

Te Ahu a Turanga; Manawatū Tararua Highway Erosion and Sediment Control Plan

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- Appendix 7 – Hazardous Substances Procedure
- Appendix 8 – Minor Changes to Management Plan Register

1 Introduction

This Erosion and Sediment Control Plan (ESCP) provides the overarching erosion and sediment control (ESC) principles and procedures for the construction of Te Ahu A Turanga; Manawatū Tararua Highway (the Project). It is to be read in conjunction with the following appended procedures and is to be updated on receipt of resource consents for the Project to ensure consistency with consent conditions:

- Appendix 1 – Chemical Treatment Management Plan (CTMP)
- Appendix 2 – Erosion and Sediment Control Monitoring Plan (ESCMP)
- Appendix 3 – Dust Control Procedure
- Appendix 4 – Dewatering Management Procedure
- Appendix 5 – Emergency Spill Response Procedure
- Appendix 6 – Stream Works procedures
- Appendix 7 – Hazardous Substances Procedure
- Appendix 8 – Minor Changes to Management Plan Register

1.1 Project Description

The Project comprises the construction of an approximately 11.5km four lane highway along a greenfields route between State Highway 57 (SH57) east of Ashhurst to State Highway 3 (SH3) west of Woodville. It incorporates a new bridge across the Manawatū River at the western end of the Manawatū Gorge.

Earthworks is proposed over approximately 195ha (calculated as a worst-case earthworks area) as follows:

- Bulk structural cut to structural fill of approximately 4,600,000m³; and
- Cut to waste, disposal of surplus material (undercut and unsuitable) of approximately 1,200,000m³.

Of the 195ha of total earthworks, on an aerial basis approximately 30% is expected to occur within the Mangamanaia stream catchment and 66% within the tributary streams that discharge direct to the Manawatū River, noting that the Mangamanaia flows to the Manawatū River upstream of the Manawatū Gorge. A small area (approximately 7.78ha, 4%) will fall into the catchment of the Pohangina River which in turn flows to the Manawatū River.

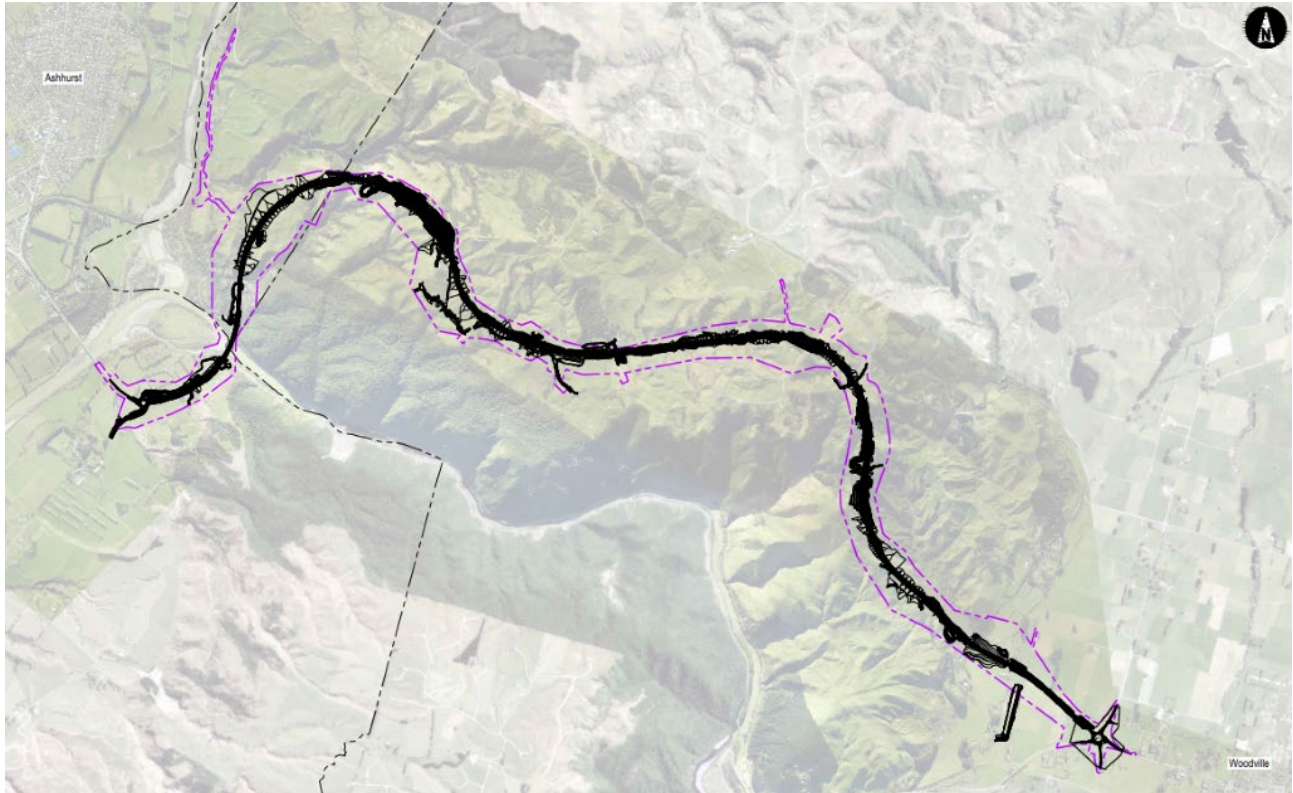


Figure 1 Project Location (proposed designation and Alignment)

2 Regulatory Framework

Earthworks covered by this ESCP are limited to those authorised by resource consent(s) granted to the New Zealand Transport Agency (the Transport Agency) by Horizons Regional Council (Horizons) and the corresponding designations to be included in the Palmerston North District Plan, the Manawatū District Plan and the Tararua District Plan, as listed in Table 1 below.

Table 1 RMA Authorisations

Designation No Consent No	Authority	Activity Authorised	Status
	Palmerston North City Council	To be completed	Appeal
	Manawatū District Council	To be completed	Appeal
	Tararua District Council	To be completed	Appeal
RC	Horizons Regional Council	To be completed	To be lodged

3 Erosion and Sediment Management Team

3.1 Structure

The earthworks operations will be split into the following four management zones:

Zone 1	CH2840 to CH 3900
Zone 2	CH 3900 to CH 7100
Zone 3	CH 7100 to CH 9565
Zone 4	CH 9565 to CH 13800

Each Zone will have a Zone Manager, Project Engineer, Site Engineer and Site Supervisor. The Project Engineer will have direct day to day responsibility for the operation and maintenance of the earthworks and ESC within their zone and will be supported and advised by the Environmental Management Team.

The Environmental Management Team structure is provided in Figure 2 below, comprising the Environmental Manager, supported by an Environmental Technical Specialist, Environmental Coordinator, Environmental Supervisor, ESC Foremen and ESC Labourers. The ESC measures will be supervised by the Environmental Manager together with the Earthworks Manager.

The Environmental Manager will be responsible for ensuring that the Site-Specific Erosion and Sediment Control Plans (SSESCPs) are prepared in accordance with the GD05 and this ESCP.

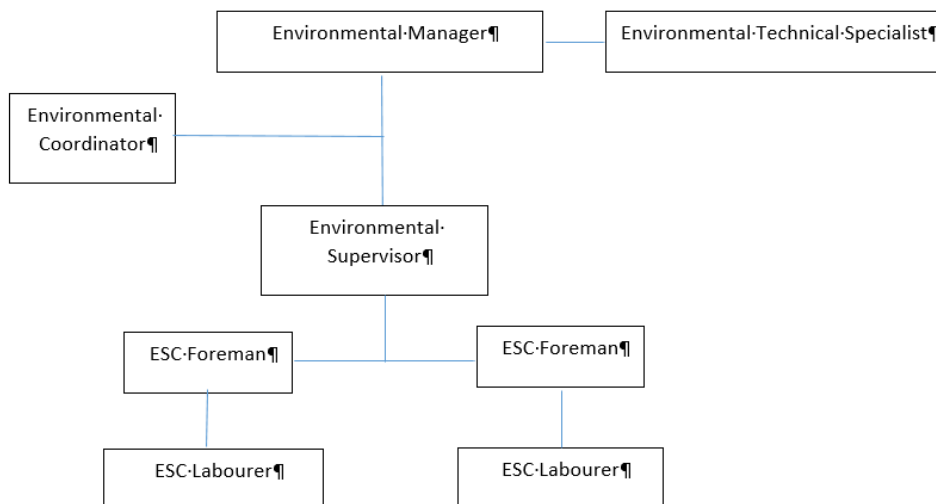


Figure 2 Erosion and Sediment Control Team Structure

The Earthworks Manager will have overall responsibility of ensuring that the SSESCPs are complied with in terms of site operations, but with installation and management of the devices being undertaken by the ESC Foremen and Labourers, under the direction of the Environmental Supervisor and management of the Environmental Manager.

A current and approved copy of all the SSESCEPs will be on site and a copy will be held with the relevant Construction Zone Managers at all times.

The Environmental Technical Specialist will prepare SSESCEPs and provide all technical specialist input into ESC management.

The Environmental Supervisor will maintain daily on-the-ground supervision of the ESC measures across the Project, supported by the ESC Foremen and Labourers, and construction teams.

3.2 Key Environmental Management Roles

3.2.1 Environmental Manager

The Environmental Manager will have overall management responsibility for all environmental management aspects of the Project. Ms Lorraine Pennington sits in that role and has held the same position for the successful delivery of the Huntly Bypass section of the Waikato Expressway, working closely with Campbell Stewart. Lorraine has previously been the Earthworks Co-ordinator and Monitoring Officer for the Waikato Regional Council.

Lorraine has a Bachelor of Applied Science (Environment Major) from the Open Polytechnic of New Zealand (2012) and has 14 years' experience working in the environmental compliance fields of local government throughout the Waikato.

Lorraine has worked for the Fulton Hogan|HEB Joint Venture on the Huntly section for the past two years and is very familiar with the environmental management systems of both companies.

3.2.2 Environmental Technical Specialist

The Environmental Technical Specialist will be the lead advisor in all ESC design, construction, maintenance and monitoring. SouthernSkies Environmental Limited (SouthernSkies) will fill the technical specialist role, led by Campbell Stewart. Mr Stewart held the same role for the Huntly Section project, and in numerous other Transport Agency projects throughout New Zealand. SouthernSkies personnel who are currently Certified Professionals in Erosion and Sediment Control (CPESC) will fulfill the "appropriately experienced and qualified professional" role in all design and certification of ESC devices.

3.2.3 Environmental Coordinator

TBC – this person will have the responsibility of liaising and working closely with the ecologists onsite so as to ensure that there is compliance with the relevant conditions of resource consents and compliance with any ecological management plans. They will also need to liaise and work closely with the Department of Conservation in relation to wildlife permits, and iwi and kaitiaki onsite throughout the entire duration of the Project's construction.

The Environmental Coordinator, along with the kaitiaki, will work alongside the Environmental Supervisor to ensure all ecological process and protocols are closely followed.

It is envisaged that this person will also be a qualified ecologist.

3.2.4 Environmental Supervisor

TBC – this person will have a very strong background in onsite ESC, and will have held a similar position on other sites. It is imperative that this person can communicate well with the earthworks teams as they need to work very closely together to achieve the best outcome. This person will also be responsible for the teams looking after the every day on-site monitoring and maintenance activities. The Environmental

Supervisor will be responsible for the operation and maintenance of the chemical treatment systems across the site.

3.2.5 ESC Foremen

TBC

3.2.6 ESC Labourers

TBC

3.3 Contact Details

The key contacts for the Environmental Management Team are as follows:

Role	Person	Details
Environmental Manager	Lorraine Pennington	
Environmental Technical Specialist	Campbell Stewart	
Environmental Coordinator	TBC	
Environmental Supervisor	TBC	
ESC Foremen	TBC	

Contact details for labourers are not provided. They will operate under the instruction of the ESC Foremen.

The key contacts for the construction team for each zone are as follows:

Zone	Role	Details
Zone 1 CH2600-CH3900	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC
Zone 2 CH3900-CH7100	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC
Zone 3 CH7100-CH9565	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC

Area 4 CH9565-CH13780	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC

4 Erosion and Sediment Control Principles

4.1 Erosion and Sediment Control Design Standard

All ESC measures implemented through the extent and duration of the Project will be designed, constructed and maintained in accordance Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016* (GD05).

In the unusual circumstance where some variation to the GD05 approach is identified as the best option for a specific area or activity, that variation will be subject to the approval of Horizons through the relevant SSESCP.

4.2 Erosion and Sediment Control Design Philosophy

The Project will adopt and implement the following ESC design principles:

- Emphasis will be given to erosion control and the most effective means of minimising potential sediment generation and sediment discharge from the Project.
- Sediment controls will be diligently managed to maximise their efficiency at all times.
- A “treatment train” approach will be adopted, whereby the suite of erosion control and sediment control measures, including staging and stabilisation, will be implemented to maximise sediment treatment efficiency and minimise sediment yield.
- Clean water will be diverted away from works sites via stable channels or bunds.
- Disturbance of soil will be staged and limited wherever possible to reduce the risk of sediment generation.
- Areas of disturbed soil will be stabilised either temporarily or permanently as soon as practicable to limit sediment generation through erosion.
- Design long approaches to sediment treatment devices greatly improves their performance.
- Chemical treatment will be used on sediment retention ponds (SRPs) and decanting earth bunds (DEBs) in accordance with the Project CTMP.
- Large particle drop-out pits will be utilised prior to dirty water being delivered into SRPs and DEBs.
- All weather machinery access will be provided for maintenance of all SRPs and DEBs.

4.3 Management & Design Objectives

The management and design objectives of the ESCP are:

- To operate in full compliance with the designation and resource consent conditions and demonstrate this through reporting procedures and third-party compliance monitoring.
- To operate in full compliance with the Resource Management Act 1991.
- To liaise closely with Horizons and its agents during construction over matters of ESC.
- To provide the methods that will be employed to avoid, remedy or mitigate adverse effects of sediment on the environment due to construction activities.
- To provide a safe and healthy working environment for all staff on, or near the site.
- To facilitate the very best environmental outcome through innovative, practical, and pragmatic means.

4.4 Staging and Sequencing of Works

The high-level construction programme has indicated that earthworks will be required over four years. The areas to be worked in each year will vary based on construction programming, and progressive and permanent stabilisation.

The key construction stages associated with a large infrastructure project comprise:

- a) Preparatory Works – Initial works to enable Establishment Works and Construction Works such as site surveys and investigations, monitoring set-up and some land disturbance.
- b) Establishment Works – Progressively opening up the site including, for example, constructing and/or widening access tracks to provide access for construction of sediment controls; followed by vegetation clearance, stream diversions, and construction yards.
- c) Construction Phase: Early Works – many gullies will require enabling works to establish upper catchment and stream diversions, followed by initial filling to allow for the installation of cross culverts before the commencement of “bulk” earthworks. In addition, the realigned Te Āpiti Wind Farm access tracks will be constructed prior to commencing the main Alignment works in specific catchments.
- d) Construction Phase: Main Works - Ground improvement, culvert installations, bulk earthworks (including cut and fill activities), drainage installation, bridge construction, pavements and surfacing, reinstatement of site following the completion of construction, landscaping, installation of permanent road furniture and ancillary works.

From an ESC perspective, the proposed construction methodology and sequence is a practical approach to achieving the bulk earthworks required for the Project. This incorporates consideration of water management methodologies and includes erosion and sediment control implementation.

5 Erosion and Sediment Control Implementation

5.1 Overall Approach

The ESC design approach is illustrated in Figure 3. This ESCP provides the overarching principles of the ESC implementation, and the various procedures that will be implemented, including the ESCMP. The ESCP and appendices have been informed by Technical Assessment A (ESC Assessment) and GD05. In conjunction with the ESC Assessment and GD05, this ESCP informs the development of resource consent conditions and will be updated after resource consents are granted to reflect any amendments required by the final conditions.

SSESCPs will be prepared for each works area, based on GD05 and any additional requirements imposed through the finalised resource consent conditions. The SSESCPs will be focussed technical documents including drawings that will detail the ESC measures of that area. They will be consistent with this ESCP but will not repeat the general contents of this ESCP.

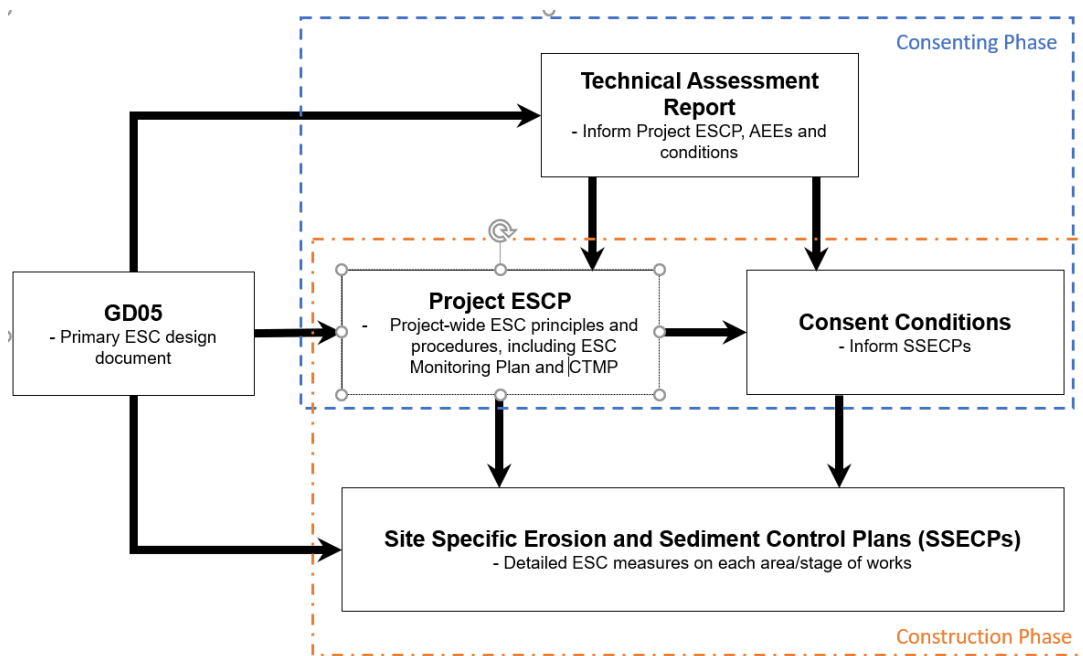


Figure 3 ESC design structure

5.2 Design and Implementation of SSESCPs

The construction of all erosion and sediment controls will be managed as follows:

- The Environmental Technical Specialist will prepare a SSESCP in conjunction with the relevant construction Zone Manager or Engineer and the Environmental Supervisor;
- The SSESCP will be approved by the Environmental Manager and then submitted to Horizons for certification against GD05.
- Once certified, the Environmental Manager will issue an approved SSESCP to the earthworks Site Supervisors responsible for the implementation.
- A pre-construction meeting will be held by the Environmental Management Team where the sediment controls to be built will be discussed and specific direction given on construction.

- The location of the controls and requirements of the relevant SSESCP will be confirmed on site with the construction team and the Environmental Management Team.
- The construction of the controls will be overseen by the Zone Site Supervisors and members of the Environmental Management Team.
- Hold points for construction will be established for each control whereby the Environmental Management Team will inspect the work completed, for example the installation of antiseep collars or the installation of primary outlet.
- Each control will be 'as built' certified by a suitably experienced ESC practitioner from the Environmental Management Team to confirm compliance with the SSESCP prior to bulk earthworks commencing in the catchment of the device(s).
- Copies of the 'as-built' certifications will be submitted to Horizons.
- All DEBs and SRPs will be labelled clearly with their identification number to aid identification of controls and effective communication both with Project and Horizons personnel.

5.3 Changes to ESC Measures

At the commencement of the Project, the Environmental Manager, Environmental Technical Specialist and Environmental Coordinator will agree with Horizons a range of minor amendments that can be made to ESC measures on site that can occur without Horizons approval. Such amendments may include:

- Minor relocation of a silt fence;
- Installation of additional control measures i.e. drop out pits and cut off drains.

All other changes to ESC measures will be discussed with the Horizons inspector and submitted with supporting information to Horizons for approval prior to being implemented.

5.4 Decommissioning ESC Measures

No ESC measures will be decommissioned without the written approval of Horizons. The Environmental Manager will be responsible for liaising with Horizons regarding the SSESCPs and will provide all decommissioning requests and plan amendment requests in writing. Copies of all Horizons sediment control decommissioning approvals and plan amendment approvals will be kept on site.

The process of decommissioning a sediment control device will be as follows:

- 1 Written approval to decommission will have been received from Horizons.
- 2 The weather conditions will be dry or no more than light showers.
- 3 The contributing catchment of the device to be decommissioned will be stabilised or diverted to another appropriate ESC device prior to decommissioning.
- 4 The water contained within the control will be of a quality that can be discharged. Where it is not it will need to be treated prior to discharge.
- 5 The control will be dewatered subject to approval (permit to pump, refer to Appendix 4 to this ESCP - Dewatering Management Procedure) by the Environmental Manager.
- 6 The "pipe work" and emergency spillway fabrications will be dismantled.
- 7 The pond or storage area will be filled in and the surface landscaped.
- 8 The surface will be grassed and stabilised with mulch.
- 9 A decommissioning notification will be given to Horizons by the Environmental Manager confirming the control has been removed.

6 Plant and Machinery

The Earthworks Manager and Project Engineers will be responsible for ensuring that plant and machinery is available at all times for the ongoing and responsive maintenance of ESC measures throughout the Project.

The Project will adopt the principles and practices of the guideline “*Keep It Clean – Machinery hygiene guidelines and logbook to prevent the spread of pests and weeds*” issued by the National Pest Control Agencies (NPCA) in collaboration with the Local Government Biosecurity Managers Group, Rural Contractors New Zealand, Federated Farmers, and Ministry for Primary Industries, Published June 2013. The management of biosecurity risks will be undertaken in accordance with a Pest Plant Procedure (note yet to be prepared).

7 Materials

The Environmental Manager in conjunction with the ESC Team will establish and maintain an on-site supply of ESC related materials such as geotextile fabrics, wire, piping, decant kits, safety fences, waratahs, and ground staples to ensure that all necessary construction and maintenance of devices can be undertaken in a timely and responsive manner for the duration of the Project.

8 Training

The objectives of this ESCP will only be met successfully when all those responsible for its implementation and review are thoroughly conversant with its content, interpretation and performance measurement.

Project staff need to be trained and up skilled to be aware of the potential impact their role can have on environmental performance and compliance of the Project. This is fundamental to achieving good compliance and environmental outcomes. The Environmental Manager will be responsible for ensuring that training is provided.

Training content will be targeted at the most relevant information for various staff roles. All training will include awareness of the activities and associated effects that earthworks can have on the local receiving environments, including an overview of the values of those environments. Training will also ensure that all staff understand what ESC measures are, the function of those measures, and the importance of diligently complying with SSESCPs. Training will ensure that staff understand the ESC management structure, and how to report on any maintenance requirements they identify during their work. It will also address the legal responsibilities of all personnel and legal consequences of non-compliance.

More specific training will be provided to staff that will be involved in the day to day implementation of ESC measures. This will include on-the-ground practical training on the construction, maintenance and decommissioning of devices.

All key earthworks and construction environmental staff will complete the International Erosion Control Association (IECA) Approved GD05 Erosion and Sediment Control Training Course which is delivered by a CPESC qualified staff member on the Environmental Management Team.

Induction training will also make contractors aware of resource consent conditions, designation conditions, environmental control procedures and the requirements of the ESCP. Specific individuals with environmental responsibilities may require the following training:

- Emergency response training;
- Spill kit training;
- Environmental auditing;

- Sampling and monitoring.

A record will be kept of people who have undertaken induction training. The Environmental Manager will have responsibility for maintaining and updating these records.

Staff involved in environmental monitoring required by any resource consent conditions and by the requirements identified within this ESCP will be trained and competent in the operation, calibration and maintenance of the equipment. Relevant staff will also be trained and competent in sample collection, handling, storage and transport methodologies and techniques. Records of staff training will be kept and made available for inspection upon request.

9 Monitoring and Responses

9.1 ESC Monitoring

Monitoring of the ESC measures and outcomes will be undertaken in accordance with the appended Erosion and Sediment Control Monitoring Plan (ESCMP, Appendix 2 to this ESCP). The ESCMP details all monitoring to be undertaken during the construction phases of the Project, including weather forecasting and monitoring, business-as-usual management of the site, rainfall trigger event monitoring, response and reporting.

9.2 Environmental non-compliance and corrective actions

Corrective actions are required when a non-compliance is identified. Corrective actions are needed for any incidents, such as failures or non-performance of ESC measures and legal non-compliance, and under the following circumstances:

- When inspection of environmental protection measures on site reveals that the measures have not been correctly installed or maintained;
- When site inspections or monitoring is undertaken that indicate expected ESC performance levels are not being achieved (refer to the ESCMP);
- When negative environmental outcomes are investigated;
- After analysing circumstances leading to an incident, emergency or "near miss".

Preventative action involves identifying any potential problems before they occur in order to minimise the potential of an occurrence.

If a non-compliance involving a discharge occurs, an Opportunity for Improvement form shall be completed detailing the environmental incident, and corrective actions shall be identified and implemented.

The Opportunity for Improvement will contain the corrective actions required to be completed by the on-site personnel to:

- eliminate;
- isolate;
- minimise;
- improve;
- remove; or any combination of the above.

A timeframe will be given for completion. Upon completion of the corrective action, the relevant personnel shall notify the Environmental Manager of the action taken, at which time the Environmental Incident will be updated and closed out if appropriate.

10 Changes and Updates to the ESCP and Supporting Documents

The ESCP and supporting documents will be reviewed on receipt of the finalised resource consent conditions and updated as may be necessary to be consistent with those conditions. Once construction of the Project has commenced, the ESCP and supporting documents will be reviewed annually, in the month of August, throughout the construction period.

The annual review of the ESCP and supporting documents will be undertaken by the Environmental Manager in consultation with the Construction Team to ensure that all compliance requirements are being

met as set out. This review may be a one off or additional reviews may be undertaken to ensure the documents are current and relevant to all activities been undertaken.

Any relevant or required significant revisions to the ESCP and supporting documents will be submitted to Horizons for review and certification at least 10 working days before becoming operational.

As part of continuous improvement, changes to the ESCP and supporting documents may be appropriate during the course of the Project. These changes may be a result of:

- Any significant changes to construction activities or methods;
- Site personnel comments;
- Audit findings and recommendations;
- Environmental monitoring records;
- Environmental complaints, incidents and emergencies;
- Details of corrective and preventative actions;
- Environmental non-compliances;
- Changes to organisational structure;
- On-going compliance with objectives, conditions and targets; and
- Possible changes in legislation and standards.

Any reasons for making changes to the ESCP and supporting documents will be documented. A copy of the original ESCP and supporting documents and subsequent versions will be kept for the Project records and maintained on site, and all documents superseded marked as obsolete. Each new / updated version of the documentation will be issued with a version number and dated to eliminate obsolete versions being inadvertently used.

11 Supporting Documents

11.1 Chemical Treatment Management Plan

Refer to the CTMP in **Appendix 1**.

11.2 Erosion and Sediment Control Monitoring Plan

Refer to the ESCMP in **Appendix 2**.

11.3 Dust Management Procedure

Refer to the Dust Management Procedures in **Appendix 3**.

11.4 Dewatering Management Procedure

Refer to the Dewatering Procedures in **Appendix 4**.

11.5 Emergency Spill Response Procedure

The Emergency Spill Response Procedures contains the procedures to be followed in the event of a spill of any kind of contaminant including flocculant and is attached in **Appendix 5**.

11.6 Stream Works Procedure

Refer to the Stream Works Procedures for construction processes and procedures for undertaking works in and around streams (attached in **Appendix 6**).

An Ecology Management Plan has been developed in consultation with our iwi partners. Freshwater ecology, and stream works management are covered in more detail in this management plan.

11.7 Hazardous Substances Procedure

The Hazardous Substances Procedure attached in **Appendix 7** contains the procedures to be followed in order to appropriately manage the use of hazardous substances on site.

Appendix 1 – Chemical Treatment Management Plan

Te Ahu a Turanga; Manawatū Tararua Highway

Appendix 1: Chemical Treatment Management Plan

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Appendix 1.B – Instructions for Maintenance of Rainfall Activated Treatment Systems

Appendix 1.C – Chemical Treatment Monitoring and Maintenance Record

Appendix 1.D – Bench Testing Results Sheets

1 Introduction

1.1 Purpose and Scope

This Chemical Treatment Management Plan (CTMP) applies to the construction of Te Ahu A Turanga; Manawatū Tararua Highway (the Project).

The CTMP sets out the methodology for determining the effectiveness and dosing rates for chemical treatment to enhance the sediment retention efficiency of sediment retention ponds (SRPs), decanting earth bunds (DEBs) and other water impoundment devices such as treatment tanks that will be used throughout the Project.

The CTMP shall be implemented for the duration of the construction of the Project. It will support the overall erosion and sediment control (ESC) principles and methods described in the Erosion and Sediment Control Plan (ESCP) and will inform the development of site-specific erosion and sediment control plans (SSESCPs).

1.2 Implementation and Operation

Table 1 details the roles and responsibilities that will apply to the implementation and management of the chemical treatment systems across the Project.

Table 1 CTMP - roles and responsibilities

Name	Role	Contact details	Responsibility
Tony Adams	Project Construction Manager	Tony.Adams@fultonhogan.com 0274377246	Overall project responsibility
Hardus Pieters	Civil Construction Manager	hardus.pieters@heb.co.nz 027 270 4181	Includes responsibility for earthworks
Shane Wilton	Structures Manager	Shane.Wilton@heb.co.nz	Responsible for structures
TBC	Earthworks Manager		
TBC	Production Manager		
Lorraine Pennington	Environmental Manager	Lorraine.Pennington@fultonhogan.com 027 503 6749	Overall responsibility for Environmental Management and Performance
Campbell Stewart	Environmental Technical Specialist	campbell@southernskies.co.nz 021 837 824	Suitable qualified and experienced erosion and sediment control specialist who prepares the erosion and sediment control plans and audits their implementation
TBC	Environmental Supervisor		

2 Methodology

In accordance with industry best practice, it is proposed to chemically dose the SRPs, DEBs and impoundment containers in accordance with the CTMP to maximise sediment retention efficiency and ensure the quality of water discharging from the device is with the range anticipated in the assessment of effects for the Project (refer to Erosion and Sediment Control Assessment, Technical Assessment A, Volume IV).

Soil sampling and bench testing (laboratory testing of chemical responses), and the management of the chemical treatment systems will be undertaken in accordance with Appendix F1 and Section F2.0 of Auckland Council Guideline 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region* (GD05).

Note: Preliminary samples have been undertaken as part of early site investigations (refer to the Chemical Analysis and Reactivity Test (CART) Report, Appendix 1.A to this CTMP) which indicate significant improvement of clarity and turbidity with the use of chemical treatment.

Ongoing sampling will also be required as the earthworks progress. In this regard protocols have been established and are set out in Section 5.

Any sampling and bench testing of sub-soils (below topsoil) that is necessary will be taken from the contributing catchment of sediment controls devices to determine the optimum chemical response and dosing rate, balanced within an acceptable pH range.

Ongoing sampling will also be required as the earthworks progress.

Bench tests of soil samples will be undertaken using:

1. Poly Aluminium Chloride (PAC).
2. Superfloc.

Superfloc is a blend of PAC and PolyDADMAC.

The recommended chemical and dose rate will be that which achieves the best settlement rate within the acceptable pH range of 5.5 to 8.5 and will not change the baseline pH beyond +/-1.

3 Implementation

The Chemical Analysis and Reactivity Test Report (CART) provided in Appendix 1.A to this CTMP confirms the efficacy of chemical treatment of typical sites' soils, based on the testing methodology described below and in the CART.

A SSES CP will be prepared for each works area. Those SSES CPs will identify and provide the sizing calculations and drawings for all ESC measures to be implemented in the corresponding area. Once a SSES CP has been certified by Horizons Regional Council (Horizons), the ESC measures will be constructed in that works area.

If the works are within an area or soil type already sampled and reported on in the CART, the chemical treatment systems will be initially set up based on the CART recommendations. If the works area is not within the extent of the CART, additional soils sampling and bench testing will be undertaken in accordance with this CTMP.

Confirmation of the recommended chemical, dose rates, roof tray sizes and header tank outlet spacings for each device will be submitted to Horizons with the as-built certification of the devices and Appendix 1.D of this CTMP will be updated with the recommended dose rates for that SSES CP area.

The relationship of the various management plans and procedures that apply to the chemical treatment system is shown in Figure 1.

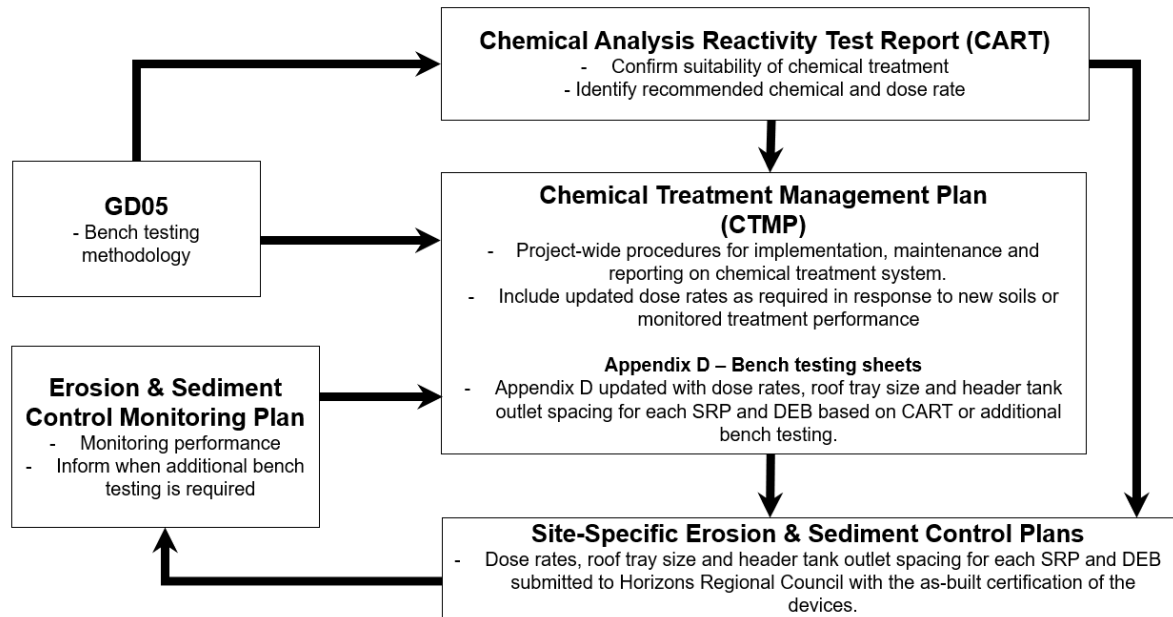


Figure 1 Implementation of the chemical treatment system

4 Flocculation System

4.1 Rainfall Activated Dosing System

The rainfall activated dosing system has been developed specifically for earthworks sites. The system uses a rainfall catchment tray to capture rainfall with the size of the tray being determined by the required chemical dose and the land catchment size.

Rainwater caught by the catchment tray is piped into a header tank, and then into a displacement tank which floats in a larger tank containing the flocculant filled to the level of an outlet pipe leading to the sediment laden diversion about 10m upstream of the inlet of the sediment control device. The greater the rate of rainwater flow into the displacement tank the greater the flow of flocculant into the sediment laden runoff channel. The header tank is designed to provide for no dosing during the initial rainfall of up to 12mm of rain under dry conditions to reflect the lag time between the onset of rainfall and the arrival of runoff at the device. The dual outlet of the header tank outlet also attenuates chemical flow during the

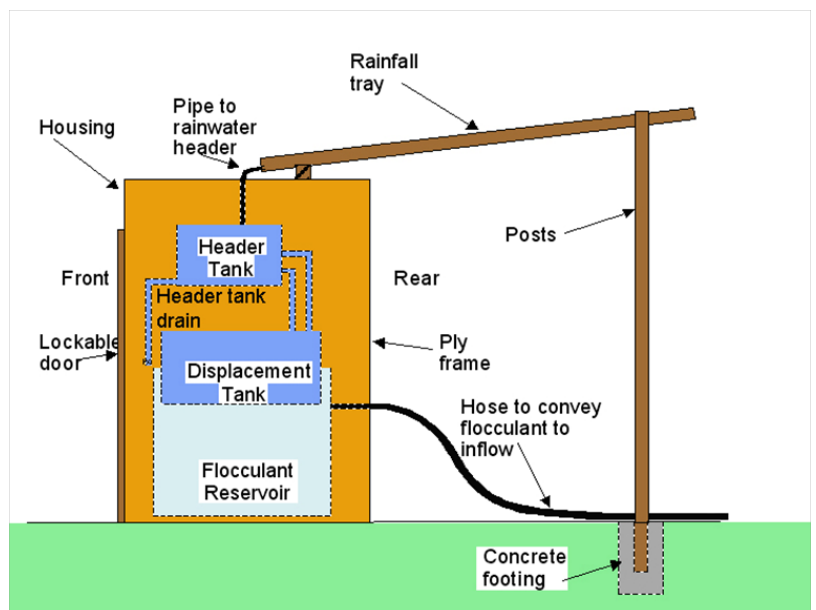


Figure 2 Traditional flocc shed schematic.

initial stages of a storm and after rain has ceased at the end of a storm.

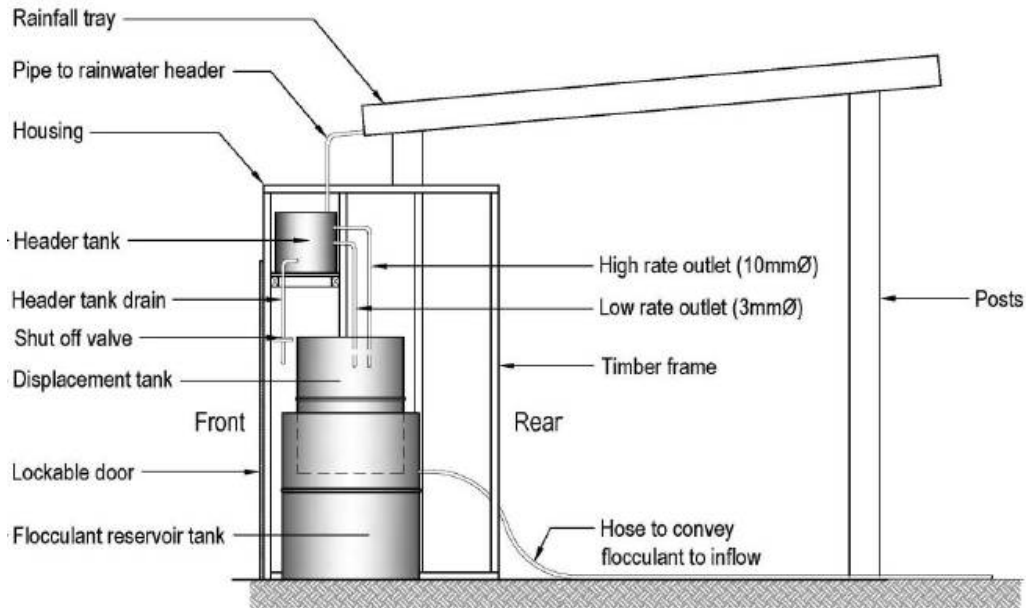


Figure 3 Components of the floc shed.

A mini Floc Shed (Figure 4) or Floc Box (Figure 5) are well suited for DEBs with catchment areas less than 3,000m² and are set up in a similar way to the traditional floc shed outlined above.



Figure 4 : Mini floc shed

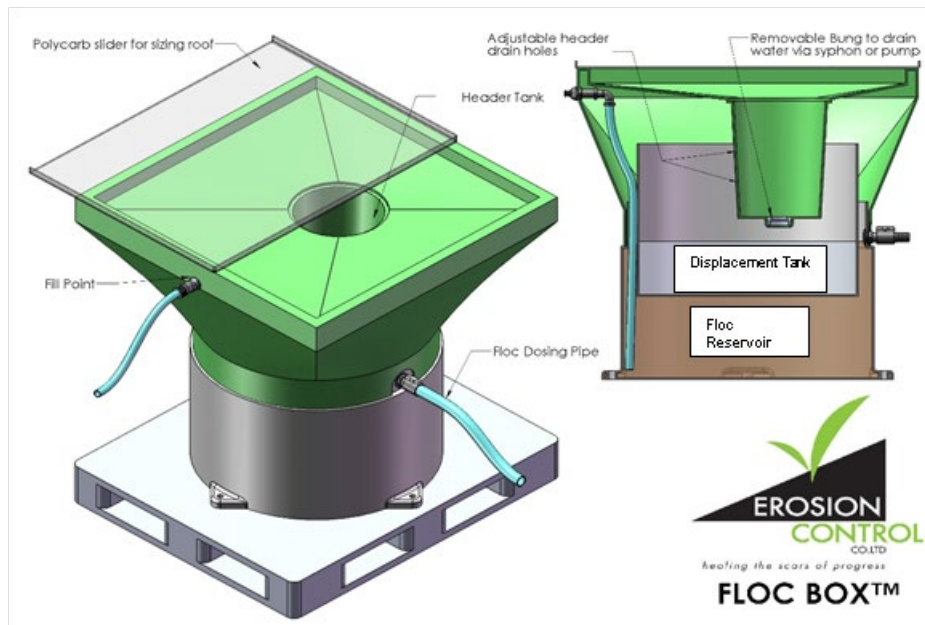


Figure 5 Floc box

4.1.1 Area of rainwater catchment tray required for rainfall activated system

The area of the rainwater catchment tray is determined by the dose required, and the area of the earthwork catchment draining to the sediment control device.

The rainwater catchment tray size is determined by the total land catchment area draining to the sediment control device including both the 'open' area and stable areas. If the catchment area is changed, then the catchment tray size should also be changed in proportion. Reduction of the tray size is easily achieved by placing a piece of plywood on top of the upstand over the lower end of the tray, thereby allowing the rain which falls on the plywood to run to waste. Floc boxes include a sliding lid that adjusts the catchment tray size in a similar way.

The required tray size will be calculated and submitted with the as-built certifications associated with each SSESCP and included in Appendix 1.D to this CTMP.

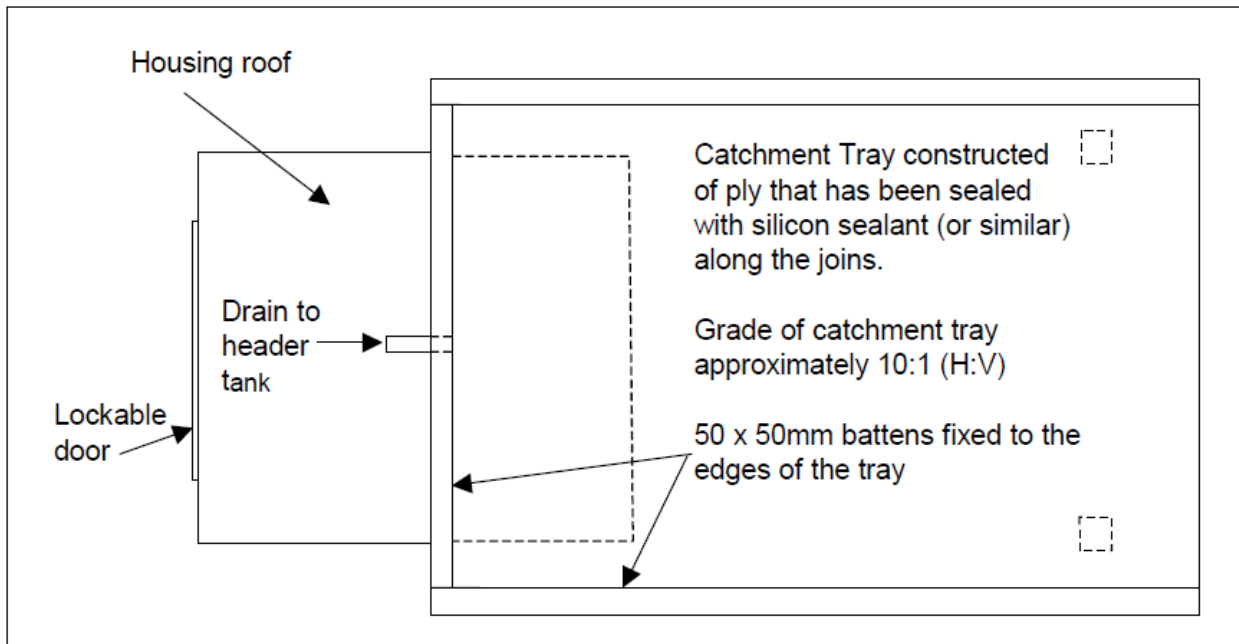


Figure 6 Roof tray design.

4.1.2 Header Tank Outlet Spacing

Rainfall from the catchment tray is drained into a header tank which has two outlets offset vertically. This provides a storage capacity that avoids dosing during initial rainfall following a dry period and to attenuate dosing at the beginning and end of a rainstorm event.

The volume between the drain (lowest) header tank outlet and the first dosing outlet is equal to the volume of 12mm of rain on the catchment tray and the volume between the first and second dosing outlets is the same.

The required header tank outlet spacing details will be calculated and submitted with the as-built certifications associated with each SSESCPs and included in Appendix 1.D to this CTMP.

Header Tank Management in summer months will be as per the GD05 guideline, which requires:

- After 3 days without rain – reduce volume by 50%.
- After 6 days without rain – empty completely.

4.1.3 Sediment Laden Runoff Channel and Dosing Point for Rainfall Activated System

The chosen chemical needs to be added to the sediment laden runoff channel to provide mixing with the sediment laden runoff before it reaches the area of ponded water in the forebay or the sediment control device itself.

All sediment laden runoff from the catchment should be combined into a single channel if possible before it reaches the chemical dosing point. To maximise mixing, the dosing point should be located at least 10 metres prior to the point where the runoff reaches the inlet of the device (in the case of a SRP, the inlet of the forebay).

The dosing point should be at a location where the chemical will fall into the sediment laden flow during periods of low flow. The end of the dosing tube should be only a few centimetres above the diversion channel to ensure that the chemical falls into the sediment laden runoff and is not blown away during periods of strong wind.

4.2 Batch Dose Treatment

Batch dosing is largely undertaken as a reactive measure to treat impounded runoff that has not been treated to the correct standard. Batch dosing is achieved by adding liquid reagent to the surface of impounded runoff to increase the rate of settlement to achieve the required standard of discharge.

Batch dosing may be undertaken as a contingency measure in devices that have been treated by a rainfall activated system. Batch dosing can be utilised during dewatering / pumping processes (refer to the Dewatering Management Procedure for specific details, Appendix 4 of the ESCP).

The criterion to establish the need for batch dosing is the clarity of the sediment laden runoff. Clarity will be measured by either of the following two techniques:

- Black disc
 - A 50-80mm diameter disc is attached to a 1m long stick with a centimetre scale starting as the disc is lowered vertically into the water to be tested until it disappears, and then is raised until it just reappears. The depth of reappearance is recorded as the clarity of the water.
- Clarity Tube
 - A clarity tube containing a magnetic back disc will be filled with water from the device. The tube will be laid horizontal and the disc will be moved down the tube until it disappears, when viewed from the end of the tube and the distance is recorded. The disc is then moved back until it reappears, and the distance is recorded.
 - Readings should be taken in diffuse sunlight or shade. If it is impossible to avoid bright sunlight, work with the tube perpendicular to the sun's plane.
 - Readings will not be taken in very low light conditions (insufficient for colour perception).

Water with a clarity of 100mm or greater is considered to be acceptable for discharge. Water with a depth of clarity of less than 60mm should be batch dosed. If the sediment laden runoff has clarity between 60-100mm after rainfall has ceased, it should be left for 48 hours to settle. If the clarity has not reached 100mm after 48 hours, or if sediment laden runoff has to be discharged within 48 hours because the pond is full, the sediment laden runoff should be batch treated.

The batch dose rate will be based on the recommendations of the CART or specific bench testing for that area and calculated against the volume of the device to be treated. The batch dose rates will be provided in Appendix 1.D of this CTMP.

4.2.1 Application Procedure for Batch Dosing

The chemical dose should be applied evenly over the surface of the sediment control device as quickly as practicable. It is best to apply the dose in one application, rather than going over the surface of the water two or more times.

The total dose may be applied in one of two ways.

- a) Spray

The chemical can be applied to the surface of the pond using a sprayer that produces large drops.
- b) Bucket

Place no more than 1 litre of chemical in a 10-litre bucket and throw the chemical onto the pond surface so that the chemical divides into drops before hitting the surface.

Settlement generally requires 1-2 hours.

4.2.2 Timing

As impounded water often develops marked temperature gradients during the day, which can inhibit mixing of the chemical that is added to the surface of the impounded water and the settlement of coagulated solids, batch treatment should be carried out in the early morning to optimise mixing of the chemical with the sediment laden runoff and the subsequent settlement of coagulated solids.

5 Determination of Dose Rate

Bench testing will be undertaken to determine the preferred chemical treatment system and optimum dose for suspended solids removal. The bench testing will also consider the effects on pH of the treated water for the sediment retention devices.

Bench testing will be undertaken as an ongoing and continual process throughout the life of the Project (refer to Section 3 of this CTMP "Implementation"). Ongoing monitoring will also be undertaken of the site's sediment retention devices as outlined in Appendix 1.C to this CTMP. If the monitoring highlights any deficiencies further bench testing will be undertaken. All bench testing results will be recorded in the Bench Testing Result Sheets in Appendix 1.D to this CTMP.

6 Monitoring and Maintenance Requirements

6.1 Routine Management and Maintenance

Instructions for routine management and maintenance of the chemical treatment system are provided in Appendix 1.B to this CTMP. A copy of this table will be kept onsite and will be available for review.

All monitoring records and maintenance checks and actions will be recorded on the monthly record sheet provided in Appendix 1.C to this CTMP. The systems will be checked after each rainfall event, and during dry periods the systems will be checked weekly.

It is also noted that chemical treatment increases the sediment removal efficiency of the sediment controls. The sediment controls will need to be regularly desilted to ensure that the maximum volume is re-established after rain events.

6.2 Contingency Management

Contingencies could include poor performance of the treatment system, or effects of other influences on sediment laden runoff quality, such as reduced pH, that might make the use of chemicals inappropriate.

If the treated water in the sediment control device is consistently very clear it could indicate overdosing, and the possibility of lowered pH which can present a risk to receiving waters as a result of elevated free aluminium concentration in the discharge. If the treated water is consistently clear the pH of the water in the sediment control device will be tested.

Contingencies such as poor treatment performance or consistently very clear treated water should be dealt with as part of the day to day environmental management of the site. Refer to the ESCMP for additional monitoring and maintenance procedures that are to be implemented across the Project.

A treatment chemical spill contingency procedure is provided in Section 6.6 below.

6.3 Record Keeping and Reporting

A copy of the maintenance record for the chemical treatment system will be kept on site (Appendix 1.C to this CTMP).

A copy of the maintenance record for the chemical treatment system will be provided to Horizons on request.

6.4 Procedure for Chemical Transportation

The use of flocculants will be in accordance with the “Construction Health and Safety Plan”¹ and Hazardous Substances Procedure².

PAC and Superfloc will be delivered to the site by commercial carriers in accordance with current Hazardous Substances and New Organisms Act 1996, and Ministry of Transport, Transporting Dangerous Goods Safety, An Industry Guide.³ These chemicals can be requested from the supplier generally in 20 litre containers, 200 litre drums and/or 1,000 litre IBCs. PAC and Superfloc all weigh about 250kg and are most easily moved within the site in a loader bucket. Transport around the site will be via suitable vehicles or machinery and containers will be sealed and secured such that the containers cannot topple over.

6.5 Storage of Chemicals on Site

Chemicals will be stored in accordance with the Hazardous Substances Procedure (Appendix 7 to the ESCP). Bulk PAC and Superfloc supplies will be held in secure storage. 200L polyethylene drums or IBCs of PAC and Superfloc will be held beside each chemical treatment shed / floc box, on level ground and secured so that the container cannot topple over. Those drums will be under the overall security and control of the site as a secure workplace. Drums of chemical will always be stored on end with the screw caps uppermost. Topping up of flocculant chemical will be made weekly as part of the regular inspection regime.

6.6 Chemical Spill Contingency Procedure

Spills will be managed in accordance with the Emergency Spill Response Procedure (Appendix 5 to the ESCP).

If there is a spill of PAC or Superfloc onto the ground it should be immediately contained using earth bunds to prevent it entering water. The spilt chemical should be recovered if possible and placed in polyethylene containers. If the spilt chemical cannot be recovered, it should be mixed with a volume of soil equal to at least ten times the volume of spilt chemical. This will effectively neutralize the chemical. The soil with which the chemical has been mixed should be buried in the ground a minimum of 0.5 metres below the surface.

If there is a spill of chemical into ponded water, discharge from the pond to natural water should be prevented.

If there is any spill into flowing water:

1. Horizons should be advised immediately.
2. The volume of the spill should be recorded.
3. If possible, the water and spilt chemical should be pumped into a bund or sediment control device until all the spilt chemical has been removed from the watercourse.
4. If the chemical cannot be removed from the watercourse any downstream users should be identified and advised.

¹ Te Ahu A Turanga: Manawatū Tararua Highway Project, Construction Health and Safety Management Plan

² For further information, refer to the Hazardous Substances Procedure, Appendix 7 to the ESCP

³ For further information, refer to Hazardous Substances and New Organisms Act 1996 (reprinted 2017), and <https://www.transport.govt.nz/assets/Import/Documents/ca67c03328/Transporting20Dangerous20Goods.pdf>

6.7 Chain of Responsibility for Monitoring and Maintenance

The Environmental Manager and the Environmental Technical Specialist will have overall responsibility for chemical treatment systems.

The ESC Foremen and ESC Labourer(s) will check the effect of PAC and Superfloc dosing on the pH of the treated water once the pond has filled for the first time and monitor pH and overall performance throughout the duration of works.

6.8 Training of Person Responsible for Maintenance and Monitoring

If a person with experience in the monitoring and maintenance of the chemical treatment system is not available, the Environmental Manager will train a person nominated by the Project team to carry out the routine monitoring and maintenance of the chemical treatment system, and to keep the required records. This person's contact details will be provided to Horizons.

6.9 Procedure Modification

It is expected that as the Project progresses, performance checks of the chemical treatment systems may be required due to changing soil types etc. This will be undertaken following additional sampling and testing and approval from the Environmental Manager.

Appendix 1.A – Chemical Analysis and Reactivity Test Report

Chemical Analysis and Reactivity Test Report

MEMORANDUM

Document Number	CART-01
Revision	1
Date	19/11/2019



Document Control

Document History and Status

Revision	Date Issued	Author	Reviewed By	Approved By	Status
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Appendices

Appendix A – Chemical Analysis Soil Sample Locations

1 Introduction

1.1 Purpose and Scope

This Chemical Analysis and Reactivity Test (CART) Report has been prepared for the construction of the Te Ahu a Turanga: Manawatū Tararua Highway (the Project).

The purpose of this report is to determine the effectiveness of chemical coagulants on common soil types identified within the Project area with the overall objective of minimising to the greatest extent practicable the discharge of suspended sediments into waterways during the construction phase of the project. It reports on initial testing undertaken, and the procedure for future testing to be undertaken during the Project.

Chemical treatment is now widely used throughout New Zealand to enhance the sediment removal efficiency of sediment retention devices implemented during the earthworks phase of infrastructure and development projects.

Soil samples have been tested with two common cationic coagulants, which neutralise the negatively charged soil particles to improve flocculation and settlement within the sediment control device. The two coagulants are complimentary, with one or other often showing a better response depending on the soils being tested.

- Polyaluminium Chloride (PAC - $[Al(OH)_aCl_b(SO_4)_c]_n$), The most common chemical widely used throughout New Zealand, a polymer originally tested and documented by the Auckland Regional Council during the construction of the ALPURT motorway extension development¹.
- Polydiallyldimethylammonium chloride (PolyDADMAC - $[C_8H_{16}NCl]_n$). A blend of 80% PAC and 20% PolyDADMAC, marketed by IXOM Chemicals as 'Superfloc'.

These coagulants contain aluminium and therefore the pH monitoring must be undertaken while chemical treatment is initiated. GD05 states that the following limitations apply to chemical treatment:

- pH must be tested as part of the bench testing methodology and should be used as a control baseline. Whatever flocculant is being used must not change that baseline from a pH beyond +/- 1 and must not fall outside of the range of 5.5 – 8.5, as measured from the primary spillway.
- Treatment should cease when the above pH limits cannot be met.

This report presents the initial results of bench test trials undertaken to determine the effectiveness of the two coagulants. Turbidity and pH measurements were undertaken and recorded for each bench test and the results used to determine the optimum chemical and dose rate for each sample provided.

1.1.1 Chemical Treatment Management System

The relationship of this CART report within the overall chemical treatment management system for the Project is shown in Figure 1 below. The CART will inform the development of the Chemical Treatment Management Plan (CTMP) that will be developed for the Project. The CTMP will be the overarching plan for the management, maintenance and report of the chemical treatment system to be implemented across the Project for the duration of earthworks. As the Project progresses further bench testing will be undertaken as new areas are opened and earth worked. The overarching CTMP will contain additional bench testing sheets as an appendix for future tests to be completed and supplied to HRC. It will also detail

¹ Auckland Regional Council Technical Publication 227 – 'The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff: Trials, Methodology and Design' June 2004

the specific set-up details for the chemical treatment of each sediment retention pond (SRP) and decanting earth bund (DEB) to be implemented in that area i.e. roof tray and header tank outlet spacing.

Site Specific Erosion and Sediment Control Plans (SSESCPs) will be prepared for each earthworks area within the Project. The SSESCPs will provide the design details for all erosion and sediment control measure to be implemented within that area.

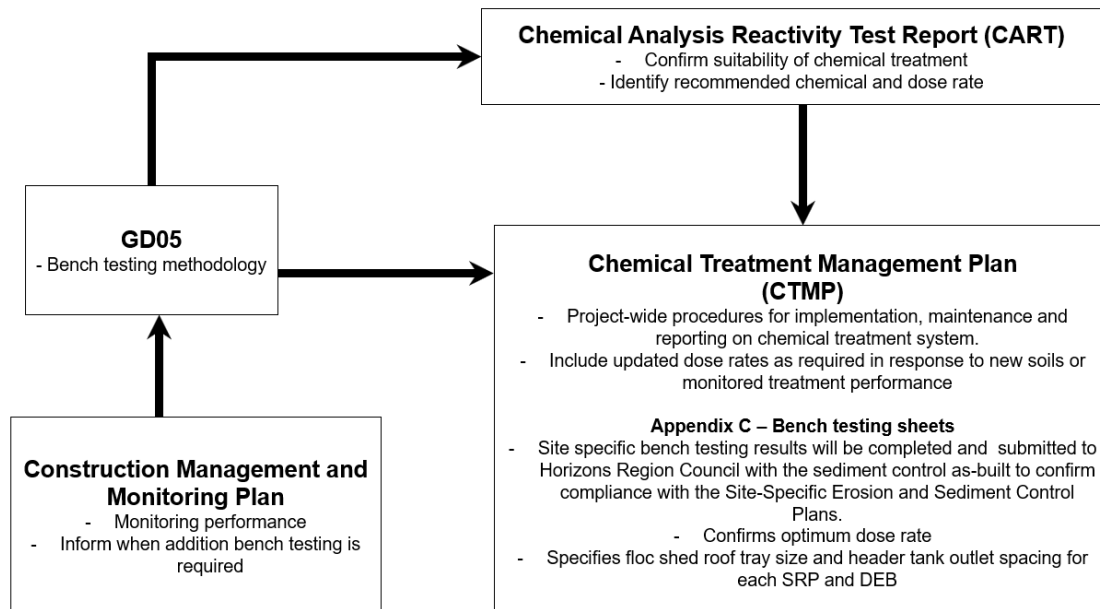


Figure 1: Chemical treatment management systems

2 Methodology

The testing methodology provided in Appendix F1 of Auckland Council Guideline Document 2016/005 'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region' Incorporating Amendment 1 (GD05) has been adopted, using PAC and PolyDADMAC supplied by IXOM Chemicals.

That methodology will be repeated for any future bench testing required in response to identified new soils, or where treatment performance is less than anticipated.

Testing was undertaken on six sub-soil samples obtained from the alignment (refer to Appendix A for locations map). Testing of each sample involved the application of five dose rates (2mg/l to 10mg/l Al) and comparison to a control. Results are reported in the following tables.

3 Initial Results

3.1 Sample 1

Location chainage 9800

Description: Residual weather mudstone overburden

PAC

Initial pH: 7.25

Initial turbidity: 2057 NTU

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	15	15	6.98	848
2	45	50	55	6.91	158
4	45	50	75	6.80	107
6	55	70	85	6.64	75
8	70	80	105	6.53	60
10	60	75	100	6.37	65



Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

SuperFloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	15	15	6.98	848
1.6	40	70	110	6.89	59
3.2	45	60	100	6.81	62
4.8	35	40	65	6.73	102
6.4	30	40	50	6.65	143
8	30	45	80	6.55	85



Control 1.6mg/L 3.2mg/L 4.8mg/L 6.4mg/L 8mg/L

3.2 Sample 2

Location chainage 9300

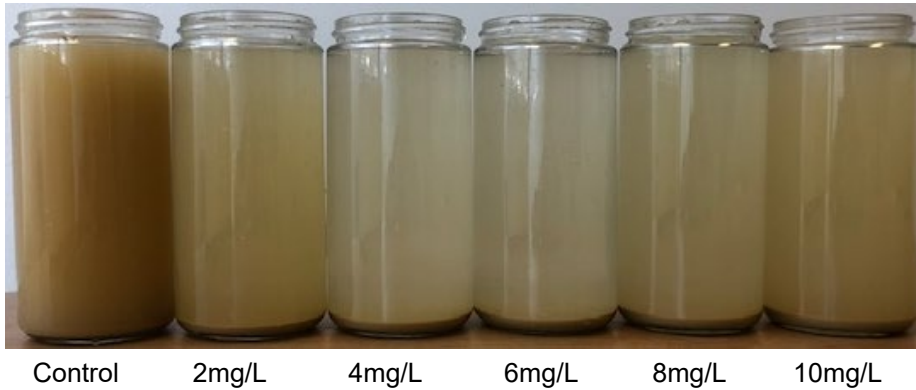
Description: Residual weather mudstone overburden

PAC

Initial pH: 6.83

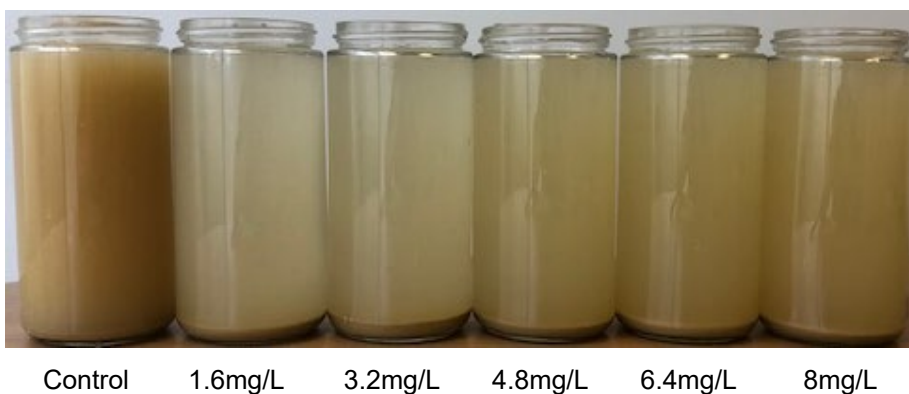
Initial turbidity: 1712 NTU

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	15	15	6.62	882
2	35	50	55	6.47	198
4	75	90	95	6.29	74
6	80	100	110	6.18	72
8	60	80	80	6.01	129
10	45	50	55	5.85	212



SuperFloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	15	15	6.62	882
1.6	65	70	95	6.55	90
3.2	65	70	80	6.49	118
4.8	45	50	55	6.41	186
6.4	30	35	65	6.36	170
8	30	30	60	6.24	220



3.3 Sample 3

Location: Chainage 6500

Description: Conglomerates

PAC

Initial pH: 7.10

Initial turbidity: 1789 NTU

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	20	35	40	7.13	304
2	70	85	105	6.97	65
4	85	90	115	6.85	50
6	80	95	120	6.63	38
8	60	80	120+	6.41	34
10	65	80	115	6.26	38



Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

SuperFloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	20	35	40	7.13	304
1.6	50	60	65	7.08	125
3.2	50	55	65	6.96	124
4.8	55	70	100	6.91	68
6.4	40	65	120+	6.83	42
8	40	55	120	6.75	43



Control 1.6mg/L 3.2mg/L 4.8mg/L 6.4mg/L 8mg/L

3.4 Sample 4

Location: Chainage 6400

Description – Weathered mudstone / sandstone overburden

PAC

Initial pH: 6.71

Initial turbidity: 1389 NTU

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	20	25	7.13	532
2	45	55	70	7.07	116
4	60	70	80	6.87	92
6	55	60	75	6.61	112
8	40	55	80	6.45	124
10	40	50	65	6.29	138



Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

SuperFloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	20	25	7.13	532
1.6	65	75	90	7.08	93
3.2	55	55	60	6.98	131
4.8	35	50	75	6.89	119
6.4	30	55	100	6.82	72
8	30	45	95	6.74	84



Control 1.6mg/L 3.2mg/L 4.8mg/L 6.4mg/L 8mg/L

3.5 Sample 5

Location: Chainage 7150

Description – Conglomerates

PAC

Initial pH: 7.20

Initial turbidity: 1119 NTU

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	20	35	7.25	340
2	30	45	50	7.19	202
4	80	90	90	7.03	67
6	105	115	120+	6.90	48
8	120	120+	120+	6.83	35
10	120	120+	120+	6.70	37



Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

SuperFloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	15	20	35	7.25	340
1.6	45	65	95	7.20	73
3.2	65	70	80	7.15	92
4.8	65	70	70	7.03	105
6.4	75	80	90	6.91	88
8	60	70	70	6.80	106



Control 1.6mg/L 3.2mg/L 4.8mg/L 6.4mg/L 8mg/L

3.6 Sample 6

Location: Chainage 9700

Description - Mudstone

PAC

Initial pH: 7.23

Initial turbidity: 689 NTU

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	30	40	55	7.12	155
2	50	70	110	7.05	45
4	60	90	120+	6.97	27
6	50	70	120+	6.86	26
8	35	60	120+	6.72	29
10	35	50	120	6.69	43



Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

SuperFloc

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0	30	40	55	7.12	155
1.6	45	55	70	7.08	83
3.2	40	65	120	7.00	36
4.8	35	55	120	6.95	36
6.4	35	50	120	6.90	50
8	35	45	110	6.82	57



Control 1.6mg/L 3.2mg/L 4.8mg/L 6.4mg/L 8mg/L

4 Discussion

The most efficient dose rate achieves the best balance between settlement response, pH response and cost of chemical throughout the duration of the Project.

The soil samples generally retained persistently mobile fine colloidal particles and had variable clarity and turbidity responses. In all cases the coagulants provided a significant improvement of clarity and turbidity compared to the control. PAC provided the most consistent rate of settlement for the soil types tested and is the recommended chemical to be used on site.

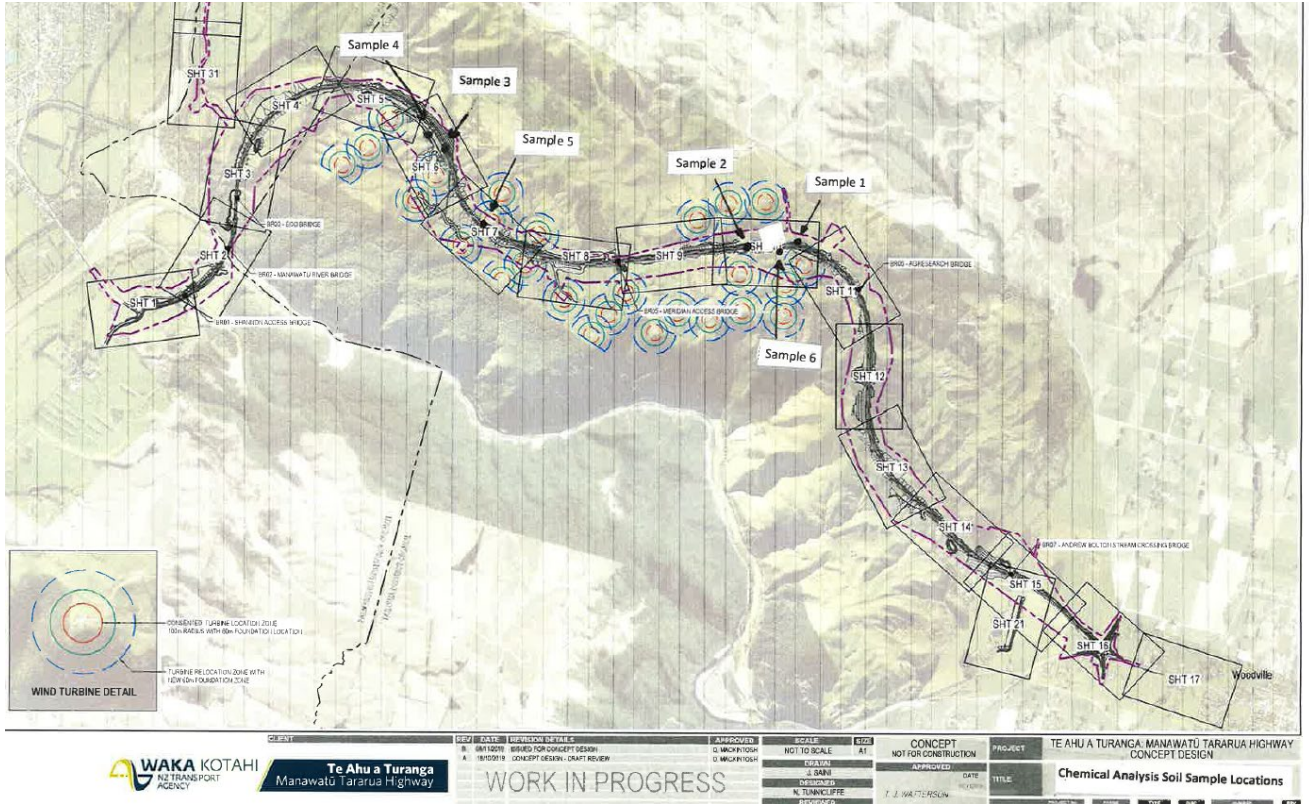
Taking account of the variability between samples, a dose rate of 6mg/l Al provided the most consistently high response. Eight (8) mg/l Al provided a minor improvement in response in some, but not all, samples but the additional cost of chemical at 8mg/l Al over the duration of the Project would not be warranted.

The tests undertaken indicate a positive response to chemical treatment with PAC, at an indicative dose rate of 6mg/l Al which equates to 93ml PAC / m³ of sediment laden runoff.

The pH response to all dose rates of PAC and Superfloc were within the acceptable range as defined with GD05 with respect to background pH and potential toxicity.

As stated in Section 1.2, the application and management for chemical at each site will be implemented in accordance with the CTMP and the dosing system setup for each device will be specified in the corresponding SSESCP. Where new soils are encountered, or responses are not as anticipated, additional bench testing will be undertaken in accordance with the GD05 methodology and included in the CTMP.

Appendix A – Chemical Analysis Soil Sample Locations



Appendix 1.B – Instructions for Maintenance of Rainfall Activated Treatment Systems

Reducing the Header Tank Water Volume

The header tank is used to avoid dosing during the initial stages of rainfall when site conditions are dry, and no runoff is to be expected.

The volume in the header tank is lowered using the lowest of the three outlet tubes.

- After 3 days without rain - reduce volume to 50%.
- After 6 days without rain - reduce volume to empty (level at lowest outlet).

Refilling the Chemical Reservoir

The chemical reservoir tank should be refilled when the white displacement tank is half full, or sooner if heavy rain is predicted. This is done by first emptying the white tank (baling with a bucket is efficient), and then refilling the black reservoir tank until the PAC or Superfloc level is at the lower edge of the outlet.

Observation of Water Quality in Sediment Control Device

The pond water quality will be observed at least weekly, and the clarity determined using a black disc and recorded on the monitoring sheet. pH shall be recorded once the pond has filled up to ensure that chemical dosing does not have an unacceptable effect.

Periodic System Checks

Check that the rainfall catchment tray is not leaking – especially along the lower edge of the tray. This should be done after rainfall has ceased.

Check the lower hose with the small tube outlet, from the header tank to the displacement tank, is not blocked.

Monitoring Records

A separate sheet is provided for monitoring records for each month (see Appendix 1.C to this CTMP). The information to be recorded is as follows:

Visual check - Check the tray for leaks, the plumbing, and the hoses from the header tank. Record 'ok' or if maintenance is required write 'M' and note requirement in Notes column.

How full is the header tank (%)? This is the volume between the lowest and middle outlets. After rain this should be either 100% after 12mm or more rain, or between 0-100% after less than 12mm rain. In summer: 50% when lowered after 3 dry days; 0% when emptied after 6 dry days.

Depth in Displacement Tank (%) - Measure depth of water in cm. Reduces to 0 when emptied.

Chemical volume added - Record the PAC or Superfloc volume added. 1 drum = 200L, 9cm in the 200L drum = 20L. The volume can also be calculated from change in water level in displacement tank where 1cm change = 4 litres of chemical.

Water Clarity - Record using black disc near device outlet. (Refer above).

Appendix 1.C – Chemical Treatment Monitoring and Maintenance Record

Site:

Sediment Control Device Name:

Month:

Maintenance Person:

Date	Visual Check	% Header Tank Full	Water depth in Displacement Tank (cm)	Chemical Volume Added	Water Clarity (cm)	pH	Notes on maintenance required or additional information	Rainfall (mm)	Initial
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									

Appendix 1.D – Bench Testing Results Sheets

1 Introduction

Soil samples were taken from the contributing catchments of (insert description of devices and catchment).

These two chemicals were tested: (delete any chemical that was not tested)

1. **Poly Aluminium Chloride (PAC)**
2. **Superfloc**

Superfloc is a blend of PAC and PolyDADMAC.

Bench test flocculation trials were undertaken to determine soil reactivity to chemical treatment in accordance with the Auckland Council Guideline GD05.

2 Bench Test Trials

2.1 Results of PAC Bench Test

Initially, bench tests using PAC. The results of the bench tests are as follows.

Sample 1, Catchment 1

Initial pH =

Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
2					
4					
6					
8					
10					

Sample 2, Catchment 1

Initial pH =

Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
2					
4					
6					
8					
10					

2.2 Results of Superfloc Bench Tests

Bench tests were also undertaken using Superfloc. The results of the bench tests are as follows.

Sample 1, Catchment 1

Initial pH =

Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
1.6					
3.2					
4.8					
6.4					

Sample 2, Catchment 1

Initial pH =

Initial Turbidity =

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final Turbidity after 60mins
0					
1.6					
3.2					
4.8					
6.4					

3 Discussion

Insert discussion and conclusion based on the bench testing results.

Include recommendation / chemical to be used and dose rate

3.1 Batch Dose Rate

Insert batch dose rate and requirements

3.2 Rainfall Activated Dosing System Details

Floc Shed Tray Size

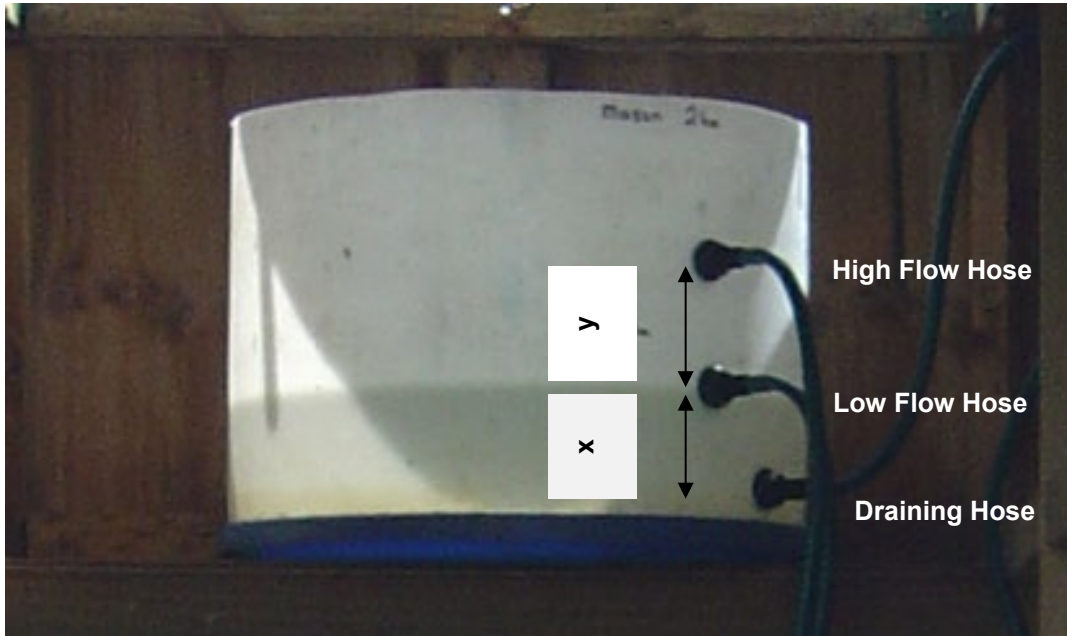
Based on the bench test results displayed in Appendix 3 undertaken on [insert date of testing] the required tray size is XXX square metres per hectare of exposed land catchment draining to the sediment control device. This is the area inside the upstand around the edge of the tray.

Sediment Retention Device	Catchment area (ha)	Tray Size (m ²)
XX	X	X
XX	X	X

Header Tank Outlet Spacing

The distance between the drain and first dosing outlet, and between the two dosing outlets, for a standard header tank made from a 200-litre drum with an internal diameter of 55 cm would be:

Sediment Retention Device	Catchment Area (ha)	Distance (x) (cm)	Distance (y) (cm)
XX	XX	X	X
XX	XX	X	X



Appendix 2 – Erosion and Sediment Control Monitoring Plan

Te Ahu a Turanga; Manawatū Tararua Highway

Appendix 2: Erosion and Sediment Control Monitoring Plan

Document Number	TAT-0-EV-06030-CO-RP-0005
Revision	A
Date	21/02/2020



Document Control

Document History and Status

Revision	Date Issued	Author	Reviewed By	Approved By	Status
A	21/02/2020	Lorraine Pennington / C Stewart			Draft
		Role			

Revision Details

Provide a brief statement on what the updates are for each revision.

Revision	Details
A	Draft

Purpose of Issue

Provide the reason for issue e.g. 85% report for peer review etc.

Revision	Details
A	Draft

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1 Introduction

The purpose of this Erosion and Sediment Control Monitoring Plan (ESCMP) is to detail the erosion and sediment control (ESC) management and monitoring system that will be implemented for the duration of the earthworks period of Te Ahu A Turanga; Manawatū Tararua Highway project (the Project). It is to be read in conjunction with the Aquatic Ecology Monitoring Protocols (Section 10 of the Ecology Management Plan). The ESCMP includes details of process and procedures that will be followed and confirms how the ESC management and monitoring will be undertaken and the methods used in the context of the Project to ensure that effects and performances are managed appropriately.

This ESCMP has been written to detail how we propose to manage and monitor ESC measures during construction, to ensure management of performance of the Project's ESC measures and to provide rapid and real time information and control to the Project team. Our iwi partners will be included throughout the development of this ESCMP and will be involved onsite throughout the construction phase.

The ongoing monitoring and reporting that is proposed in this ESCMP, creates a continuous feedback loop of the performance of the Project's ESC site and device management. This ESCMP provides the approaches to be followed in regard to ESC maintenance, monitoring and reporting and will be reviewed on receipt of the finalised consent conditions and updated as may be necessary to be consistent with those conditions.

This document will be reviewed on an annual basis. Any material changes to this document will require certification by Horizons Regional Council (Horizons).

The ESCMP covers:

- Site management structures, practices and procedures.
- Weather Monitoring.
 - Prior to commencement of construction works two automated weather stations will be installed onsite (at the eastern and western rises of the Ruahine Range).
- Erosion and Sediment Control Monitoring
 - Scheduled site visits, pre and post rain event monitoring and water sampling.
 - Automated turbidity recording on two selected Sediment Retention Ponds which will include rainfall event triggered manual turbidity monitoring.
 - Chemical treatment will be monitored in accordance with the Project's Chemical Treatment Management Plan (Appendix 1 to the Erosion and Sediment Control Plan (ESCP)).
- Reporting
 - Rainfall trigger event reporting following a rainfall trigger event (as defined in Section 3.2 of the ESCMP).
 - Recommendations of changes that need to be implemented on site and modifications to any ESC devices or practices will also be included.
- Annual Reporting
 - A Monitoring and Maintenance annual report will be completed and issued to Horizons and iwi partners by the end of June after the completion of each earthworks season. This report will contain all the monitoring results and interpretation of the fluctuations

and observations recorded over the previous year, as well as any changes or modifications that are proposed to this ESCMP.

1.1 Site Specific Erosion and Sediment Control Implementation

The construction of all erosion and sediment controls will be managed as follows:

- The Environmental Technical Specialist will prepare a Site-Specific Erosion and Sediment Control Plan (SSESCP) in conjunction with the relevant construction zone Project Engineer, Site Engineer and the Environmental and Site Supervisor's.
- The SSESCP will be approved by the Environmental Manager and then submitted to Horizons for certification against GD05 and the consent conditions.
- Once certified, the Environmental Manager will issue an approved SSESCP to the appropriate earthworks zone Site Supervisor responsible for implementation.
- A pre-construction meeting will be held by the Environmental Management Team where the sediment controls to be built will be discussed and specific direction given on construction.
- The location of the controls and requirements of the relevant SSESCP will be confirmed on site with the construction team and the Environmental Management Team.
- The construction of the controls will be overseen by the Site Supervisors and members of the Environmental Management Team.
- Hold points for construction will be established for each control whereby the Environmental Management Team will inspect the work completed, for example the installation of anti-seep collars or the installation of primary outlet.
- Each control will be 'as built' certified by the Environmental Management Team to confirm compliance with the SSESCP prior to bulk earthworks commencing in the catchment of the device(s).
- Copies of the 'as-built' certifications will be submitted to Horizons.

1.2 Erosion and Sediment Control Inspections

The Environmental Manager and / or Environmental Supervisor will conduct routine (minimum weekly) inspections of the site. These inspections will take place with adequate time allocated and will be thorough and systematic. Members of the construction team including the relevant zone's Project Engineer and/or Site Engineer and/or /Site Supervisor, will accompany the Environmental Manager or Environmental Supervisor on these inspections so that the Environmental Manager or Environmental Supervisor can better understand the work occurring at that time and that programmed to take place. It is also useful for the Project Engineers to be reminded of their ESC obligations and for both parties to recognise good performance and outcomes, and where performance has not been to the standard expected or required by consents and GD05. This is particularly relevant in identifying how communication between personnel can be improved to avoid a recurrence of an issue.

Communication is critical to the successful implementation of SSESCPs. Internal inspections will cover all areas of the Project, even those that may have been dormant for some time, to ensure that the controls are still operating properly. These internal inspections will be captured in writing and will include actions and timeframes for close out.

1.3 Weather Monitoring

1.3.1 Rain Forecast

Rain forecasts relevant to the site will be checked daily using the MetService / MetVuw online forecasting systems. Close monitoring of the rain forecast will be necessary to ensure the appropriate site works can be implemented prior to rainfall trigger events.

The daily weather forecast checks will be forwarded to all Project Engineers, Site Engineers and Site Supervisors every morning and will be recorded in the daily prestart job sheets.

If the forecasts show more than 20mm of rainfall over a 24-hour period, then this will trigger the pre-rain event environmental team inspections as outlined in section 3.2 of this ESCMP (pre-rain event with forecast >20mm over 24 hours). This is in addition to the routine pre-rain event inspections undertaken by Site Engineers and Site Supervisors as detailed in section 3.3 of this ESCMP below. Note the pre-rain forecast trigger of >20mm over 24 hours is less than the rainfall trigger monitoring (referred below) to provide a buffer and to ensure no actual rain event of 25mm is “missed” by the construction team.

1.3.2 Rain Gauges

Two telemetered rainfall monitoring stations will be installed on site to provide real-time continuous rainfall intensity and volume data which will be able to be observed online by Project personnel. Email and/or text notifications will be programmed to ensure relevant staff, including the Environmental Management Team, are alerted when rainfall trigger events occur onsite.

1.4 Erosion and Sediment Control Device Monitoring

1.4.1 Site inspections

Routine inspections are undertaken during and post instalment of ESC devices. During construction certain stages are identified for inspection, such as during the installation of anti-seep collars, level spreaders, and T-bars.

Post construction monitoring is undertaken once a SRP or DEB is operational, and the rainfall activated chemical treatment system is operational for the first time. Monitoring will take place as soon as practicable following the first rainfall event that generates a discharge. This is to assess the performance of the device and chemical treatment system and the resulting quality of treated water being discharged from the site.

The site will be inspected weekly as a minimum by the Environmental Manager and / or Environmental Supervisor and/or Environmental (ESC) Technical Specialist during the course of the works. These inspections will ensure that all ESC devices are installed correctly and then operate effectively throughout the duration of the works. This inspection programme will provide certainty to all parties that appropriate measures are being undertaken to ensure compliance with conditions of consent and the SSESCPs. The inspection regime will keep ESC management at the forefront of works on site. Any potential problems will be identified immediately, and remedial works will be promptly carried out.

The inspection programme shall consist of:

- Weekly site walkovers involving the Environmental Management Team to inspect all ESC measures, identify any maintenance or corrective actions necessary, assign timeframes for completion, and identify any devices that are not performing as anticipated through the SSESCP.
- Pre-rain event: Prior to all forecast rainfall events (as detailed above in section 3.2 of this ESCMP), additional inspections will be made of ESC devices, including chemical treatment systems and automated monitoring devices, to ensure that they are fully functioning in preparation for the forecast event. These will be undertaken by the Site Engineers and Site Supervisors.
- Pre-rain event with forecast > 20mm over 24 hours: Prior to forecast rainfall “trigger” events the site will be inspected by the Environmental Management Team (in addition to the business as usual pre-rain inspections undertaken by the Site Engineers and Site Supervisors). The aim of the inspection will be targeted at any additional ESC measures that are required to be installed

to ensure that the site's ESC management system performs effectively during an expected larger event.

- **Rainfall Trigger Inspections:** In addition to the general post rainfall event monitoring, during or immediately after rainfall trigger events (subject to health and safety restrictions) inspections will be made of all SRPs and DEBs, with manual turbidity and pH testing of the inlet and outlet flows undertaken along with a general inspection of the sediment control devices. Clarity of the water within the device adjacent to the decant outlet will be measured using either a clarity tube or black disc indicator. The purpose of these inspections is to confirm the performance of devices under the stress of heavy rainfall, obtain a spot check efficiency of the device and to compare the field results with the results gained from the automated turbidity monitoring stations set up on two SRPs, as described below in section 1.4.2 to this ESCMP.

The rainfall trigger alerts will be generated via the on-site rainfall gauge and will be linked to the mobile phones of the Environmental Management and Construction Teams.

The key rainfall event triggers driving specific device monitoring are as follows:

- >25mm rainfall over any 24-hour period
- >15mm rainfall within an hour

1.4.2 Automated Monitoring

Continuous turbidity monitoring will be undertaken at the inlet and outlet of two SRPs. The location of these monitoring stations will be determined in consultation with Horizons. The purpose of this automated monitoring is to provide real time performance indicator of the treatment efficiency of the device for all rainfall events that result in a discharge. This information will inform the overall likely performance of the devices across the site, when used in conjunction with manual turbidity monitoring undertaken during rainfall trigger events.

The inlet sensor will be located upstream of the SRP forebay and upstream of the chemical application point.

The outlet sensor will be located within the discharge manhole or an alternative location at the discharge point of the SRP.

This data will be accessible online in real-time.

The use of turbidity allows for the Project to observe live real time data and formulate decisions based on data obtained throughout the entire rain event.

1.4.3 Clarity Monitoring

As well as manual turbidity recording, manual clarity checks will be made at each SRP and DEB, using the following procedure:

Black disc

- A 50-80mm diameter is attached to a 1m long stick with a centimetre scale starting at the disc is lowered vertically into the water to be tested until it disappears, and then is raised until it just reappears. The depth of reappearance is recorded as the clarity of the water.

Clarity Tube

- A clarity tube including a magnetic back disc will be filled with water from the device. The tube will be laid horizontal and disc is moved down the tube until it disappears, and the distance is recorded. The disc is then moved back until it reappears, and the distance is recorded.
- Readings should be taken in diffuse sunlight or shade. If it is impossible to avoid bright sunlight, work with the tube perpendicular to the sun's plane.
- Readings will not be taken in very low light conditions (insufficient for colour perception)

1.4.4 pH Monitoring

pH will be recorded at each device receiving chemical treatment, using the following procedure:

1. Ensure that the pH meter has been calibrated and that the calibration has not expired.
2. Use the pond water (or water that is to be discharged) to rinse out a small container then half fill with water from the same source.
3. Immerse the pH meter in the water and leave for up to 1 minute or until the reading stabilises and doesn't change. Place the container in a shaded place (out of direct sunlight) while it stabilises.
4. Record the pH reading given on the meter along with the date, time, and source of the water (e.g. SRP 4).

1.5 SRP Treatment Efficiency Threshold

Treatment efficiencies of the two continuously monitored SRPs will be assessed against an average efficiency of 90% across a rainfall trigger event. The average efficiency will be calculated from the inlet and outlet readings taken over the duration of the event. Where an efficiency of 90% across a rainfall trigger event is not achieved, the following will occur:

- Within 24hrs of a threshold exceedance, a full audit of the condition of the control device and its contributing catchment will be carried out and recorded in writing.
- Remedy and record any obvious causes on site that may have contributed to a threshold exceedance as soon as practicable.
- Identify any additional reasons for the exceedance and opportunities to modify the management of the site to improve overall efficiency which may include:
 - Consider additional ESC;
 - Refinement of chemical treatment systems;
 - Progressive stabilisation in sub-catchments;
 - Increase maintenance of controls; and
 - Amendments to methodologies and sequencing of works and refinement of controls necessary (check that a further approval is not required from Horizons).
- In consultation with Horizons, implement alterations to ESC measures and methodologies.

1.5.1 Data Interpretation

All data will be compiled to allow for the analysis of device efficiency in relation to rainfall, earthworks area and overall ESC management. This will also inform potential for modification of site ESC practices to better retain sediment within the site, if that is deemed necessary.

2 Management Responses

In addition to the SRP treatment efficiency exceedance responses detailed above, if one of the following cases occur, additional management responses will be triggered as outlined below. In some instances,

responses may need to be discussed and agreed with Horizons to ensure the most appropriate outcomes are achieved.

- i. A failure of a perimeter control that has resulted in visible discharge of sediment to a stream.
- ii. A failure of a SRP or DEB that has resulted in a visible discharge of sediment to a stream.
- iii. Slumping / mass movement or erosion associated with the works, but which is outside the catchment of a sediment control device or has resulted in a device being over-topped by sediment, where that sediment has discharged to a stream.
 - Remedy the failure or event to prevent further uncontrolled discharges.
 - Implement the Event Based ecology and water quality monitoring described in Section 1.1.5.3 of the Aquatic Ecology Monitoring Protocols, Section 10 of the Ecology Management Plan.

3 Reporting

3.1 Site Auditing

Daily inspections will be undertaken by the ESC Foremen.

An internal audit will be undertaken by the Environmental Manager and / or Environmental (ESC) Technical Specialist weekly at a minimum. Any maintenance actions will be undertaken that day where practical.

Actions will be loaded into the Environmental Management system and Work Instructions with details and timeframes will be issued by the Environmental Supervisor to the relevant ESC Foreman, with specific actions and closeout timeframes. The ESC Foreman will report completion of those actions and the Environmental Supervisor will inspect the works and close-out the items in the management system.

For programmed Horizons inspections, a member of the Environmental Management Team will accompany the Horizons inspector in all audits. Usually a member of the Construction Team will also be present.

As for internal audits, all ESC maintenance actions identified by the Council inspector will be recorded into the Project Environmental Management system. Work Instructions, with details and timeframes, will be issued to the ESC Foreman by the Environmental Supervisor, based on the Council's instructions. The ESC Foreman will report back the completion of those actions to the Environmental Supervisor who will inspect the works and confirm that those actions have been completed. Confirmation will be emailed to the Council inspector.

3.2 Rainfall Trigger Event Report

Following a rainfall trigger event, a report will be produced to provide Horizons and iwi partners a summary of the performance of SRPs, DEBs and overall ESC system observed during the rainfall event. The report will include:

- A summary of the rainfall (total and intensity)
- Summary of the data acquired from the automated turbidity monitors from the two SRPs, including summary of event-based efficiency.
- A summary of the manual monitoring undertaken and comparison of manual monitoring results with automated results.
- Identification if a threshold exceedance occurred. This will outline what exceedance occurred, the extent of the exceedance, any actions taken to mitigate the effects of the event and a proposed management response if required.

- A record of any other matters which may have compromised the overall ESC performance during the rain event and the identified mitigation, maintenance and management response.

The Rainfall Trigger Event Report will be provided to Horizons and iwi partners within 10 days of the rainfall trigger event.

3.3 Annual Report

An annual report containing monitoring results and an assessment of discharge compliance will be provided to Horizons within the month of July of each year. This report will contain the following details.

- A summary of the results of all monitoring within that period.
- A summary of any threshold exceedances that occurred and the response actioned.
- Any proposed changes or updates to the ESCMP are to be discussed with Horizons. Written certification from Horizons must be provided if any significant changes to the ESCMP are made.

Appendix 3 – Dust Management Procedure

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CP-RP-0006-A
Procedure:	Appendix 3: Dust Control Procedure		

Document Status

The most recent revision of this document is in Sharefile as the initial Documentation Management System.

1 Application

This Procedure forms a part of the Erosion and Sediment Control Plan (ESCP) for Te Ahu A Turanga: Manawatū Tararua Highway (the Project). The proposed construction works on the Project include bulk earthworks operations and haul roads that will require dust management.

The purpose of this plan is to ensure that the required level of dust management is achieved on site during these operations.

2 Scope of works


The proposed construction works on the Project will include the following:

- Ground improvements
- Excavations
- Bridge construction (inside & outside highly sensitive ecological areas)
- Upgrading of existing road network
- Construction of roundabouts on existing road network
- Construction of a visitor centre

3 Potential Environmental Impacts of Activities.

The key potential environmental aspects and impacts relating to dust generation are:

Aspects	Impacts
Dust generation from earthworks, material movement, crushing, vehicle movements and bare soil particularly during dry, windy weather conditions.	<p>Nuisance to local residents from airborne dust and dust on local roads.</p> <p>Health and safety hazard to site workers from airborne dust particles</p> <p>Deposition of dust to surrounding terrestrial and aquatic habitats, contributing to sediment loads.</p> <p>Dust particles in the environment affecting wind turbines</p>

 		PROCEDURE	
Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CP-RP-0006-A
Procedure:	Appendix 3: Dust Control Procedure		

4 Key Responsibilities

Responsibilities

The **Environmental Manager** is responsible for:

- Communicating upcoming weather forecasts to the team
- Reviewing and updating this Procedure
- Organising monitoring as required;
- Developing and delivering training material on dust control;

The **Earthworks Manager** is responsible for:

- Ensuring the implementation of this Procedure;
- Communicating requirements to relevant site personnel; and
- Ensuring personnel have received appropriate training to competently carry out their duties with respect to this procedure.

The **H&S Manager** is responsible for:

- Inspections and checks in order to verify conformance with this Procedure;
- Assisting the Construction Manager in their duties.

All **Site Personnel** involved in activities with a potential to generate dust are responsible for:

- Following the requirements of this Procedure;
- Following the requirements of the Emergency Spill Response Procedure (Appendix 5 to the ESCP) in the event of spills (e.g. from stockpiles);
- Reporting any defects, incidents or accidents to the Construction Manager or Environmental Manager.

For activities with a potential to generate dust, relevant Work Instructions will establish the controls to be applied. During the development of Work Instructions, the following issues will be considered.

5 General Procedure

It is a key principle for the Project that a proactive approach will be taken to dust management on the site, rather than a reactive approach involving dust control once effects are occurring. As construction of the Project involves large scale earthworks and pavement construction, both of these activities have the potential to generate dust. To minimise potential dust nuisance:

- Earthworks will be staged (as far as practicable) so as to minimise the length of time that areas are exposed to drying;
- The route and speed of vehicles working on the site will be controlled appropriately, limiting vehicle speeds over unsealed surfaces to 20 km/hr during dry weather, when within 100 m of sensitive receptors; and
- Materials will be applied on surfaces to minimise dust generation.
- Pavement works will be closely monitored during the time of stabilisation to ensure there is no cement dust mobilisation from the works.

 		PROCEDURE	
Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CP-RP-0006-A
Procedure:	Appendix 3: Dust Control Procedure		

For activities with a potential to generate dust relevant Work Instructions will establish the controls to be applied. During the development of work methods, the following issues will be considered, although the main controls will be stabilisation and watercarts.

6 Dust Management

6.1 Dust Sources & Generation

The construction activities that will take place throughout the Project that may generate discharges of dust to air are:

- Earthworks, including vegetation removal, stripping of topsoil.
- Vehicle movements on unpaved surfaces.
- Loading and unloading of materials.
- Wind generated dust from dry exposed surfaces such as stockpiles and yard areas
- Use of cement and/or lime for assisting in structural fill compaction.
- Pavement construction (cement stabilisation)

6.1.1 Factors Influencing Dust Generation

The major factors that influence dust generation are:

- Wind speed across the surface;
 - The critical wind speed for pickup of dust from surfaces is 5 m/s (18km/h) as an hourly average.
 - Pickup increases rapidly above 10 m/s (36km/h) as an hourly average.
- The percentage of fine particles in the material on the surface.
- Moisture content of the material on the surface.
- The area of exposed surface.
- Disturbances such as traffic, excavation, loading and unloading of materials.
- The height of the source above the surrounding ground level (for drops of material).

The smaller the particle size of the material on the surface of a road or an exposed surface, the more easily the particles are able to be picked up and entrained in the wind. Moisture binds particles together preventing them from being disturbed by wind or vehicle movements.

The larger the area of exposed material the more potential there will be for dust emissions. Vehicles travelling over exposed surfaces tend to pulverise any surface particles. Particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents due to turbulence between the wheels and the surface. Dust is also sucked into the turbulent wake created behind moving vehicles.

6.2 Dust Monitoring

Due to large areas of the Project alignment being isolated from the surrounding community we recognise that any potential dust nuisance is likely to be confined to a small group of sensitive receivers in close proximity to the Project works. As such, dust monitoring and mitigation will be focused on these areas/receivers. Monitoring will consist of visual checks made by the Site Engineers and Site Supervisors during the day.

Specific dust monitoring will include the use of nephelometers near houses at either end of the alignment that are downwind under prevailing winds and close to the works. For sensitive ecological areas and where wind turbines are downwind and within 100 metres of the site, deposition monitors will be installed.

 		PROCEDURE	
Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CP-RP-0006-A
Procedure:	Appendix 3: Dust Control Procedure		

6.3 Meteorological Monitoring

Meteorological monitoring at a location near the Project on the Ruahine Ranges will be undertaken so as to inform staff of the occurrence of strong wind conditions (10 m/s hourly average or greater), which can exacerbate dust emissions from exposed areas.

The equipment is to include the measurement of wind speed and direction at a height of 10 m above ground level. The equipment will be set up at a location near the Project alignment on the Ruahine Ranges where there is sufficient cell phone coverage for telemetry purposes and no nearby obstructions, such as buildings or tall vegetation. The equipment is to be setup in accordance with 'AS2923 – 1987 Ambient Air Grade for Measurement of Horizontal Wind for Air Quality Applications'

Real time meteorological data from station will be continuously recorded using an electronic data logging system with an averaging time for each parameter of not more than two minutes. The results are be available to staff in real time, with the logging system automated to send messages to site operations to alert them that wind speeds are 10 m/s or greater.

6.4 Sensitive Receivers

A small number of neighbouring properties have been identified as sensitive receivers due to their proximity to the construction works. These properties are located into three discrete groups along the alignment. (Refer Table 1 below and Figures 1 – Sensitive receivers map).

Table 1 Sensitive Receivers

Reference	Address	Building Type	Distance to Works
TAP09, TAP10	Ruahine Range Area	Turbines	Within 100m of Project works in direction of West to N'westerly winds from Project site
F2, F4, E1, E2	Ruahine Range Area	Ecological	Within 100m of Project works in direction of West to N'westerly winds from Project site
B1	Ballantrae Area	Research	East & north of Project works within 100m
TAP46, TP49	Ballantrae Area	Turbines	Within 100m of Project works
F7, E4	Ballantrae Area	Ecological	Within 100m of Project works
R5, R6, R9	Woodville Area	Residential	Within 100m of Project works in direction of East & S'Easterly winds from Project site

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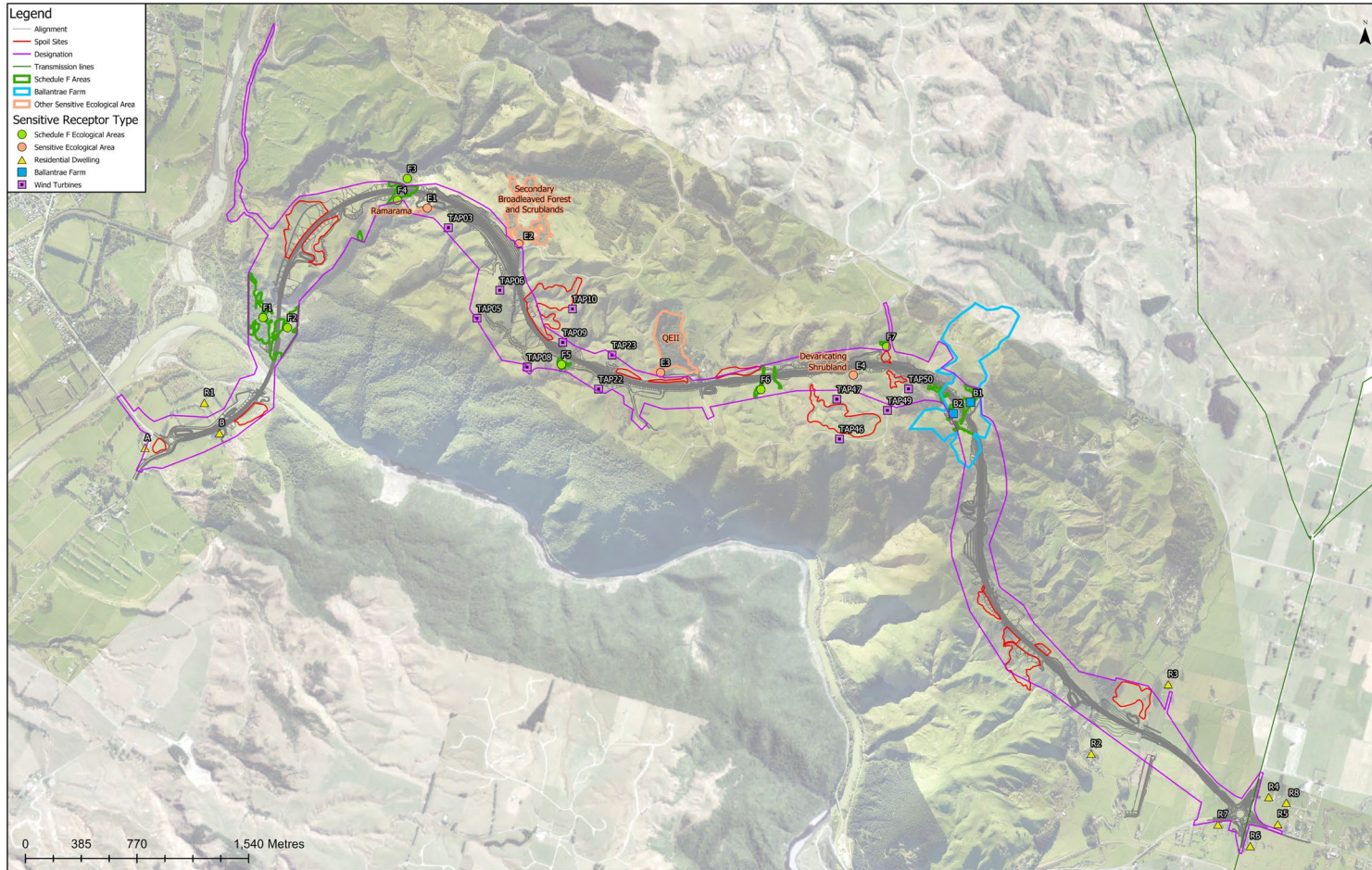


Figure 1 Sensitive Recievers

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Dust Risk zones have been defined by reference to the location of these receivers and are shown below in Table 2.

Table 2 Extent of Dust Risk Zones

Sensitive Receiver Group	Dusk Risk Zone Extent (Chainage Start and Finish)
Ruahine Range Area	TBC
Ballantrae Area	TBC
Woodville Area	TBC

6.5 Dust Monitoring

There will be daily observations of active work areas for any significant visible dust emissions. This monitoring will focus on haul routes, frequently trafficked areas, excavation sites and fill/spoil areas, with particular attention of the areas within 200m of residences and 100 of those other areas (i.e., wind turbines and sensitive ecological areas) identified as being sensitive receivers. During prolonged dry weather, observations will be carried out more frequently.

Checks of weather forecasts at the start of each day (particularly the absence of rain and whether strong winds are expected) will be used to inform activities to be undertaken, including advising staff of the potential risk for dust impacts.

All staff working in these areas will be trained on what to look for and required to be aware of the potential for dust nuisance. Work instruction and daily toolboxes will reinforce this requirement.

For the sensitive residential receivers detailed above (being R4, R5 near Woodville), instrumental continuous dust monitors (nephelometers) will be established in general accordance with AS/NZS 3580.12.1:2015¹ or similar. These monitors will provide real-time feedback on dust levels near these sensitive locations, to provide notice of elevated dust levels and to allow a pro-active response. This monitor will be located between the construction works and receptors R4 and R5 when construction works are within approximately 100m of any of those receptors.

A 1-hour average trigger level for PM₁₀ is the most suitable for managing dust when using nephelometer instruments. The following concentration trigger will be used, but may be reviewed subject to operator experience and/or community feedback:

Trigger concentration (PM₁₀): 150 µg/m³, hourly average

Should this trigger level be reached then an automated message will be sent to site operations. Dust generating activities will cease in that location until such time that emissions can be adequately controlled, and concentrations reduce to within the trigger levels. This may mean an increase in water application, using polymers to increase the effectiveness of the water management, reconsidering construction activities, and/or ceasing work in some areas.

Dust deposition monitoring will be undertaken in and around the most exposed wind turbines (TAP9, TP10, TAP47 and TAP50) and sensitive ecological areas (F2, F4, F7, E1, E2, E4 and B1) for the duration of construction works in a given area (i.e., those located within 100m of the Project works and downwind during

¹ AS/NZS 3580.12.1.2015. Methods of sampling and analysis of ambient air – Part 12.1: Determination of light scattering integrating nephelometer method.

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prevailing winds of construction works). Deposition monitors once set up collect deposited material. A baseline sample will be collected over a month, after which the collected sample is retrieved and sent to a laboratory for analysis to confirm the rate of measured deposition. The results can then be compared to a trigger value of 4 grams per square metre per 30-days above background levels (4 g/m³/30-days) (Ministry for the Environment's 'Good Practice Guide for Assessing and Managing Dust' (MfE 2016) for the duration of the construction works.

The results of deposition monitoring should be reviewed each month against site activities for the period coinciding with the monitoring. Where results are elevated (i.e., those that approach or exceed the above trigger value) then the potential causes will be investigated, and where possible additional control measures implemented to minimise ongoing emissions. This could include (but not be limited to) an increase in water application, using dust suppressants to increase the effectiveness of the water management, or reconsidering construction activities.

Directional dust deposition gauges in relation to monitoring downwind of identified wind turbines will be used. The methodology is set out in AS/NZS 3580.10.2:2013².

In relation to ecological receptors, where deposition on horizontal surfaces is more a concern, a traditional dust deposition gauge will be used. The methodology is set out in AS/NZS 3580.10.1:2016³.

6.6 Dust Management Toolbox

The following dust management and mitigation measures will be undertaken as required to minimise overall dust emissions and nuisance.

6.6.1 Water Resources

The Project will have one surface water take authorised by Horizons as described in Table 3 below.

Table 3: Consent to take Water

Resource Consent	Description of Authorised Activity	Instantaneous Take Rate Restriction	Daily Allocation	Annual Allocation
TBC [not yet applied for]	To take xxm3 of water from the Manawatū River			

This consent will be utilised. Water will be withdrawn and made available for water carts by way of a pump system from the Manawatū River and will be pumped along the alignment and to three separate water reservoirs located for water trucks to access for dust control purposes.

Each reservoir will have the capacity to hold 3000 cubic meters of water. This allows the team to take the water from the Manawatū River at a slow and consistent rate, while having enough water for construction and dust control at the times when it is needed.

² AS/NZS 3580.10.2:2013. Methods for sampling and analysis of ambient air. Determination of particulate matter - Impinged matter - Gravimetric method.

³ AS/NZS 3580.10.1:2016. Methods for sampling and analysis of ambient air. Determination of particulate matter - Deposited matter - Gravimetric method.

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6.6.2 Water Carts

Water carts or tankers will act as the primary method for controlling dust on site (Refer Photo 1 and 2). Water cart use will be focused in the dust risk zones described in Table 2 (Section 6.3). The number of carts required, and the frequency of watering will be determined by the Earthworks and Environmental Managers who will consider vehicle movements, weather conditions, and the proximity of the nearest sensitive receiver.



Photo 1: Water Cart in Operation

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Photo 2: Water Tanker in Operation

6.6.3 Surface Application of Dust Suppressants


Biodegradable dust suppressants may be used to protect the high-risk areas and be applied to surfaces where dust has been identified as a significant risk. The inert nature of these products makes them ideal as an environmentally friendly application. The decision as to whether a polymer stabiliser will be utilised rests with Construction and Environmental Managers.

Polymer stabilisers will not only be used to treat dust nuisance issues but also as a soil binder if it is deemed suitable. Polymers added to water can improve the efficiency and effectiveness of the water application for dust suppression on high risk haul roads that have the potential to cause significant dust concerns.

6.6.4 Hay Mulch Stabilisation

Hay mulch stabilisation will eliminate open areas as sources of dust. Hay mulch may also be used to stabilise finished areas adjacent to sensitive receivers or neighbours to mitigate as much dust nuisance as possible.

Hay mulch is only effective in low wind zones unless it is applied with a tacifier to reduce the likelihood of it being blown off before the area can be stabilised. It is noted that a large percentage of the route is a high wind zone.

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6.6.5 Progressive stabilisation

Areas of work will be progressively stabilised, either temporary or permanently, including the rolling and finishing off areas as works progress. This helps to minimise the duration that areas could give rise to dust emissions impacting on sensitive locations.

6.6.6 Loading and Unloading of Materials

The drop height of material from the operation of diggers and loaders is to be minimised to reduce the potential for wind-blown dust. Digger and loader operators should be trained to ensure that the material being dropped from the digger/loader bucket is done as close as practicable to the truck or surface being loaded and not from an unnecessary height.

6.6.7 Top Soil Stockpile Management

Topsoil stockpiles will all be located as far from sensitive receptors as possible and the surface of the stockpile stabilised with grass seed and hay or straw mulch upon their completion. Topsoil stockpiles will also be constructed with a low profile wherever possible to reduce the height of the bund and thus further reduce the stockpiles ability to generate dust as it has a lower profile exposed to wind. Wherever practically possible stockpiles will not be positioned any closer than 100m from a dwelling house.

6.6.8 Entraceways

Stabilised entranceways will be constructed at all site entrances to minimise the tracking of material out of the construction areas and onto local roads where it would dry and become a source of dust. The standard of the construction for these entranceways is described in the Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region*, June 2016 (GD05).

Portable water blasters and water carts will be available to wash the road adjacent to the entranceways in the event of construction vehicles tracking material onto either local roads or the State Highway. Road sweeper vehicles and sucker trucks will routinely maintain the roads around the site entrances in order to keep fine material accumulating on the road surface where vehicle movement might generate dust.

6.6.9 Restriction of Work

If wind conditions are severe enough, construction activities may need to be restricted or cease altogether in order to mitigate any potential dust issues when within 100 m of sensitive receivers. The decision to restrict or cease all work will be made by the Construction Manager and the Environmental Manager.

To assist in making the decision the following criteria shall be reviewed:

- Wind speed and direction currently prevailing (such as 10 m/s as an hourly average).
- The construction activity currently being performed, and the length of time that activity is to continue.
- The distance to the nearest sensitive receptor and the nature of their sensitivity (such as 200m of a dwelling, 100m of a wind turbine or sensitive ecological area).
- The presence of historical complaints and the outcome of investigations into those complaints.
- The existence of a current complaint.
- The mitigation measures currently being applied and the additional measures that might be utilised.

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6.6.10 Sensitive Area Screening

As a contingency measure for sensitive locations within 50 m of potential dust sources and should monitoring (described in Section 5.5) indicate the need, wind break fencing could be erected between the sensitive location and the source to help further minimise dust impacts on the receptor.

6.6.11 Site Wide Communication of Dust Risk

On site delineation of the dust sensitive zones will be marked with Dust Risk signs (Refer Photo 3) to prompt and remind construction staff that they are operating in a sensitive area. Site wide text message warnings will be issued by the Environmental Manager to Project Engineers & Site Engineers, (including pavement crews) when environmental conditions reach a point where a dust nuisance is possible.



Photo 3: Dust Risk Signs will assist with Communicating the Risk to Construction Staff

6.6.12 Complaints

Complaints may be received by one or more of the regulatory authorities, a member of the public, or a member of the Project team. It is the responsibility of the Environmental Manager to respond to and follow up all complaints relating to dust. The Environmental Manager is responsible for ensuring suitably qualified personnel are available to respond to complaints at all times including after hours and on weekends when complaints regarding dust could be received.

On call staff will be notified of the complaint via the Communications Manager acting in accordance with the complaint management procedures detailed in the Communications Management Plan. The on-call staff will respond by visiting the area in question and then implementing dust mitigation measures where it is deemed necessary and in accordance with direction from the Environmental Manager.

6.6.13 Weather Monitoring

The Environmental Manager will obtain daily forecasts and circulate to all Zone Managers and Project Engineers and other appropriate Project staff. Dust control measures will be prepared if dry, windy conditions are forecast.

Appendix 4 - Dewatering Management Procedure

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code	TAT-0-EV-06030-CO-RP-0007-A
Procedure:	Appendix 4: Dewatering Management		

Document Status

The most recent revision of this document is in Sharefile as the initial Documentation Management System.

1 Application

This Dewatering Management Procedure forms a part of the Erosion and Sediment Control Plan (ESCP) for Te Ahu A Turanga; Manawatū Tararua Highway (the Project). The proposed construction works on the Project will include piling, earthworks and streamworks operations that require dewatering by pumping.

The purpose of this Procedure is to ensure that the required level of sediment treatment on site is achieved during these operations.

2 Scope of works

The construction activities of the Project include the following:

- Ground improvements
- Excavations
- Bridge construction and culvert installations (inside & outside highly sensitive ecological areas)
- Upgrading of existing road network
- Construction of roundabouts on existing road network
- Construction of a visitor centre

3 Potential Environmental Effects

The key potential environmental aspects and impacts relating to dewatering are:

Aspects	Impacts
Very high sediment loads from construction water.	Overloading of sediment control devices, causing sediment to discharge direct to water.
Incorrect machinery being used	Incorrect processes being followed onsite, causing sediment discharge to land where it may enter water, or direct to water, which may then cause damage to aquatic life and environment.

4 General Procedure

Sediment retention ponds (SRPs) and decanting earth bunds (DEBs) are to be constructed in accordance with Auckland Council's Guideline Documents 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016'* (GD05). The control devices will be chemically dosed with Polyaluminium Chloride (PAC) to improve the efficiency of the devices when receiving pumped water from dewatering operations.

There will be two procedures for dewatering excavations from the site. Each of these procedures has a specific methodology for ensuring that the sediment treatment achieved by the procedure is in accordance with GD05 requirements and industry best practice.

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The two procedures are:

- Pumping directly from the excavation or stream diversion works to the receiving environment without any treatment.
- Pumping to a sediment control device where the flows will be stored, batch dosed with PAC, and then discharged to the receiving environment.

Any pumping will require a “permit to pump” to be signed by the Environmental Manager, prior to any works commencing (refer Appendix 4.A to this Procedure). This allows for a thorough and robust assessment of the activity and the risks associated.

All dewatering and pumping activities will be overseen by the Environmental Supervisor / an ESC Foreman.

4.1 Direct Pumping

This option is the least likely to be utilised in practice and relies on impounded water within an excavation having a greater clarity than 100mm at all times and the ability of the pump to be able to remove the impounded water without disturbing any sediment. This method is not to be used for dewatering depths of less than 500mm.

NOTE: when pumping from stream diversion works, while the stream is being de-fished, the pump must have a mesh screen of not more than 3mm to protect against fish from being sucked into the pump. The velocity at the screen must be less than 0.3m³/second.

The procedure for pumping directly to the receiving environment will be as follows:

- Dewatering and Pumping Record Sheet (Appendix 4.A to this Procedure) is to be completed and signed off.
- Prior to pumping the clarity of the impounded water is to be confirmed as being greater than 100mm and a pH within the range of 5.5-8.5.
- The inlet to the pump is to be supported no less than 500mm above the base of the excavation in a location and manner where the inlet will not disturb settled sediments within the excavation. Where possible a floatation device shall be installed on the pump inlet to ensure pumping down from the cleanest water.
- The outlet of the pump is to be located on a stabilised surface/area to prevent erosion. It is preferable to discharge the pump to a piped stormwater system.
- During pumping the clarity of the impounded water is to be checked and recorded every 15 minutes. If the clarity drops below 100mm pumping is to stop and an alternative pumping procedure used.

4.2 Batch Dosing

In this method impounded water shall be pumped to a SRP or DEB to be stored and batch dosed, with PAC. When the depth of clarity has increased to greater than 100mm and the pH has been checked and confirmed to be within the range of 5.5 – 8.5 then the stored water will be discharged via the decant of the DEB or SRP. Batch dosing will only be undertaken by a member of the erosion and sediment control team as described in Figure 2 of the ESCP.

The procedure for batch dosing is as follows:

- Dewatering and Pumping Record Sheet (Appendix 4.A to this Procedure) is to be completed and signed off.
- Pumping to a DEB or SRP that already has a contributing catchment should only occur if there is a minimum 24hrs of fine weather forecast.
- The outlet or dewatering device of the SRP or DEB to receive the pumped flows is to be capped or raised to prevent a discharge while water is being pumped to the device.
- The pumped water shall be discharged in a manner that minimises disturbance within the SRP or DEB and must be to the forebay or inlet of the device.

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- Pumping may continue until complete or until the SRP or DEB has filled to the level of the primary spillway. Pumping is not to continue once this level has been reached.
- Once pumping is complete, the water clarity and pH is to be checked. If water clarity is greater than 100mm and pH is within the range 5.5-8.5, then the DEB can be allowed to discharge. If not, the volume of stored water is to be noted and the correct volume of Polyaluminium Chloride (PAC) added.
- The dose rate is determined by the Chemical Treatment Management Plan (Appendix 1 to the ESCP).
- The PAC is to be added to the surface of the SRP or DEB by spraying with a backpack sprayer with a 'stream' outlet rather than a 'mist'. PAC is to be sprayed evenly over the surface of the SRP or DEB. Pondered water can develop marked temperature gradients during the day through its depth which can inhibit mixing of PAC. It is therefore recommended that batch treatment be carried out, whenever possible, in the early morning. Refer to Section 4.2 of the CTMP for the batch dosing methodology.
- PAC is to be mixed into the surface as well as practical using a pole or similar without disturbing the sediment at the base of the device.
- The SRP or DEB is then to be left for a minimum of 2 hours to allow settlement to occur.
- Following 2 hours the clarity and pH is to be checked and recorded.
- In the event that the clarity of the SRP or DEB is still less than 100mm, specialist advice is to be sought from the ESC Team.
- In the event that once the clarity of the DEB is greater than 100mm, however the pH is outside the limits of 5.5 – 8.5 then specialist advice is to be sought regarding correction of the pH level.
- Once the clarity of the SRP or DEB is greater than 100mm and the pH is within the range of 5.5 – 8.5, the water can be discharged by removing the cap or lowering the dewatering device (t-bar). The time of this discharge and the pH and clarity are to be recorded on the Dewatering and Pumping Record Sheet (Appendix 4.A to this Procedure).

5 Procedure Modification

It is expected that as the Project progresses, modification of the dosage rates may be required due to changing soil types etc. This will be undertaken following additional sampling and testing and approval from the Environmental Manager in accordance with the CTMP.

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Appendix 4.A

Dewatering and Pumping Record Sheet – Permit to Pump

Date:	Time:				
Location of water to be pumped					
Estimated volume of water to be pumped					
Weather forecast for following 24hrs (Note a 48hr period may need to be considered if intending to hold the water for a longer period)					
Proposed dewatering method (Circle):					Signed
Direct pumping					
Batch dosing					Device pumping to (i.e. DEB 12):
<u>Direct pumping</u>					Sign as confirmation
Is clarity of impounded water greater than 100mm?					Yes / No
Is pump inlet supported a minimum of 500mm above the base of the excavation?					Yes / No
Is the outlet of the pump stabilised to prevent erosion?					Yes / No
Confirm clarity of water at pump inlet every 15 minutes during pumping					
Time					
Clarity					
Signed					
<u>Pumping to an impoundment device</u>					Sign as Confirmation
Impoundment device to be used:					E.g. DEB 12
Is the outlet capped prior to pumping or dewatering device (t-bar) raised above primary spillway?					Yes / No
Volume pumped (stored within impoundment device) Time pumping stopped					m ³ am/pm
If, clarity is greater than 100mm and pH is between 5.5-8.5 – OK to discharge. Record details					mm pH
Or, if not, batch dosing to occur. Confirm volume of impounded water Confirm batch dose rate Volume of chemical to be added:					m ³ ml/m ³ L
Clarity is greater than 100mm prior to discharge (record clarity)					mm
Measured pH is between 5.5-8.5 prior to discharge. Note: if pH is outside this range refer to Environmental Manager / Project Manager for corrective actions					pH
Time of discharge					am/pm

Appendix 5 - Emergency Spill Response Procedure

 		PROCEDURE	
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Procedure:	Appendix 5: Emergency Spill Response		

Document Status

The most recent revision of this document is in Sharefile as the initial Documentation Management System.

1 Application

This Procedure forms a part of the Erosion and Sediment Control Plan (ESCP) for Te Ahu A Turanga; Manawatū Tararua Highway (the Project). The purpose of this Procedure is to have the procedures in place to manage spills that occur, and to reduce environmental impact of these incidents.

2 Scope of works

The construction activities of the Project include the following:

- Ground improvements;
- Excavations;
- Bridge construction and culvert works (inside & outside highly sensitive ecological areas);
- Upgrading of existing road network;
- Construction of roundabouts on existing road network;
- Construction of a visitors' centre;

3 Potential Environmental Impacts of Activities.

The key potential emergency situations and the environmental impacts of these are:

Aspects	Impacts
Accidental spills and leaks of oils and chemicals to water bodies.	Acute and chronic harm to aquatic ecosystems and riparian habitats.
Failure of slopes, stockpiles or environmental controls leading to severe sedimentation and contamination of watercourses.	Suffocation of benthic life and harm to other aquatic life. Decrease in water quality.
Fire and explosion leading to noxious air emissions and damage to habitats and wildlife.	Impacts on local air quality, nuisance/danger and harm to local residents and wildlife.

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4 Key Responsibilities

Responsibilities.

The **H&S Manager** is responsible for:

- Ensuring controls to prevent emergency situations are in place; and
- Ensuring controls to manage emergency situations are in place.

The **Earthworks Manager/Project Engineers** are responsible for:

- Ensuring the implementation of this Procedure;
- Communicating requirements to relevant site personnel; and
- Ensuring personnel have received appropriate training to competently address emergency procedures.

The **Environmental Manager** is responsible for:

- Ensuring adequate spill response materials are available for all activities;
- Ensuring that all spill kits are in stock; and
- Ensuring all site personnel have received appropriate instruction and training in avoiding and dealing with emergency situations.

All **Site Personnel** are responsible for:

- Following the requirements of this Procedure; and
- Reporting any defects, incidents or accidents to the Earthworks Manager or Environmental Manger.

5 Oil and Chemical Spills

5.1 Prevention

- All oils and chemicals on site must be stored securely within a site approved Hazardous Substances structure in accordance with the Hazardous Substances Procedure.
- All refuelling and plant or equipment maintenance activities will be undertaken in accordance with the Hazardous Substances Procedure (Appendix 7 to the ESCP).
- Spill kits will be kept at identified locations throughout the construction zone, but also at the following key locations:
 - All hazardous substances storage facilities;
 - Areas designated for the handling and use of hazardous substances;
 - Vehicles carrying hazardous substances (e.g. refuelling vehicles);
 - In the vicinity of, and readily available for all work areas;
- Spill kits will comprise, as a minimum, the following:
 - Sawdust (or equivalent absorbent material);
 - An absorbent boom;
 - Absorbent matting;
 - Disposable overalls, gloves and boot covers; and
 - A designated container for the disposal of contaminated equipment and soils.

All spill kits will be regularly inspected to ensure that they are fully stocked at all times.

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5.2 Response to Spills

In the event of an oil or chemical spill **to the ground**:

- The supervisor of the works will:
 - Identify the source and nature of the spill and prevent further release;
 - Immediately contain the spill and prevent it from spreading, using the spill kit or other available material;
 - Advise the Environmental Manager/Project Engineer immediately;
 - Clean up and dispose of any contaminated material in designated contaminated waste containers, no chemical dispersants are to be used in this process; and
 - Notify the Environmental Management Team and Project Engineer of the actions taken to clean up;
- The Environmental Manger will assess any wider impacts resulting from the spill; and
- The Project Engineer will complete an Opportunity for Improvement (OFI) form, including detailing any further actions required.

In the event of an oil or chemical spill **to watercourses or treatment ponds**:

The site personnel involved will:

- Immediately contain the spill and prevent it from spreading using the absorbent boom or matting if appropriate;
- Identify the source and nature of the spill and prevent further release;
- Notify the Environmental Manager & Project Engineer and agree further actions; and
- Where possible clean up spilt material from the water course using absorbent matting or other suitable material from the spill kit, no chemical dispersants are to be used in this process;
- The Environmental Manger will assess the nature of the spill and potential wider impacts; and
- The relevant site personnel will complete an OFI for the incident, ensuring that the cause of the spill is identified and actions to prevent or minimise the potential for a reoccurrence are implemented.

If any spills exceeding 20L on the ground, or 5L over water occur, the Environmental Manager will immediately advise Horizons and Iwi Partners, with a full detailed report being completed and submitted to these parties within 48 hours.

All spills will be recorded, and a monthly spreadsheet made available to Horizons and Iwi Partners on request.

6 Failure of stockpiles, embankments and environmental controls (e.g. sediment ponds)

Procedures to address the failure of stockpiles, embankments and environmental controls are set out in the ESCP (Section 9 - Monitoring and Responses, and in particular section 9.2 Environmental non-compliance and corrective actions).

The monitoring and maintenance of control devices is covered by the ESCP and the ESCMP.

7 Fires and Explosion

7.1 Prevention

- Smoking is not permitted in the vicinity of Hazchem depots or vulnerable vegetation.
- Open fires are not permitted on site for any reason.

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7.2 Response

All hazardous substances containers/structures will be stocked with an appropriate fire extinguisher, sand bucket and other fire fighting equipment. Site vehicles will carry fire extinguishers.

In the event of a minor fire site personnel are permitted to utilise available equipment to extinguish it, if adequately trained with the use of the fire extinguisher. Water should **not** be used to extinguish a chemical or oil-based fire and more serious fires should only be tackled by professional fire fighters.

On identification of a fire or explosion Fire & Emergency NZ is to be contacted **immediately**, followed by the Construction Manager and Environmental Manager.

All personnel should be evacuated from the area of a serious fire or explosion, or where an explosion risk (e.g. near Hazardous Substances storage structures) may exist.

Measures should be taken to minimise the spread of a fire where possible and protect surrounding habitats.

Measures should be taken to minimise the spread of fire water and prevent release into water courses, using available spill kits and containment ponds where appropriate.

Following a fire or explosion the Health & Safety Manager will carry out a thorough investigation of the cause and will raise a report detailing the actions taken to prevent a reoccurrence.

8 Training

In order to prevent the occurrence of spills it is essential that site personnel have received appropriate training. Spill response training will be undertaken for all staff, including the use of spill response kits and emergency prevention and response. It is the responsibility of each Project Engineer to ensure their personnel have received the appropriate emergency training.

9 External Emergency Contacts

Emergency services, Fire, Police Ambulance	Dial 111
Horizons Regional Council	0508800800

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CO-RP-0008-A
Procedure:	Appendix 5: Emergency Spill Response		

Project Emergency Contacts

Management Team

Construction Manager	Tony Adams	0274377246
Earthworks Manager	TBC	
Environmental Manager	Lorraine Pennington	0275036749
H&S Manager	TBC	

Construction Team:

Zonwe	Role	Details
Zone 1 CH2600-CH3900	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC
Zone 2 CH3900-CH7410	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC
Zone 3 CH7410-CH9900	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC
Zone 4 CH9900-CH13780	Zone Manager	TBC
	Project Engineer	TBC
	Site Engineer	TBC
	Site Supervisor	TBC

In the event of an out of hours environmental emergency one of the above contacts should be notified immediately.

Appendix 6 - Stream Works Procedure

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CO-RP-0009-A
Procedure:	Appendix 6: Stream Works Procedure		

Document Status

The most recent revision of this document is in Sharefile as the initial Documentation Management System.

This Procedure forms part of the Erosion and Sediment Control Plan (ESCP) for the Te Ahu A Turanga; Manawatū Tararua Highway (the Project). The proposed construction works for the Project will include works being undertaken to divert flowing watercourses and install culverts.

The purpose of this Procedure is to ensure that the required level of environmental protection is achieved during these operations.

1 Scope of works

The proposed construction works on the Te Ahu A Turanga; Manawatū Tararua Highway (the Project) will include the following:

- Ground improvements;
- Excavations;
- Bridge and culvert construction (inside & outside highly sensitive ecological areas);
- Upgrading of existing road network;
- Construction of roundabouts on existing road network; and
- Construction of a visitors' centre.

2 Potential Environmental Impacts of Activities.

The key potential environmental aspects and impacts relating to stream works are:

Aspects	Impacts
Sedimentation from in stream works. Long-term erosion.	Dirty water discharge from culvert works, causing sedimentation downstream, infilling of stony bottom watercourse, damage to aquatic life and ecosystems. Erosion caused by works changing water velocity and alignments.



For all instream works, Site Specific Erosion and Sediment Control Plans (SSESCPs) will be prepared and certified by Horizons, and relevant Work Instructions will establish the controls to be applied. During the development of Work Instructions, the following issues will be considered.

3 Design

All permanent culverts proposed under the state highway have been modelled and designed to pass a 1:100 year ARI storm event. Erosion control has been designed for the 1:100 year ARI storm event to ensure that there is no additional scouring that occurs at the inlet and outlet of all culverts. The effects of climate change on rainfall over the design life of the Project have been provided for in the design.

All permanent stream diversions have been modelled and designed to convey a 1:100 year flood event. Stream diversions have been designed on a like for like basis, that is, any replacement stream will mirror the same type of stream that was there prior to the works commencing.

Any temporary culverts and stream diversions are designed to convey a 1:20 year rainfall event as far as practicable or otherwise certified through the relevant SSESCP by Horizons. Flows in excess of a 20-year

 		PROCEDURE	
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event will be accommodated in part by the diversion and within the works area, by providing temporary non-erodible flow paths.

There are a large number of stream works locations along the length of the alignment associated with culvert installation and stream diversions (the location and construction details of these are contained in the Construction Environmental Management Plan).

4 Methodology for stream diversion

All stream works and culvert works will be undertaken in accordance with a SSESCP. Wherever practicable, construction works will take place “in the dry” and “offline” i.e. with flows diverted around the works site. Where this approach is not practicable the SSESCP will detail the approach to be undertaken to manage the interface between the existing freshwater environment and the construction process. This may include temporary damming and over pumping.

Diversions will be installed, stabilised and made live prior to streamworks commencing. The site of the diversion will be treated by appropriate controls, such as silt fencing, following which the diversion will be constructed and stabilised with geotextile lining pinned at 500mm centres, or similar. Once constructed, flows from the original channel will be diverted using sheet steel or sandbag dams and the channel will be isolated upstream and downstream.

Once the diversions are installed, a Project ecologist will de-fish the off-line section of stream, following which the stream can be dewatered to a sediment control device (refer to Dewatering Procedure Appendix 4). The channel will be mucked out and material disposed elsewhere within a control area. Any temporary stockpiles will be located away from the floodplain of the stream. This process is covered in detail in the Freshwater Ecology Management Plan (refer Technical Assessment H).

Once the works are complete and the new flow channel has been stabilised, the stream can be redirected into its new flow path. A sheet steel or sandbag dam will be installed across the upstream end of the diversion to divert stream flows into the new channel / pipe. The diversion will be allowed to drain by gravity. Following this, a sediment control measure will be installed at the downstream end and the diversion will be filled.

5 Fish Passage

The provision of fish passage through culverts is covered in more detail in the Freshwater Ecology Management Plan

Appendix 7 – Hazardous Substances Procedure

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CO-RP-0010-A
Procedure:	Appendix 7: Hazardous Substances		

Document Status

The most recent revision of this document is in Sharefile as the initial Documentation Management System.

1 Application

This Procedure forms a part of the Erosion and Sediment Control Plan (ESCP) for Te Ahu A Turanga; Manawatū Tararua Highway (the Project). The purpose of this Procedure is to outline the hazardous substances that may be required onsite in relation to erosion and sediment control.

A full Hazardous Substances Management Plan will be part of the site Health and Safety Management Plan.

2 Scope of works

The construction activities of the Project include the following:

- Ground improvements.
- Excavations.
- Bridge construction and culvert installation (inside & outside highly sensitive ecological areas).
- Upgrading of existing road network.
- Construction of roundabouts on existing road network.
- Construction of a visitors centre.

3 Objectives

The objectives of this Hazardous Substances Procedure are:

- To aid compliance with the HSE and HSNO legislation and regulations (refer Health & Safety Management Plan)
- To operate in full compliance with the Resource Consent condition requirements.
- To eliminate wherever practically possible the harmful effects of hazardous substances on people and the environment.

4 Potential Environmental Impacts of Activities.

The key potential environmental aspects and impacts relating to hazardous substances are:

Aspects	Impacts
<p>The discharge of hazardous chemicals into the environment from incorrect storage and use of materials.</p> <p>Fuels and oils not stored/used causing spills to land and water.</p> <p>Chemicals used onsite causing spills to land and water.</p>	<p>Spills causing harm to aquatic environments causing harm to ecosystems.</p>

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CO-RP-0010-A
Procedure:	Appendix 7: Hazardous Substances		

Key Responsibilities

Responsibilities.

The **H&S Manager** is responsible for:

- Leading and advising upon the overall management of hazardous substances.
- The development of a schedule for the completion of hazardous substance audits across the Project.
- Production of a bi-annual audit schedule for hazardous substances permanent and semi-permanent (more than 3 months) storage facilities.
- Completion of audits outlined in the audit schedule.
- The review of audit and inspections results of hazardous substances facilities and processes.
- The monthly reporting of any hazardous substance management near misses and incidents.
- Communicating with local enforcement agencies such as Worksafe NZ or the Regional/District Councils.
- Completing audits of hazardous substances facilities and processes.
- Audit and inspection results, including actions and close outs.
- Site plans.
- Safety data sheets.
- Emergency response plans.

The **Earthworks Manager/Project Engineers** are responsible for:

- Ensuring that a staff member, who has successfully completed the “Managing Hazardous Substances” training program, is nominated as the “Person in Charge” and is made available for all work areas where hazardous substances are used or stored.
- Supporting the “Person in Charge” (described below) to achieve full compliance with hazardous substances management requirements.
- Ensuring that inspections are carried out of hazardous substance storage facilities.
- Ensuring that the hazardous substances inward goods process is adhered to within the Project.

The **“Person in Charge”** is responsible for:

- Ensuring the necessary test certificates are obtained for their location.
- Ensuring the necessary approved handler’s certificates are obtained.
- Maintaining site plans.
- Overseeing the deployment of suitable PPE and equipment to staff.
- Provision of information and documents regarding effective disposal of hazardous substances.
- Maintaining an up to date register of hazardous substances under their control.
- Ensuring that an up to date safety data sheet is obtained and made available for all hazardous substances under their control.
- Ensuring the correct signage is used for the hazardous substances under their control.
- Ensuring the correct labelling is used for the hazardous substances under their control.
- Providing to the Environmental Manager up to date copies of register, site plans and SDS.

The **Environmental Manager** is responsible for:

- Supporting the overall management of hazardous substances.
- Arranging the delivery of a hazardous substance training program for all staff, including the “Person in Charge”.

All **Site Personnel** are responsible for:

- Following the requirements of this Procedure.
- Reporting any incidents or accidents to the Health and Safety Manager.

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CO-RP-0010-A
Procedure:	Appendix 7: Hazardous Substances		

5 Hazardous Substances Registers

A register of the Hazardous Substances stored and used on site shall be maintained and updated on at least a monthly basis. A copy of the register will be kept near the various storage locations along with a copy held at the main site office.

6 Safety Data Sheets

A Safety Data Sheet (SDS) shall be held for every Hazardous Substance stored and used on site. The SDS shall not be more than 5 years of age. Copies of the SDS will be kept near the various storage locations along with a copy held at the main site office.

7 Diesel Storage

As part of this Project, diesel will be delivered by mobile mini tankers to the machines. 40,000L double skinned fuel tanks may be established on site at key locations. While diesel is not a particularly flammable substance, it is an environmental hazard, with considerable clean-up costs if it should leak into a drain, watercourse or the soil. When using or storing diesel, the following safety measures will be adhered to:

- Containers will be positioned away from any source of direct heat.
- Drums will be located in an area where the risk of collision with vehicles, such as forklift trucks, is minimised as far as practicable.
- Leaks and spills will be confined to the vicinity of the drum with the source of the spill stopped immediately (i.e. drum up-righted or plugged), contained and cleaned-up quickly.

8 Refuelling Procedures

The following procedure will be followed when refuelling construction vehicles on site.

- The location of the refuelling will not be any closer than 50m from a watercourse.
- Both the vehicle being refuelled and the vehicle dispensing the fuel will be turned off.
- The refuelling will only take place when a spill kit is immediately available.
- Refuelling will take place away from any "hot works" or heat sources.
- The refuelling process will be constantly monitored by the staff responsible for dispensing the fuel and will not be left unattended at any time.

This process will be explained to all personnel during the induction to site, special guidance will be given to mobile refuelling staff to reinforce the above procedure.

9 PAC Storage

As part of this Project, Polyaluminium Chloride (PAC) will be used as a flocculent for the treatment of sediment laden water. Large quantities of flocculent will only be stored at the main compounds in a hazardous goods shed. Small quantities of the flocculants will be stored adjacent to the floc box rain activated dosing sheds out in the field. The Safety Data Sheet for LiquidPAC and superflocB are attached in Appendix 7.A to this Procedure.

10 Concrete Works

As part of this Project a large volume of concrete will be used for construction. Concrete works are recognised as a potential risk to aquatic life in water courses and sensitive receiving environments. As such a Concrete Pump "Permit to Pump" (Appendix 7.B to this Procedure) has been developed to assist staff in adopting the best construction process and practices associated with concrete work to prevent adverse effects on the environment.

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Appendix 7.A

Safety Data Sheet for LiquidPAC and SuperflocB

Safety Data Sheet



1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name: LIQUIPAC (POLYALUMINIUM CHLORIDE)

Other name(s): Liquipac * Liquid PAC * Liquid polyaluminium chloride * PAC solution * Polyaluminium chloride solution * Liquipac 1210A

Recommended Use of the Chemical and Restrictions on Use Flocculating agent for potable water and industrial water treatments.

Supplier: Ixom Operations Pty Ltd (Incorporated in Australia)
NZBN: 9429041465226
Street Address: 166 Totara Street
Mt Maunganui South
New Zealand

Telephone Number: +64 9 368 2700
Facsimile: +64 9 368 2710
Emergency Telephone: **0 800 734 607 (ALL HOURS)**

Please ensure you refer to the limitations of this Safety Data Sheet as set out in the "Other Information" section at the end of this Data Sheet.

2. HAZARDS IDENTIFICATION

Not classified as a Dangerous Good under NZS 5433:2012 Transport of Dangerous Goods on Land.

Classified as hazardous according to criteria in the HS (Minimum Degrees of Hazard) Regulations 2001.

SIGNAL WORD: WARNING

Subclasses:

Subclass 6.1 Category D - Substances which are acutely toxic.
Subclass 6.3 Category A - Substances that are irritating to the skin.
Subclass 6.4 Category A - Substances that are irritating to the eye.

Water Treatment Chemicals (Subsidiary Hazard) Group Standard 2006
Approval Number: HSR002684



Hazard Statement(s):

H302 Harmful if swallowed.
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary Statement(s):

Prevention:

P103 Read label before use.
P264 Wash hands thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Safety Data Sheet

**Response:**

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337+P313 If eye irritation persists: Get medical advice/attention.

Storage:

No storage statements.

Disposal:

P501 In case of a substance that is in compliance with a HSNO approval other than a Part 6A (Group Standards) approval, a label must provide a description of one or more appropriate and achievable methods for the disposal of a substance in accordance with the Hazardous Substances (Disposal) Regulations 2001. This may also include any method of disposal that must be avoided.

3. COMPOSITION AND INFORMATION ON INGREDIENTS

Components	CAS Number	Proportion	Hazard Codes
Polyaluminium chloride	1327-41-9	30-60%	H302 H315 H319
Water	7732-18-5	to 100%	-

4. FIRST AID MEASURES

For advice, contact a Poisons Information Centre (e.g. phone Australia 131 126; New Zealand 0800 764 766) or a doctor.

Inhalation:

Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. Seek medical advice if effects persist.

Skin Contact:

If skin or hair contact occurs, immediately remove any contaminated clothing and wash skin and hair thoroughly with running water. If swelling, redness, blistering or irritation occurs seek medical assistance.

Eye Contact:

If in eyes, hold eyelids apart and flush the eye continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre or a doctor, or for at least 15 minutes.

Ingestion:

Rinse mouth with water. If swallowed, give a glass of water to drink. If vomiting occurs give further water. Seek immediate medical assistance.

Indication of immediate medical attention and special treatment needed:

Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media:

Not combustible, however, if material is involved in a fire use: Extinguishing media appropriate to surrounding fire conditions.

Specific hazards arising from the chemical:

Non-combustible material.

Special protective equipment and precautions for fire-fighters:

Decomposes on heating emitting toxic fumes, including those of hydrogen chloride. Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to products of decomposition.

Product Name: LIQUIPAC (POLYALUMINIUM CHLORIDE)

Substance No: 00000015710

Issued: 01/02/2017

Version: 5

6. ACCIDENTAL RELEASE MEASURES

Emergency procedures/Environmental precautions:

Clear area of all unprotected personnel. If contamination of sewers or waterways has occurred advise local emergency services.

Personal precautions/Protective equipment/Methods and materials for containment and cleaning up:

Slippery when spilt. Avoid accidents, clean up immediately. Wear protective equipment to prevent skin and eye contact. Contain - prevent run off into drains and waterways. Use absorbent (soil, sand or other inert material). Collect and seal in properly labelled containers or drums for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling: Avoid skin and eye contact and breathing in vapour, mists and aerosols.

Conditions for safe storage, including any incompatibilities: Store in a cool, dry, well ventilated place. Store away from incompatible materials described in Section 10. Keep containers closed when not in use - check regularly for leaks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Workplace Exposure Standards: No value assigned for this specific material by the New Zealand Workplace Health & Safety Authority. However, Workplace Exposure Standard(s) for constituent(s):

Aluminium, as Al: Soluble salts WES-TWA 5 mg/m³

As published by the New Zealand Workplace Health & Safety Authority.

WES - TWA (Workplace Exposure Standard - Time Weighted Average) - The eight-hour, time-weighted average exposure standard is designed to protect the worker from the effects of long-term exposure.

These Workplace Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These workplace exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Appropriate engineering controls:

Ensure ventilation is adequate and that air concentrations of components are controlled below quoted Workplace Exposure Standards. Keep containers closed when not in use.

If in the handling and application of this material, safe exposure levels could be exceeded, the use of engineering controls such as local exhaust ventilation must be considered and the results documented. If achieving safe exposure levels does not require engineering controls, then a detailed and documented risk assessment using the relevant Personal Protective Equipment (PPE) (refer to PPE section below) as a basis must be carried out to determine the minimum PPE requirements.

Individual protection measures, such as Personal Protective Equipment (PPE):

The selection of PPE is dependent on a detailed risk assessment. The risk assessment should consider the work situation, the physical form of the chemical, the handling methods, and environmental factors.

OVERALLS, SAFETY SHOES, CHEMICAL GOGGLES, GLOVES.

Safety Data Sheet



Wear overalls, chemical goggles and impervious gloves. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

If determined by a risk assessment an inhalation risk exists, wear a suitable mist respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Clear Liquid
Colour:	Pale Amber
Odour:	Mild
Solubility:	Soluble in water.
Specific Gravity:	1.20 @20°C (at 10.1% Al ₂ O ₃)
Relative Vapour Density (air=1):	Not available
Vapour Pressure (20 °C):	Not available
Flash Point (°C):	Not applicable
Flammability Limits (%):	Not applicable
Autoignition Temperature (°C):	Not applicable
Boiling Point/Range (°C):	Not available
Decomposition Point (°C):	Not available
pH:	2.6 +/- 0.3 @25°C
Freezing Point/Range (°C):	-12.0 (approx.)

10. STABILITY AND REACTIVITY

Reactivity:	Reacts with calcium hypochlorite. Reacts with alkalis. Slowly corrodes metals. Reacts with cyanides.
Chemical stability:	Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Possibility of hazardous reactions:	Can react with calcium hypochlorite , alkalis , metals , cyanides .
Conditions to avoid:	None known.
Incompatible materials:	Incompatible with calcium hypochlorite , alkalis , metals , cyanides .
Hazardous decomposition products:	Hydrogen chloride.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Safety Data Sheet



Ingestion: Swallowing can result in nausea, vomiting, diarrhoea, and gastrointestinal irritation.

Eye contact: An eye irritant.

Skin contact: Contact with skin will result in irritation.

Inhalation: Breathing in mists or aerosols may produce respiratory irritation.

Acute toxicity: No LD50 data available for the product. However, for constituent(s)
POLYALUMINIUM CHLORIDE:
Oral LD50 (rat): 681 mg/kg.
Oral LD50 (mice): 316 mg/kg.

Chronic effects: No information available for the product.

12. ECOLOGICAL INFORMATION

Ecotoxicity Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Disposal methods:

Refer to local government authority for disposal recommendations. Dispose of material through a licensed waste contractor. Normally suitable for disposal at approved land waste site.

14. TRANSPORT INFORMATION

Road and Rail Transport

Not classified as a Dangerous Good under NZS 5433:2012 Transport of Dangerous Goods on Land.

Marine Transport

Not classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea; NON-DANGEROUS GOODS.

Air Transport

Not classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air; NON-DANGEROUS GOODS.

15. REGULATORY INFORMATION

Classification:

Classified as hazardous according to criteria in the HS (Minimum Degrees of Hazard) Regulations 2001.

Subclasses:

Subclass 6.1 Category D - Substances which are acutely toxic.
Subclass 6.3 Category A - Substances that are irritating to the skin.
Subclass 6.4 Category A - Substances that are irritating to the eye.

Water Treatment Chemicals (Subsidiary Hazard) Group Standard 2006
Approval Number: HSR002684

Safety Data Sheet



Hazard Statement(s):

H302 Harmful if swallowed.

H315 Causes skin irritation.

H319 Causes serious eye irritation.

16. OTHER INFORMATION

'Registry of Toxic Effects of Chemical Substances'. Ed. D. Sweet, US Dept. of Health & Human Services: Cincinnati, 2016.

Reason(s) for Issue:

5 Yearly Revised Primary SDS

This SDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Ixom Operations Pty Ltd cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Ixom representative or Ixom Operations Pty Ltd at the contact details on page 1.

Ixom Operations Pty Ltd's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

Safety Data Sheet

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name: SUPERFLOC B SERIES

Recommended Use: Water treatment flocculant.

Supplier: Orica New Zealand Limited
Street Address: Orica Chemnet House
Level four, 123 Carlton Gore Road
Newmarket, Auckland
New Zealand
Telephone Number: +64 9 368 2700
Facsimile: +64 9 368 2710
Emergency Telephone: 0 800 734 607 (ALL HOURS)

2. HAZARDS IDENTIFICATION

Not classified as a Dangerous Good under NZS 5433:1999 Transport of Dangerous Goods on Land.

Classified as hazardous according to criteria in the HS (Minimum Degrees of Hazard) Regulations 2001.

Subclasses: Subclass 6.1 Category D - Substances which are acutely toxic.
Subclass 6.3 Category A - Substances that are irritating to the skin.
Subclass 6.4 Category A - Substances that are irritating to the eye.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Components / CAS Number	Proportion	Risk Phrases
Polydiallyldimethylammonium chloride 26062-79-3	0.5-5%	R52/53
Water 7732-18-5	Balance	-
Polyaluminium chloride 1327-41-9	30-35%	R22 R36/38

4. FIRST AID MEASURES

Inhalation: Remove victim from area of exposure - avoid becoming a casualty. Seek medical advice if effects persist.

Skin Contact: If skin or hair contact occurs, immediately remove any contaminated clothing and wash skin and hair thoroughly with running water. If swelling, redness, blistering or irritation occurs seek medical assistance.

Product Name: SUPERFLOC B SERIES
Substance No: 000000016077

Issued: 10/01/2006

Version: 2

Safety Data Sheet

- Eye Contact:** If in eyes, hold eyelids apart and flush the eye continuously with running water. Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Ingestion:** Rinse mouth with water. If swallowed, give a glass of water to drink. If vomiting occurs give further water. Seek immediate medical assistance.
- Medical attention and special treatment:** Treat symptomatically.

5. FIRE FIGHTING MEASURES

- Hazards from combustion products:** Non-combustible material.
- Precautions for fire fighters and special protective equipment:** Decomposes on heating emitting toxic fumes, including those of hydrogen chloride . Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to products of decomposition.
- Suitable Extinguishing Media:** Not combustible, however, if material is involved in a fire use: Water fog (or if unavailable fine water spray), foam, dry agent (carbon dioxide, dry chemical powder).

6. ACCIDENTAL RELEASE MEASURES

- Emergency procedures:** If contamination of sewers or waterways has occurred advise local emergency services.
- Methods and materials for containment and clean up:** Slippery when spilt. Avoid accidents, clean up immediately. Contain - prevent run off into drains and waterways. Use absorbent (soil, sand or other inert material). Neutralise with lime or soda ash. Collect and seal in properly labelled containers or drums for disposal.

7. HANDLING AND STORAGE

- Precautions for safe handling:** Avoid skin and eye contact and breathing in vapour, mists and aerosols.
- Conditions for safe storage:** Store in a cool, dry, well ventilated place and out of direct sunlight. Store away from incompatible materials described in Section 10. Keep containers closed when not in use - check regularly for leaks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits:
No value assigned for this specific material by the New Zealand Occupational Safety and Health Service (OSH).

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Substance No: 000000016077

Issued: 10/01/2006 **Version:** 2

Safety Data Sheet

Engineering controls:

Natural ventilation should be adequate under normal use conditions. Keep containers closed when not in use.

Personal Protective Equipment:

The selection of PPE is dependant on a detailed risk assessment. The risk assessment should consider the work situation, the physical form of the chemical, the handling methods, and environmental factors.

Orica Personal Protection Guide No. 1, 1998: C - OVERALLS, SAFETY SHOES, CHEMICAL GOGGLES, GLOVES.

Wear overalls, chemical goggles and impervious gloves. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

If risk of inhalation exists, wear suitable mist respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Liquid
Colour:	Amber
Solubility:	Miscible in water.
Specific Gravity:	1.20 @20°C
Relative Vapour Density (air=1):	Not available
Vapour Pressure (20 °C):	Not available
Flash Point (°C):	Not applicable
Flammability Limits (%):	Not applicable
Autoignition Temperature (°C):	Not applicable
Boiling Point/Range (°C):	ca. 100
pH:	2.7

10. STABILITY AND REACTIVITY

Chemical stability:	This material is considered stable.
Conditions to avoid:	None known.
Incompatible materials:	Incompatible with acids , alkalis , and calcium hypochlorite .
Hazardous decomposition products:	Hydrogen chloride.
Hazardous reactions:	None known.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product

Product Name: SUPERFLOC B SERIES
Substance No: 000000016077

Issued: 10/01/2006 Version: 2

Safety Data Sheet

label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion: Swallowing may result in nausea, vomiting, and abdominal pain.

Eye contact: May be an eye irritant.

Skin contact: Contact with skin may result in irritation.

Inhalation: Breathing in mists or aerosols may produce respiratory irritation.

Long Term Effects:

No information available for the product.

Toxicological Data:

No LD50 data available for the product. However, for constituent(s) POLYALUMINIUM CHLORIDE: (1):

Oral LD50 (rat): 681 mg/kg.

Oral LD50 (mice): 316 mg/kg.

12. ECOLOGICAL INFORMATION

Ecotoxicity Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Disposal methods: Refer to Waste Management Authority. Dispose of material through a licensed waste contractor.

14. TRANSPORT INFORMATION

Road and Rail Transport

Not classified as a Dangerous Good under NZS 5433:1999 Transport of Dangerous Goods on Land.

Marine Transport

Not classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea; NON-DANGEROUS GOODS.

Air Transport

Not classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air; NON-DANGEROUS GOODS.

Product Name: SUPERFLOC B SERIES
Substance No: 000000016077

Issued: 10/01/2006

Version: 2

Safety Data Sheet

15. REGULATORY INFORMATION

Classification: Classified as hazardous according to criteria in the HS (Minimum Degrees of Hazard) Regulations 2001.

Subclasses: Subclass 6.1 Category D - Substances which are acutely toxic.
Subclass 6.3 Category A - Substances that are irritating to the skin.
Subclass 6.4 Category A - Substances that are irritating to the eye.

16. OTHER INFORMATION

(1) 'Registry of Toxic Effects of Chemical Substances'. Ed. D. Sweet, US Dept. of Health & Human Services: Cincinnati, 2002.

This material safety data sheet has been prepared by SH&E Shared Services, Orica.

Reason(s) for Issue:

Change in Hazardous Substance Classification

This MSDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Orica Limited cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Orica representative or Orica Limited at the contact details on page 1.

Orica Limited's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

Product Name: SUPERFLOC B SERIES
Substance No: 00000016077

Issued: 10/01/2006

Version: 2

Project Name:	Te Ahu A Turanga: Manawatū Tararua Highway	WBS Code:	TAT-0-EV-06030-CO-RP-0010-A
Procedure:	Appendix 7: Hazardous Substances		

Appendix 7.B

Concrete Pump "Permit to Pump"

Header	Location	Lot No	
Check Item	Initial	Date	Comments
Pump Operator Pre-start Checks Completed			
Pump set up level			
Steel delivery line in good condition			
Rubber Delivery hose in good condition			
Delivery Line Adequately Supported			
Delivery Pipe Connections correct & Locking Pins Fitted			
All radios are working satisfactorily and communication checks have been carried out			
Concreting Crew briefed on Work Instructions			
All crew have correct PPE, skin fully covered (arms and legs)			
Permit to Pump – Issued / Rejected Project Engineer / Construction Manager / Superintendent			
Name:	Signed:	Date:	
Prior to Cleaning Lines			
Reducer and Hose removed			
Permit to Clean Lines – Issued/Rejected Project Engineer / Construction Manager / Superintendent			
Name:	Signed:	Date:	

Appendix 8 – Minor Changes to Management Plan Register

Register of Minor Changes to Management Plan		Management Plan: Erosion and Sediment Control Management Plan		
Change Number	Date of Change	Description of Change	Authorized by Environmental Manager	Management Plan Reversion into which the change was formalised
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