Environmental Protection Measures on NZ State Highway Roading Projects
Volume 2: Key Issues & Observations from the Study

Transfund New Zealand Research Report No. 225

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Contents

Executive Summary

This project, *Environmental Protection Measures on New Zealand State Highway Roading 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 roading projects in the future. The fact is that the majority of issues that are encountered when dealing with roading 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 underestimated so that on future roading projects these impacts can be better anticipated.

The study was carried out in 2001 and is based on a sample of 35 state highway roading 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.

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 roading. 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.

This Volume 2 report highlights significant issues and observations from the study. The aim of this volume 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 Volume 2 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 this 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 Roading 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 roading 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 roading 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 roading 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 roading projects is currently conducted.

1. Introduction

This is Volume 2 of *Environmental Protection Measures on New Zealand State Highway Roading Projects* (Transfund New Zealand Research Reports No. 224, 225), containing a summary of key issues and observations from a review of environmental controls on a sample of 35 past and present state highway roading projects.

This volume has been prepared to accompany the main report, which is a reference guide to past practice (Volume 1, Transfund New Zealand Research Report No. 224). The objective of the report is to draw out key observations from the study 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 – either to reduce potential impacts on the environment or to reduce the adverse side-effects of existing environmental controls.

The results of the study have been drawn from historical file records, site visits and interviews with people originally involved in the construction phase of each project (either as road-builders, regulators or affected property owners) to find out how these environmental controls are working out in practice.

The study has found many useful examples of good environmental management practice (as detailed in Volume 1). There are also, however, some areas where the results of the study suggest that practice could potentially be improved. These areas are the focus of this Volume 2 report.

The report identifies specific areas where investigations for the study have indicated that problems are still occurring from time to time on roading projects and where further action may be needed by Transit New Zealand to avoid, remedy, or mitigate adverse environmental effects. Also identified are issues relating to the use of certain environmental control measures (imposed on roading projects either as consent conditions or as mitigation measures in assessments of environmental effect (AEE)). Feedback from the study suggests that some of these controls may not actually be working or may be imposing a high cost on construction activities in exchange for relatively little environmental return. Further research is required in these areas.

2. Key Issues & Observations from the Study

2.1 Conditions Setting Suspended Sediment Limits

Summary: *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.*

Discussion: A condition that is widely applied to resource consents for roading works is the requirement that suspended sediment levels or change in water clarity downstream of a construction site should not exceed a specified level. A typical condition is that suspended sediment shall not increase by more than $50g/m^3$ or $100g/m^3$, or that water clarity downstream of the site shall not be reduced by more than 33% or by more than 50%.

This kind of condition would normally be expected to work well under the Resource Management Act (RMA) in that it sets clear parameters and appears to be effects-based. With this condition the person conducting the activity (the earthmoving contractor) has the freedom to choose the most appropriate methods of sediment control for the circumstances, as long as the prescribed suspended sediment limits are achieved.

Theoretically, this approach should work well. But from interviews with both contractors and regional council monitoring staff, it appears that there are a number of significant problems with the implementation of this kind of condition.

The first problem is to obtain reliable measurements. It is often difficult to work out how, when and where these downstream water samples should be taken. Suspended sediment does not always rapidly disperse across the width of a stream to give a consistent concentration. Rather it may be far more visibly concentrated on one side than the other. The location of the sampling point will therefore affect the result.

Results can also vary markedly depending on the earthmoving work that is being done on the day and on the state of the weather. If it is raining or has recently rained, then the suspended sediment levels could be a magnitude of difference higher than those immediately before. For monitoring purposes, therefore, comparing one set of weekly or even daily or hourly results with the next may be practically impossible. In fact, the results will say more about changes in the weather than the standard of sediment control on site.

Whether a sample with a high reading is actually indicative of a significant adverse effect on the waterway can also be uncertain. The limits of $50g/m^3$ or $100g/m^3$ of suspended sediment (as commonly used in consent conditions) will not necessarily be relevant to all rivers and streams. Whether or not a stream is affected by this kind of increase in suspended sediment will depend on the existing characteristics of the waterway in question (i.e. its normal clarity, fauna, flora, and propensity to flood). Levels that are harmful to one stream may not be significantly harmful to another.

Most important, however, is the question of what should then happen if a high suspended sediment reading is recorded. These readings are taken to indicate that there are deficiencies in the standard of sediment control on the construction project. But they can give no indication of what *specifically* is wrong with the sediment controls, or what should be done by the contractor to put them right (for example whether a particular settling pond is not up to standard, or that more silt screens are required at a certain point).

In practical terms the contractor may not be able to do much more to improve sediment controls on the site. In this situation, if no one can actually point to a failure in the control measures, then little if anything is actually gained from continuing with the measurement of downstream suspended sediment levels.

The reality is that it is not unusual for the limits of $50g/m^3$ or $100g/m^3$ to be exceeded on a road construction project (sometimes by orders of magnitude). On several of the projects investigated it was known or strongly suspected that this had been the case. Yet on each of these projects, as regional council enforcement staff confirmed, all reasonable precautions were being taken to minimise the loss of sediment from the site. Nothing more could have practically been done about it, even though, technically speaking, the project was in breach of a condition of consent.

That contractors are not regularly prosecuted for breaching this type of condition is more a reflection of the fact that the condition is often not actually monitored or that, when monitored, a reasonably pragmatic approach is taken by the enforcement agency.

Because of these difficulties many of the people interviewed for this study, both from regulatory agencies and within the roading industry, have suggested that the use of this type of condition should be reviewed. In its place it is proposed that sediment control should be judged not on the basis of downstream suspended sediment levels but rather in terms of the design and maintenance of actual physical sediment containment measures on site. These are things that the contractor actually has control of and which, when measured against a pre-agreed sediment control plan, he or she can be realistically held accountable for.

2.2 A Greater Role for Sediment Control Plans

Summary: *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).*

Discussion: There is scope for the greater use of sediment control plans as a regulatory alternative to detailed sediment-related conditions of consent. This kind of approach is already being used to an extent by some regional authorities, and has the potential to be more widely developed.

The aim is to minimise reliance on detailed resource consent conditions for the control of sediment and instead to deal with these controls in a separate and all-inclusive management plan. Under this scenario the resource consent would only require all work to be "undertaken in accordance with an approved sediment management plan" – with no other sediment related consent conditions needing to apply.

This one condition (requiring an approved management plan) means that the management plan is enforceable under the RMA but also that the details of the plan can be subject to change.

The ability to change the plan means that the contractor, working with council land management and compliance staff, is able to respond rapidly and in innovative ways to changing sediment situations on the ground. The same is not possible where the methods to be used for sediment control have been spelt out as conditions of resource consent. In this latter situation a more cumbersome legal process is required to bring about a change of conditions.

On a complex modern roading project this kind of change to the sediment control strategy may be required on a weekly or even daily basis. It is also not unusual to find that methods proposed before the commencement of construction of a project turn out to be impractical or ineffective in the field. In these situations the ability to switch to other methods is useful.

Another way to achieve this kind of flexibility is to apply very general sediment control conditions. Examples here are consent conditions that include requirements such as that the work should be undertaken "in accordance with good earthmoving practice". These types of conditions leave it open to the contractor to decide on the best methods to be used for sediment control. Such conditions are, however, very difficult to enforce if the contractor is not performing to a reasonable standard. Good and bad earthmoving practices come down to a matter of opinion.

The other alternative, which also allows flexibility, is to require construction works to achieve minimum performance standards for suspended sediment in adjacent streams. The idea is to leave the contractor to decide on the methods, as long as he/she complies with the suspended sediment limits. This approach is sound in principle but (as discussed in the preceding Section 2.1) has some serious problems with implementation. There are, in particular, issues with the accurate measurement of compliance, the meaning and relevance of the limits, and the fact that full compliance can at times be practically beyond the contractor's control.

Sediment control plans, on the other hand, concentrate on what it is that the contractor will physically do on the site to control sediment, which are things that the contractor has full control over and that he or she can actually be held completely accountable for.

Sediment control plans are not new. They are usually a standard requirement for all major state highway roading projects in New Zealand. But in most cases they are regarded as only a supplement to other over-riding controls imposed through the resource consent. The function of the plan in these cases is to ensure that the contractor has planned out his/her sediment controls before starting on the site, and that the sediment control conditions included in the resource consents have been incorporated in the plan. They therefore typically occupy only a second tier in the overall management of sediment issues on a construction site, and for this reason are often not treated very seriously by the contractor. The focus remains instead on the consent conditions with which the contractor is specifically required to comply.

The difference with the process proposed here is that the sediment control plan should become in effect the main regulatory document for sediment control – with compliance measured exclusively in terms of doing or not doing the sediment control actions that the plan describes.

For such a process to work, it does however require appropriate systems of control and accountability. It also demands a greater degree of effort to be put in to the preparation and maintenance of sediment control plans, compared with the way that these documents have mostly been drawn up in the past.

Fundamental to this process is the need for the plan, and any changes to it, to gain prior approval from delegated regional council staff. It also requires that the preparation of the plan should begin at an early stage, ideally in conjunction with the preparation of consent applications, or at least during the stage of detailed design. This is appropriate if the plan is to effectively replace detailed sediment control conditions in the project's resource consents.

A high quality of sediment control plan is now possible with the help of best practice guidelines such as the Auckland Regional Council document TP90 (*Erosion & Sediment Control: Guidelines for Land Disturbing Activities*, ARC Technical Publication No.90, March 1999)

It is envisaged that the initial sediment control plan would be handed on to the successful contractor who would then have the opportunity to seek changes to it according to his/her own ideas and strategy for construction of the project, but subject nevertheless to these changes being accepted by delegated council staff.

Regional council staff interviewed for this study commented that earlier input from them, in the design of sediment controls on roading projects, would have advantages for both their own interests and those of the road builder. Land management staff often have considerable local knowledge to offer and will also be able to indicate (at an earlier rather than later stage) the types of sediment controls that they, as agents of the regulatory authority, believe the site will require.

An initial sediment control plan prepared early in the process would also have the advantage of indicating to tenderers the types and scale of sediment control works anticipated for the project. Contractors interviewed for this study have commented on the difficulty they have in pricing jobs where the type and scale of sediment control that will be required is unclear. On some modern roading projects this can be a significant area of cost.

It needs to be emphasised, however, that if management plans for sediment control are to be prepared at this early stage in a project they must be kept open to future amendment, both leading up to and during the construction phase.

Changes to the management plan could be dealt with through the partnering process as currently employed by Transit New Zealand on larger roading works. Partnering is already being successfully used in an informal way to deal with sediment control issues. The proposed approach would formalise this kind of arrangement, with the ultimate approval of on-going changes to the sediment management strategy being at the discretion of a delegated council officer.

2.3 Controls Limiting the Area of 'Opened Ground'

Summary: *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.*

Discussion: As a way of minimising exposure to surface erosion, some regional authorities are requiring that earthmoving projects should be limited in the amount of ground that they can have opened up at any one time. A project may be limited, for example, to a maximum of 4 or 8 hectares of opened ground. The intention is to ensure that if a storm passes over the site the overall erosive impact of the storm will be limited. Clearly the more bare ground that is exposed the greater is the potential for erosion.

Several of the contractors interviewed for the present study were however critical of this restriction. Their concern is that the restriction can have an impact on the amount of earthwork able to be completed within the construction period, and the cost implications of this. Their argument is that the increased costs are not balanced by an equivalent increase in benefits to the environment.

With any earthmoving project the ground must first be laid open for a while so that it can dry, because wet earth cannot be used as a fill material. "Opening up" the ground involves stripping away the grass cover and discing the soil. The ground is then left to dry out in the air and sun until it is in a satisfactory condition for excavating. If rain threatens during this drying period, the ground will be rolled flat again to repel rainwater, then disced again once the rain has passed so that the drying may continue.

Conditions for drying will vary during the course of the year. During the winter period (roughly May–August), drying will be practically impossible so at this time most construction sites will completely close down. Then, from about September onwards, the number of days when drying is possible will start to increase. The optimum drying, and therefore optimum earthmoving period, is usually from December through to February, with the peak in February. This is when the bulk of the earthmoving is normally done.

The overall efficiency of this work will obviously be affected, however, if the contractor is limited in the amount of ground that can be opened. This effect applies particularly in the prime earthmoving period from December to February.

Restrictions imposed at this time of the year will prevent full use from being made of these optimal summer conditions.

This kind of impact on the efficiency of the earthmoving work will also have a financial cost. On recent (year 2000) stages of the Albany-Puhoi (Alpurt) motorway project in Auckland, for example, restrictions on the opening of new ground were calculated to be directly responsible for an extra $2million being added to the overall cost of the job.

Delays caused to key sections of the Alpurt project are reported to have resulted in significant liquidated damages being imposed on the contractor. Furthermore, at least one major contracting firm is also known to have declined to tender for work on this particular project specifically because of the anticipated financial risk associated with the 'limit on opened ground' condition.

Apart from costs, some respondents also questioned whether in fact these open ground restrictions are actually making a significant difference to the amount of sediment that is likely to escape from an earthmoving site. They argue that other sediment controls on their own (silt ponds, etc.) should be sufficient. Some also claim that the effect of the restriction may actually be to increase rather than decrease the total loss of sediment.

The argument here is that, by limiting the amount of ground that can be opened and dried during the main summer period, a greater proportion of the total amount of ground must be dried out at other less optimal times when the rate of drying is slower. The effect of this slower drying is that the average amount of time taken for the ground to dry out *per hectare* will be longer for the project as a whole than if full use was able to be made of the mid-summer period.

It might, for example, take 20% longer on average for each hectare of ground to dry out if a greater proportion of the total area of land has to be opened and dried outside the main summer earthmoving period. If so this would mean that, on average, all of the land in the construction site will be correspondingly potentially exposed to erosion for 20% longer. Spread out over the whole construction period this would presumably translate, again on average, to a probability of 20% more erosion from the site.

The argument therefore is that even though the restriction would mean less erosion per storm event, the total amount of erosion over the lifetime of the construction project would be the same as or more than if the restriction had not been in place.

These may be valid arguments. In any case it is clearly important that further research work should be directed at these controls. The potential cost implications of this restriction, as occurred at Alpurt, are such that there must be absolute certainty and confidence in value of these controls if they are to continue to be used in their present form. Other forms of restriction (for example relating the permitted area of opened ground to the availability of machinery) may be more appropriate.

2.4 Restrictions on the Timing of the Construction Season

Summary: *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.*

Discussion: In some regions restrictions are applied to earthmoving activity over the winter months. Conditions will require, for example, that earthworks should not be carried out between 1st of June to the 30th of September in a given year. The aim is to ensure that earthmoving machinery is kept off the site while the ground is wet and liable to be churned up in to erodible mud.

In most circumstances this restriction is not an issue because earthmoving sites will typically close down anyway over the winter months as the ground gets too difficult to work. The same is not true, however, of the occasional summer where unusually dry weather conditions make it possible for an earlier start or later finish to the season. In this case a fixed start or finish date will mean that machinery that would otherwise be operating may have to be stood down. This can incur significant opportunity costs on the contractor.

These costs are estimated at between $500 and $1,500 per item of machinery per day (depending on the type and size of machine). This means for example that on a project where, say, 5 earthmoving machines are being used and these are held back from work for a period of, say, 4 weeks, then an opportunity cost of approximately $150,000 will be incurred (assuming an average cost of $1000 per machine per day).

In a "worst case" scenario, the restriction could also potentially mean that work that would otherwise have been able to be completed within one construction season is forced over in to a second year. This would have significant financial implications for the contractor, meaning an extra winter close-down (with associated costs) and the tying up of machinery that could have been put on to other projects at the start of the new season.

Some of the contractors interviewed for this study were critical of these restrictions, claiming that they incur costs on a project for little or no environmental gain. Their argument is that if ground conditions are too wet then work will stop as earthmoving becomes impractical anyway, meaning that the process should be self-regulating.

Pre-determined dates, they argue, can only approximate the timing of the arrival of unworkable conditions.

However, the concern of the regional councils is that contractors may be tempted to push the boundaries and work well in to periods when the ground conditions are marginal. Council staff interviewed for this study claimed that there have been previous instances where this has occurred. What the restriction does is give the council the opportunity and authority to intervene and enforce, if necessary, the closure of the site if conditions are deemed to be unsuitable. It can also provide the opportunity for additional sediment control measures to be applied to the project as a pre-condition to granting a period of extension.

Unfortunately, without more detailed research it is impossible to know specifically what difference such restrictions are making to the overall standard of sediment control on earthwork projects. Further empirical research is required.

In the meantime, however, a great deal rests on the way that these conditions are administered by the relevant councils. At least one contractor interviewed said that, while he had some reservations about this type of condition, he had generally found that the restrictions were pragmatically handled by the local regional council (in this case Auckland Regional Council). The key to this was the council's willingness to provide an extension of time if weather and ground conditions appeared favourable, and its usually prompt turn-around time for such applications. This kind of pragmatism and flexibility was seen as essential to the administration of this type of control.

2.5 Restrictions on Earthwork During the Spawning Season

Summary: *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.*

Discussion: Resource consent conditions for roading projects will often include a condition restricting the timing of earthworks to avoid the trout spawning season. The concern here is that sediment generated from the work will interfere with the spawning (mostly because it will settle on the bed of the spawning stream where trout eggs have been laid, and will suffocate the eggs by clogging up the pores where water flows between the gravels). Conditions will therefore typically require that there should be either no channel work, or no construction work at all, during this period.

There are, however, some issues with the use of this restriction. One of the more obvious is the lack of a common consensus on what actually defines the "spawning season" for trout. In the review of case studies for this investigation the season was variously described as starting at any time between April and August and finishing anywhere from September through to November. Only the interval from August to September was commonly agreed as being part of the season.

The range of definitions reflects the fact that the start and end of the spawning season is never particularly clear-cut. The main run will typically occur around August–September (depending on prevailing river conditions), but lesser spawning activity will still happen either side of this for a period of months. How much of this other spawning activity is significant enough to be included in the definition of the "spawning season" comes down to a matter of personal interpretation.

The issue is that the definition thereby given to the spawning season will have direct implications for any road construction activity that is restricted by the timing of the season. Clearly, if work that could otherwise have been done at this time is prevented from happening, a cost will be incurred.

The cost impact will depend on whether the restriction applies to all or just part of the construction project. If, for example, only channel work is affected then this can often be separately programmed without major disruption to the project as a whole.

However, if all work is required to stop at this time, then the cost impact can be more significant. The cost of standing down machinery is in the order of $500 to $1500 per item of machinery per day.

With these types of cost involved it would be useful for the trout spawning season to be more accurately defined.

Also useful to know more specifically would be the benefits that are actually gained from these controls. Restrictions on earthmoving and construction work during the spawning season have historically been used as a ‘precautionary’ measure based on general principles of effect. There is, however, insufficient knowledge of the actual likelihood of sediment damage to spawning beds in the context of earthmoving activities associated with different scales of roading projects. It is possible but still unclear whether such projects would be likely to actually generate sufficient sediment to cause a smothering of the beds. If they do not, then the question needs to be asked whether the spawning season should be treated any differently to other times of the year. Effects on the trout fishery are not limited only to this season.

2.6 Stormwater Treatment Devices

Summary: *Stormwater treatment devices (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.*

Discussion: Conditions requiring the installation of stormwater treatment devices for the collection of sediment and oil in stormwater run-off from the finished road were applied to 4 of the 35 projects reviewed in this study. These "treatment devices" have usually been some form of grit and oil trap. On the Rosebank/Patiki Interchange project in Auckland for example, two very large (20m x 2m x 2.1m, or $84m^3$) settling tanks were installed for this purpose, although in most other cases the grit and oil traps would normally have a capacity of about $1m^3$ to $4m^3$.

A recent study commissioned by Transit New Zealand[1] shows that the very large tanks installed on the Rosebank project are indeed working to some degree. The study shows, from samples taken at the inlet and outlet to the tanks, that a partial removal of contaminants (suspended solids, total PAH [polycyclic aromatic hydrocarbons], copper, lead and zinc) is being achieved. Exact rates of removal varied between samples and between different contaminants but were typically given in the order of 30% to 40%.

Less is known about the performance of the much smaller treatment devices (those with a capacity between $1m^3$ and $4m^3$) used on other projects reviewed in this study such as those installed at Pukerua Bay SH1 Rural Section Upgrade and the White Bridge project on the Arthur's Pass road. These are less than 5% of the size of the $84m^3$ sumps installed at Rosebank and will therefore be correspondingly less effective in the capture and retention of stormwater contaminants. Smaller sumps mean shorter retention time and a greater re-suspension of settled materials.

However, if a direct relationship is assumed between sump capacity and contaminant removal, then the amount of contaminant collected from stormwater by the Pukerua Bay and White Bridge treatment devices would be in the order of 2% of the total (calculated as 5% of the 30% - 40% removed using $84m^3$ sumps).

While this is only a very rough calculation it serves to illustrate the point that smaller sumps may not actually be making any significant difference to stormwater quality. If indeed only 2% of contaminants are being removed then it raises the question of whether these devices are worth having at all.

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[1] Larcombe, M. April 2001. *Auckland Northwestern Motorway: Efficiency of stormwater treatment tanks at Rosebank and Patiki Interchanges*. Report to Serco Consultancy. 27pp.

Furthermore, the treatment devices in question are often only installed as part of an isolated one-off highway improvement project. Those installed at White Bridge, Pukerua Bay and Rosebank for example are all flanked on either side by long sections of highway where otherwise no such devices are in place. Therefore while contaminants may be captured at the project site, the stormwater from the rest of the highway and from other surrounding sources will continue to flow unimpeded into the receiving waters. It is uncertain therefore whether any significant difference is likely to be made to the water quality of the wider catchment.

Nevertheless, the lack of knowledge of the actual effectiveness of stormwater treatment devices is not preventing the installation of these devices from being a requirement on some roading projects as conditions of resource consent.

This is a concern, given that the cost of installation of the four tanks at Rosebank was in the order of $45,000 each (a total of $180,000), while those on the Pukerua Bay project are estimated to have been installed at a total cost of about $2,000 each. Whether any significant environmental gain has been made from this expenditure still remains to be seen.

This is clearly an area for further research. Field tests are required to establish whether existing stormwater treatment units are actually making a significant difference to the quality of stormwater discharge, and the extent to which any such improvements are significant in terms of the quality of water in the catchment as a whole. This research needs to be undertaken before any further units are installed.

2.7 Management of Dust Impacts

Summary: *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.*

Discussion: Dust can be a significant problem on road construction projects, causing both nuisance effects and physical damage to crops, commercial activities, people and livestock. In one of the cases investigated for this study the cost of dust damage (to a hydroponic lettuce-growing operation) was valued at about NZ$100,000.

Unfortunately very few methods are available for dust control. Water spraying (either from a water cart or fixed overhead sprayers) is more or less the extent of current technology, but can be ineffective in very hot dry conditions. Chemical suppressants have also been used from time to time but are mostly unsuitable for use in places where heavy machinery is operating (in that they can not be used in places where most of the dust is actually generated). Previous research[2] has highlighted a need for further work in this area.

With these technical limitations it is not surprising, therefore, that the AEEs (Assessments for Effects on Environment) for roading projects usually have little to say on the subject of dust. Impact assessors appear to have little or no idea of what else to do other than to spray the ground with water. Furthermore, few seem to know (or to even consider) what should then be done if water spraying does not work. Should there be some kind of clean-up? And if so, then at what point would a clean-up be required? Further research and guidance from Transit New Zealand would be useful in these areas to improve the standard of dust management planning for state highway projects. Alternative methods of dust control, methods for assessing dust impact and protocols and procedures for the clean-up of dust associated with roading projects need to be examined.

Work recently completed by the Ministry for the Environment[3] (MfE) on guidelines for dust management is likely to be helpful as a starting-point for the development of similar protocols for Transit New Zealand.

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[2] Bartley Consultants, 1995. Effects of dust palliatives on unsealed roads in New Zealand. *Transit New Zealand Research Project No.38, 132p.*

[3] Ministry for the Environment, 2001. Good practice guide for assessing and managing the environmental effects of dust emissions. 58p.

2.8 Land Reparation Issues & Dealings with Landowners

Summary: *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.*

Discussion: Interviews have been conducted with farmers whose properties were affected by some of the state highway roading projects that have been investigated for this study. Several of these farmers were critical of the standard of post-construction restoration work on their land. Of particular note was the quality of fencing, topsoiling and/or re-grassing. In some cases these problems, and the conflicts that arose from dealing with them, had caused considerable stress for the landowner and seriously affected their attitude toward co-operation on future roading projects.

Typical fencing issues included the quality of workmanship and the standard of materials used, or problems with crooked fence-lines, loose battens, un-anchored strainer posts; the use of staple-gun staples to hold batten wires; and lower grade materials being used to replace previously high quality fences.

Typical complaints in relation to topsoil were that the quality and/or depth of the topsoil had not been up to standard, in that the soil contained wire, stumps, rocks and other rubbish, or that the soil was not really 'topsoil'' at all.

Problems reported with re-grassing included unseasonal sowing of grass seed (meaning the grass did not survive well), poor quality seed, poor choice of seed varieties, inadequate ground preparation, inclusion of weeds in the seed supply and/or lack of fertiliser to get the seed started.

Other problems were also reported by farmers (drainage and landscaping issues for example), but fencing, topsoiling and re-grassing were the most common themes.

This feedback indicates that there are areas for improvement in regard to land restoration on future roading projects. It suggests that tighter control should be imposed on (in particular) the drafting of specifications for fencing, topsoiling and re-grassing. But above all it points to the importance of ensuring that well-developed systems of communication are established between the road-builders and the affected landowners to ensure that the work is done in sympathy with farmers' needs.

Investigations suggest that later conflict is much less likely to occur if such consultation processes are in place.

This comment on the importance of consultation is supported by feedback from practically all of the farmers who had complained about the standard of restoration of their land. Almost invariably the main cause of the problem was attributed to a lack of communication, where decisions on fencing etc. had been made without prior reference to the landowner. The problems thereby created would often be compounded by the fact that no one could be found by the farmer (because there was no communication system) to put the matter right. Three or four farmers interviewed gave accounts of having been sent back and forth between the various contractors, subcontractors and engineers, trying unsuccessfully to find out who was ultimately in charge.

It is significant to note, therefore, that these problems were almost entirely restricted to projects where no 'partnering' consultation process had been established (either because the projects concerned pre-dated partnering or because, as small projects, partnering was not specifically required). Yet, had partnering been used on these projects, the same problems would probably not have occurred. This conclusion is supported by an almost entire absence of conflict with landowners where partnering had been used on the projects studied. Indeed, the farmers and other parties involved in these projects often commented specifically on the value of the partnering process, and the success of the process in averting problems that they believe would otherwise have occurred.

The success of partnering in these situations suggests that there may be a case for facilitating the greater use of partnering in some form on smaller projects. It is only mandatory at present on projects over NZ$3million[4] in value, whereas on smaller projects (<NZ$3m) it remains optional. The greater use of partnering on these projects would be encouraged by developing a partnering process that was more easily adapted to small scale projects.

[4] All monetary values are in NZ dollars (as at 2001).

2.9 Timing of Re-grassing

Summary: *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".*

Discussion: A comparatively minor condition, but one that has caused some difficulty and unnecessary cost on a few construction projects, is the requirement that, for erosion control purposes, finished earthworks are to be "immediately re-grassed".

Where this requirement has been strictly observed, problems with the survival of the grass have sometimes occurred because conditions at the time are simply too dry for grass seedlings. Contractors will put the seed on, as they are required and paid to do, but in the knowledge that in the middle of the summer construction season the grass will probably die.

Grassing with hydroseed costs in the order of 50 cents per square metre. This equates to $1,000 for the cost of grassing an embankment about 200m long by 10m high. This resource is wasted if it is required to be applied at a time when the grass will not survive.

2.10 Simplification of Resource Consents

Summary: *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.*

Discussion: The size and complexity of resource consent conditions has been increasing in recent years. Resource consents that would have once been limited to a single sheet can now run in to tens of pages and dozens of conditions of consent. The sheer number of conditions on some projects makes it a major exercise to fully comprehend what is required. This is a problem in particular for the contractor who is responsible for putting the conditions in to effect.

The complexity of consents is often compounded, however, by the fact that on larger projects several different consents are likely to be required to cover the full range of construction activities. The usual legal convention is for these consents to be issued as separate documents, each with its own set of standard and special conditions. But in producing so many separate consent documents there is invariably repetition, overlap, and sometimes contradiction between the conditions of the various resource consents.

The result can be an unnecessarily large and complex mass of paperwork for the contractor and all other parties to deal with. This is not in the interests of easy comprehension and the smooth administration of conditions of consent.

Where multiple consents are involved, the preference would be for councils to produce the associated conditions as a single comprehensive list. This is the approach taken for example by Nelson City Council and (subject to legal verification) could presumably be used by councils elsewhere.

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*
Whangamoa North Deviation (SH6) *Nelson*
White Bridge & Approaches Reconstruction (SH73) *Arthur's Pass*