local media and roadside information displays.

21. Noise

21.1 Noise Reduction

... screen plantings ...

For some properties in the vicinity of the *Ngutukaka* realignment project the AEE predicted a slight increase in noise. For others the noise would be predicted to decrease. Negotiations were carried out with all affected residents to determine appropriate mitigation measures. The main mitigation measure proposed was screen-planting along the batter slopes between the road and the houses.

Feedback

Screen planting will not usually have much effect on reducing noise. It can however reduce perception of the noise source (the passing traffic) and thereby reduce the degree of potential annoyance.

... engine muffling ...

With the *Goodwood* realignment the AEE states that all earthmoving equipment would be muffled to the manufacturers' recommendations and that all pumping equipment would also be muffled, particularly if operated at night.

Consent conditions for the *Hawkswood* deviation project also included a requirement for all heavy machinery to be muffled in accordance with manufacturers standards.

Feedback

This condition (that machinery should be muffled in accordance with manufacturers' specifications) may seem obvious. It does, however, ensure that contractors are obliged to take prompt action to repair mufflers if these are damaged at any time.

... double glazing ...

In the case of the *Gorge Creek* realignment project, a condition of the final designation was that compensation would be paid to an adjacent landowner to cover the reasonable costs on double-glazing of windows for noise reduction purposes. It was for two sides of the landowner's house (unless this condition was to be waived by the landowner, either in whole or in part).

Feedback

This payment of double glazing costs was part of an overall lump sum compensation payment.

... noise barriers, road surfacing ...

No specific noise mitigation measures were proposed for the *Pukerua Bay* SH1 upgrade project. However, the AEE states that, in the event that noise reduction is later found to be required, the options are to either reduce the noise at source; place a

barrier between the noise source and the affected dwelling; or to treat for noise protection at the affected dwelling itself. "At source" treatment options included the use of either an asphalt or friction-course road surface (which would have the effect of reducing noise levels by between 3 and 6 dBA). The noise barrier options were to place either a solid fence or earth mounding in the line of sight between the road and the housing (with the predicted effect of a reduction in noise of up to 10 dBA). Alternatively, the treatment of affected dwellings would normally mean the installation of special glazing.

The conditions of designation for this project went on to require that the road surface (in the vicinity of a nearby cemetery and houses) should be at least of the acoustic standard as a small grade chipseal finish.

A noise barrier fence was also required as a condition of consent for earth-moving works associated with the construction of the *Stoke Bypass*. The specifications for the fence were that it should be constructed of sheet materials having a superficial mass of no less than 15 kg/m², with no gaps, and a height of no less than 2.4 metres.

Feedback

The requirement for a noise barrier fence became an issue for the Stoke Bypass project because this "prescriptive" condition also stood alongside "descriptive" conditions stating allowable levels of noise. Because of the contractor's use of modern (low-noise) earthmoving machinery he was able to achieve the noise standards specified, which therefore brought in to question whether it was relevant, or fair, to also require an expensive noise fence to be built. The council later agreed and accepted that the noise fence should not be additionally required.

With care and on-going planning the contractor on the Stoke Bypass project was able to apply various simple but effective measures to reduce noise for local residents. This included the placement of topsoil heaps where they would act as a noise bund, and the organisation of the excavation of borrow material so that most of the noisy loading work could be carried out behind the screening of a hill.

... keep construction noise "to a minimum" ...

The consent for the *Rosebank* interchange project generally required that the design of the construction techniques should seek to ensure that nuisance factors such as noise, dust and vibration were prevented or minimised as far as may be practical.

21.2 Noise Standards & Noise Regulations

... in accordance with the Noise Control Act ...

The AEE for the *Butts Road* realignment project stated that work would be carried out in accordance with the Noise Control Act 1982.

Feedback

The Noise Control Act 1982 no longer exists. This was repealed by the Resource Management Act in 1991.

... in accordance with the District Plan ...

For the *Glenhope* realignment, the AEE refers to the noise standards contained in the Nelson and Tasman Resource Management Plan. It was confirmed that these noise standards (although not actually specified in the AEEs) will be met.

Feedback

The Glenhope project area is rural in character with the nearest house being about 100 metres from the site. Noise has not been an issue.

... in accordance with NZ Standards ...

The conditions of consent for the *Hawkswood* deviation and the AEE for the *Waimate*, *Kuaotunu* and *Stoke Bypass* projects refer to compliance with NZS 6803P:1984 (NZ Construction and Demolition Noise Standards).

... variations on NZ Standards ...

In a separate resource consent for earthmoving for the *Stoke Bypass* project, stricter construction noise conditions were applied. These were:

7.30am - 6.00pm Monday to Friday inclusive, and 9am - 6pm Saturday	55 dBA L ₉₅ 85 dBA L _{max} 70 dBA L ₁₀
At all other times	45 dBA L ₁₀ 75 dBA L _{max}

These noise limits are 5 dBA more stringent than the recommended upper limits specified in NZS 6803P:1984, having been adjusted to take into account that the construction period was projected to run for more than 18 weeks.

Feedback

The contractor for the Stoke Bypass project noted that in the summer the noise from cicadas sometimes exceeded the construction noise limits. Ironically, when the machinery then started up the cicadas would go quiet and the overall measured noise level would drop.

The AEE for the *Pukerua Bay* project also stipulates that during the construction period noise levels will not exceed the recommended maximum levels of NZS 6803P (Construction and Demolition Noise Standards) over a 24-hour period. Thereafter, once construction is completed, the AEE (and subsequent designation conditions) state that noise from traffic would meet the Transit New Zealand Draft Noise Guidelines.

In the final conditions of consent for this project, however, the construction noise standards were modified to the extent that on Saturdays, Sundays and Public holidays (at any time of the day or night), and on weekdays between 2000-0630h, the [noisier] weekday Standards for 0630-2000 hours will apply, providing that written agreement is obtained from the occupiers of affected dwellings.

22. Vibration

... reduced road vibration ...

Vibration was an issue specifically addressed in the AEE for the *Pukerua Bay* SH1 upgrade project. It was predicted in the AEE that there would be no significant change to the amount of ground vibration experienced by neighbouring residential properties, and may actually slightly reduce vibration effects as a result of the improved (smoother) road surface. The AEE states that further improvement would be possible by using, if necessary, a smoother road seal, such as asphalt concrete or friction course.

Feedback

A resident adjacent to the Maisey's project commented that the only thing that bothered him with the construction work was not noise or dust, but rather the amount of vibration caused by the roller.

23. Dust

... water sprayers to be provided ...

The AEE for the *Kaimatira* realignment stated that dust would be controlled. Water spraying is given only as an example of a method that may be used for this purpose.

For the *Waimate* and *Spiral Hill* projects, the AEEs are more specific in stipulating that dust will be controlled by the use of water sprayers and/or carts.

The AEEs for the *Shannon*, *Potts Hill* and *Laws Hill* realignment projects state that water spraying will be undertaken to control dust, and note that this will be a specific requirement in the contract documentation for the job.

Feedback

Local farmers at Laws Hill said there had been a slight problem with dust at times during the project, despite the use of water carts, but that this had not generally bothered them. Dust was seen as an inevitable short-term consequence of this kind of work.

One of the farmers adjacent to the South of Shannon realignment said that a paddock of calves had been affected by dust. The farmer initially thought that the calves (which were all coughing) had throat infections and started drenching, then realising that dust was in fact the cause. Other neighbours also found the work dusty but felt that this was inevitable and had no complaint. Water carts were used by the contractor.

On the Ngutukaka project there was a similar problem with dust while work was under way to clear up a large landslide. An adjacent farmer complained that the dust caused by this work was causing irritation to the eyes of his sheep. The sheep were moved to another paddock.

A couple of the local farmers interviewed about the Pukerua Bay project remarked that there had been some problems with dust but generally felt that reasonable measures were being taken to control it, and that dust was an inevitable part of the job. One farmer was however concerned at the amount of dust landing up on his pasture and shelter-belts (particularly, with drought conditions at the time, there was no rain to wash the dust off once it had settled). He was concerned that dust on the grass may be causing increased wear on the teeth of his sheep.

Dust was also a problem at Belmont Road during the construction of that project. However, residents generally felt that the efforts to control dust were reasonable, and that the amount of dust was tolerable, particularly for a rural situation.

Another resident at Belmont claimed that his car had suffered from severe rust as a result of lime dust blowing off the truck-loads of lime that were carried to the construction site. [Note: this would have been hydrated lime, used for ground stabilisation, and which is known to corrode steel. For this

reason drivers passing through road works where hydrated lime has been used are usually advised to wash their cars when they return home.] He said that there had been a lot of dust and as an asthma sufferer he just had to go away at times. He nevertheless had no particular complaint about the dust and acknowledged that this was an inevitable consequence of the work. He felt that that the contractors could have done little else to control it.

*A local resident complained that there was a major dust problem during the construction of the **Eland** realignment, which was built during a very dry hot summer. Subsequently she had to dry-clean all her curtains and sheepskin rugs (at her own cost). She said that the contractor had nevertheless taken reasonable measures taken to dampen down the dust, but the extremely dry conditions that summer had meant that these measures were not entirely successful.*

The AEEs for the **Ngutukaka**, **Goodwood**, **Homer to Murrells**, **Maisey's** and **Butts Road** realignment projects state that water spraying will be carried out only as required. Similarly, in the **White Bridge** AEE dust control was only required (through the use of a water sprayer, or other methods) if dust was actually created. This is a high rainfall area, with about 5,000mm of rainfall per year, which means that dust is not usually a major issue.

Feedback

*An unusual situation was confronted on the **Maisey's** realignment project where it happened that one of the properties adjoining the site included a hydroponic lettuce growing operation. Hydroponic crops are sensitive to dust, either through having the dust settle directly on the leaves, or by acting as a vector for the airborne fungal disease "Pithium". Transit New Zealand in this case undertook to compensate for any incidents of Pithium during the course of the work. The disease was thereafter reported almost as soon as work commenced on the project. Whether this was in fact caused by dust from the road works is still debated, but compensation (about \$100,000) was nevertheless required to be paid.*

Most other residents in the area were conscious of the dust but thought of it as a short-term inconvenience that they were prepared to live with. It was generally agreed that not much more could have been done to keep the dust under control.

*The contractor on the **Maisey's** project considered that in hind-sight it may have been better to have timed construction for a less sensitive time of the year for hydroponics. He suggests that an automatic sprinkler system may have also been useful (to spray both the road surface and any loading machinery working in the area). Filtered air pumps were also proposed as a way of servicing the hydroponic glass-houses. This was, however, rejected by the owners.*

Chemical dust suppressants were also considered but would have been of no use in this case. Suppressants are unable to be used in situations where there is either a constant removal or constant laying down of fill, and it

will break up if driven over by heavy vehicles. This severely limits the usefulness of suppressants for most rooding situations.

... take “all practicable measures” to control dust ...

For the *Arahura* realignment project on the West Coast of the South Island, the AEE proposes that the consent holder (Transit New Zealand) will adopt “all practicable measures” to prevent fugitive dust and potentially airborne material (from either the construction area or from earth stock-piles).

In consent conditions for the *Glenhope* realignment project, the requirement is simply that “operations should be carried out and measures implemented to ensure that dust does not become a nuisance to the public in general at all times”.

Feedback

There have been no particular issues with dust on the Glenhope realignment project, despite drought conditions in the area. Only one water cart has been in use on the site. The lack of concern with dust most likely reflects that fact that this is a remote rural area.

... cover loads, wash truck tyres ...

Other dust control measures are proposed (where required) in the AEE for the *Pukerua Bay* project. Apart from the use of water sprayers, the AEE also indicates that highway load trucks will be covered to minimise the escape of dust and debris, and truck tyres will be washed down before leaving the site. Stock piles of earth that have the potential to cause nuisance to neighbouring residents will be either covered or dampened. These same dust mitigation measures were also included as specific conditions in the designation for this project.

In consent conditions for this project (including consents for the discharge of dust and exhaust fumes to air), the regional council required that dust emissions should be controlled so that dust is not noxious, dangerous or offensive at or beyond 50 metres from the boundaries of the deposit areas. The consent also required that “all practical steps” should be taken to minimise the emission of particulate matter at the construction site.

Feedback

What constitutes “offensive” dust has proven difficult to define for the Pukerua Bay project. This can be very subjective.

Most of the dust at Pukerua Bay has originated from the haul roads, rather than the main work area. The difficulty is that the haul roads are on a slope. If these are watered the risk is that they will become slippery and unsafe. They have therefore been kept dry.

Sourcing water for dust spraying was another issue at the Pukerua Bay project site. The water-cart sub-contractor was for some time taking water directly from the main stream. The regional council complained that this was sometimes sucking the stream dry and therefore instructed the sub-contractor to make other arrangements.

... *dust management plan, definition of "objectionable dust" ...*

Consent conditions for earthmoving work associated with the *Stoke Bypass* project included a requirement that the consent holder comply with a Dust Management Plan (a standard plan, previously developed by the council). This requires that dust should not be objectionable beyond the work site, with various performance standards given as to what would constitute "objectionable" dust. These are:

- "Discolouration of clothes hanging to dry on an exterior clothes line in an eight hour period.
- Dust deposits on dwellings or other property over and above normal soiling from atmospheric dust fall.
- The level, geographical spread and frequency of complaint.
- Clearly visible clouds of dust being blown off site."

The Dust Management Plan then sets out a number of alternative dust control measures including:

- "Spraying water or otherwise treating area likely to generate excessive dust through machinery movements or wind.
- Water tanker(s) kept on site at all times and ready for immediate use.
- Providing drive-through water baths for all "dirty" vehicles leaving the site and going onto and across public roads.
- Delineating area, other than the actual work area and access roads, to reduce to a minimum area requiring dust control.
- Maintaining haul roads in good order by regular grading to ensure there is no build-up of dust.
- Providing an earth bund around the earthworks area to act as a buffer.
- Removing any thick layers of dust that may build up in various locations by traffic movements and wind action, before the dust is transported off site by the wind.
- Re-vegetating areas where earthworks are complete as soon as possible.
- Any other appropriate methods."

Feedback

Dust was a problem at times with the Stoke Bypass project. The dry conditions meant that it was sometimes physically impossible for the water spraying to keep up with the rate of evaporation. The main issues with dust on this project were chiefly concerned with soiled laundry and dust getting into houses.

The Engineer for the project felt that the performance standards for dust were, in the end, quite useful as they took away some of the subjectivity of what defines "objectionable" dust. This made it easier to enforce dust controls on the contractor. The performance standards provided here by Nelson City Council were considered to be more or less an accurate reflection of normal tolerance to dust in this kind of urban environment.

Interestingly, the contractor on the Stoke Bypass project also found it useful to have some kind of objective criteria for defining "objectionable" dust. A certain amount of dust will always be unavoidable with this kind of construction project, and sensitivities to dust will vary from person to person. It can be useful, therefore, to have some kind of pre-determined indicators (preferably independently assessed) to help the respective parties agree on whether dust has reached an objectionable level and, if

so, what should be done about it. For the **Stoke Bypass** project, a team was set up (including the council compliance officer, supervising engineer and community liaison group representative) to investigate dust complaints. This appears to have worked reasonably well. If there was a problem the contractor would see what could be done to mitigate or fix it.

Dust was not specifically identified as an issue in planning for the **Pokeno** bypass. However, one respondent said that there was a moderate dust problem with this work, owing mainly to the fact that the shingle stock piles for the project had been located too close to the town.

Sensitivity to dust will vary from place to place, and dust control measures should be adjusted accordingly. An example of a highly dust-sensitive situation was during construction of the **Napier–Hastings Expressway** (1999), which was built through apple orcharding land during the spring blossom period. The contractor was obliged to use between 6 and 8 water carts at any one time to keep the dust down to an appropriate level, and would stop work whenever wind speeds exceeded 30 km/hour. However, in wetter, more remote areas, dust control may not be necessary at all.

Sensitivity to dust will also vary from person to person. At one point on the **Stoke Bypass** project one woman would ring the council every day to complain about the dust and would be genuinely upset by dust, for example, on her outside picnic table. Others in the same area were not at all bothered by it.

On one project where dust was a continuing and unavoidable problem, the contractor undertook to organise or pay for the cleaning of curtains, stereo equipment etc. affected by the dust. Although a certain level of dust nuisance must be expected and tolerated where residential properties are immediately adjacent to a construction work, it may be appropriate in some situations (as here) for the contractor to cover cleaning costs or otherwise arrange for cleaning where the dust nuisance exceeds reasonable limits.

24. Rubbish Disposal

... cover rubbish bins ...

The *White Bridge* AEE required that a covered rubbish container (mini skip) should be provided on site for organic refuse that might otherwise attract Kea, rodents and other pests, with the refuse to be regularly emptied off site. Similar requirements also applied to the *Otira Viaduct* project through regional council conditions of consent.

Feedback

A continual effort was required to keep litter under control on the Otira Viaduct project. The keas would be quick to make off with any scraps of paper etc. left about the site.

... rubbish to be removed ...

For the *Hawkswood* deviation project, the AEE stipulated that all non-earth waste material would be removed from the site for dumping at an approved landfill. Also as a condition of consent for this project (as recommended to the district council through the AEE), the consent holder was to ensure that, on completion of construction, all plant, equipment, chemicals, fencing, signage, debris, rubbish and other material bought on-site would be removed so that the site is cleaned to a level which existed before construction. The condition requires that this final clean-up should be undertaken in consultation with affected landowners.

A condition of the *Makarora* bridge widening AEE (included at the request of DOC) was that, on completion of the work, the site is to be left in a clean state free of all rubbish, waste material, excess rock and excess base course material. A similar requirement also appears in the *Whangamoia North* AEE.

A similar condition (that all floodways should be left in a tidy condition) also appears in regional council consents for the *Belmont* realignment project.

25. Fire Prevention & Control

... no fires permitted, fire extinguishers available ...

The AEE for the *White Bridge* project in the Arthur's Pass National Park area specified that fires for burning surplus timber and other debris would not be permitted on the project site. The AEE also required that the site should be equipped with a high volume fire pump and discharge hoses, plus a number of fire extinguishers, with a site rule that a fire extinguisher should be available adjacent to the work site during any welding or gas cutting. Plant was required to be fitted with mufflers and spark arrestors "where appropriate".

26. Light Spillage

... *control light spillage* ...

The issue of potential light spillage appears in the AEE for the *Pukerua Bay* upgrade project, with concern for the possible effects of unwanted light spillage onto private rural properties that are adjacent to a newly-lit intersection at a junction between a local road and State Highway 1. In consideration of this effect the AEE proposed the use of semi cut-off type street lanterns which limit the amount of backward light. It was proposed that lighting would generally meet the requirements of NZS 6701:1983.

The final conditions of the designation for this project went on to set a maximum limit of 8 lux on the face of any existing residential house in the vicinity of the intersection.

27. Odour

... *trapped piggery odour* ...

An unusual issue arose in the case of the *Maisey's* deviation and road widening project which involved the construction of a 6 to 9-metre high road embankment as part of the deviation. The embankment was to cross over a shallow gully where a small piggery was located and which had a history of odour problems affecting the immediate neighbours. The concern was that the construction of the embankment would act as a barrier to air movement and thereby intensify the odour problem by causing air to "pond" behind the embankment during cold windless nights.

The AEE for the project proposed that a further study would be undertaken to assess this as a potential effect. Two separate reports were subsequently commissioned. Both concluded that increased air ponding would probably occur, but differed in their conclusions as to how significant this effect would be in terms of increased odour.

A recommendation of the council to Transit New Zealand (as part of the designation process) was for Transit to take some action to either lower the proposed embankment height or take other action to mitigate the effects of the piggery smell. This recommendation was however rejected by Transit on the basis of advice that the change in odour would be minor.

Feedback

The piggery was later bought out by Transit, in any case, as a result of land purchase agreements. This indirectly solved the problem and ended further debate on the issue.

28. Traffic Management

... prepare a traffic management plan ...

The AEEs for the *Kaimatira, Laws Hill, White Bridge, Homer to Murrells* and *Shannon* realignments and the *Kuaotunu* seal extension all state that a traffic management plan will be prepared and implemented by the construction contractor.

The same also applied to the *Pukerua Bay* SH1 upgrade project. The AEE for this project specified the various components of the traffic management plan, which included:

- Programme of works.
- Hours of work.
- Proposed Traffic Control Method (signs; temporary marker posts, amber flashing lights, temporary bypass traffic lanes, etc.).
- Proposed speed restrictions.
- Contingency plans (a 24-hour call-out for emergencies).
- Public notification – advertisements, radio reports.
- Monitoring and maintenance of Traffic Management Procedures.
- Contractor's Traffic Control Supervisors.

Feedback

Contractors generally acknowledge the value of traffic management plans. However, there are questions over whether this is something that is appropriate for inclusion in an AEE or condition of resource consent. Traffic management plans are standard contractual requirements between the contractor and Transit New Zealand. They are more of a road safety than resource management issue.

... in accordance with the Transit NZ Roadworks Safety Handbook ...

For the *Ngutukaka* realignment project the AEE simply indicated that traffic management would be in accordance with Transit New Zealand's publication *Working on the Road – A Handbook for Temporary Traffic Control and Safety at Roadworks Sites* (1993).

Feedback

The 1993 handbook has now been superseded. The traffic management guideline now in use is the "Code of Practice for Temporary Traffic Management" (2001).

29. Impact on Retailing

... township revitalisation package ...

One of the main issues for the *Pokeno Bypass* project was the prospective loss of trade for businesses in Pokeno township. To mitigate the effects of this loss of trade resulting from the bypass, Transit New Zealand co-operated with the local authority and local businesses to come up with a revitalisation package to make the township a more attractive place for travellers to stop over and for new businesses to establish. Proposals included the installation of new kerbing, culverts, street paving, tree and flower planting, seating areas, public toilet facilities (costing \$80,000), and better street lighting.

Feedback

The former owner-operator of the Pokeno Service Station (still owned by him but leased out to another operator) was asked what he thought of the bypass. He replied that it had had a "devastating" effect on his business, with turnover dropping by 45% in the first year after the bypass was put through. He claimed that business as a whole in the town (where he owns and leases out two or three other premises) had never recovered from the effect of the bypass. However, he was optimistic for the future, and thought that the beautification of the town and the supply of new amenities (in conjunction with the bypass) had been very good and that this had improved the town environment.

Another respondent (shop owner) agreed that the town improvements at Pokeno had worked well for improving the look of Pokeno. However, he was concerned that an advertising budget, which he had understood (from a public meeting) that Transit New Zealand would provide to the town, had not come about. He claimed that a number of things that had originally been agreed to by Transit New Zealand, in terms of mitigation measures, had not been carried out.

Nevertheless a number of improvements had been made to the town ahead of the bypass (some funded by Transit New Zealand within the terms of their funding limitations, some funded by other agencies). This included street widening, laying cobblestones, providing parking areas and street lamps.

Two other respondents (residents only) said that Pokeno was generally a better place to live in now that the bypass had been built and that, unlike before, they now "have a main street".

A survey has recently been carried out by Pokeno retailers to find out why visitors stop in the town. The survey found that visitors generally make a conscious prior decision (rather than impulse decision) to stop there, knowing that they can park safely in the town and walk around the shops with ease. The town has set out to market itself as a quiet "village" stop-over, rather than try to compete with the style of the fast-food chains.

A couple of respondents remarked that one of the successes of the organisation of the Pokeno bypass project had been the setting up of a local liaison committee (initiated by Transit New Zealand), with representatives from local retailers, the regional and district councils, power board, MPs and the construction contractor. The committee met on a monthly basis at the start of the construction project (although less often once the project was under way) and helped to ensure co-ordination and information flow between the various parties. This organisation had a valuable 2 years' lead time ahead of construction of the bypass.

The Transit New Zealand project manager for the Pokeno bypass said that, in his experience at Pokeno, the key issue with any bypass, in terms of reducing adverse effects on a town, is to ensure that in the design of the bypass convenient access is maintained (for example, that there should not be any 90° turns off the highway that might discourage passing traffic from turning off). The nature of access will have an enduring effect on the town.

Another important consideration (according to the Transit New Zealand project manager for Pokeno) is to make sure that there is the least possible disruption to access during construction. Passing traffic will be less inclined to stop off in the town if obstructive or confusing roadworks have to be negotiated. A local restaurant owner also noted this same concern in relation to work on the Ngutukaka project. Trade at the restaurant was noticeably disrupted for about a month while roadworks occurred around the restaurant entranceway.

30. Maori Cultural Issues

30.1 Waahi Tapu & Cultural Landmarks

... respectful disposal of surplus fill ...

A special requirement of the *Kaimatira* realignment AEE (from an agreement between the local iwi and Transit New Zealand, decided over a succession of hui) was that all soil removed from the cliffs as part of the earthwork for the project would not be either used as road fill or transported away from the site. The cliffs were said to be the site of an old pa and a place used for testing out newly-built ocean-going canoes, with the canoes in question having been pushed off the cliff top and into the river below. Representatives of the iwi wished to see soil from the site respected in recognition of the significance of the location. During construction of the realignment the cut material from the cliffs was therefore proposed to be transported a short distance away to be deposited in behind the cliffs. Material would be brought in from elsewhere for road fill.

Feedback

A total of 77,000m³ of earth was removed as cut-to-waste from the cliffs at Kaimatira, with 18,000m³ having to be brought in as fill. This 18,000m³ could not be taken from the cut-to-waste taken from the cliffs because of the agreement with iwi. Rather, this material was separately quarried from a knoll on the farm land in behind the cliffs and transported to the site.

There remains some confusion over whether the iwi meant that none of the 77,000m³ of fill could be used from the cliff, or whether this instruction applied only to the material at the cliff top. There are conflicting opinions. However, at last contact (with the iwi agency as part of this study) it was confirmed that the whole volume of earth is indeed what had been intended.

Written historical accounts confirm that a pa site was once at the top of the Kaimatira cliffs, although no evidence of the site now remains. The pa is recorded as having been attacked and destroyed by a Ngatiapa raiding party some time in the early 1700s. The legend of the testing of a canoe also appears in earlier histories of the Wanganui River. The story relates how it was here at Kaimatira that a canoe was once built for a special mission to the Cook Strait area where it was to be used to hunt down and kill a giant man-eating cuttlefish said to live in the vicinity of the landmark in the Strait now known as "The Brothers". According to the legend the canoe was tested out for this mission by dropping it into the river from the top of the Kaimatira cliffs (a drop of about 40 - 50 metres).

... historic monument and rest area ...

Also as part of the *Kaimatira* realignment, it was agreed between the local iwi and Transit New Zealand that a memorial to the site, in the form of a canoe prow (to be designed and constructed by a local Maori designer) should be erected. This was to commemorate the history of the site as a place where the seaworthiness of ocean-

going canoes was tested by pushing them off the top of the cliff and in to the Wanganui River. The monument was to be erected at a rest area formed on part of the old road alignment.

Feedback

*A canoe prow monument was sponsored and built at **Kaimatira** under this agreement and includes a commemorative plaque describing the story of a canoe being pushed from the top of the cliffs in to the river.*

*A rest area (also the site of the monument) has been created at **Kaimatira** on part of the old road alignment. A nearby landowner claims that there have been problems with this rest area, which he says has come to be used as a place for dumping and burning stolen cars and for dumping rubbish (about 100 skinned possum carcasses were dumped there one night). Some thieves who attempted to break in to his house used the rest area as a place to park their car. Certainly, when visiting the rest area for the present study, a large amount of rubbish was found to be lying about, including various car parts and several sheep carcasses that had been tipped down the bank on the river edge.*

... historic way-markers on the greenstone trail ...

Landmarks of a different kind were identified in the AEE for the *Otira Viaduct* project. These were in the form of a number of large boulders, referred to as "kaitiaki", which have historical significance as way-markers on the South Island greenstone trail. After extended consultation with iwi it was agreed that one of the kaitiaki could be demolished. Kaumatua from both the east and west sides of the pass were brought to the site to conduct rituals and prayers to facilitate the demolition. Other kaitiaki in the area were protected with barriers during the construction period to ensure that they would not be disturbed or damaged.

Feedback

With the agreement of the iwi, the removal of the one kaitiaki that had to be demolished to make room for the viaduct proceeded without difficulty. Thereafter all efforts were made to protect the other kaitiaki, including building a temporary roof over the top of one of them to protect it from anything falling from above.

30.2 Human Remains & Artefacts

... cease work if human remains are found ...

For the *Kaimatira, Shannon, Butts Road, Goodwood, Gorge Creek, Pukerua Bay, Glenhope, Whangamoia North* and *Spiral Hill* realignments, the *Makarora* bridge widening, and *Kuaotunu* seal extension, a requirement of the AEE and/or resource consent was that in the event of any human remains or Maori artefacts being uncovered all work should cease immediately to allow the site to be inspected by tangata whenua. Work should resume only when arrangements for dealing with the find have been agreed with the relevant tangata whenua, and actioned.

Feedback

One of the problems with this condition that work should cease on the discovery of remains is that it implies that all work should cease once artefacts or suspected artefacts are found. A contractor who worked on the Bushey Park realignment project near Wanganui reported that, at one point on this project all work was closed down for half a day when a passing motorist mistook a shelly rock strata for an old midden site and reported this to the council. The site was eventually confirmed as a natural rock form, but for the time that this was being investigated the contractor was not permitted to work even in an area where 20 metres of overburden had previously been removed and where there was no chance whatsoever of striking artefacts or bones. The contractor had no problem with ceasing work in the area where a midden site had been suspected, but did not believe it was necessary that all other work on the project should cease at the same time.

A similar condition appears in the resource consent for *Thames Coast* coastal protection works project. In this case the consent requires that work should stop immediately and that the Council should be notified within 48 hours. Work may then recommence only with the written approval of the regional council, after the council has considered (1) tangata whenua interests and values, (2) the consent holders interests, and (3) and archaeological or scientific evidence.

The *Hawkswood* deviation resource consent included a condition that if human remains or artefacts are found the Rununga and the Archaeological Association would be advised. A site inspection would be carried out by the appropriate tangata whenua and statutory authorities who would then determine whether the discovery is likely to be extensive and whether a thorough site investigation is required, with the materials in question to be removed by the iwi responsible. The wording of this condition follows that recommended to the council in the AEE for this project.

The AEE for the *Laws Hill* realignment project also refers to procedures for dealing with the discovery of human or archaeological remains and notes that these procedures are to be set out in the contract documents for the project.

... iwi representative to observe ...

For the *Thames Coast* rock protection project the consenting regional council required that the local iwi authority (as well as the council) should be notified at least five days prior to the commencement of the work. The AEE for this project also proposes that at key times, particularly during the excavation of the footing for the structures, a representative of the iwi will be contacted so that an observer, acting on behalf of the iwi, can be present if required. Similar measures were also taken at *Glenhope* and *Maisey's*.

A condition of consent for *Stoke Bypass* was that the consent holder should “ensure that the interests of Maori are safeguarded and protected by the inclusion of an appropriate *Maori Interests* clause in the contract documentation for the project.

This clause (as proposed) would see the appointment of an Iwi Liaison Officer (ILO), appointed by the local iwi, to observe the work and liaise between the Iwi, the Engineer and the Contractor. The ILO would not be permanently on site, but would be

advised of the discovery of any bones, middens or archaeological sites during the excavation (with work to stop in the meantime). The ILO would then commission an investigation of the find, oversee the continuing excavation, or allow the work to resume. The same concept of a protocol for dealing with archaeological finds of Maori significance was also picked up in the AEE for the *Maisey's* deviation and road widening project.

Feedback

*An iwi representative who was interviewed confirmed that this monitoring occurred during excavation phases of the work on the **Thames Coast** project (a relatively small part of the overall job). There were no discoveries of archaeological material.*

*On the **Glenhope** project an agreement had earlier been reached between the iwi and Transit New Zealand whereby an iwi observer would be on site during the opening up of new ground. Being in a fairly remote area there were however difficulties in contacting the observer and ensuring that he was present when fresh earthmoving occurred. An arrangement was eventually made whereby messages would be left for him to know that ground was to be opened up so that he could be present if available, although this in the end was not often. In any event no Maori artefacts were found on this project. Nor had it been considered likely that anything would be found there as the area had no previous history of occupation or knowledge of any waahi tapu.*

*A Monitor was appointed to the **Maisey's** project on the same basis whereby he would be informed ahead of the opening of any new ground.*

*The expectation for the **Stoke Bypass** project had been similar, although the iwi initially provided three full time monitors instead of the expected one part time. It became apparent early on, however, that there was not sufficient work to keep three full time monitors busy. Two of the monitors therefore withdrew from the job. The third was employed on the site as a driver for one of the water carts.*

*A memorandum of understanding was drawn up separately between Transit New Zealand's Planning Consultants for the **Thames Coast** project and the local iwi agency, which required that an iwi representative should be present to monitor any excavations along the foot of the sea walls.*

However, the existence of a memorandum of understanding (MOU), including an agreed procedure for dealing with archaeological finds or human remains, does not always necessarily guarantee that any such discovery will be dealt with promptly. A recent (2001) discovery of human remains in Thames Township, during the laying of utility services by the Thames-Coromandel District Council, resulted in the project being stalled for a 6-week period while the respective iwi and hapu debated who the remains belonged to, and what should be done with them.

In this case the District Council had both an existing MOU and agreed procedure for dealing with the discovery of waahi tapu, but this, in the end, did not prevent major delays and costs (specific amount unknown, but

understood to be in the tens of thousands of dollars) being incurred on the project. The remains were eventually shifted to a short distance away, with a traffic island built over the top.

... archaeologist to observe ...

In the case of the *Rosebank* interchange Transit New Zealand was required, as a condition of the coastal permit, to have a qualified archaeologist on site during the initial excavation works to determine whether or not archaeological evidence was present in the coastal marine area.

The same was also proposed in the AEE for the *Waimate* realignments project where work was to occur in an area where local iwi thought it possible that at one time previous Maori occupation may have existed. The AEE proposed that an archaeologist should be on hand during the initial removal of topsoil to examine the surface below the plough line for evidence of occupation (including darker patches of soil or unusual soil patterns, or shells, bone, burnt stones or flakes of unusual stone). Work was to stop immediately if a discovery was made while both the Historic Places Trust and local iwi would be consulted.

... archaeological survey, inspection by iwi ...

For the *Kuaotunu* seal extension project, the AEE and consent conditions required that an archaeological survey would be carried out on all areas to be cleared for filling and cutting in order to confirm or otherwise the existence of any historical or cultural site. The resource consents for this project also required that local iwi should be notified 10 working days prior to the commencement of work and given the opportunity to inspect the whole of the construction site.

30.3 Recovery of Maori Medicinal Plants

... identify, remove, transplant native medicinal plants ...

Along with the responsibility to watch out for artefacts, it was agreed that the iwi observer for the *Glenhope* project would also be responsible for looking out for Maori medicinal plants.

Feedback

*It is not known what plants were specifically likely to have been of concern at **Glenhope** and whether these were likely to be common or rare. If these were common plants it is unclear why they should have been of special importance in this area.*

31. Community Liaison

... *community liaison, meetings, newsletters, signage* ...

A condition of (earthmoving) consent for the *Stoke Bypass* was that Transit New Zealand would set up a liaison group involving members of the local community and council, with meetings to be held on at least a monthly basis during the course of the project. Transit New Zealand was also required, under the consent condition, to provide at least three community information newsletters during the period of the excavation work, and to erect a sign on the site of the work containing a description of the work, the start and estimated completion dates and the name, address and phone number of a 24-hour contact person.

A requirement of the AEE for the *Kuaotunu* seal extension project was that the contractor establish a working liaison with affected property owners and the local community to ensure that any issues of concern are dealt with during the construction phase and that local people are generally kept informed.

Feedback

The liaison group approach for the Stoke Bypass project proved to be very useful (according to a wide range of respondents). A total of 24 parties were represented and would meet every two months to exchange information and discuss concerns.

Practically everyone interviewed in relation to this project was enthusiastic about how useful and effective these sessions had been. The process was found to be an effective way of dealing with issues at an early stage before they became a problem. Examples of this were the planned cessation of noisy pile-driving work during School Certificate study week, and the provision of extra dust controls at times when the fruit processing plants were likely to be particularly susceptible.

The process also forced a discipline on the parties responsible for the running of the project to set aside a regular time slot to make sure that this communication was maintained.

The newsletters were also found to be surprisingly helpful. After an initial hesitance, the contractor put out the first newsletter and had such a positive response to it (and to subsequent newsletters) that approximately six of these were produced (twice as many as were required by the condition of consent). The content of the newsletters had to be kept fairly general at times, owing to the uncertainty of future weather conditions etc.

A similar partnering group was set up for the Glenhope project (although not specifically required as a condition of resource consent). The Transit New Zealand project manager and site engineer advised that this was found to be a useful process, for much the same reasons as with the Stoke Bypass. In addition, the partnering proved to be a useful way of picking up local knowledge from neighbouring farmers. The contractor also received

a significant amount of help from farmers, which originated from these sessions. A monthly newsletter was also put out for this project.

*Similar positive experiences were reported in respect of the partnering that occurred with the **Kuaotunu** project. The partnering group involved the regional and district council, ratepayers association, community board and local landowners. Regular meetings were organised throughout the project and a monthly newsletter was produced. An engineer on the project commented that the process meant that any problems people had with the project were able to be headed off early on, and that the forum was instrumental in enabling the project to be finished within time and within budget.*

*The regional council enforcement officer for the **Kuaotunu** project was also very positive about the value of the partnering approach on this job. He contrasted this project with the **Thames Coast** coastal protection works where, in the absence of any such partnering group, some issues had remained unresolved.*

*On other projects, for example the **Maisey's** realignment, some of the residents (either directly or indirectly affected by the work) indicated that they would have liked to be kept more closely informed. It was also felt that the system of communication was often too ad-hoc, with the result that it could take a considerable while for any problems to be worked out and then followed through. It is thought that if there had there been regular programmed meetings with landowners then these issues could have been more quickly and easily resolved. The same comments were also made in relation to the design phase of the project where some of the residents felt that they were not being kept adequately informed while changes were being made to the plans.*

*Looking back on the **McArthur's** project, the contractor also believed that a lot of the problems encountered on this job (in particular in dealings with the **QEII Trust**) could have been either avoided or greatly reduced if there had been a formal partnering arrangement in place.*

32. Public Complaints

... maintain a record of complaints ...

Regional council consent conditions and the final notice of designation for the *Pukerua Bay* SHi upgrade project included a requirement that the consent holder (Transit New Zealand) should maintain a record of any complaints received alleging adverse effects caused by the construction work. The record was required to include the name and address of any complainant and other relevant details, including the prevailing weather conditions and date and time of the complaint.

Consent conditions for earthmoving activity associated with the *Stoke Bypass* project also required that a log should be kept of all complaints concerning noise.

Feedback

The site engineer for the Stoke Bypass project commented that the register of complaints had been a good way of ensuring that the contractor had a process to work through formally dealing with complaints from the public. The register included columns to document what if any action had been taken by the contractor to deal with any complaints arising.

33. Project Management & Supervision

... prepare a "quality management plan" ...

The coastal permit for the *Rosebank* interchange, issued by the Minister of Conservation, required that prior to the commencement of works a project "quality plan" should be submitted to the Regional Conservator of DOC and to the regional council for their approval to illustrate how the broader conditions of the coastal permit would be followed. The consent also requires the appointment of an "appropriately qualified and experienced quality systems manager" (name and qualifications of whom to be supplied to DOC and the regional council).

The *Rosebank* coastal permit also required monthly reports on the results of monitoring of the project quality plan (to be copied to DOC and the regional council).

Feedback

The requirement for monthly monitoring reports for the Rosebank interchange project was later changed to 3-monthly reporting to better coincide with the actual regularity of monitoring.

... prepare an "environmental protection plan" ...

For the *White Bridge* project, the AEE required that the contractor prepare an "Environmental Protection Plan" before any construction was undertaken. This Plan was to be agreed to by DOC (as administrators of the Arthur's Pass National Park), Transit New Zealand and the Engineer in charge of the contract.

Feedback

The contractor for the White Bridge project found the requirement for the preparation of an environmental protection plan to be both good and bad. It was good insofar as it forced a discipline of planning on to the environmental management of the project, but was bad in that it also simply added to the mountain of contractual and resource consent paperwork that the contractor had to take care of, with much of the content of the plan being just a repeat of what was already covered in existing material. Once the plan had been written, therefore, it was not much used.

... appoint an environmental manager ...

During the initial period of work on the Oira Viaduct project the contractor appointed an environmental manager to oversee all environmental responsibilities. It is thought that this helped to raise awareness of environmental management obligations among the contract staff.

... responsibility for subcontractors ...

Consent conditions for the *Thames Coast* project include a requirement that "the consent holder shall be responsible for all sub-contracted operations, and must ensure sub-contractors are made aware of the relevant conditions of consent and ensure

compliance of all operations with those conditions". The consent also specifically required that the design and construction of the works should be carried out under the supervision of an appropriately experienced engineer who will ensure that the works are undertaken in accordance with accepted engineering practice.

Feedback

The regional council officer overseeing the Thames Coast project remarked that there had been problems in the past where sub-contractors had not been made aware of resource consent conditions by the principal contractor. The council now has a standard condition in all such consents which makes this obligation clear.

34. Contractor Training

... environmental training, briefing for contractors ...

The AEE for the *Rosebank* interchange project proposed a special training course for contractors working on the project to raise awareness of potential environmental risks and effects on the Waitemata Harbour. The training programme was proposed to take the form of an in-house, pre-construction seminar, with follow-up site inspections.

The same was required as a regional council condition of consent for the *Kuaotunu* seal extension project, with all sub-contractors to be briefed on the significance of the area with regard to conservation values in the area including the presence of Kiwi, indigenous vegetation and fisheries values.

Feedback

The briefing given to contractors and sub-contractors on the Kuaotunu project evidently went well (according to the regional council compliance officer). This helped to ensure that those involved in the project were aware of any particular local sensitivities including, in this case, the local kiwi population. Likewise, the environmental training/induction at Rosebank appears to have been reasonably well received, thanks in part to the support of the contract management.

... environmental "code of conduct" ...

A mitigation measure (and later condition of consent) for the *Otira Viaduct* project on the SH73 Arthur's Pass road was that all construction staff should be provided with information on the environmental values and sensitivities of the area, along with a "code of conduct" for carrying out work in the area.

Feedback

For the Otira Viaduct project the "code of conduct" was regarded as a standard part of the basic site induction provided to all workers, and was not generally an issue. The staff were also given the occasional briefing on environmental matters, including presentations from the man responsible for kiwi monitoring to keep them informed about what the kiwi were up to in the area.

35. Monitoring

... monitor establishment of grass ...

The AEE for the *Eland* realignment project explains that, because of the erodible nature of the terrain in the construction area, monitoring will be undertaken during construction and during the subsequent maintenance period to check on the establishment of grass cover on cut and fill batters. A similar requirement for monitoring the establishment of grass cover on the completion of construction work appears, as a condition of land use consent, in the resource consent for the *Hawkswood* deviation.

... monitor forest regeneration over 10 years...

For the *Silverstream* 4-laning project Transit New Zealand was required, as a condition of consent, to monitor the success of re-planting along the re-vegetated cut-face created by the road-widening. The condition stipulates that this monitoring should be conducted annually over a period of ten years by a qualified native forest ecologist, and should include observations on the survival of buffering plants; the number of wind-thrown shrubs and plants adjacent to the cut-face; any changes in species composition; and the presence of exotic weeds.

Feedback

An original submitter/opponent on the Silverstream project (now a strong advocate of the work that was done) maintains that, in her opinion, a 10-year monitoring period was appropriate. Although the project worked out very well in the end, it is conceivable that it might not have. She felt that the monitoring would mean that a system would be in place to detect and repair any problems that might have arisen.

However, with the recovery of the bush so clearly under way, it now does seem excessive to require that monitoring should persist for the full 10-year term. It is not surprising, therefore, that this condition seems to have been largely disregarded or forgotten about since the restoration work was completed. Certainly, a native forest ecologist was brought in only once prior to the commencement of work, and once again at the end of the project (in 1997/98). There would have been little reason for return inspections to occur after that date.

... monitor mudflat flow patterns, siltation ...

The AEE for the *Rosebank* interchange proposed pre-construction monitoring of flow patterns in the mudflats next to the construction area. The AEE also proposed pre- and post-construction visual monitoring to identify any areas of ponding or siltation around the mangroves.

The monitoring conditions contained in the coastal permit for the *Rosebank* interchange project were more detailed (based in large part on a Memorandum of Understanding (MOU) on environmental monitoring between Transit New Zealand and the Auckland Regional Council). The consent conditions required three-monthly

audits to be undertaken by Transit New Zealand, with each of these audits to include a general assessment of environmental effects for the project. The consent required the resulting audit reports to be submitted to both DOC and the regional council. In the event of a non-compliance with the consent conditions being identified in any one of these audits, the consent requires consultation between Transit New Zealand, DOC and the regional council to determine appropriate remedial works (and/or further monitoring).

The monitoring programme required by the *Rosebank* consent (and based on the Transit New Zealand/ARC MOU) included:

- Monitoring sediment accretion rates in the adjacent mudflats.
- Monitoring visual changes to sediment accumulation and water flow in the adjacent mudflats (by use of photographs).
- Monitoring by aerial photography (or similar) to detect any long-term changes in the biological community or structure of the mudflats.

The monitoring programme was also required to incorporate a method for establishing baseline conditions and for establishing whether significant adverse effects were occurring as a result of the reclamation and associated works.

The concern with sedimentation in the Waitemata Harbour comes from historical (but unconfirmed) suggestions that the rate of accretion in the Pollen Island area may have increased during construction of the earlier North-Western motorway (a matter referred to in the *Rosebank* AEE). Sedimentation, causing a shallowing of the tidal mudflats, can gradually lead to the successional displacement of mangroves. This may be caused by a difference in water depth of as little as 50mm.

The monitoring conditions for the *Rosebank* interchange project include an authority for the DOC Regional Conservator or ARC to either halt or modify the work or require remedial work to be carried out, in the event that the monitoring results indicate the occurrence of an adverse environmental effect.

Feedback

The monitoring programme for the Rosebank interchange project was substantial, and probably excessive, particularly as the strict sediment containment controls on the project and the comparative lack of large-scale earthworks actually meant that the amount of sediment leaving the site was generally very minor. It hardly needed detailed survey-plot monitoring to confirm what would have been quite apparent from casual observation.

It was also hard to see, in the end, the actual application for the information collected from this monitoring of sedimentation in the mangrove and mudflat areas. All the data could have reasonably shown, and only some time after the event, is whether or not increased sedimentation had occurred. It would not have been possible to use this data to point with certainty to the specific cause of the sedimentation, or to identify what action might be needed to correct it.

Elaborate monitoring programmes provide some kind of comfort and assurance to those specifically concerned with the welfare of, in this case, the Waitemata Harbour. But the results of this monitoring are too often of

*academic value only. There was for example a proposal at one time on the **Rosebank** project that sediment accretion monitoring should be undertaken up to half a kilometre away from the actual work site in the Waitemata Harbour. It does not seem to have been fully thought through how this monitoring would actually assist with identifying and remedying the causes of sediment run-off from the site.*

This is the key point since, despite all else, the road work is hardly likely to be abandoned if a certain amount of sedimentation is found to be occurring. What matters is not that this is later proven, but rather that systems are in place during the course of the project to ensure that, where sediment run-off is seen to be occurring (something that is likely to be plainly visible), practical measures are able to be promptly put in place to prevent or mitigate that effect.

*An irony with the **Rosebank** project was that the monitoring activity itself (with monitoring teams having to walk out on transects across the mudflats to get to the measurement stations) was ultimately more damaging to the surrounding mangroves than the actual construction activity. The ground surveys were eventually abandoned for this reason. Thereafter, monitoring was limited to visual inspections from the shore.*

*The aerial monitoring at **Rosebank** has shown no change to date. Nor is any change now expected. Transit New Zealand is negotiating the discontinuation of aerial monitoring, which was initially proposed to run for a period of 6 years.*

... photographs, before and after ...

In consent conditions for the 1997 resource consent for the **Thames Coast** rock protection project, the regional council required Transit New Zealand, as the consent holder, to take photographs of the various sites where rock protection work would occur, both before and after construction, to be taken at low tide.

Feedback

*The regional council did not follow up to check on whether before and after photographs had been taken for the **Thames Coast** project, and therefore could not say whether the condition had been complied with. Presumably because the project went so smoothly, and to everyone's general satisfaction, there was never any question of having to prove how the work site was "before". However, this may have been more of an issue if problems and disputes had arisen, and in that case a photographic record could have proven valuable.*

... record gravel extraction quantities ...

For the **Homer to Murrells** project, one of the regional council conditions of consent for gravel extraction was that there should be a record of all gravel removed. A copy of this record was required to be submitted to the council each month.

Feedback

*One of the main reasons for requiring a record to be kept of gravel extraction on the **Homer to Murrells** project was presumably for the payment of royalties, in the form of a "site use fee", to DOC. DOC charged a total of about \$20,000 for gravel taken from within the park (charged on a per cubic metre basis).*

... monitoring programme to be designed ...

Resource consent conditions for the **Pukerua Bay** SH1 upgrade project required environmental monitoring to assess the effectiveness of efforts by the contractor to minimise suspended solids content in stormwater discharge from the construction site. The consent in this case does not actually specify what type of monitoring should be undertaken, but rather leaves the design and parameters of the monitoring programme to be worked out by Transit New Zealand (subject to final approval of the regional council).

Feedback

*The contractor for the **Pukerua Bay** project commented that the monitoring process seemed to be working well, with an environmental consultant coming on site once a week to monitor and audit the work.*

... weekly compliance inspections by consultants ...

Monitoring was proposed in the AEE for the **Glenhope** realignment project, which was to take the form of an "environmental effects register". This was to be mainly a compliance monitoring exercise, carried out on a weekly basis by the consultant, and intended to check on whether the works complied with "all environmental legislation, regulations and approved practices". The AEE document includes, as an appendix, a copy of a draft environmental effects register to be "fine-tuned when consent conditions and contract specifications are known". Monitoring was to comprise:

- Observation, verification and checking of sample aspects of physical works.
- Checking and verification of Contractor's records.
- Written instructions to the Contractor indicating action and repairs needed.
- Inspection of the entire project prior to the expiry of the maintenance period.
- Observation of traffic control and worker safety from random visits.

Feedback

*Both the supervising engineer and contractor for the **Glenhope** project found the environmental effects register to be a useful discipline. A check-list system was used for these assessments.*

... compliance inspections by council staff ...

For the **Glenhope** project the council proposed to carry out its own weekly monitoring inspections (with the costs of monitoring to be charged on to Transit New Zealand), although with the possibility of less regular inspections over time. Council inspections were also proposed as a condition of consent for spoil dumps associated with the **Whangamoa North** deviation project, with at least one annual inspection, to be conducted either during or immediately after a rainfall event.

... *monitor & maintain stormwater sediment traps* ...

The equivalent condition of consent for the *Glenhope* realignment was simply that “all stormwater and sediment control structures shall be regularly monitored and maintained in effective operational order at all times” (with the note that the sediment control structures may be progressively decommissioned as bare soil surfaces are re-vegetated or otherwise protected from soil erosion).

... *water quality sampling* ...

For the *Kuaotunu* seal extension project, the AEE proposed that there should be water quality monitoring prior to, during and after construction of the road works to identify whether potentially toxic minerals may be entering the natural watercourses, with sampling to specifically test for concentrations of arsenic (As), aluminium (Al), lead (Pb), iron (Fe), sulphur (S), plus pH (acidity) levels and concentrations of suspended sediment.

This monitoring programme was later incorporated as a condition of consent for the project, with monitoring and reporting to be undertaken on a monthly basis during the period of construction, then once every two months in the year following construction, and once every six months after this for another four years. The consent requires that remedial action should be taken if any results of this monitoring indicates a significant increase in water contamination.

Feedback

An engineer for the Kuaotunu project suggests that, in the end, only suspended sediment and arsenic measurements were truly relevant to this job. Levels of aluminium, lead, iron, sulphur and acidity were of academic interest only.

... *Blue Duck, Kiwi* ...

The AEE for the *Otira Viaduct* proposed that three types of monitoring should be carried out for this project, including the monitoring of Blue Duck and Kiwi; the monitoring of sediment loads in the river; and the monitoring of vegetation recovery.

A survey of Blue Duck and Kiwi in the area had been undertaken as part of the initial investigation work for this project. The intention was to continue this monitoring both during and after the construction phase. The AEE is unclear about the purpose of this monitoring, except to say that “the focus of mitigation and monitoring is on maintaining the equality of the environment on which [the Blue Duck and Kiwi] depend”. Great Spotted Kiwi monitoring was also required in one of the regional council conditions of consent. The condition required Transit New Zealand to undertake a monitoring programme in consultation with DOC to determine if any individual Great Spotted Kiwi may be at risk from construction-related activities.

Feedback

Blue Duck monitoring on the Otira Viaduct project was, in the end, limited to an informal monitoring by site workers (to report if they happened to see any Blue Duck in the area). No Blue Ducks were seen.

Kiwi monitoring at the Otira Viaduct involved the engagement of an expert for night-time listening, with this monitoring work undertaken every 3 months. It is arguable if this monitoring was altogether necessary, although it did at least provide an assurance to DOC and to the wider public that, as expected, the roadworks were not having an adverse effect on the local Kiwi population. (The number of birds recorded as present in the area actually increased by one between the start and finish of the construction period.) Several of the site workers also took an interest in the Kiwi monitoring, which probably had the spin-off effect of causing a greater degree of overall environmental awareness around the construction site.

Knowledge of the whereabouts of the local Kiwis also influenced a design decision not to proceed with the construction of a lookout track overlooking the viaduct, which would have gone through a Kiwi area. The concern was that a walking track through that area would increase the likelihood of people bringing in dogs.

Kiwi monitoring was also initiated on the White Bridge project. Each 3-monthly monitoring exercise (costing about \$2,000) would involve listening for birds over a series of three nights. Again, the monitoring provided a reliable assurance of a nil effect on the local Kiwi population as a result of the roadworks. It was valuable, therefore, in terms of maintaining good relationships with local people and with DOC. It also helped to impress upon the contractor the ecological significance of the area.

A Kiwi monitoring programme was also proposed in the AEE and consent conditions for the *Kuaotunu* seal extension project. The survey was to identify any birds or bird eggs at risk from the construction activities and arrange for their relocation away from the area of work. The conditions of consent for this project specifies that the survey should identify the location of Kiwis in the area, their movements, nests and territories within the vicinity of the proposed works. The consent required that the survey work should continue throughout the course of the construction project.

... suspended sediment monitoring ...

Sediment load monitoring for the *Otira Viaduct* project, as prescribed by the AEE, was to involve the collection of water samples at regular intervals about 50m downstream of the site. The aim of the monitoring was to get a long-term picture of any trends in sediment loading over the period of construction. Consent conditions from the regional council later set the point of measurement at 200m downstream of the site.

Feedback

It soon became apparent on the Otira Viaduct project, however, that the monitoring of sediment loads in the river would be of little value or meaning, due to the naturally high and naturally fluctuating turbidity of the water. A turbidity meter was specifically bought for the project (\$2,000) and used initially, but measuring was soon abandoned.

... noise monitoring ...

Noise monitoring was required as a condition of consent for earthmoving work associated with the *Stoke Bypass* project. Noise measurements were required to be taken at least once during the first and second months, then at no more than two-monthly intervals, or in the event of a public complaint. Non-compliance with the noise standards for the project would require immediate remedial action and a written report to the council and the local community liaison group.

... independent performance reports ...

For the *Stoke Bypass* project Transit New Zealand was also required, as a condition of the earthmoving consent, to appoint an “independent person” to report monthly to the council on the performance of the Engineer and the Contractor (with respect to meeting the requirements of the various management plans for the project), including procedures for complaints and community liaison.

Feedback

*There was in the end some doubt over the value that these independent performance reports for the *Stoke Bypass* project, considering that a partnering group process was also running at the same time (at which all of the relevant parties would meet on a two-monthly basis). The independent reports seemed to overlap with many of the matters involving the partnering group, but represented only one person’s interpretation of these issues.*

Furthermore, although on this project the person who fulfilled this role did so very capably, in other hands it could have been quite a different matter. This is a potentially highly political role to be left in the hands of a one person.

36. Notification of Commencement of Work

... 48 hours notice prior to commencement of work ...

A condition of consent for the *Makarora* bridge widening project was that the local DOC field centre should be notified 48 hours before any work is undertaken. This condition derives from a Department of Conservation request (referred to in the AEE for the project) that an on-site meeting between the Contractor, Transit New Zealand and DOC representatives should be held before commencement of any work.

Consent conditions for the *Twizel Bridge* widening project also included a condition requiring notification of the regional council at least 2 working days before the commencement of work, as well as notification at least 2 working days after the works are completed.

... 2 weeks prior notice of commencement of work ...

For the *Kuaotunu* seal extension project, notification of the start of construction was required to be given to the regional council two weeks before commencement of work.

Feedback

This condition, it seems, is often overlooked. With two weeks to go on a project the contractor is usually focussed on other things, and may be still unsure of the exact start date for the commencement of physical works so far out from the beginning of the job. It is nevertheless not considered unreasonable that the council should be provided with prior notice of the commencement of work, although a full two weeks notice may be overly optimistic.

... notification when work is "about to start" ...

In consents for the *Glenhope* project it was a condition that the council Consent Planner should be "notified when work is about to start".

Appendix 1 : List of Case Studies

The findings in this investigation of environmental protection measures on state highway roading projects have been drawn from a review of the following case studies:

Arahura to Kaihinu Realignment (SH6) *Hokitika*
Belmont Road Realignment (SH58) *Wellington*
Bluff Creek Realignment (SH73) *Arthur's Pass*
Butts Road Realignment (SH1) *South Otago*
Craigieburn Stream Bridges & Approaches (SH73) *Arthur's Pass*
Eland to Glengarry Realignment (SH5) *Hawkes Bay*
Glenhope to Kawatiri Realignment (SH6) *Murchison*
Goodwood Realignment (SH1) *Coastal Otago*
Gorge Creek Realignment (SH8) *Central Otago*
Hawkswood Deviation (SH1) *Cheviot*
Homer Tunnel Portal to Murrells Bridge Realignment (SH94) *Milford*
Kuaotunu Hill Seal Extension (SH25) *Coromandel*
Laws Hill Realignment (SH57) *Manawatu*
Maisey's Road to Trafalgar Road Deviation & Widening (SH60) *Nelson*
Makarora Bridge Widening Works (SH6) *Haast Pass*
McArthur's Bend Realignment (SH1) *Dunedin*
Ngutukaka Realignment (SH1) *Coastal Otago*
North of Kaimatira Road Realignment (SH4) *Wanganui*
Oakmere Realignment (SH5) *Hawkes Bay*
Orewa Bridge Replacement (SH1) *Auckland*
Otira Viaduct (SH73) *Arthur's Pass*
Pokeno Bypass (SH1) *Pokeno*
Potts Hill Realignment (SH57) *Manawatu*
Puhoi Bridge Realignment (SH1) *North of Auckland*
Pukerua Bay to Plimmerton SH1 Rural Upgrade (SH1) *Wellington*
Rosebank & Patiki Interchange (SH16) *Auckland*
Silverstream 4-laning (SH2) *Wellington*
South of Shannon Realignment (SH57) *Manawatu*
Spiral Hill Realignment (SH4) *Central North Island*
Stoke Bypass (SH6) *Nelson*
Thames Coast Coastal Protection Works (SH25) *Thames Coast*
Twizel River Bridge Widening (SH8) *Twizel*
Waimate Realignments (SH1) *Waimate*
Whangamoia North Deviation (SH6) *Nelson*
White Bridge & Approaches Reconstruction (SH73) *Arthur's Pass*

