Northern Corridor Improvements

Assessment of Construction Water Management

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Executive summary

Purpose

This report assesses the potential effects of the Northern Corridor Improvements Project (the Project) associated with construction water management. The report describes the activities to be undertaken during the construction phase of the Project and outlines the erosion and sediment control methodologies and measures to be implemented during this phase. These methodologies and measures represent best practice for the nature of the construction to be undertaken.

Assessments Undertaken

The assessment associated with this report was undertaken over the entire Project area and included desktop reviews and associated site visits.

The construction activities were assessed according to a risk framework. The erosion and sediment control philosophy and principles that will apply throughout the construction phase are set out in detail in the report. A series of risk mitigation tools will be implemented during the construction phase.

This report is based on a conceptual approach and provides a suite of methodologies for earthworks activities. This approach provides certainty that the construction activities can occur with minimal sediment discharges and associated construction related effects.

Results of Assessments

Much of the Project involves the widening the existing State Highway carriageway and as such minimal earthwork activities are proposed. The exception is the more significant area of earthworks associated with the SH18 / SH1 tie in location. A “traditional” construction water management approach is proposed for this area including the use of sediment retention ponds and flocculation management.

The remaining parts of the Project largely rely on cut and cover activities as works progress, in addition to other erosion and sediment control measures.

During construction proposed permanent stormwater wetland facilities will be utilised wherever practicable to provide detention locations (for construction) and allow for further treatment of discharges to occur. Cut and cover and use of swales, where available, and check dams (as dirty water treatment controls) will also be used throughout.

Works are required on the causeway between the Rosedale Wastewater Treatment Plant ponds to accommodate new traffic lanes and the Busway. Specific methodologies to manage sediment in this area include the use of clean rock groynes and working within isolated environments.

Suggested Approach for Effects Identified/Recommendations

A range of construction water management techniques (including erosion and sediment control measures) are proposed to be implemented on the Project. These will be designed, constructed and maintained in accordance with recognised guidelines and will at all times achieve, as a minimum, the requirements of the NZTA Guideline and TP90.

The construction water management methodologies proposed will be included in the development of a CESCP (Construction Erosion and Sediment Control Plans) which will be submitted to Auckland Council for certification, prior to any construction activity. The CESCP approach allows for flexibility and input from the Project team, Auckland Council and the contractor whilst ensuring that the standards in TP90 and the NZTA Guideline are met. Risk management forms a key part of the Project implementation and will form a component of the CESCP process.

Flocculation management will be implemented on the site as a risk management tool and will form part of the CESCP.

Monitoring will also be required as part of the CESCP, is a key tool for the success of the Project and is to be implemented in an adaptive management framework whereby there is a continuous improvement process at all times for construction water management methodologies and specific measures.

This approach enables flexibility and innovation while still ensuring the potential adverse effects are managed appropriately and in accordance with best practice.

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Glossary of Abbreviations

Item	Description
AEE	Assessment of Environmental Effects
AUP	Auckland Unitary Plan Operative in Part (15 November 2016)
BPO	Best Practicable Option
CEMP	Construction Environmental Management Plan
CESCP	Construction Erosion and Sediment Control Plans
CWR	Construction Water Management Report
DEB	Decanting Earth Bunds
ESC Team	Erosion and sediment control team
PAC	Polyaluminium Chloride
RL	Reduced Level
RMA	Resource Management Act 1991
RWWTP	Rosedale Wastewater Treatment Plant
SCPA	Sediment Control Protection Areas
SEA	Significant Ecological Areas
SH x	State Highway (number)
SQEP	Suitably Qualified and Experienced Environmental Practitioner
SRP	Sediment Retention Ponds
UHH	Upper Harbour Highway
USLE	Universal Soil Loss Equation

Terms and Definitions

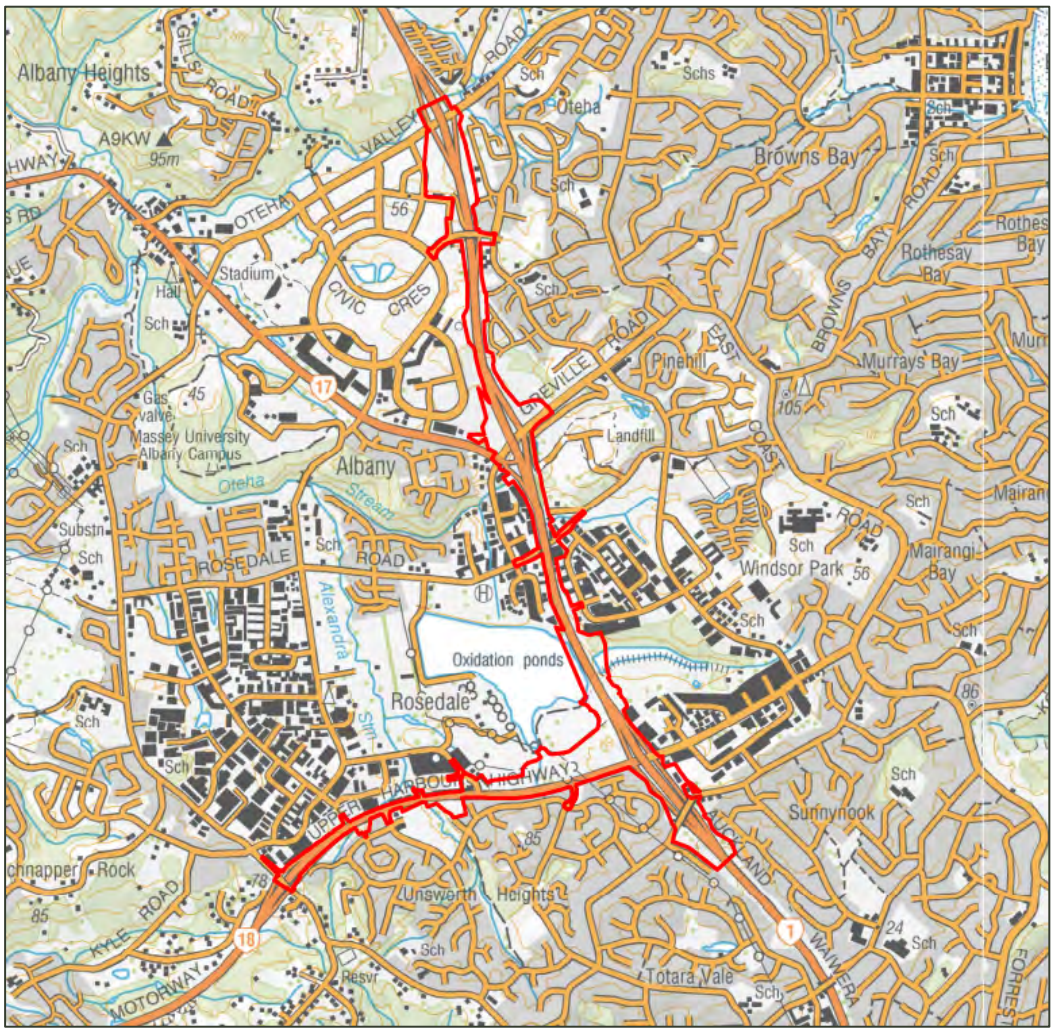
Item	Description
Designation	Defined in Section 2 and Section 166 of the RMA as provision made in a district plan to give effect to a requirement made by a requiring authority under section 168 or section 168A or clause 4 of Schedule 1.
Discharge	An activity that results in a contaminant being emitted deposited or allowed to escape.
Diversion of Stormwater	Redirecting stormwater from its existing course of flow; causing it to flow by a different route.
Do Minimum	Term used in the context of a comparison between the effects of a project and the effects that would occur if the project was not undertaken (i.e. for the comparative evaluation of the effects 'with and without' the project).
Erosion Control	Methods to prevent or minimise the erosion of soil, in order to minimise the adverse effects that land disturbing activities may have on a receiving environment.
Project Area	The Project area is the Project corridor and immediate surrounds.
Project Corridor	The Project corridor is the extent of works contained on SH18 between Albany Highway and Constellation Drive, and SH1 between Upper Harbour Highway interchange and 90 m north of the Oteha Valley Road interchange. The Busway component of the works extends from Constellation Bus Station to the Albany Bus Station at Oteha Valley Road.
The Project	The Northern Corridor Improvements Project including alterations to designations, new designations and activities requiring regional resource consents.
Sediment Control	Capturing sediment that has been eroded and entrained in overland flow before it enters the receiving environment.

1 Introduction and Description of Project

1.1 Project Background

The Northern Corridor Improvements Project (the Project) is an accelerated project. The Project area covers the area of State highway 18 (SH18) between Albany Highway and Constellation Drive, and State highway 1 (SH1) between Upper Harbour Highway (UHH) interchange to just beyond the Oteha Valley Road Interchange as indicated on **Figure 1** below and confirmed in the suite of plans provided in **Volume 5**.

Figure 1 Extent of Project Area



Source: Base Map from LINZ

The Project proposes to upgrade the existing State highways within the Project area. In summary, the key elements of the Project are as follows:

- North and West Motorway Interchange connections – SH1/SH18;
- State highway capacity and safety improvements;
- Northern busway extension from Constellation Bus Station and connection to Albany Bus Station;

- Reconfiguration of Constellation Bus Station converting it from a terminus station to a dual direction station;
- Shared Use Path (SUP) provision along existing SH1 and SH18 routes for the full extent of the Project corridor:
  - Constellation Bus Station to Oteha Valley Road;
  - Constellation Drive to Albany Highway; and
  - Intermediate linkages to local network.

A full description of the Project, including its components and construction, is contained in section 5 of the Assessment of Environmental Effects (AEE).

1.2 Purpose of this Report

This report is one of a suite of technical reports that has been prepared to inform the AEE for the Project. The particular focus of this Construction Water Management Report (CWR) is to outline the construction water management approach and to assess the effects of the construction phase, specifically as it relates to water discharges, with an emphasis on minimising sediment-related discharges.

The construction methodology which applies to the Project has been developed as a realistic and feasible methodology from which the anticipated effects on the environment of these activities can be identified. It is important that this report is read in conjunction with the Design and Constructability Report (**Volume 3 – Technical Assessment 15**).

Further, it is important to recognise that this report provides a methodology and management approach that demonstrates that the Project can be constructed with minimal adverse effects. With the appointment of a contractor at the time of Project implementation, there is flexibility within the methodologies and approach, in particular through the use of Construction Erosion and Sediment Control Plans (CESP), for further innovation while still ensuring effects are managed appropriately. This flexible approach is paramount to the success of the Project.

1.3 Project Earthworks and Project Scheduling

The total earthworks for the Project equate to approximately 61 ha. The earthworks areas are predominantly within a narrow corridor and include works associated with pavement repair and replacement. This report also considers streamworks, concrete management and working with a number of potential contaminants.

In general terms, the Project is essentially a road widening proposal. From a construction water management perspective, the management of earthworks is a relatively simple exercise. There are, however, some more significant bulk earthworks activity within the SH18 corridor associated with the SH18/SH1 tie in (north and west bound ramps) as well as the Paul Matthews Road Link.

The Project is anticipated to take 3.5 years to construct, and will be undertaken on a number of fronts or work faces. Construction zones have been identified which are illustrated in **Appendix A**. These zones are discrete areas of the Project. However, construction works may occur concurrently within zones to maximise earthwork and construction efficiencies and assist with the minimisation of the works duration.

The main area of earthworks for the Project is that associated with the SH1 to SH18 works necessary to construct the ramps (Construction Zone 1). This zone equates to approximately 21 ha in surface area although this does not equate to 21 ha of earthworks as some of this area is subject to hardstand and hardfill activities. The remaining parts of the Project do not require substantial bulk earthworks,

but there is, nevertheless, approximately 61 ha surface area of total works including pavement regrading.

Works will also occur with the drainage channels located to the south of Rosedale Wastewater Treatment Plant (RWWTP) Pond 1 (these channels fall within the definition of 'stream' within the Auckland Unitary Plan). The works will involve the filling of those streams. In addition, works are proposed within the banks of the Alexandra Stream, Oteha Stream and Lucas Creek associated with outfall structures. A number of artificial watercourses (stormwater drains) are also affected by the Project including the stormwater discharge channel from the Masons Road stormwater pond and the channels adjacent to the Moro Pond. These artificial watercourses drain to the Auckland Council stormwater network.

For the construction of the Project between chainage 15000 and 15300, the Project works will involve the widening of the existing SH1 causeway on both the eastern and western side of the existing motorway as shown within the Design and Constructability Report. Consultation with Watercare has confirmed that sediment discharge into the RWWTP ponds needs to be minimised to ensure ongoing compliance with existing operational consents.

1.4 Erosion and Sedimentation Processes

From an erosion and sediment control perspective it is important to recognise that erosion occurs when the surface of the land is worn away (eroded) by the action of water, wind, ice or geomorphological processes. Through the erosion process, soil particles are dislodged, generally by rainfall and surface water flow. As rain falls, water droplets concentrate and form small flows. As this flow moves down a slope, the combined energy of the rain droplets and the concentration of flows has the potential to dislodge soil particles from the surface of the land.

Sedimentation occurs when these soil particles are deposited. The amount of sediment generated depends on the erodibility of the soil, the energy created by the intensity of the rain event, the site conditions (for example the slope and the slope length) and the area of bare earth or unstabilised ground open to rainfall.

Erosion control is based on the practical prevention of sediment generation in the first instance. If erosion control measures and practices are effective then sediment generation will be minimised and the primary reliance on the sediment control measures is reduced.

Sediment control refers to management of the sediment after it has been generated. It is inevitable that some sediment will be generated through land disturbance activities even with best practice erosion control measures in place. Sediment control measures are designed to capture this sediment and to minimise any resultant sediment-laden discharges to waterways.

Rather than primarily relying on sediment control measures, reducing erosion will have the direct effect of reducing sediment generation and therefore less sediment laden runoff will need to be intercepted, treated and discharged from the sediment control measures. This Project relies heavily on erosion control practices as a key measure in reducing sediment yields from the site, in particular progressive stabilisation.

In addition to structural practices, which include physical measures such as sediment retention ponds, the Project will use a series of non-structural practices that will focus on various site management practices, such as staging of construction works and providing an appropriate level of resourcing for environmental management and monitoring.

With the above in mind, the erosion and sediment control measures for the Project are designed to minimise the extent of soil erosion and manage any resultant sediment yield. Erosion control will be the highest priority however sediment control will also be a critical feature.

Operational stormwater management during the construction phase is a separate and unique stage in the water management of the Project. This aspect predominately occurs after earthworks activities have ceased in an area, and erosion and sediment controls are no longer appropriate, but before long term operational stormwater controls are in place. Stormwater management measures are proposed for impervious construction areas and the pavement of the Project. These measures are detailed in the Assessment of Stormwater Management (**Volume 3 – Technical Assessment 11**).

1.5 Overview of Erosion and Sediment Control Approach

Prior to any land-disturbing activities occurring, erosion and sediment control measures will be installed to minimise potential adverse effects by achieving industry best practice. Both the Technical Publication No. 90 Erosion and Sediment Control: Guidelines for Land Disturbing Activities (TP90), Auckland Council and the *NZTA Erosion and Sediment Control Guidelines for State Highway Infrastructure, Construction Stormwater Management* (dated September 2014) (NZTA Guideline) have been considered in the design of the erosion and sediment control measures. The most stringent design criteria from these guideline documents have been applied.

TP90 has been incorporated into the Auckland Unitary Plan Operative in Part (15 November 2016) (AUP) by reference and is the operative guidance document for this aspect of the Project. Auckland Council has also recently produced an updated draft erosion and sediment control guideline document (GD05). While in a final form, GD05 is not yet operative as a plan change to the AUP is required. Importantly, the design measures within GD05 are largely reflected within TP90 and the NZTA Guideline.

For the Project, in particular in relation to the design of the sediment retention ponds, the guidance document that provides the largest volume criteria will be adopted and this is reflected in the conditions of consent.

This CWR provides an overview of the erosion and sediment management techniques and measures that will be used within the Project area, provides specific examples of those techniques and measures and also outlines the environmental objectives.

Detailed area and/or activity specific erosion and sediment control plans will be required and will need to be in accordance with the general principles of the CWR. These are referred to as CESCP and will be prepared as part of a Construction Environmental Management Plan (CEMP) process. This process will provide the ability for the various parties to have further input into the methodologies implemented to ensure enhanced outcomes and the opportunity for other non-structural measures and innovative practices to be implemented. The CESCPs for each specific package of work, or specific area, will be submitted to the Auckland Council for certification, as part of a CEMP, prior to undertaking the construction work.

Following installation of the erosion and sediment controls, ongoing site monitoring will occur to ensure that the construction water management measures have been installed correctly, and are functioning effectively throughout the duration of the works. This is referred to as an adaptive monitoring programme. During construction, a variety of measures will be used to manage construction activities and ensure that construction is being undertaken in a way that avoids, remedies or mitigates potential adverse effects on the environment. These measures will include specific erosion and sediment control measures, environmental monitoring and environmental auditing.

2 Statutory and Non Statutory Planning Framework

The statutory and non-statutory planning framework that applies to the earthwork activities that will be undertaken as part of the Project is set out below. When considering these requirements, several key features of the Project are of importance in terms of construction water management, namely:

- Proximity to stream systems;
- The values of the receiving environments adjacent to, or downstream of, the Project;
- Site topography which is predominantly of flat grade; and
- Areas of exposed soils.

The resource consents required for earthworks are identified within Section 6 of the AEE.

2.1 Statutory Framework

2.1.1 Resource Management Act 1991

The Resource Management Act 1991 (RMA) regulates activities that may affect the environment, including stormwater discharges. Section 3 of the AEE sets out the relevant statutory provisions including sections 5 to 8. For the purpose of this assessment, it is relevant to consider the following key provisions:

- Section 105 of the RMA requires consideration of the following factors for an application for a discharge permit:
  - The nature of the discharge and the sensitivity of the receiving environment to adverse effects;
  - The applicant's reasons for the proposed choice; and
  - Alternative methods of discharge, including any discharges into any other receiving environments.
- Section 107 of the RMA places restrictions on the grant of certain discharge permits where, after reasonable mixing, the discharge is likely to give rise to the following effects in the receiving waters:
  - The production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials;
  - Any conspicuous change in colour or clarity;
  - Any emission of objectionable odour;
  - The rendering of fresh water unsuitable for consumption by farm animals; and
  - Any significant adverse effects on aquatic life.

2.1.2 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management 2014 contains objectives and policies relating to water quality. These objectives and policies are discussed in detail in Section 11 of the AEE. There are no specific freshwater quality limits for the freshwater bodies within the Project area.

2.1.3 Auckland Unitary Plan – Operative in Part (15 November 2016)

Chapter E26 contains the regional earthworks rules for infrastructure providers. The AUP identifies Sediment Control Protection Areas (SCPA) which are considered higher risk locations and can be particularly vulnerable to impacts from the discharge of sediment. SCPAs are defined as those areas

either side of a foredune or 100m landward of the coastal marine area (whatever is the more landward of mean high water springs) or 50m landward of the edge of a watercourse, or wetland of 1000m² or more.

As set out in Section 6 of the AEE, resource consent for a restricted discretionary activity is required for the majority of the earthworks.[1] However, an additional resource consent for a discretionary activity is required for earthworks within Significant Ecological Areas (SEAs).[2]

The assessment in this report has taken into account the following relevant standards, matters of discretion and assessment criteria from the AUP:

- For earthworks within the SCPA:
  - E26.5.5.2 – general standards;
  - E26.5.7.1 – matters of discretion; and
  - E26.5.7.2 – assessment criteria.

2.2 Non-statutory framework

2.2.1 NZ Transport Agency Environmental Objectives

The NZ Transport Agency has also adopted, as part of its wider environmental plan, a series of erosion and sediment control objectives for roading projects as set out in *Environmental Plan: Improving Environmental Sustainability and Public Health in New Zealand* (June 2008). Key erosion and sediment management objectives from Section 2.4 of this plan are outlined below:

- Ensure construction and maintenance activities avoid, remedy or mitigate effects of soil erosion, sediment run-off and sediment deposition;
- Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular emphasis on high-risk areas; and
- Use bio-engineering and low-impact design practices where practicable.

These objectives have been considered and reflected within this report. Section 1.1 of the NZTA Guideline contains the same objectives.

2.2.2 Auckland Council Guidance

As outlined above, the erosion and sediment controls set out in this report have been developed in accordance with TP90. TP90 provides information on the appropriate use, design and construction of erosion and sediment control practices for the Auckland region. TP90 represents industry best practice and generally provides the accepted design criteria for ESC measures. The key principles from TP90 are included in **Appendix G** of this report.

Auckland Council, through its earthworks programme (including TP90) adopts a "best practicable option" (BPO) approach to regulate earthworks rather than a specific discharge standard. This approach recognises that the potential adverse effects from earthworks can be appropriately controlled by undertaking best management practices on-site to control sediment generation and eventual sediment yield.

Auckland Council recognises that there is a degree of risk associated with accepting a BPO approach and in accepting this risk, carefully considers the time of the year within which the earthworks will be

[1] See E26:A103; E26:A106; E26:A107; and E26:A117.

[2] See E26:E118.

undertaken. This is primarily due to the expected increased risk of effects over high rainfall periods, in particular with soils containing higher percentages of clay and fine silts, or when the slopes are steeper on a site. The highest probability of rain events occurs in the winter months and as a general rule, earthworks over the period May through to September are avoided where possible.

As outlined above, Auckland Council has recently produced an updated draft erosion and sediment control guideline, referred to as GD05, which is intended to eventually replace TP90. However, GD05 is not yet operative, and it is not currently being used by Auckland Council. The contents of the draft GD05 largely reflect the same principles and outcomes as contained in TP90 and, in that respect, the best practice guidance within TP90 is likely to remain unchanged under GD05 (subject to any further amendments prior to finalisation). Through the development of the CESCPs a BPO approach will be adopted and the most stringent of TP90 and NZTA Guideline will apply.

3 Existing Environment

The existing environment relevant to the assessment in this report is set out in the following technical reports:

- Catchments, hydrology and water quality – Assessment of Surface Water Quality Effects (**Volume 3 – Technical Assessment 12**);
- Stormwater management ponds and Council's stormwater network –Assessment of Stormwater Management (**Volume 3 – Technical Assessment 11**);
- Streams and the RWWTP ponds – Assessment of Freshwater Ecological Effects (**Volume 3 – Technical Assessment 5**);
- Vegetation – Assessment of Terrestrial Ecological Effects (**Volume 3 – Technical Assessment 13**); and
- Amenity and landscape values – Assessment of Landscape and Visual Effects (**Volume 3 – Technical Assessment 8**).

In summary, the key features of the existing environment that have been considered in the context of the preparation of this report are:

- Flat topography with some small isolated steeper sections of earthworks, particularly in the vicinity of the SH18/SH1 ramps and Construction Support Areas;
- The immediate receiving environment of the Project area predominately consists of the road corridor and its associated drainage reticulation systems and constructed operational stormwater management features such as stormwater wetland facilities (as illustrated in the Assessment of Stormwater Management);
- As set out in the Assessment of Freshwater Ecological Effects, there are a range of artificial and natural watercourses within, or in the vicinity of, the Project area including:
  - Lucas Creek;
  - Oteha Stream; and
  - Alexandra Stream.

The Project also affects the Rosedale Landfill and includes potential discharges to the RWWPT ponds. Earthworks within the Rosedale Landfill location are not covered by this report and are addressed in the Assessment of Effects – Encroachment on Rosedale Landfill Effects. Similarly, the management of earthworks associated with contaminated sites is not addressed in this report. Methodologies relating to the management of earthworks within contaminated sites are set out in the Assessment of Land Contamination Effects (**Volume 3 – Technical Assessment 6**).

3.1 Amenity

Earthworks can also have effects on amenity values, including;

- Earthworks involving cut and fill have the potential to affect the visual qualities in the immediate area, including natural landscapes and views. Large areas of fill have the potential to block views, while large cuts can create a 'scar' or a visually dominant face. In addition, sediment laden water can also be considered as a visual amenity effect.
- Dust from earthwork activities can have a potential effect on amenity values at a local scale. The level of dust generated by earthworks is dependent on a number of matters including soil characteristics, rainfall, wind and method of excavation.

- Where earthworks result in the movement of vehicles to and from a site there is potential for soil to be deposited in an indiscriminate and uncontrolled manner in transit (e.g. soil falling off tyres, soil being blown off uncovered loads).

Any adverse effects on amenity values will be temporary and generally restricted to the time required to complete the earthworks.

3.2 Operational Stormwater Management

Earthworks can create or worsen flooding and land instability and careful management is required to avoid these potential effects. For example, filling parts of an overland flow path is likely to impede runoff and worsen flooding upstream, potentially enlarging the area affected by inundation. The potential flooding impacts of the Project are assessed within the Stormwater Management Assessment Report. Earthworks activity will need to manage the potential impacts on existing stormwater systems (both in terms of quality and quantity) while construction occurs. In addition, there will need to be a transition in some locations from managing construction discharges to operational stormwater discharges.

Where new stormwater facilities are to be constructed as part of the Project, consideration will be given to utilising the same footprint and location for sediment control purposes. It is recommended that the operational water treatment devices will generally need to transition from construction water management device to an operational device when 80% of the catchment is in its permanent form (e.g. stabilised by vegetation and roads sealed).

3.3 Vegetation

The effects of earthwork activities on vegetation will depend on the type, extent and values of the vegetation cover being removed or modified. The removal of vegetation can result in exposed soil which can cause other effects such as erosion, increased surface water and sediment runoff, and dust nuisances. Vegetation removal will be addressed under the CESCP and will be required to comply with the erosion and sediment control requirements.

The Assessment of Terrestrial Ecological Effects outlines the existing values of the Project area that may be impacted by construction activities.

4 Management Plan Approach

The purpose of this CWR is to describe the methods and practices to be implemented to minimise the effects of construction related discharges (including sediment generation and yield) on the receiving environments associated with the Project. The information set out in the appendices of this report is based on the indicative construction methodologies included in the Design and Constructability Report.

The process of construction water management, and in particular the erosion and sediment control for the Project, is based on the implementation of detailed CESCPs to be submitted as part of the CEMP prior to construction activity occurring.

The principles in Section 5 of this CWR and the conditions of consent will be used to inform the development of the CESCPs which will detail the actual practices and processes for specific work areas or activities. The CESCPs will contain the specific detail of the measures to be implemented based on the detailed design and confirmed construction methodologies.

The CESCP will form part of the CEMP and will include a flocculation management and monitoring plans. The CEMP may be provided in stages or in relation to specific works.

The inclusion of all the management plans within the CEMP allows the contractor on site to have a single document reference point with the various sub documents within it.

5 Sediment Control Design Philosophy and Principles

5.1 Introduction

This section outlines the general principles for erosion and sediment control for the Project and sets the context of the assessment. As outlined in Section 1.5 above, the earthworks methodology and associated management has been designed in accordance with NZTA Guideline and TP90. In addition, the AUP assessment criteria have informed the overall approach. This assessment is based on the conceptual construction sequencing discussed in the Design and Constructability Report.

The Transport Agency has a proven track record with respect to the management of erosion and sediment discharges associated with infrastructure projects. Many of its previous projects (for example, the Southern Corridor Project) have demonstrated the effectiveness of the NZ Transport Agency's approach which is based on the Council's approval of management plans, or the equivalent, throughout the Project life.

5.2 Overall Erosion and Sediment Control Approach

The erosion and sediment control principles that will apply to the Project are set out below. Erosion and sediment control measures will be undertaken and implemented with a hierarchy and priority order as follows:

- Avoidance of adverse effects will be the first priority.
- Erosion control will be a priority in all circumstances by preventing sediment generation through a range of structural (physical measures) and non-structural (methodologies and construction sequencing) means. A cut and cover methodology will likely be a key erosion control methodology, whereby as areas of earthworks are exposed they will be stabilised on the same day or prior to rain events.
- Sediment Retention Ponds (SRPs) and Decanting Earth Bunds (DEBs) will be utilised in some circumstances, and in particular are expected to be required associated with the SH18 works. Due to the restricted room within the Project area, and the relatively flat contour, alternative devices such as cut and cover and check dams provide viable and effective solutions.
- Flocculation to enhance sediment removal will be utilised where SRPs and DEBs are installed. Soil samples will be taken from the alignment and tested for settlibility to demonstrate the effectiveness (or otherwise) of flocculation with the sediments to be encountered. These soil samples will complement the existing sampling and flocculation testing already undertaken.
- Various innovative products may also be used where effective in achieving the conditions of consent, and could include measures such as filter socks in a check dam design.

The erosion and sediment control methodologies within the CESCPs will use the NZTA Guideline and TP90 as a minimum standard, but will also require continuous improvement where the monitoring programme shows that the measures implemented are not effective or that undesirable water quality trends are becoming established. Such measures may include baffles in sediment retention ponds and specific design amendments as required.

The implementation of CESCPs will allow for future innovation (including as a result of the monitoring programme outcomes), flexibility and practicality of approach to erosion and sediment control and will ensure that the Project continues to adapt appropriately to changing conditions. The construction related sediment controls must remain in place until all earthworks for that sub catchment are stabilised, and permanent stormwater facilities for the corresponding catchment must be in place and operational prior to the impervious area of that sub catchment area reaching 80%.

5.3 Guiding Design Criteria for Erosion Control Measures

The normal approach is to divert 'cleanwater' around earthworked areas to limit the runoff volume going into the sediment control devices. The diversion of 'cleanwater' from outside of the area being earthworked will not always be practicable due to some of this cleanwater coming from the impervious surface of the existing motorway. Temporary diversion channels will be based on a hot mix bund to be established at the edge of the work extent. The CESCPs will specify cleanwater diversion channels and the design for these. The cleanwater diversion channels will be designed for a 1% AEP rainfall event (where practicable) and will be based on a practicable and agreed approach (with Auckland Council) on a case by case basis.

Other cleanwater from beyond the Project area is largely associated with existing urban development. This stormwater is typically already diverted into the stormwater network. However, stormwater from some small areas of the neighbouring catchment flows through areas to be subject to earthworks as part of the Project. These areas very small and appropriate methods to address this stormwater runoff can be incorporated into the CESCPs.

Progressive and rapid stabilisation of disturbed areas utilising hardfill will be ongoing throughout the Project. Mulch (hay/straw and wood) will be utilised in places outside of the earthworks footprint in areas such as construction support areas and temporary fill sites. Stabilisation requirements will apply, particularly in relation to stockpiles and batter establishment. Stabilisation of earthworked areas is designed to control both erosion and dust. Dust management is addressed further in Section 7.0 of the Assessment of Air Quality Effects which recommends the implementation of a Dust Management Plan.

While most construction access will be from existing roads, stabilised entrance ways will be established at all ingress and egress points to the construction areas. No vehicles will leave the construction works area unless tyres are clean and excessive sediment, such as deposited sediment (not dust), will not be deposited onto road surfaces. Wheel wash facilities will be established only if necessary.

5.4 Guiding Design Criteria for Sediment Control Measures

All SRPs to be implemented will be based on the largest volume criteria from TP90 and the NZTA Guideline.

Flocculation, with associated treatment, of sediments entering SRPs and DEBs will be utilised to enhance settling of suspended sediments. Section 9.8 of this report outlines the results of the flocculation testing.

Pumping of sediment laden runoff during construction is expected to be required periodically during excavation works. These flows will be pumped to SRPs, to grass buffer zones or to temporary sediment retention devices such as turkey nests which will assist with retaining any sediment contained within the runoff. If no onsite treatment option is available, then the pump volumes will be sucker trucked away and disposed of at an approved location.

Where practicable, permanent stormwater devices will be installed early in the Project and will be utilised to assist with the management of construction runoff from the Project before being retrofitted for the purpose of stormwater treatment once the Project is complete.

All SRPs and DEBs will be fitted with floating decants with a mechanism to control (or cease) outflow during pumping activities to these structures. This mechanism could take the form of a manual decant pulley system or outlet plug.

All super silt fences and silt fences will be based upon the design criteria within the NZTA Guideline. Super silt fences will be used in those areas of work adjacent to, or in the immediate vicinity of any freshwater stream systems, including Lucas Creek, Oteha Stream and Alexandra Stream. The super silt fence fabric will be installed with a minimum 200mm of fabric placed upslope at the base of the trench to minimise any failure of these devices and ensure that they remain in place and effective for as long a period of time as possible.

Dirty water runoff diversion channels will be sized, in accordance with the NZTA Guideline to cater for the 1% AEP rainfall event which will ensure that all storm events up to this design are diverted to control measures without overtopping. This approach will prevent uncontrolled runoff within the site boundaries.

5.5 Sequencing of Erosion and Sediment Controls

From an erosion and sediment control perspective, the following sequence of installation will typically apply:

- Install perimeter controls such as clean water diversions if necessary (for most of the Project clean water diversions will not be necessary);
- Install key sediment controls;
- Install diversion channels to ensure all “dirty” water runoff flows to sediment control devices;
- Install long term stormwater controls if applicable and utilise these for short term construction activities if practicable;
- Undertake as built plans for structural erosion and sediment controls to confirm that sizing and design of controls is appropriate (where cut and cover applies an as-built process will not occur);
- Undertake main earthworks following associated methodologies and in particular progressive stabilisation;
- Ongoing assessment and adjustment of erosion and sediment control measures;
- Ongoing maintenance of erosion and sediment controls as necessary;
- Completion and final stabilisation; and
- Removal of erosion and sediment controls once full stabilisation is achieved.

The erosion and sediment controls developed for the Project utilise a range of erosion and sediment control measures that represents the BPO approach. Progressive stabilisation will be part of these controls and will be undertaken to ensure that erosion is minimised from completed earthworks. This is of particular importance when considering the establishment of batter slopes where progressive hardfill and mulching will minimise erosion and sediment generation and will also ensure dust is not generated from such areas.

For earthworks related activities where detention devices are used and where slopes allow for and require check dam installation, flocculation is to be utilised to reduce environmental risk as outlined within Section 9.8 of this report. This applies to all sediment retention ponds along the alignment but in particular with regard to the SH18/SH1 ramps.

6 Management Approach to Erosion and Sediment Control

The CESCPs to be developed for the Project will contain the details for, and design of, the specific erosion and sediment control measures to be implemented.

The development of the erosion and sediment control measures will focus on:

- Undertaking an overview of the Project so that all construction activities, and the full effects of these construction activities, are considered as a "package" rather than an isolated set of work activities.
- Minimising potential adverse effects by utilising measures which meet or exceed industry best practice guidelines (NZTA Guideline and TP90). In many circumstances, due to the cut and cover approach of the Project, traditional erosion and sediment control measures will not be suitable and innovative concepts and management practices will be required such as the use of check dams for treatment of dirtywater runoff within swale locations.
- Undertaking pre-construction meetings for specific stages of work and having regular weekly meetings (toolbox meetings) on site with relevant personnel, including Auckland Council, as part of the construction phase.
- Specific training of contractor staff in erosion and sediment control during induction.
- Maintaining a register of control measures and "As Built" information of key controls such as diversion bunds to allow for quick referencing and understanding of erosion and sediment control measures. **Appendix B** of this report contains a series of standard NZ Transport Agency checklists which will be adopted for the Project.
- Including both structural and non-structural elements within the methodologies to be employed such as:
  - Manually raised decant devices on SRPs where installed;
  - Flocculation of sediment in construction runoff as a risk management tool;
  - Proactive monitoring programme;
  - Risk identification within the CESCPs and associated management of this risk;
  - Progressive stabilisation as works progress;
  - Weather response; and
  - Ensuring contracting staff are aware of the erosion and sediment controls employed and do not remove them without seeking appropriate approval.

Any significant modifications to the erosion and sediment control drawings certified by Council as part of any CESCP will require a further certification by Auckland Council prior to implementation in the construction phase. Where necessary, updated CESCPs will be lodged and a pre-construction meeting on site held with Auckland Council prior to installing any erosion and sediment controls and prior to the commencement of earthworks activity.

Upon completion of the installation of all approved structural erosion and sediment controls, as-built certification plans will be provided.

6.1 Erosion and Sediment Control Responsibility

The approach taken for erosion and sediment control includes a concept whereby planning and implementation of all the erosion and sediment control methodologies and measures are undertaken by an experienced team to ensure that all relevant aspects of the Project are taken into consideration as part of these decisions. This approach will ensure that adequate resources, commitment and

expertise are provided in relation to erosion and sediment controls from start to finish of the Project (design through to disestablishment).

Table 1 below outlines the expected responsibilities for erosion and sediment control.

Table 1 Erosion and Sediment Control Responsibilities

Organisation	Responsibilities
NZ Transport Agency	Ensuring CESCPs are included in contract documentation as necessary to ensure sub-contractor buy in. Reviews of CESCPs as required. Audits of Erosion and Sediment Control (E&SC) devices and methodologies. Record keeping as necessary.
Principal Civil Contractor	Preparation of CESCPs with NZ Transport Agency. Implementation of CESCPs. Installation of control devices. Inspection and Maintenance of control devices. Stabilisation. Training. Reporting.
Auckland Council	Certification of CESCPs. Certification of revised CESCPs. Auditing to ensure compliance with CESCPs and consent conditions.

All people working on site, or with site responsibilities, will be required to undertake a formal induction process.

The induction will include information on key environmental risks, environmental controls such as erosion and sediment control devices, noise and dust mitigation measures and waste management. Training will also focus on:

- Understanding the resource consent conditions;
- Construction and maintenance of erosion and sediment control devices;
- Environmental audits and inspections; and
- Contingency and/or additional measures that may be able to be applied to the Project as a result of the monitoring programme.

Site staff will be made aware of the restrictions in operations when working near designation boundaries, residential areas and areas that require specific protection as part of the work programme.

Ongoing training opportunities will be identified throughout the earthworks in response to issues or challenges identified.

6.2 Construction Monitoring Plan

As part of the erosion and sediment control implementation, ongoing site monitoring by a site based erosion and sediment control team (ESC Team) will occur to ensure that the proposed construction water management measures have been installed correctly, methodologies are being followed and are functioning effectively throughout the duration of the works. Any measures requiring attention will be

identified, and if necessary, relevant ESC Team members will be consulted to ensure continual improvement is sought. This may include undertaking assessment of environmental risk and in the circumstance of higher risk areas being identified, more stringent controls will be considered. This will include in particular, more progressive stabilisation, and a greater emphasis on the cut and cover methodologies.

Visual inspections of any downstream freshwater receiving environments will occur throughout the construction period by the ESC Team with particular attention during and after periods of rainfall and pumping activities. In the context of visual inspections, the receiving environment is defined as the immediate receiving environment adjacent to the area of works but will include downstream of reticulated systems where such systems are utilised as the discharge location.

As part of the visual inspections process, any significant change in water clarity from that prior to the rainfall event, or upstream of the site of works, as a result of the earthworks activity will result in a review of the erosion and sediment control measures implemented and changes made as necessary.

Weather forecast monitoring will also ensure that critical works such as those associated with stream diversion and culvert installation occur during a suitable weather window. The internet site www.metvuw.co.nz will provide one of the key tools in this regard with local weather forecasting also utilised as necessary.

Monitoring requirements will be included within the CESCP. A focused monitoring programme will be developed by the contractor and will target specific activities and locations identified within the CESCPs. The monitoring plan will include:

- Pre-construction monitoring;
- Rainfall monitoring;
- Routine device monitoring;
- Triggered device monitoring;
- Flocculation management monitoring; and
- Other monitoring requirements.

These specific elements are discussed in more detail below.

6.2.1 Pre-Construction Monitoring

Prior to the commencement of construction, pre-commencement photographs will be taken in the vicinity of the proposed discharge points and any receiving environments near these works. These records will show the visual state of the receiving environment at and within the vicinity of the discharge point prior to works commencing. This photographic record will be compiled into a log book and will allow a visual comparison of before, during and at completion of the construction of the Project.

6.2.2 Rainfall Monitoring

To assist with identification of higher risk periods, such as during rainfall events, the Project will utilise existing rainfall gauges within the Project area (such as RWWPT rain site). This will provide data for the ESC Team relating to both rainfall quantities and intensities which will assist with confirming adequacy of the erosion and sediment control measures and methodologies.

In addition, the Project will utilise rain forecasting (such as metvuw) to understand forecast weather patterns and therefore enable more focused management of higher risk activities during rainfall periods. This may include ensuring that any works within stream or channel systems are fully stabilised prior to rain events to minimise scour and erosion.

6.2.3 Routine Device Monitoring

The appropriate installation, location, maintenance, and monitoring of control devices and associated methodologies will ensure compliance of the measures with the relevant standards and conditions of consent. For a significant portion of the Project, the key methodology is based around a cut and cover exercise where stabilisation will be established over a short duration period and utilised as an erosion protection layer.

The purpose of this monitoring is to ensure that all practices, control measures and devices are constructed, operated and maintained so they remain in full compliance with conditions of consent and fully effective in minimising discharges at all times. Device monitoring will largely target erosion and sediment control activities including silt fences, stabilisation including mulching and sediment retention ponds.

This monitoring is aimed at the early detection of activities or problems that have the potential to result in adverse environmental effects. The devices monitoring will act as a trigger for more detailed monitoring should this be required.

It is essential that the monitoring of devices include inspections during rain events so that the success of the devices and controls can be reviewed and improved if appropriate.

Monitoring of these devices will include qualitative monitoring of the following:

- Integrity and effectiveness of all erosion control and sediment treatment devices;
- Activities on site;
- General site conditions and other activities occurring within the catchment; and
- General status of the immediate receiving environment.

The details of the visual (qualitative) inspections will be recorded.

Where actual problems with the integrity and/or effectiveness of the devices are observed (i.e. for both erosion and sediment control and other on-site activities) these will be rectified immediately.

6.2.4 Triggered Device Monitoring

In addition to the Routine Device Monitoring, there will be more detailed inspections of devices, on-site practices and other catchment activities that will be undertaken in response to certain “triggers”. The triggers for these more intensive / repeat investigations include observations such as:

- Activities observed to be happening on-site that are likely to compromise the effectiveness or integrity of that site’s erosion and sediment controls;
- Taking into account antecedent climatic conditions, a conspicuous change of water colour at the downstream receiving environment that is very different to the colour that is normally associated with conditions at the same site, and with such change in colour not evident at upstream locations above the construction zone;
- Obvious accumulation of sediment in the vicinity of the discharge points, or anywhere else within or in proximity to the active construction zones;
- Streambank collapse or obvious signs of channel erosion / instability in the immediate receiving environments;
- Visual reports / evidence of changes to downstream community structure (e.g. fish kills, death or discolouration of instream plant communities, increased weed growth); and
- Spillage / accident reports by site personnel.

If the results of any routine device monitoring identify any of these triggers, then a more detailed response will occur as follows:

- Ascertain that in all probability the issue is associated with the Project;
- Inform and liaise with Auckland Council;
- Ascertain the magnitude of the adverse effects (this may involve undertaking immediate monitoring of the ecological variables);
- If the effects have been more than minor, ascertain what response is necessary;
- Determine how to monitor the effectiveness of the response(s); and
- Implement and monitor the response.

A continual feedback loop is included in this process until it has been verified that the implemented responses have been successful. Changes to construction site practices or to specific devices may also need to be implemented to avoid any future similar events.

6.2.5 Flocculation Management Monitoring

Flocculation of sediments, using additional flocculant products, will occur in all SRPs on the Project and also for specific pumping activities. In particular, the works at the SH1 and SH18 interchange will be subject to flocculation management as per Section 9.8 below. The application of flocculants will be carried out in accordance with best practice principles, and will be undertaken in accordance with this report and approved CESCPs. Flocculant socks will also be utilised within the check dams to assist with sediment deposition. The designs for these measures are illustrated within **Appendix C**.

A core part of flocculation management will be monitoring, in order to check that the systems are all working as anticipated and to provide data to facilitate management of the flocculants systems including the flocculant socks. The monitoring that will be carried out is as follows:

- Discharge and receiving environment pH levels at weekly intervals where flocculation is utilised. It is expected that with the correct use of polyaluminium chloride, in accordance with a chemical management plan to be provided as a condition of consent, no residual aluminium (pH) impacts will result;
- Periodic visual checks of devices during periods of discharge to confirm water clarity. Note that the flocculation management plan will determine this clarity but it is currently assessed as 100mm visual clarity from the top of the water column; and
- Confirmation of flocculant dosage rates and maintenance requirements.

6.2.6 Other Monitoring Requirements

In addition to the devices and flocculation treatment monitoring, the other on-site activities such as storage of hazardous chemicals, refuelling facilities and practices, site offices, haul roads, stock-piles and dust control will also all need to be regularly checked and inspected. The intention underlying these checks is to ensure that they are being properly maintained at all times, and that they remain within the specified standards including consent conditions.

Contingency measures (such as the requirement for spill kits to be present in re-fuelling areas) form part of the responsibility of the ESC Team.

Construction support areas will also need to be incorporated into this monitoring programme to ensure that they do not become a source of contamination and are managed appropriately at all times.

7 Project Construction Risk Assessment

For large earthworks projects, sediment yields are typically estimated using models such as the Universal Soil Loss Equation (USLE). The primary purpose of the USLE is to provide a measure of the risk of sediment generation and yields, and to assist in identifying controls required for managing this risk to the environment from sediment discharges. Further, the USLE can be used as a comparative tool to gain an appreciation of the expected increase in catchment wide sediment yields as a result of the earthworks activity. The USLE is not appropriate and is not designed for assessing sediment yields from streamworks activities.

The Project is lineal in nature and effectively involves road widening activities, with the exception of the SH1/ SH18 ramp works. The Project will involve works occurring on several "fronts" and will also be subject to ongoing stabilisation as works progress. Much of the surface area of works also includes working on hardstand and/or hard fill locations and as such, the sediment yield risk is low. The effectiveness of undertaking a detailed sediment yield calculation (USLE) is of limited value as it will not assist with determination of risk locations. The Project includes a wide range of small activities and cut and cover approach which is not conducive to using a USLE approach and it has therefore, not been undertaken for the Project.

Before undertaking any Project earthworks, and before finalising the erosion and sediment control measures to be used, all relevant parties need to understand the Project's environmental risks with the activity for that particular area of works. This involves ensuring that the Project is understood from a physical perspective (such as slope and geology), the receiving environment is understood with any specific values clearly identified, earthwork areas and volumes are understood, methodologies confirmed and the timing and duration of works are accounted for. These aspects will all form a key component of the CESCPs where a more formal risk assessment will be detailed.

This "risk assessment" will also require further consideration of specific site environmental conditions such as any contamination, subsequent stockpiling and removal of soils.

A preliminary risk assessment during the development of this report has determined that the potential risk of an elevated sediment yield is low, primarily because of the gentle slopes of the Project area and the relatively small area of earthworks themselves. Notwithstanding this comment, the higher risk areas and activities within the Project are identified as:

- Those works associated immediately adjacent to stream systems (associated with outfall structures);
- Works associated with the streams south of Rosedale Pond 1;
- Pumping of any sediment laden water from excavations; and
- Earthworks activities on any steeper slopes (greater than 15 degrees) such as that associated with the batters at the SH1 / SH18 ramps.

The following risk management tools are critical to this Project and should form a key component of its implementation:

- The competency and performance of the successful contractor (currently unknown);
- Timing and duration of works; and
- The quality of the erosion and sediment controls implemented.

The risk management tools that will be used for the Project are outlined below.

Further it is recognised that while there are some higher risk activities, the activities associated with the Project are overall low risk and involve minimal earthworks activity. On this basis, no winter exclusion period is necessary. Prior to undertaking works within this winter period a CESCP will be required specific winter works details will be provided for this period. This approach provides certainty for Auckland Council that winter specific measures will be installed as necessary and certainly for the contractor that works can largely continue throughout the year.

7.1 Risk Mitigation Tool # 1 - Construction Erosion and Sediment Control Plans

CESCPs are detailed erosion and sediment control plans which will be submitted for specific work areas, or activities, within the Project. They will be developed prior to the commencement of work and provide the detailed design, specific erosion and sediment control measure location, staging and sequencing of works for the specific location or activities.

The CESCPs will:

- Contain an assessment of the alternative options for erosion control in that area;
- Take into account the environmental and ecological values within the area of the works and the receiving environment;
- Identify the specific measures to be implemented;
- Identify how the proposed erosion and sediment control measures meet design standards;
- Include an assessment of risk factors including erosion and sediment control management measures;
- Identify organisational responsibilities for implementing, monitoring, reporting and maintenance of erosion and sediment control measures; and
- Outline the proposed monitoring and reporting methods.

7.2 Risk Mitigation Tool # 2 – ESC Team Approach

An ESC Team approach will be developed to ensure effective implementation of the ESCPs and foster a compliance culture. The ESC Team will consist of representatives of the contractor, the NZ Transport Agency and Auckland Council.

The contractor resource should include dedicated erosion and sediment control expertise with practical skills to take “ownership” of all erosion and sediment control devices and ensure appropriate design, implementation and maintenance continues. Site personnel should be carefully selected to ensure the success of any erosion and sediment management programme. Site personnel should be part of an active educational programme, which will include regular briefings on erosion and sediment control principles and practices.

ESC Team meetings should be integrated into regular site meetings. The ESC Team will take a proactive approach and will have the responsibility for initial risk assessment as part of the CESCPs, implementation programming, reviewing monitoring data and incorporating outcomes into erosion and sediment control measures with ongoing assessment and adjustment.

The ESC Team will meet regularly (minimum 2 weekly basis) to identify activities and/or areas of high risk for sediment generation and discharge to the receiving environment, and identify risk mitigation measures, as well as being responsible for identifying appropriate control of high risk activities.

A team approach ensures that adequate resources, commitment and expertise are provided in relation to the erosion and sediment control aspects from beginning to the end of the construction activities.

7.3 Risk Mitigation Tool # 3 - Guideline Implementation

The NZTA Guideline and TP90 will be applied to all earthworks forming part of the Project (the most stringent requirement in these standards will apply).

All relevant erosion and sediment control measures will be in place and operational before any site works activities for any specific area are undertaken.

All erosion and sediment control measures will need to be retained and maintained in good working order until all site works and earthwork and streamwork activities within that area have been completed and the site secured to minimise erosion and any further discharges of sediment from the site.

While the erosion and sediment control measures are designed for specific locations, the methods to be used will be standardised as much as possible throughout the Project (e.g. all cleanwater and dirtywater diversion channels will be set, where practicable, at the maximum catchment size throughout the entire Project).

7.4 Risk Mitigation Tool # 4 - Implementation

For all earthworks operations compliance should be achieved with the following standards:

- Stripping vegetation and topsoil only when earthworks will immediately follow. No areas of works should be stripped unless they are to be subject to immediate works. If areas are stripped and exposed to erosion and works are not to occur then temporary stabilisation will need to take place;
- Staging of earthworks should be based on optimising earthworks efficiency with available resources;
- Progressive stabilisation rather than leaving stabilisation until the end of the earthworks operation. Setting timeframes for areas to be open before stabilisation is required should be established with a 14 day period recommended. Stabilisation methodologies will need to be based on proven options and will include mulch, geotextile and hard fill;
- Preparation of earthworks areas to minimise erosion, through stabilisation and the installation of contour drains across slopes, when heavy rain is forecast; and
- Minimising activities that could exacerbate erosion, such as stockpiling of material in flow paths.

7.5 Risk Mitigation Tool # 5 - Monitoring

Construction monitoring will be implemented as outlined in Section 6.2 above. This monitoring will include a regular site walkover prior to, during and post rainfall with a particular focus on higher risk locations. Taking a proactive approach will assist in understanding and addressing any on site issues and allow for optimisation of existing controls, addition of new/additional controls if required and better management of any risk identified.

8 Specific Project Area Assessment

The proposed construction zones are shown in **Appendix A** and the conceptual erosion and sediment control plans are set out in **Appendix D**. An overview of the construction water management techniques and measures for each zone is contained in **Appendix H**.

Table 2 below outlines the construction zones, cut and fill areas and total earthworks areas. The specific measures implemented for each of the zones is outlined within **Appendix D** and **Appendix H**.

In addition, Section 9 below contains an overview of specific activities and how these will be managed within the Project.

Table 2 Project Zone Earthwork Areas

Construction Zone	Cut Area (ha)	Fill Area (ha)	Total Area (ha)
Zone 1 – SH1/SH18 Interchange	5.3374	5.2025	10.5399
Zone 2 – SH18 to Constellation Drive	7.2112	3.3342	10.5454
Zone 3 – SH1 Northbound	8.5839	5.3229	13.9068
Zone 4 – SH 1 Southbound	7.9907	3.2040	11.1947
Zone 5 – SH1 Median	2.117	NA	2.117
Zone 6 – Albany Park and Ride	0.4106	0.4785	0.8891
Zone 7 – Busway Albany to Greville	2.4721	1.7959	4.268
Zone 8 – Busway Greville to Constellation	4.0156	3.2431	7.2587

9 Specific Project Activity Assessment

9.1 Erosion and Sediment Control Devices

SRPs are proposed primarily for the SH1/SH18 works and will be designed with a length to width ratio of 3:1, side slopes of 2:1 and a depth of 1.5m. The SRP depth can be amended to ensure effective operation if required. Proposed new wetland features, or the footprint of these features, will be utilised as necessary for this same purpose. In addition the SRPs will also be utilised in Construction Support Areas.

Appendix E of this CWR provides the calculations illustrating the SRP sizing criteria. Specific details will be provided within the CESCPs.

The conceptual design details for the erosion and sediment controls to be implemented are provided in **Appendix C and D**. These plans outline the control measures that are expected to be used, and the methodology to be implemented within each zone.

Where possible, the sediment retention ponds are proposed to be established in the same footprint as the permanent stormwater wetlands. It is likely that the permanent stormwater pond wetland outlet and downstream reticulation system will be established and isolated by a bund from the SRP feature. The SRP will then be established and discharge via a design outlet into the permanent stormwater outlet.

The cleanwater diversion channels are based on a hot mix bund to be established on the edge of the existing sealed carriageway and divert flows away from the works location. Within the Project area, there are a wide range of catchment sizes and characteristics that will require specific cleanwater diversion channel designs. However, for the existing motorway surface the cleanwater diversions will be sized for the 1% AEP storm event with discharge locations for every 100m lineal length of motorway. Calculations are provided within **Appendix F**. These diversions form part of the erosion and sediment control risk management framework for the Project.

Dirtywater diversion channels will be utilised in a few places to allow surface flow to be diverted to treatment devices. These will be based on NZ Transport Agency standard of 1% AEP storm event with adequate room assessed within the necessary catchment areas to install such devices.

As earthworks commence in each location where a sediment retention pond (or potentially a decanting earth bund) is required, the specific as built catchment will be determined and the diversion channel sizing calculated from this contributing catchment area accordingly.

9.2 Culvert and Outfall Installations

Culvert works are required in a number of locations with the key purpose of the culvert installations to allow for road construction and/or ongoing reticulation of the motorway stormwater system. Culvert locations have been identified and are illustrated within the ESC Plans within **Appendix D** and will be subject to either:

- Do nothing and retain existing culvert;
- Installation of new culvert or repair existing culvert; or
- Divert and abandon existing culvert location.

It is important that the culvert activities are undertaken early in the construction program to ensure that the surrounding earthworks can be completed. The culvert locations are largely dry environments and

act as conduits during periods of rainfall. Provision for fish migration and spawning is therefore not required in these locations.

All culvert works will be undertaken in dry environments. This will be achieved by undertaking such works during a period of no flow, undertaking culvert installation offline prior to diversion of flows or if flow occurs during the works period, then pumping around the area of works will occur. No formal channel diversions are expected to be required as part of the culvert establishment.

Prior to works commencing, the specific methodology will need to be determined and will be detailed within the CESCP for the location in question. This information will include specific culvert sizing, based on upstream catchment area and characteristics, timing of works and the expected duration of works.

If the works are necessary on a culvert that is subject to flow, the culvert installation will be undertaken in dry conditions, isolated from the existing flows. This is based on:

- A pump will be installed approximately 5m upstream of the works extent of an upstream temporary bund. This pump will pump upstream flows around the work area to discharge back downstream of the culvert works. Sand bags or similar will be used to impound flows for this pump. The inlet of the pump will be supported above the base of the impoundment area to minimise sediment input. It is important to note that the capacity of the pump will be determined to manage the low flows during works. This aspect will be detailed in the site specific CESCP.
- The initial excavation will remove any vegetation or other material from the work area followed by the excavation of unsuitable material. This excavated material will be disposed of elsewhere on site within the catchment of other erosion and sediment controls.
- Once all unsuitable material has been removed, the culvert area will be backfilled with bedding material to an appropriate depth for culvert installation. The culvert will be installed with associated wingwalls, retaining walls and backfill as necessary. Rock rip-rap erosion control will also be installed at the inlet and outlet of the culvert.
- The associated activity over the culvert will occur (filling etc.) with other erosion and sediment controls in place which typically includes the installation of a super silt fence. When the works have been completed any disturbed area will be fully stabilised with either hardfill or mulch.
- For all culvert works:
- Prior to any works commencing with the culvert installation, a suitable weather window will be confirmed (3 day fine weather window recommended) and any concerns or further clarification at the time, will be addressed immediately and prior to any works commencing on site.
- Replacement culverts are expected to be installed in sections or pipe jacked with that particular section fully completed and stabilised within the day works programme.
- Any water within the works area that results from the pipe installation will be pumped to a decanting device or sucker truck for removal from the site.
- On completion of the culvert extension, all plant and resources will be demobilised and the site will be permanently stabilised to as per Auckland Council requirements. Should any rock armouring be required to be placed at the outlet of the culvert for stabilisation of the streambed and banks, this can be accommodated as required. The sizing and detail of this rip rap is specified within the Assessment of Stormwater Management.

In the event of high rainfall during the course of culvert installation, or prior to leaving the site for more than a 24 hour period, the Project team will ensure the following:

- Any loose material that could enter a stream system is to be removed;
- Any downstream sand bag barriers will be checked and, if required removed for heavy rainfall and stream flow events; and
- All existing and additional sediment control measures will be inspected and secured and maintained where required should a significant rainfall event be imminent.

The key construction water management process is ensuring that at the end of every day, and in particular prior to rain events, that a fully stabilised work site remains that can effectively continue to operate as required with minimal scour and contaminated discharge.

Extended working hours will be considered if it is believed significant benefit with regard to programme and environment impact is either required or possible.

For culvert outfall locations a Super Silt Fence will be established between the edge of the outfall construction activity and any stream system. No instream works are required. This in particular applies to the outfall in the vicinity of the Lucas Creek, the outfall in the vicinity of the Oteha Stream and two outfalls in the vicinity of the Alexandra Stream. The locations of the outfalls are illustrated within the Assessment of Stormwater Management. On completion of the outfall structure full stabilisation will need to occur prior to removal of the Super Silt Fence. Rip rap material will be placed as clean rock only.

These works will only be undertaken when a period of fine forecast weather is recorded with duration of works kept to a minimum period.

Culvert and outfall installation works for the Project that follow this methodology are assessed as appropriate and will achieve minimal discharges to the environment.

9.3 Retaining Wall Construction

Due to the space constrained nature of the widening component of the Project, a number of retaining walls are required to achieve the geometry for the additional lanes of the motorway. These are illustrated within the ESC Plans within **Appendix D** of this report.

Retaining walls are to be established as discrete project tasks and as such an activity specific CESCP could be developed for their construction. This activity will follow the sequence as set out below:

- All retaining wall works are to be undertaken from a hard stand area with all machinery to be on this stabilised hard stand platform. This will be achieved by either working from the existing motorway or by placement of hardfill in these locations;
- Where machinery cannot operate as above, a silt fence will be placed around the lower area of works to ensure that any sediment generated is fully captured and treated within this treatment device;
- Material deliveries such as poles, timber and concrete will all be within this “managed” environment;
- Any spoil generated from the retaining wall construction will be loaded immediately onto a truck or equivalent and removed from the area of works to an authorised location that is subject to an approved CESCP. The construction support areas will have the ability to stockpile this material; and
- Concrete works for the retaining wall will be undertaken with care to ensure minimal spill and concrete splash results. Cement contaminated water will require treatment before discharge, and this will either be conducted on site using treatment tanks with the water pH tested before discharge, or the water removed from site and treated elsewhere through the use of sucker trucks. Concrete placement will be carefully controlled to ensure minimal loss to the environment using pumps and skips. Concrete truck wash and pumps will occur on site with a dedicated concrete wash facility or within the yard of the concrete supplier.

Such a retaining wall construction sequence and methodology is assessed as the best practicable option.

9.4 Drainage/Utility Installation

When undertaking placement of pipe networks for stormwater management and other utility services the first step is to identify the specific location of the works and the nature of the environment within which it is to be undertaken. Particular regard is to be had to any specific overland flow paths through which the works will occur. These utility services works are typically lineal in nature and require removal of spoil and placement of hardfill bedding and backfill.

For all works outside of overland flow paths, the process will include:

- Provide cesspit protection for all adjacent cesspits. Ensure this practice does not result in the full blockage of cesspits and result in localised flooding;
- If the works are adjacent to any stream systems these will be protected by placement of Super Silt Fence between the works and the stream environment. These will be maintained to ensure capacity and functionality remains and can be moved with the works as they progress;
- Undertake the works with excavation, placement of utility and backfilling as necessary and ensure that completed areas are fully stabilised at the completion of the day's work. This stabilisation will be achieved through the use of hay mulch, hardfill or temporary placement of geotextile; and
- Stockpiles of any spoil material will be avoided by removal of this material offsite. However, where necessary they will be stockpiled in a compacted manner and will be protected from erosion and dust generation by the placement of geotextile over the stockpile. Any stockpile of hardfill material will be placed such that it is not subject to scour from surface runoff and is also protected during periods of rain with filter socks.

If works are to be undertaken within a swale or overland flow path, care will be taken to ensure that these can continue to operate during the works. Temporary coffer dams may be used within swales, both upstream and downstream during periods of flow, with connected solid novacoil pipes taking any swale water around the works area on a temporary basis. On completion of such works the coffer dams would be removed and a stabilised surface will remain.

Within overland flow paths, the key erosion and sediment control methodology is non-structural in that it centres on ensuring material is not stockpiled within such flow paths and the flow path is stabilised on completion of works and during works when rain is forecast.

While these works are relatively minor, they do form part of the consent and works package and require full consideration within a CESCP as necessary. With the provision of appropriate control measures as noted above the discharges from these activities are assessed as minor.

9.5 Bridge Construction and Demolition

The Project requires modification to existing structures and construction of new structures. Bridge construction will typically involve piling operations and reinforced concrete column and crosshead construction. Bridge beams will be cast off-site in a precast concrete construction yard and then transported to site and placed in position with the top slab poured in situ. Barrier, settlement slabs and wing walls are also all poured in situ.

Specific erosion and sediment control measures will be applied to these bridge sites and will utilise construction water management techniques to be detailed within CESCPs.

9.5.1 Bridge Pile Construction

All bridge pile construction, including the use of any associated sheetpiles, will be undertaken outside of any stream channel.

The key erosion and sediment control methodology associated with the works is the use of non-structural practices, and of particular importance is the use the following techniques:

- Weather forecasting will be undertaken using, for example, *www.metvuw.co.nz* which will provide an indication when high rain events are predicted;
- Prior to predicted periods of rainfall, all high environmental risk activities, such as the use of wet concrete, will cease within any flood plain locations;
- While some temporary storage of fuels or storage of hazardous substances will be within some identified flood plain/overland flow areas, they will be removed prior to and during rain events. All refuelling for activities in these locations will be via mobile units only;
- Any dewatering will be undertaken with particular care to ensure pH and water quality issues do not arise. Sucker trucks will be the predominant mechanism for removal of this water;
- Structural erosion and sediment controls will include the following measures.
- Utilisation of a fully stabilised surface, with compacted clean granular material or similar, over the entire working footprint. This will ensure that any machinery working within this location does not generate sediment;
- Any stockpiles of material, such as drill spoil material, will be removed from the site on sealed truck units. While it is envisaged that no stockpiles of spoil material will be located within floodplain/overland flow locations, if this is required they will be temporary and short term only; and
- Below any drilling or earthworks activities, a super silt fence will be established in a horseshoe configuration which will capture any runoff from these activity. This will typically be located around the perimeter of the works and will ensure that the works area is fully isolated. The super silt fence is designed for the capture and treatment of sediment only and is not designed for concrete contamination. As an alternative, or a backup to the super silt fence, filter socks may be used and can be pegged to the ground surface below the works area. These will be bark or mulch filled filter socks which will assist with filtering sediment and also reducing the pH of concrete discharge if this results.

For all concrete works over the Project alignment the environmental controls are centred on the full removal of any slurry from the site. Housekeeping practices are critical in ensuring that concrete slurry is minimised. These practices include:

- Ensuring concrete spills are minimised;
- Cleaning up of any concrete spills that result; and
- Having a dedicated concrete wash area for items such as concrete tools and barrows.

For any concrete slurry generated this will be removed from the site with sucker trucks.

9.5.2 Bridge Demolition

Bridge demolition will occur in the location of McClymonts Road. This will effectively be undertaken by a specialist team and will be subject to a CESCP prior to works commencing.

Below any drilling or earthworks activities, a super silt fence will be established in a horseshoe configuration which will capture any runoff from this activity. This will typically be located around the perimeter of the works and will ensure that the works area is fully isolated. The super silt fence is designed for the capture and treatment of sediment only and is not designed for concrete contamination. As an alternative, or a backup to the super silt fence, filter socks may be appropriate and can be pegged to the ground surface below the works area. These will be bark or mulch filled filter socks which will assist with filtering sediment and also reducing the pH of concrete discharge.

On completion of the demolition the area of disturbance will be fully reinstated to a stabilised surface and hence will have minimal opportunity for any sediment or other contaminant runoff.

From a structures perspective, it is assessed that proven and best practice methodologies apply which will ensure minimum discharges and effects result.

9.6 Pumping

Pumping may be necessary in some parts of the Project. Where SRPs are installed they will be fitted with floating decants (or a plug outlet) with a mechanism to control outflow such as a manual decant pulley system to be used during pumping activities to these structures. These decants will only be lowered once an acceptable standard of discharge quality can be achieved which is assessed as measured by achieving a minimum 100mm clarity at the top of the water column. The pumping rates and volumes to SRPs will be designed for the total pump volume to be fully captured within the retention structure.

Further pumping may also be required with associated activities such as bridge construction. The pump discharge will be well away from any stream systems and if a SRP is unavailable will be to a turkeys nest as shown within **Appendix C**.

In circumstances where there are no treatment options, then a sucker truck will be used to dispose of the water away from the site to an authorised location. At all times there will be no discharge from pumping activities directly to a receiving environment.

9.7 SH1 Causeway Works

For the construction of the Project between chainage 15000 and 15300, the Project works will involve the widening of the crest of the existing SH1 causeway on both the eastern and western side of the existing motorway as shown on Drawing Number DRG – 1605 within **Appendix D**. To manage erosion and sediment control in the Rosedale Waste Water Treatment Ponds, the Project needs to be constructed carefully and consideration must be given to, firstly, reducing the potential for sediment generation and, secondly, managing any suspended material generated from the earthworks. Watercare consultation has confirmed that sediment discharge into the RWWTP ponds needs to be minimised to ensure ongoing compliance with existing operational consents, particularly with respect to suspended solids levels.

As the detailed design stage is yet to be undertaken and a contractor is still to be appointed, final details of the causeway works are yet to be decided. An indicative construction methodology is outlined in the Design and Constructability Report. The contractor may choose to develop an alternative methodology within the requirements of the consent conditions subject to the agreement of the NZ Transport Agency and Watercare.

The diversion of cleanwater from the existing motorway surface away from the causeway activity is important to ensure the success of the works. This approach will be based on a hot mix bund to be established on the edge of the existing sealed carriageway and divert flows away from the works location. Specific design for each area will be required, however, for the cleanwater diversions will be sized for the 1% AEP storm event with discharge locations for every 100m lineal length of motorway. These discharge locations will take the form of a flexi flume or lined channel to beyond the works area.

The general sequence of works for the methodology considered in the Design and Constructability Report will include:

- Install sheet piles or place a clean rock coffer groyne / dam at the extent of the works within the wastewater pond environment. This can have geotextile material place through the centre of the rock which will effectively form a containment area within which the works will occur. The rock from this placement will be used to line the final batter face on completion of the reclamation activity;
- Remove existing rock rip rap material and stockpile adjacent to the works within the catchment of a Super Silt Fence device;
- Construct bunded area beside the existing carriageway to temporarily stockpile contaminated excavated material from the wastewater pond for removal off site;
- Excavate toe in a sequenced manner as below:

- Monitor groundwater elevation, flow and quality;
- Install trench stops to control groundwater flow; and
- Remove water from excavations as necessary by pumping and discharging it into appropriate storage. There remains the potential to utilise the new northern wetland feature for this purpose.

- Continue to temporarily stockpile contaminated excavated material from the wastewater pond for removal off site if contaminated;
- Line bottom of toe excavation with approved geotextile; and
- Fill excavated area with approved GAP100 and line external batter face with rock lining (this can be sourced from the outer groyne feature).

In addition, during these temporary works there is the potential to install a silt curtain on the extent of works, within the pond environment, which may assist with further entrapment of suspended sediment loads. The need for this silt curtain device will be minimised through the use of clean rock (or sheet piles) on the outer edge of the temporary works such that it provides an isolated works environment.

This above sequence of works could occur in a series of approximately 100m lengths (exact lengths to be determined) to allow a controlled and sequenced reclamation process to occur. For each agreed length of works the same sequence of actions as above would occur until the full embankment is at the required width. Following this, full restoration and stabilisation of the area can occur.

As can be seen from the above methodology, the key erosion and sediment measure for these works are based on a construction sequence and programme. Utilisation of clean hardfill is critical in ensuring that sediment generation is minimised.

Importantly the RL of the external groyne coffer dam will need to be approximately 0.3m above the highest water level that can occur within the Rosedale pond environment.

It is anticipated that erosion and sediment can be controlled using the above methodologies because:

- Selecting all fill material that is considered to be clean hard fill (contains very low or no-fines) would reduce sediment yield;
- Selecting clean and non-contaminated fill material would prevent contaminants from being washed into the pond environment; and
- Staged construction will limit potential sediment yield.

With the above methodologies in place for the causeway work, sediment yields will be effectively minimised. The proposed construction monitoring programme outlined in Section 6.2 will also ensure that if sediment yields are larger than anticipated, that changes to the methodologies and erosion and sediment control measures will be implemented.

9.8 Flocculation Management Treatment

Chemical treatment using an industry standard flocculant will be utilised for the various sediment retention devices as well as specific activities like pumping. Using flocculants is necessary to provide “polishing” for the removal of fine clay particles which will be generated from the earthwork activities. Testing of the soil properties for chemical reactivity was undertaken from a small sample of soils to be encountered along the Project alignment. It is recognised however, that different soil types will be found as the Project progresses and as such, while the testing illustrates that Polyaluminium Chloride (PAC) was effective, specific dose rates, and possibly changes to the flocculant itself, may need to occur for specific locations and activities. Ongoing testing will be required to confirm these particular details which will be outlined within the CESCPs.

Two soil samples were taken from the Project both from within the SH1/SH18 location within the proposed construction support areas (at approximately chainage 500 and 650). Both soil samples were taken from 1m below the current surface and were of the subsoil clay substrate.

Plate 1 Soil Sample One – Chainage 500

Plate 2 Soil Sample Two – Chainage 650

Flocculation testing was undertaken and through that testing it was recorded that both of the soil samples provided had fine clay particles which remained in suspension long enough to potentially create settling issues during treatment of sediment laden runoff.

Chemical treatment was investigated utilising PAC which demonstrated effective removal of suspended solids within the water column. The results are detailed below in **Table 3.**

Table 3 Soil Flocculation Results

Soil Sample And Dose Rate (Mg/L Of Aluminium)	Clarity After 30 Minutes (Cm)	Ph After 30 Minutes
Sample 1		
0	1.0	6.36
2	6.0	5.72
4	7.0	5.43
6	10.0	5.15
8	10.0	4.94
Sample 2		
0	8.0	6.76
2	10.0	6.54
4	10.0	6.31
6	10.0	6.09
8	10.0	5.91

The photographs below illustrate the effectiveness of the addition of flocculants to the soil samples.

Plate 3 Soil Sample One Prior to Chemical Flocculation

Plate 4 Soil Sample One Following 30 minutes of Chemical Flocculation (PAC)

Plate 5 Soil Sample Two Prior to Chemical Flocculation

Plate 6 Soil Sample Two Following 30 minutes of Chemical Flocculation (PAC)

This study demonstrates that PAC achieved effective removal of suspended solids and would be effective for the Project at relatively low dosage rates, with the turbidity levels being significantly reduced. The samples reacted well to the flocculant and there was significant deposition of sediment noted in the base of the sample jars following addition of the chemical. It is therefore recommended that the Project uses a coagulant such as Poly Aluminium Chloride or an alternative flocculant that achieves similar results. This could include the use of organic flocculants if effectiveness is not compromised with respect to water quality. A flocculation management plan will be provided for certification prior to works commencing and will be based upon the use of rainfall activated devices for the SRPs and flocculant socks for the check dam structures.

9.9 Construction Support Areas

Construction support areas are identified in the drawings provided in **Appendix D**. The Design and Constructability Report provides specific details about the activities that will occur at each location.

The following requirements will apply in relation to these locations:

- All construction support areas will be compacted hard-fill unless existing hardstand (sealed) areas exist such as at the construction support areas on Rosedale Road and Paul Matthews Road;
- Unless haul roads to the construction support areas are routed through rock subgrades, wheel wash stations will be provided at all exit locations. The location of many of the construction support areas identified mean that wheel wash stations, if installed, could be co-located next to entry and exit points;
- All construction support areas will be used for stockpiling of earthworks, including contaminated soil if this is required; and
- All construction support areas will also be used as structure compounds.

Establishing the construction support areas will typically involve stripping of topsoil (unless the location already has an existing hardstand surface), contouring and placement of hardfill dependent upon the use of the yard area. Construction support areas will be required to have adequate erosion and sediment control and due to the temporary nature of the exposed area, will typically be based upon runoff diversion channel and sediment retention ponds followed by a progressive cover of hardfill material. This hardfill will consist of clean granular metal compacted with a track roller.

If necessary, cleanwater diversions will be established at the perimeter of the site to intercept and divert offsite water and overland flow from upstream catchments from entering the areas.

Where necessary, silt fences will be placed during the construction support area establishment phase of works such as the location on Paul Matthews Road. The construction support area establishment is recognised as a quick process whereby earthworks activity to establish the platform is completed as a single operation. Immediately on reaching grade the area will be stabilised with a 50 to 100mm thick layer of clean hardfill material. This has the purpose of achieving immediate stabilisation but also ensuring traffic movement to and from the Project will not be a generator of any further sediment yields.

Further water management practices to be used in the operation of the construction support areas during construction will be as follows:

- Vehicle movements and parking will only be within designated areas of hardstanding;
- Non-sediment contaminants (chemicals, petroleum and solvent based) products are to be stored within appropriately designed bunded areas;
- Contaminated material (soil) stored in the area will be managed within self-contained locations and will not utilise the sediment control measures installed;
- Regular clearing of sealed hardstanding areas will be carried out using a road sweeper to remove deposited material from the surface that could become mobilised during rain events; and
- All material (non-contaminated) stockpiles located within the construction support areas confines will ensure treatment through the sediment control measures.

The specific detail of the measures proposed for each construction support area will be included within the CESCPs to be submitted prior to construction commencing.

During the operation of the construction support area, the sediment control measures and associated runoff diversion channels will remain in place.

9.10 Stormwater Wetland Establishment

Numerous long term stormwater wetlands are to be constructed along the Project. While these wetlands occupy relatively large footprints, they do not involve significant volumes of earthworks. The stormwater management areas form an important part of the Project, and, from an erosion and sediment control perspective, they will need to be constructed in an isolated manner. In locations such as that immediately south of the SH1 causeway works, the positioning of the wetlands is the same as that proposed for construction related SRPs and as such the permanent stormwater ponds footprint can be used early in the Project for erosion and sediment control purposes.

The works for the construction of the wetlands will generally involve the use of an excavator and motorscrapers removing the topsoil and clay material from the location and then final contouring to be undertaken.

Prior to these works commencing, the perimeter of the excavation area will be marked with a topsoil bund or a Super Silt Fence so that it is clear where the works boundary exists to prevent machinery moving outside of and disturbing unnecessary areas. In addition, the bund will be formed so that it can act as an impoundment area if necessary with decanting devices installed. Some pumping may

be necessary which will follow the process as outlined within Section 9.6. The plans in **Appendix D** illustrate the proposed erosion and sediment controls for these devices.

The wetland features will be formed and fully stabilised with the permanent planting and mulching programme prior to removal of any erosion and sediment controls installed.

Where an operational stormwater treatment device is located at the same location as the construction water management device, the timing of the switch from construction to operational water treatment device needs to be considered. In these circumstances, the sediment retention device will be constructed but with the outlet device incorporating the same outlet structure device as the permanent structure. The SRP will continue to operate as a construction related device and once the criteria for operational implementation is met, then the outlet will be changed to reflect operational requirements. Flocculation management will be reconsidered and may no longer be necessary at this stage.

It is recommended that the operational water treatment devices will generally need to progress from the construction water management device when 80% of the catchment is in its permanent form e.g. stabilised by vegetation and roads sealed.

9.11 Vegetation Removal

Vegetation removal will form part of the overall land disturbing activity that needs to be undertaken for the Project, and will occur prior to any earthworks. While the vegetation removal itself does not include earthworks activity, there may be a number of associated earthworks activities such as tracking and access road construction.

Prior to undertaking vegetation removal, appropriate erosion and sediment control measures will be installed that will apply to the subsequent earthworks operation. This will typically be based on the wider earthwork erosion and sediment control measures. However, if these are unable to be installed appropriate erosion and sediment control measures such as silt fences or immediate stabilisation using mulched tree vegetation will be used.

Importantly, if vegetation removal is required as a standalone activity, then specific CESCPs will be developed.

The vegetation removal component of the Project is a relatively short-term activity and the specific control measures to be employed will be fully detailed and designed within the CESCP for specific locations.

9.12 Dust

Earthwork activities have the potential to generate dust that may be considered to be a nuisance in times of dry and windy weather. Dust management will be addressed in the Dust Management Plan required as part of the conditions of consent. Further details about the management of dust are set out in the Assessment of Air Quality Effects (**Volume 3 – Technical Assessment 1**).

10 Assessment of Effects

A range of land-disturbing activities will be undertaken as part of the Project and these activities have numerous requirements under the relevant policy and planning documents. The details of the applicable documents are discussed within the AEE. When considering these policy requirements, several key items are of importance in terms of construction water management discharges, including:

- Proximity to streams;
- Values of the receiving environments adjacent to, or downstream of, the Project;
- Site topography; and
- Areas of exposed soils.

In addition, the overall approach has been informed by the requirements in Part 2 of the RMA and the matters set out in sections 105 and 107. All these matters have factored into the BPO approach adopted in this report. None of the streams within the Project area are used as a human drinking water source, or for stock drinking purposes.

Table 4 Overall Assessment of Earthworks Activities

Construction Assessment Criteria	Description
Erosion and Sediment Control and Environmental Management	Environmental control measures will be fully implemented as part of the Project implementation. These will be implemented in accordance with measures and methods outlined in this report and the CESCP's which will require future Council certification prior to works commencing. Any construction activities will be managed to a minimum standard associated with TP90 and the NZTA Guideline. This is based on a BPO approach and includes sequencing of works, minimisation of duration of works, undertaking all works in accordance with a CESCP and undertaking construction monitoring.
Water Quality	All discharges will be treated to a minimum standard associated with TP90 and the NZTA Guideline. These Guidelines are exceeded in many circumstances and includes flocculation management, comprehensive methodologies and stabilisation techniques.
Aesthetics and odour	After reasonable mixing, any sediment discharged will not give rise to: ■ Conspicuous oil or grease films, scums or foams, or floatable or suspended materials; ■ Any conspicuous change in the colour or visual clarity; and/or ■ Any emission of objectionable odour. These environmental controls are comprehensive and reflect the best practical option approach while also adopting the standards from the relevant guidelines and requiring the monitoring of discharges. With treatment and after mixing no conspicuous change to the receiving waters is expected. Similarly, no emission of objectionable odour is expected.

From a water quality perspective the following assessment criteria from the AUP E.26.5.5.2 are relevant:

- Land disturbed for the operation, repair, renewal, upgrading or maintenance of utilities will be stabilised by re-vegetation, grassing or other suitable means as soon as practicable after completion of the works to avoid erosion and scouring.

Progressive stabilisation forms a key component of the Project construction works. This includes the use of hard fill, geotextiles and mulching to minimise erosion and hence minimise any subsequent sediment generation and yield.

- Land disturbance must not, after reasonable mixing, result in any of the following effects in receiving waters:
  - The production of conspicuous oil or grease films, scums or foams, or (a)floatable or suspended materials;
  - Any conspicuous change in the colour or visual clarity;
  - Any emission of objectionable odour;
  - The rendering of fresh water unsuitable for consumption by farm animals; or
  - Any significant adverse effects on aquatic life.

Compliance with TP90 and the NZTA Guideline, along with a comprehensive monitoring and adaptive management approach, will ensure that these effects do not occur. In addition, the development and implementation of CESCPs will allow for specific management techniques and practices to be tailored for particular activities and locations. The effects of the Project on aquatic ecology are addressed in the Freshwater Assessment Report.

- Best practice erosion and sediment control measures must be implemented for the duration of the land disturbance. Those measures must be installed prior to the commencement of land disturbance and maintained until the site is stabilised against erosion. Best practice in Auckland is generally deemed to be compliance with Auckland Council Technical Publication 90 Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region or similar design.

A BPO approach will be adopted that is in accordance with the most stringent requirements of TP90 or the NZTA Guideline. This approach requires the implementation of erosion and sediment control measures to be in place prior to works commencing and to remain in place until such a time as the location of works, or activity, is fully stabilised.

- Dewatering of trenches and other excavations must be done in accordance with best practice and must not result in a discharge of untreated sediment laden water to any stormwater reticulation system or water body.

Trenching activities will be the subject of a CESCP where water management will be addressed. As specified within the CWR in Section 9.6, any pumping activity will require controls to be in place to ensure water quality is achieved and there are no effects occur downstream.

- Trenching must be progressively closed and stabilised such that no more than 120m of continuous trench is exposed to erosion at any one time.

As detailed above, progressive stabilisation forms a key component of the Project construction works and this also applies to trenching activities.

- Only cleanfill material may be imported and utilised as part of the land disturbance.

No importation of fill is expected to be required for the Project however if this is to occur it will be cleanfill only and will meet the necessary cleanfill criteria. Some hardfill will be imported to the site as part of the Project implementation.

11 Summary and Conclusions

A range of construction activities that will be undertaken as part of the Project have the potential to impact on the ecological values of the receiving environments.

This report is based on a conceptual approach and provides a suite of methodologies for earthworks activities. This approach provides certainty that the construction activities can occur with minimal sediment discharges and associated construction related effects.

The following key points are noted for the construction related methodologies for the Project:

- A range of construction water management techniques (including erosion and sediment control measures) are proposed to be implemented for the Project. These will be designed, constructed and maintained in accordance with recognised guidelines and will at all times achieve, as a minimum, the requirements of the NZTA Guideline and TP90.
- The construction water management methodologies rely on the development of CESCPs which will be submitted to Auckland Council for certification, prior to any construction activity.
- The CESCP approach allows for flexibility and input from the Project team, Auckland Council and the contractor whilst ensuring that the standards in TP90 and the NZTA Guideline are achieved.
- Risk management forms a key part of the Project implementation and will form a component of the CESCP process.
- Flocculation management will be implemented on the site as a risk management tool and will be done so in accordance with all CESCPs.
- Monitoring will be required as part of the CESCP and is a key tool for the success of the Project and is to be implemented in an adaptive management framework whereby there is a continuous improvement process at all times for construction water management methodologies and specific measures.

This approach enables flexibility and innovation while still ensuring the potential adverse effects are managed appropriately and in accordance with best practice.

12 References

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Appendices

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Appendix A
NCI Construction Zones

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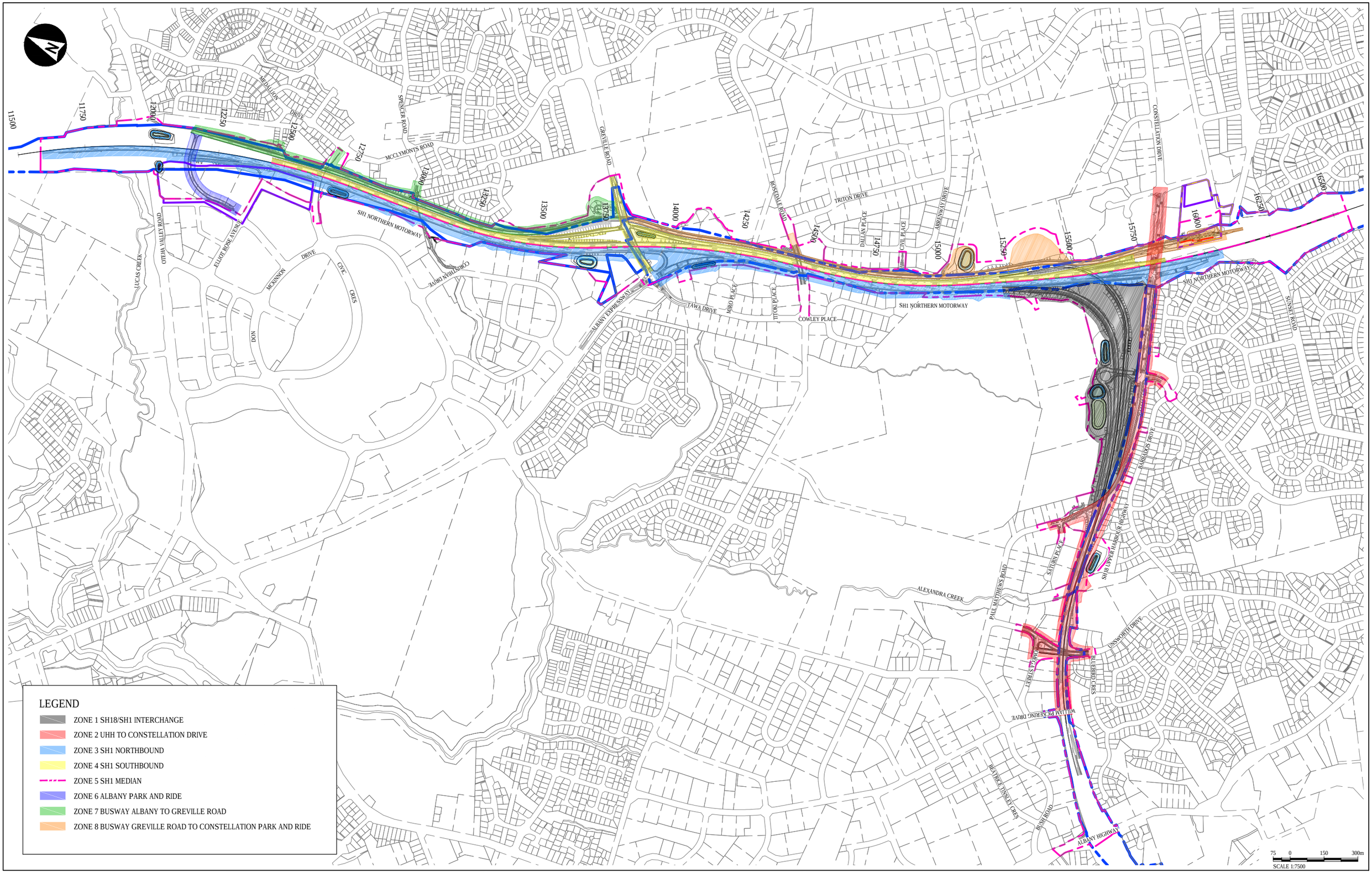

LEGEND

- ZONE 1 SH18/SH1 INTERCHANGE
- ZONE 2 UHH TO CONSTELLATION DRIVE
- ZONE 3 SH1 NORTHBOUND
- ZONE 4 SH1 SOUTHBOUND
- ZONE 5 SH1 MEDIAN
- ZONE 6 ALBANY PARK AND RIDE
- ZONE 7 BUSWAY ALBANY TO GREVILLE ROAD
- ZONE 8 BUSWAY GREVILLE ROAD TO CONSTELLATION PARK AND RIDE

aurecon

NZ TRANSPORT AGENCY WAKA KOTAHI

CLIENT

REV	DATE	REVISION DETAILS	APPROVED
A		PRELIMINARY ISSUE	
			-

WORKING DRAFT

SCALE	SIZE
1:1000	A1

DRAWN: C. LANE
DESIGNED: M. FAN
CHECKED:

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONSTRUCTION STAGING OVERALL PLAN

DRAWING No.

PROJECT No.		STAGE		WP		TYPE		NUMBER		REV
250310	–	5DOC	–	3DES	–	DRG	–	2199	–	A

Appendix B
NZ Transport Agency ESCP Checklists

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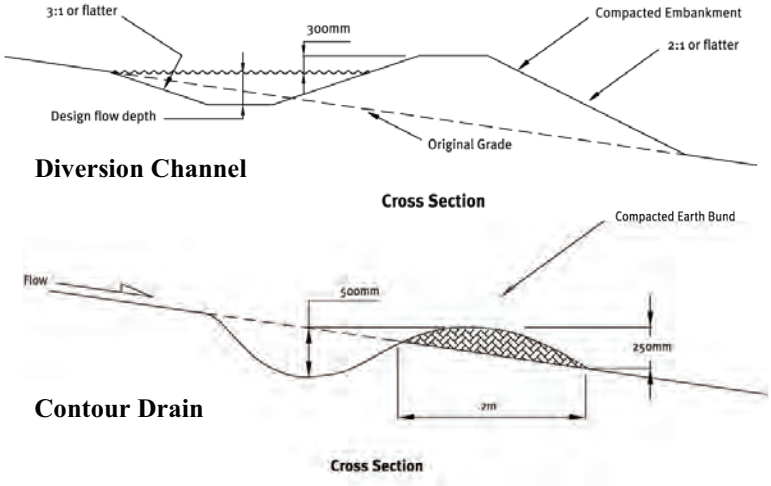
NZ TRANSPORT AGENCY WAKA KOTAHI	Erosion and Sediment Control Inspection Checklist
Check List for Contour Drains and Diversions	

Contractor: Inspector:	Date: Time:	Consent #:	Site:

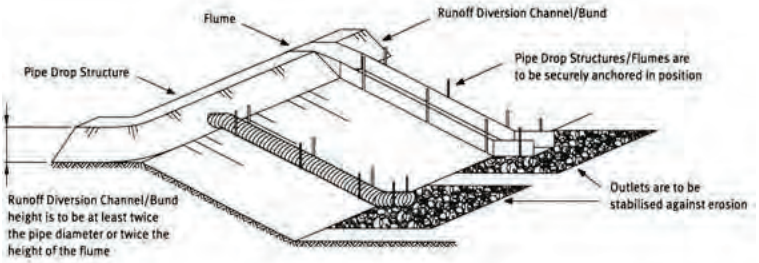
Site Inspection of Erosion and Sediment Control Practices

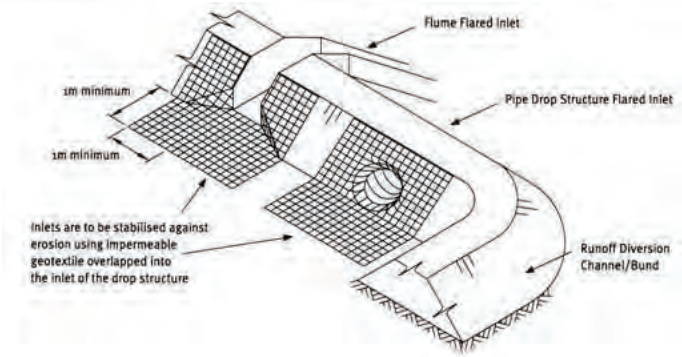
Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Contour drains				
Minimum compacted height is 250 mm				
Minimum depth of 500 mm				
Longitudinal grade < 2% w/out lining				
Catchment area < 0.5 ha				
Parabolic flow area and not V shaped				
Diversion channels and bunds				
Choose a route that avoids trees, services, fence lines or other natural or built features				
Channels shall be trapezoidal or parabolic in shape.				
Internal side slopes no steeper than 3:1 External side slopes no steeper than 2:1				
Bunds shall be well compacted				

Outlets shall be stable and protected as needed				
Diversions shall be stabilised to prevent erosion				
Maintenance				
Contour drains				
Repair or reinstate drains if destroyed by equipment				
Inspect contour drains after rainfall and repair as necessary				
Check outfall for erosion and repair as needed				
Diversion channels and bunds				
Inspect weekly and after every rainfall and repair immediately				
Remove accumulated sediment				
Check inlets and outlets to ensure that these remain scour and erosion free				
Look for low spots where water can pond, formation of tunnel gullies and debris blockage				
Check for stabilisation cover				
Protect bunds from equipment damage				
Decommissioning				
Contour drains				
Spread bunded area and stablise				
Diversion channels and bunds				
Fill in channels and spread bunded area and stabilise				

NZ TRANSPORT AGENCY
WAKA KOTAHI

Erosion and Sediment Control Inspection Checklist





Check List for Pipe Drop Structures

Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Use when slopes > 3:1				
Do not use on slopes < 5:1				
Must be of an impervious material				
Diversion channel or bund must be 2 x height of flume or pipe				
Must have a stabilised entry apron to prevent scour or piping				
Must extend beyond toe of slope with erosion protection at outfall				
Maintenance				
Inspect weekly and after each rain				

Keep the inlet open at all times				
Check for evidence of water bypass, undermining, ponding or overtopping.				
Check for scour at the base of the pipe and repair, protect or reduce flows				
Decommissioning				
When areas draining to the pipe are controlled, all disturbed areas stabilised and permanent stormwater drainage has been installed.				

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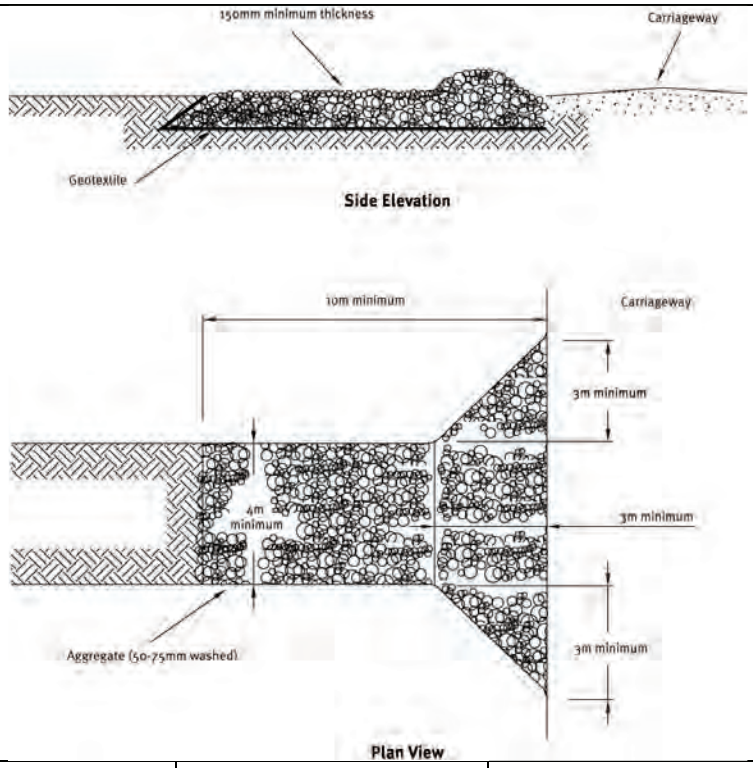
Erosion and Sediment Control Inspection Checklist



Check List for Stabilised Entranceways

Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Area cleared of unsuitable material and smooth graded				
Geotextile placed over this area ensuring it is properly pinned and overlapped				
At least 10 m of aggregate, 4 m wide and 1.5 x aggregate size in depth. Aggregate 100-105 mm washed aggregate				
Ensure that vehicles cannot bypass the entranceway				
Can be used with a shaker ramp (cattle stops) or with a wheel wash				

Maintenance				
Inspect weekly and after each rain				
Maintain the entranceway to prevent it becoming a source of sediment				
If used with a wheel wash, ensure that this drains to an approved sediment retention practice.				
Decommissioning				
Remove aggregate and geotextile and stabilise. At this point ensure that traffic is kept off of the area				

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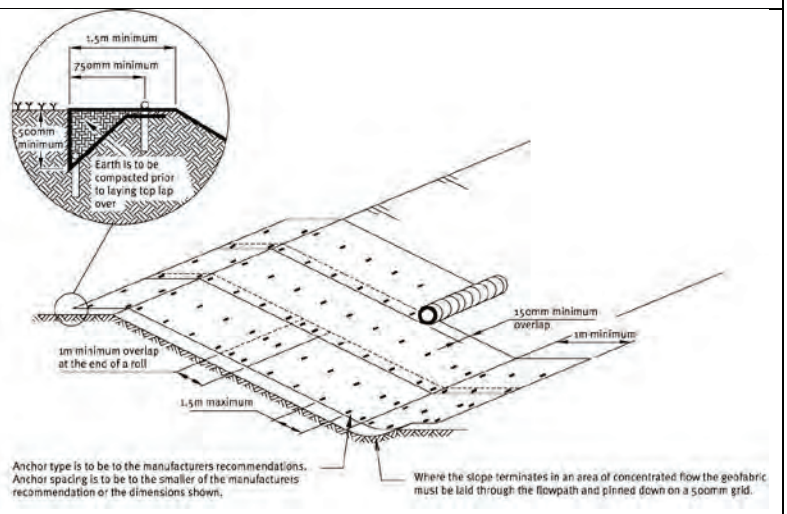
Erosion and Sediment Control Inspection Checklist

Check List for Geotextiles



Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Has the site been prepared to ensure complete contact of the blanket or matting with the soil				
Area graded and shaped for installation				
All rocks, clods, vegetation or other obstructions removed				
Seedbed prepared by loosening 50 mm to 75 mm of topsoil				
Area seeded prior to blanket installation unless specified otherwise				
Wire staples, stake pins or wooden stakes have been placed to anchor mats and blankets to the ground. Propoer sized anchoring materials have been used				
On slopes, has the blanket started at the top of the slope and rolled downslope				
Are blanket edges overlapped				

In channels is there an anchor trench >300 mm deep x 150 mm across at the lower end of the project				
Intermittent check slots at 8-10 m intervals				
Are side fabric edges keyed in at least 100 mm deep x 100 mm wide				
Channel fabric begun at the downstream end with upstream geotextile overlapping < 75 mm				
Upstream end keyed in >300 mm x 150 mm wide				
Geotextile anchored securely with appropriate anchors				
Seed and fill turf reinforcement matting with soil if specified				
Maintenance				
Inspected daily and after each rain				
All rills, tears, missing pins or other damage repaired immediately				
Decommissioning				
If geotextile is temporary, remove it and stabilise the area				
If geotextile is permanent, ensure good stabilisation exists				

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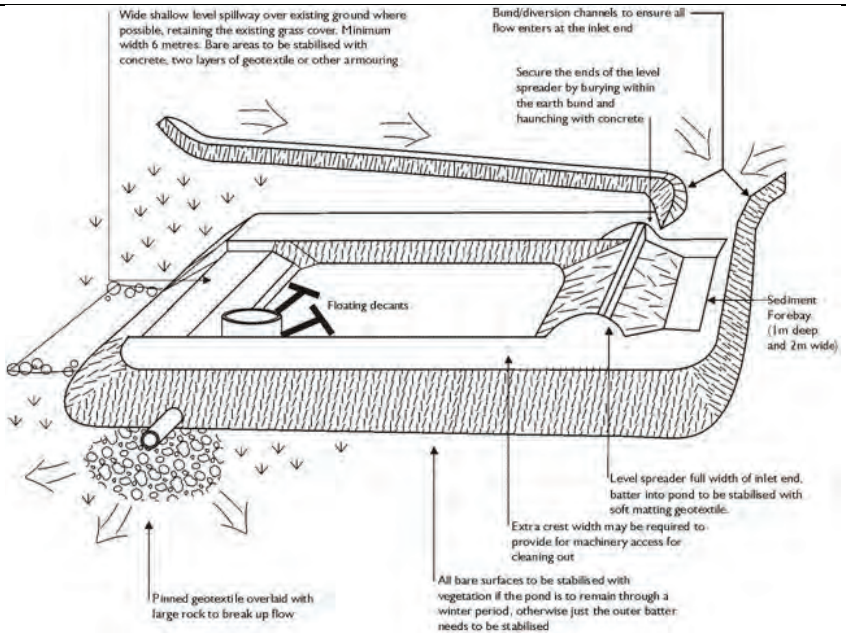
Erosion and Sediment Control Inspection Checklist

Check List for Sediment Retention Ponds



Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Implement sediment control downslope of the proposed sediment retention pond				
Clear areas of proposed fill of topsoil or other suitable material down to competent material.				
If the pond is to be converted to a permanent stormwater management pond ensure that a key trench is constructed				
Use only approved fill material.				
Place and compact fill in layers per the engineering recommendations				
Construct fill embankment 10% higher than the design height to allow for settlement				

	Install pipework and anti-seep collars or filter collars during construction of the embankment and ensure good compaction around pipes				
	Construct the emergency spillway				
	Install and stabilise the level spreader				
	Securely attach the decant system to the horizontal pipework. Make all connections watertight. Place any manhole riser on a firm foundation of concrete or compacted soil				
	Protect inlet and outlet with fabric				
	Install baffles when the pond's length to width ratio < 3:1				
	Provide an all weather access track for maintenance				
	Check all elevations to ensure proper function and rectify any inaccuracies				
	Stabilise both internal and external batters with vegetation and the emergency spillway in accordance with the approved erosion and sediment control plan				
	Undertake an As Built assessment at the completion of consruction and rectify any discrepancies with the design				
Maintenance					
	Clean out pond before the volume of accumulated sediment reaches 20% of the total pond volume. A staff gauge would assist in this determination				
	Clean out ponds with high capacity sludge pumps or with excavators loading the material onto sealed tip trucks to an area that will not discharge sediment off-site				
	Clean out forebay after each runoff event if there is any evidence of sediment deposition				
	Inspect pond every day and before every forecasted rainfall event				
	Inspect for correct operation after every runoff event				
	Immediately repair any damage caused by erosion or construction equipment				
Decommissioning					
	Install a silt fence or other device downhill from the pond				
	Dewater pond				
	Remove and correctly dispose of all accumulated sediment				
	Backfill the pond and compact soil. Regrade as required				
	Stabilise all exposed surfaces				

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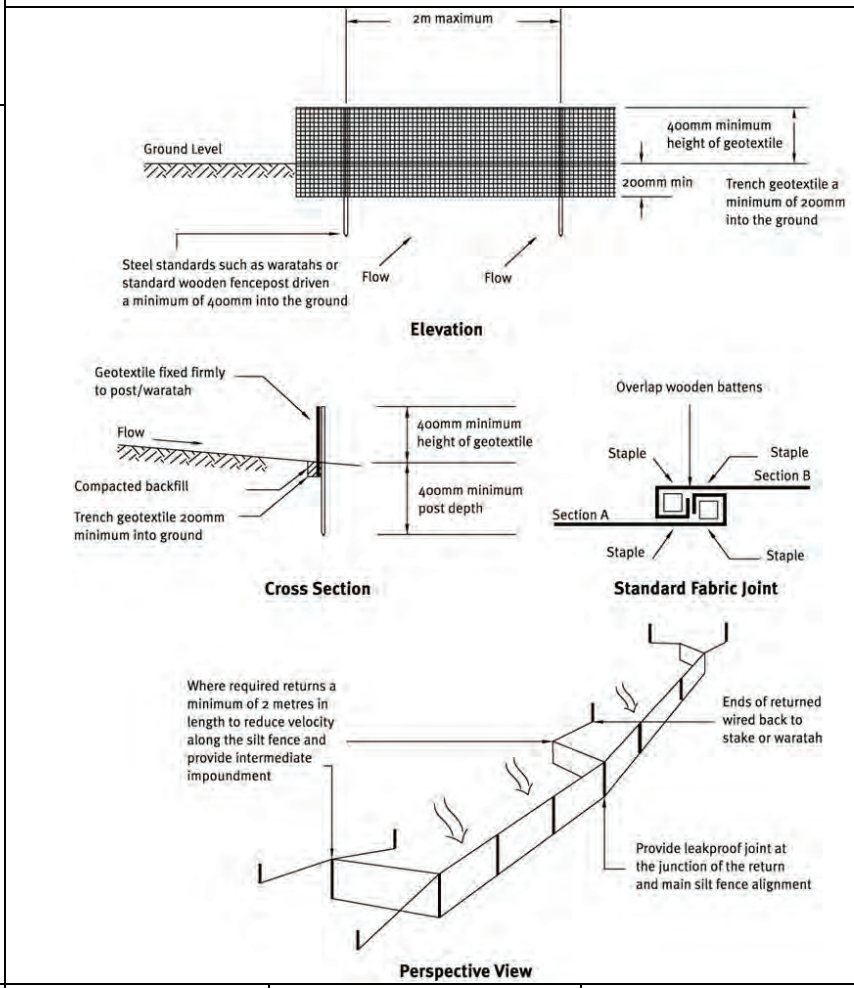
Erosion and Sediment Control Inspection Checklist

Check List for Silt Fence



Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Use silt fence material appropriate to the site conditions and in accordance with the manufacturer's specifications				
Always install silt fences along the contour				

Excavate a trench a minimum of 100 mm wide and 200 mm deep along the proposed line of the silt fence				
Use supporting posts of tantalised timber a minimum of 50 mm square or steel waratahs at least 1.5 m length				
Install the support posts/waratahs on the downslope edge of the trench and silt fence fabric on the upslope side of the support posts to the full depth of the trench and then backfill the trench with compacted soil				
Reinforce the top of the silt fence fabric with a support made of high tensile 2.5 mm diameter galvanised wire. Tension the wire using permanent wire streainers attached to angled waratahs at the end of the silt fence				
Where ends of silt fence fabric come together, ensure they are overlapped, folded and stapled/screwed to prevent sediment bypass				
Maintenance				
Inspect silt fences at least once a week and after each rainfall				
Check for damage including rips, tears, bulges in the fabric, broken support wires, loose posts/waratahs, overtopping, outflanking, undercutting and leaking joins in the fabric				
Make any necessary repairs as soon as they are identified				
Remove sediment when bulges occur or when sediment accumulation reaches 50% of the fabric height				
Remove sediment deposits as necessary (prior to 50% level) to continue to allow for adequate sediment storage and reduce pressure on the silt fence				
Dispose of the sediment to an area where sediment cannot be transported downstream				
Decommissioning				
Do not remove silt fence and accumulated sediment until the catchment area has been appropriately stabilised				
Remove and dispose of accumulated sediment				
Backfill trench, regrade and stabilise the disturbed area				

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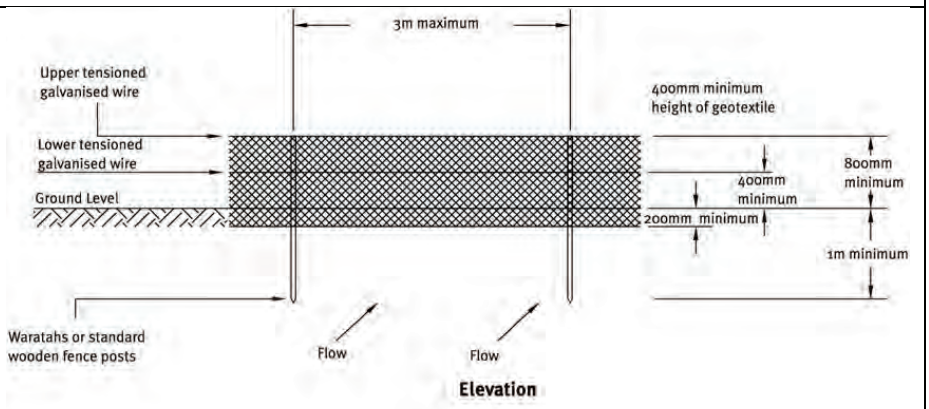
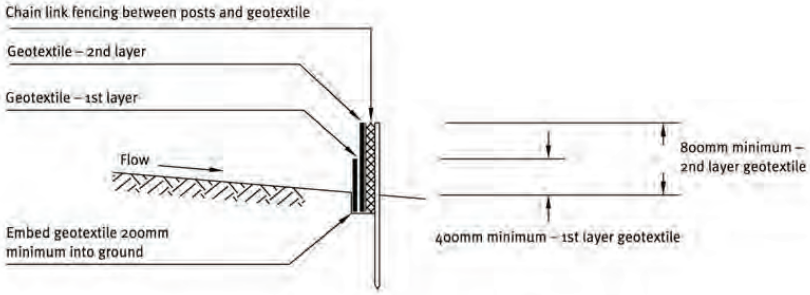
Erosion and Sediment Control Inspection Checklist

Check List for Super Silt Fence



Elevation



Cross Section

Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Use super silt fence material appropriate to the site conditions and in accordance with the manufacturer's specifications				
Always install super silt fences along the contour				
Excavate a trench a minimum of 100 mm deep along the proposed line of the super silt fence				

Use supporting posts of tantalised timber (No. 3 rounds, No. 2 half rounds) or steel waratahs at least 1.8 m in length				
While there is no need to set the posts in concrete, ensure the 1.8 m long posts are driven in > 1 m				
Install tensioned galvanised wire (2.5 mmHT) at 400 mm and again at 800 mm above ground. Tension the wire using permanent wire strainers attached to angled waratahs at the end of the super silt fence				
Secure chain link fence to the fence posts with wire ties or staples, ensuring the chain link fence goes to the base of the trench				
Fasten two layers of geotextile fabric to the base of the trench (a minimum of 200 mm into the ground) and place compacted backfill back to the original ground level				
When two sections of geotextile fabric adjoin each other, ensure that they are doubled over a minimum of 300 mm, wrapped around a batten and fastened at 75 mm spacings to prevent sediment bypass				
Maintenance				
Inspect fences at least once/week and after each rainfall				
Check for damage including rips, tears, bulges in the fabric, broken support wires, loose posts/waratahs, overtopping, outflanking, undercutting and leaking joins in fabric				
Make repairs as soon as identified				
Remove sediment when bulges occur or when sediment accumulation reaches 50% of the fabric height				
Remove sediment deposits as necessary (prior to 50% level) to continue to allow for adequate sediment storage and reduce pressure on the super silt fence				
Dispose of the sediment to an area where sediment cannot be transported downstream				
Decommissioning				
Do not remove super silt fence and accumulated sediment until the catchment area has been appropriately stabilised				
Remove and dispose of accumulated sediment				
Backfill trench, regrade and stabilise the disturbed area				

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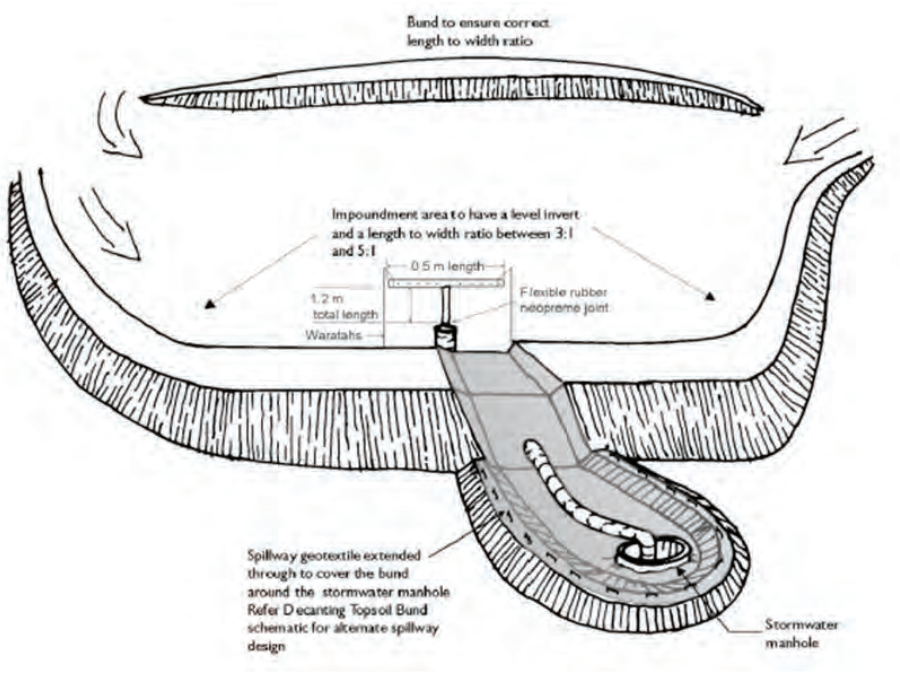
Erosion and Sediment Control Inspection Checklist

Check List for Decanting Earth Bund



Contractor: Inspector:	Date: Time:	Consent #:	Site:

Site Inspection of Erosion and Sediment Control Practices

Erosion and Sediment Control Practice	Yes	No	N/A	Corrective Action
General Information				
Do you know what receiving system the project drains into				
Are you aware of local rainfall patterns during various times of the year				
Soil types and erosion potential for site				
Is a copy of the erosion and sediment control plan on site				
Is temporary fencing placed in areas where no construction is to take place				
Construction				
Build Decanting Earth Bunds along the contour to obtain required volumes				
Remove all organic/ vegetation before construction				
The Decanting Earth Bund is to be keyed into the existing ground to a minimum depth of 0.3 m				

	The Decanting Earth Bund is to be made with a clay-silt mix of suitable moisture content to achieve a reasonable compaction standard (90%). It is considered that this can be achieved, in most instances, by track rolling at 150 - 200 mm lifts. Particular care is required to achieve good compaction around the outlet pipe that passes through the bund to avoid seepage and potential failure				
	Install a 150 mm diameter non-perforated outlet pipe through the bund and this is to discharge to a stable erosion proofed area or stormwater system				
	A T-Bar decant is attached by way of a standard 100 mm tee joint (glued and screwed). The decant is 100 mm dia. PVC pipe 0.5 metres long with 20 equally spaced holes of 10 mm diameter and fixed firmly to a waratah standard to achieve 3 litres/second/ha of contributing catchment				
	A sealed PVC pipe (with endcaps) is placed on top of the decant to provide buoyancy				
	Use a flexible thick rubber coupling to provide a connection between the decant arm and the discharge pipe. To provide sufficient flexibility (such as is required for the lower decant arm) install two couplings. Fasten the flexible coupling using strap clamps, glue and screws				
	The decant is fastened to two waratahs by way of a nylon cord to the correct height				
	Provide an emergency spillway to a stabilised outfall 150 mm above the level of the top of the decanting novacoil pipe. This can be a trapezoidal spillway with a minimum invert length of 2 m which is smooth, has no voids and is lined with a soft needle punched geotextile to the stabilised outfall. Ensure the geotextile is pinned at 0.5m centres				
	The emergency spillway is to have a minimum freeboard of 250 mm, i.e. between the invert of the spillway to the lowest point of the top of the bund				
	Undertake an As Built assessment at the completion of construction to check against design. If there are discrepancies rectify immediately				
Maintenance					
	Inspect decanting earth bunds at least once/week and after each rainfall				

Check for damage including • Spillway • Outlet erosion • Decant or fitting damage • Embankment seepage or along outlet pipe • Blockages to holes in decants				
Make any necessary repairs as soon as identified				
Remove sediment when sediment accumulation reaches 20% of volume				
Dispose of the sediment to an area where sediment cannot be transported downstream				
Decommissioning				
Do not remove Decanting Earth Bund and accumulated sediment until the catchment area has been appropriately stabilised				
Dewater bund area				
Remove and dispose of accumulated sediment				
Remove pipes, fabric and other construction materials				
Backfill, regrade and stabilise the disturbed area				

Appendix C
ESCP Design Drawings

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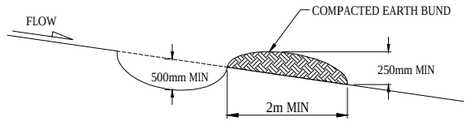
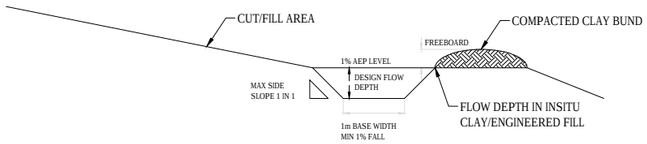
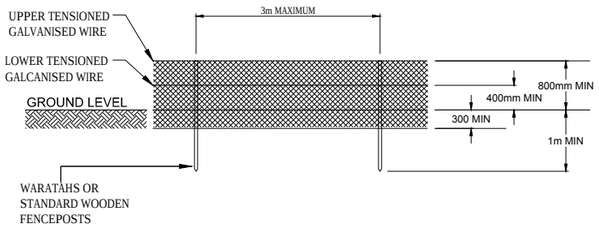
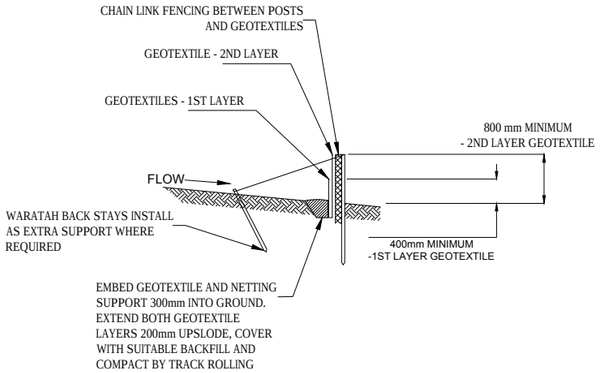


CONTOUR DRAIN DETAIL
1:50

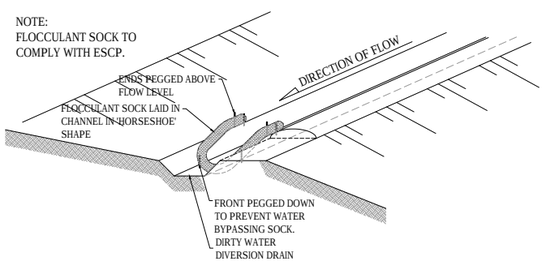


DIRTY WATER DIVERSION CHANNEL DETAIL
1:50





SUPER SILT FENCE DETAIL
1:50



FLOCCULATION SOCK / CHECK DAM DETAIL
1:100

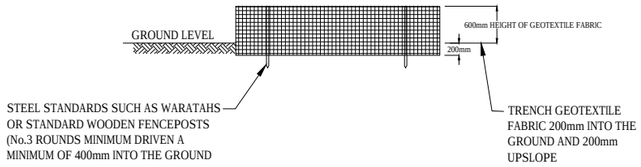
500 0 1000 2000mm
SCALE 1:50

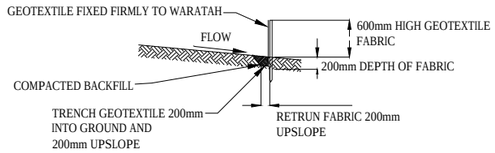
250 0 500 1000mm
SCALE 1:25

1 0 2 4m
SCALE 1:100

NOTES:
1. POST SPACING CAN BE INCREASED FROM 2m TO 4m IF SUPPORTED BY A 2.5mm DIAMETER HIGH TENSILE WIRE ALONG THE TOP WITH CLIPS EVERY 200mm.

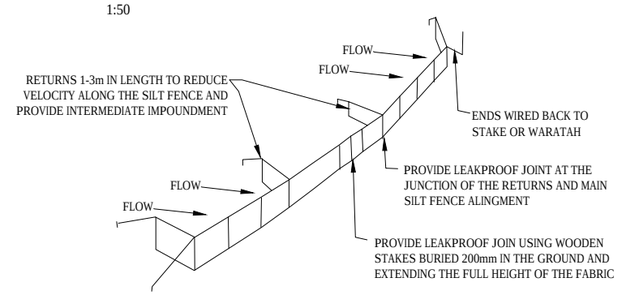
2. WRAP BOTH ENDS OF THE FABRIC AROUND ON STAKE AND CLAMP THE OTHER STAKE TO IT USING SELF TAPPING WOOD SCREWS AT 150mm SPACINGS



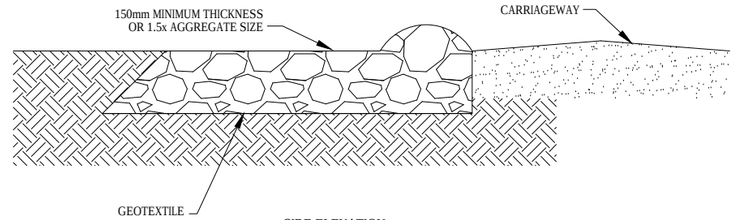


SILT FENCE CROSS SECTION
1:50

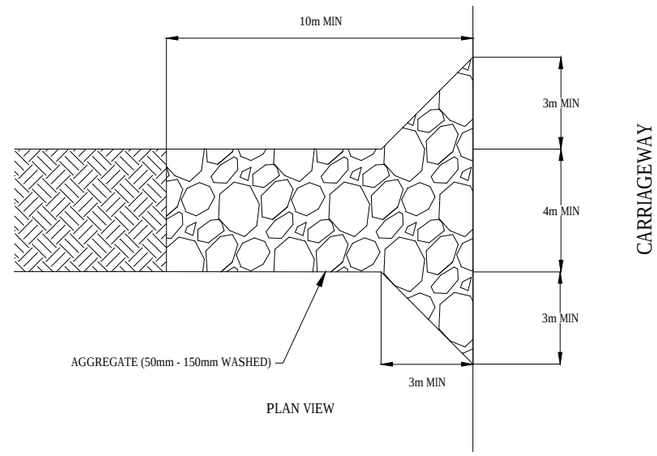
STANDARD DETAIL FOR FABRIC JOIN
1:50



SILT FENCE RETURNS AND WIRE
1:50

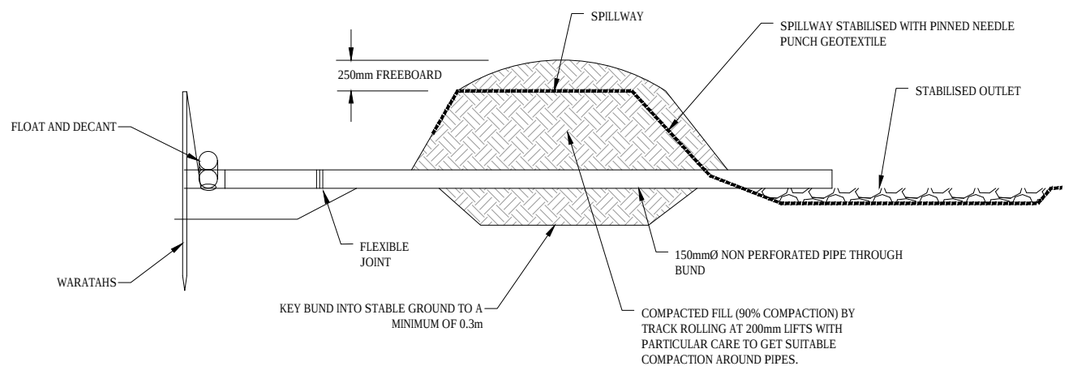


SIDE ELEVATION



PLAN VIEW

STABILISED CONSTRUCTION ENTRANCE DETAIL
1:100



DECANTING EARTH BUND
1:25

RidleyDunphy environmental & planning consultants

aurecon

CLIENT

NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
A	30/11/16	ISSUED FOR CONSENT	G. RIDLEY

SCALE	SIZE
NOT TO SCALE	A1

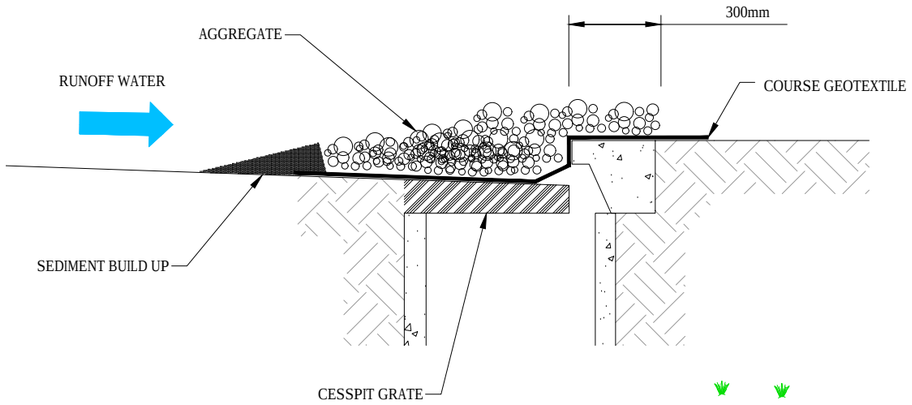
DRAWN: V. SMITH
DESIGNED: G. RIDLEY (EXTERNAL)
CHECKED: M. DUNPHY (EXTERNAL)

PRELIMINARY
NOT FOR CONSTRUCTION

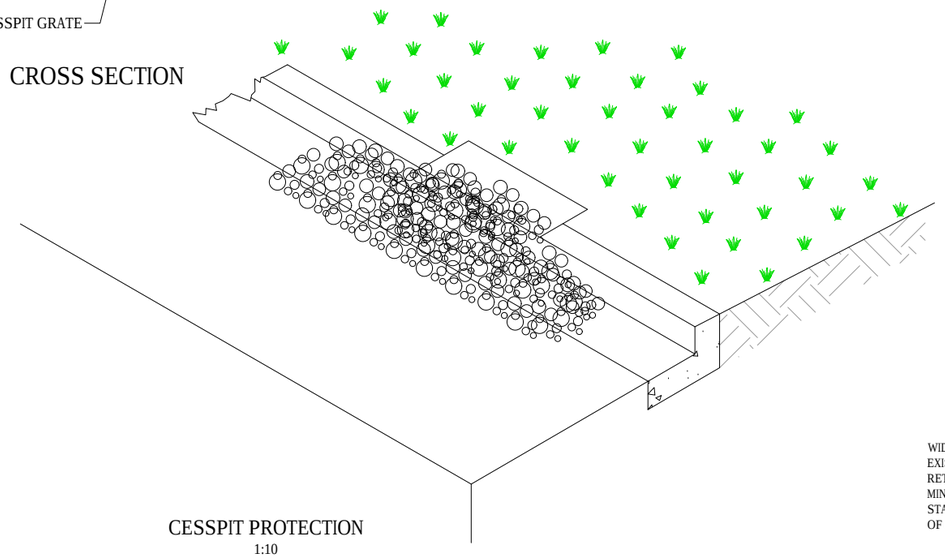
APPROVED
DATE 06/12/16
J. HIND
J. HIND

PROJECT	NORTHERN CORRIDOR IMPROVEMENTS
TITLE	EROSION & SEDIMENT CONTROL STANDARD DETAILS SHEET 1

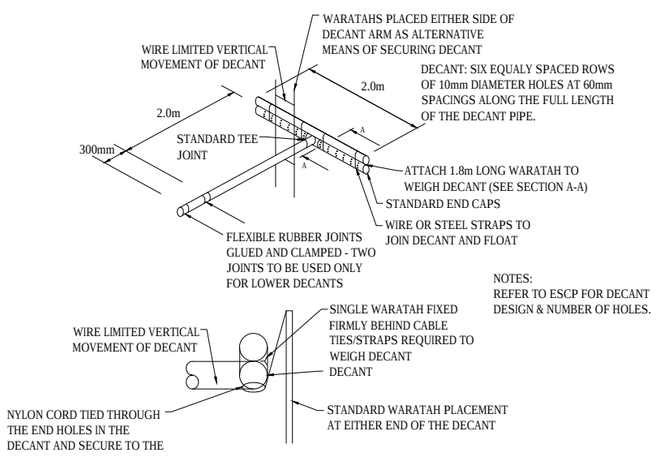
DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1620	A



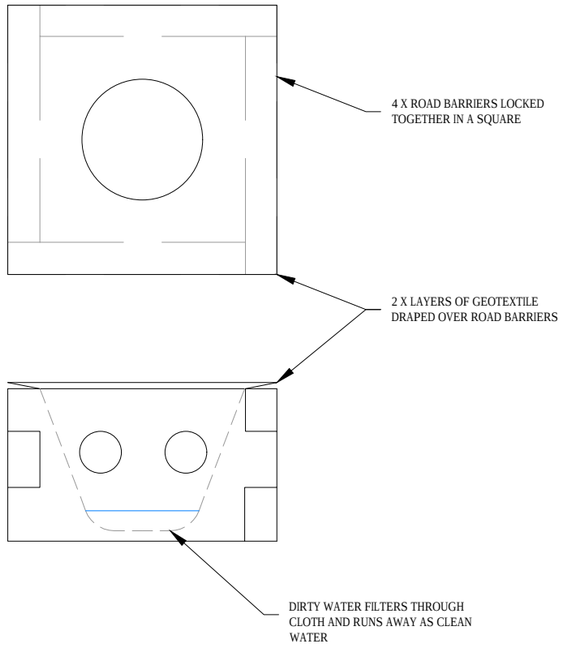
CROSS SECTION



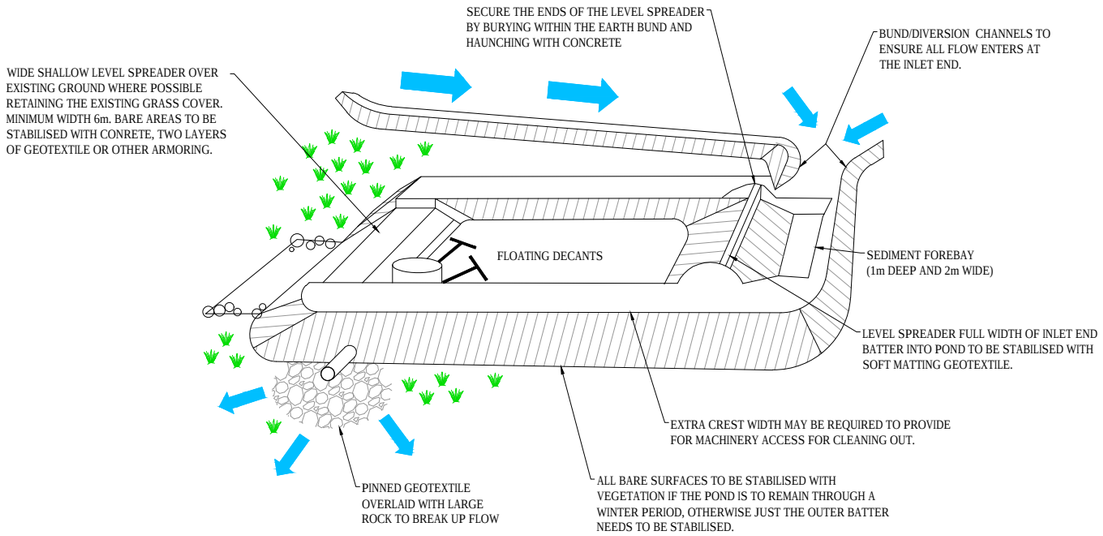
CESSPIT PROTECTION
1:10



DECANT DETAIL
1:50



TURKEYS NEST DETAIL
NOT TO SCALE



CONCEPTUAL SEDIMENT RETENTION POND
1:200

100 0 200 400mm
SCALE 1:10

2 0 4 8m
SCALE 1:200

500 0 1000 2000mm
SCALE 1:50

RidleyDunphy environmental & planning consultants

aurecon

CLIENT

NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
A	30/11/16	ISSUED FOR CONSENT	G. RIDLEY

SCALE	SIZE
NOT TO SCALE	A1

DRAWN: V. SMITH
DESIGNED: G. RIDLEY (EXTERNAL)
CHECKED: M. DUNPHY (EXTERNAL)

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE 06/12/16
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: EROSION & SEDIMENT CONTROL STANDARD DETAILS SHEET 2

DRAWING No. | PROJECT No. | WBS | TYPE | DISC | NUMBER | REV
250310 – 3PRE – 3DES – DRG – 1621 – A

Appendix D
ESCP Conceptual Plans

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LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

KEY PLAN

SUBJECT TO SEPARATE CESCP AS NECESSARY

NEW PROPOSED WETLAND TO OFFSET LOSS OF EXISTING NZTA POND AT CH 12460 AND TO MANAGE NEW IMPERVIOUS SURFACES

SH1 NORTHERN MOTORWAY

11600 11650 11700 11750 11800 11850 11900 11950 12000 12050 12100 12150 12200 12250 12300 12350

PROJECT EXTENTS

PROJECT EXTENTS

NEW PROPOSED OTEHA WEST WETLAND

SUBJECT TO SEPARATE CESCP AS NECESSARY

OTEHA VALLEY ROAD

LUCAS CREEK

CORNERSTONE DRIVE

MATCHLINE JOINS SHEET 2

ELLIOT RD

PROJECT EXTENTS

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. OTEHA WEST WETLAND AND EAST WETLAND TO BE SUBJECT TO SEPARATE CESCP.
5. BUSWAY BRIDGE TO BE SUBJECT TO SEPARATE CESCP.
6. OTEHA EAST WETLAND TO BE USED AS AN EMERGENCY BACKUP FOR PUMPING ACTIVITIES.
7. CHECKDAMS TO BE UTILISED IN BASE OF CUT AND IN LOCATION OF FUTURE STORMWATER SWALES.
8. CONSTRUCTION YARD SUBJECT TO SEPARATE CESCP.
9. SRP WITHIN CONSTRUCTION YARD TO BE USED DURING ESTABLISHMENT ONLY AND ONCE YARD STABILISED WITH HARD FILL THEN SRP WILL BE UTILISED FOR CONTAINMENT OF OTHER RUNOFF.

10 0 20 40m
SCALE 1:1000

RidleyDunphy
aurecon

CLIENT
NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
A	19.09.16	PRELIMINARY ISSUE	G. MOORE
B	30.11.16	ISSUED FOR CONSENT	G. RIDLEY

SCALE	SIZE
1:1000	A1

DRAWN: V. SMITH
DESIGNED: G. RIDLEY (EXTERNAL)
CHECKED: M. DUNPHY (EXTERNAL)

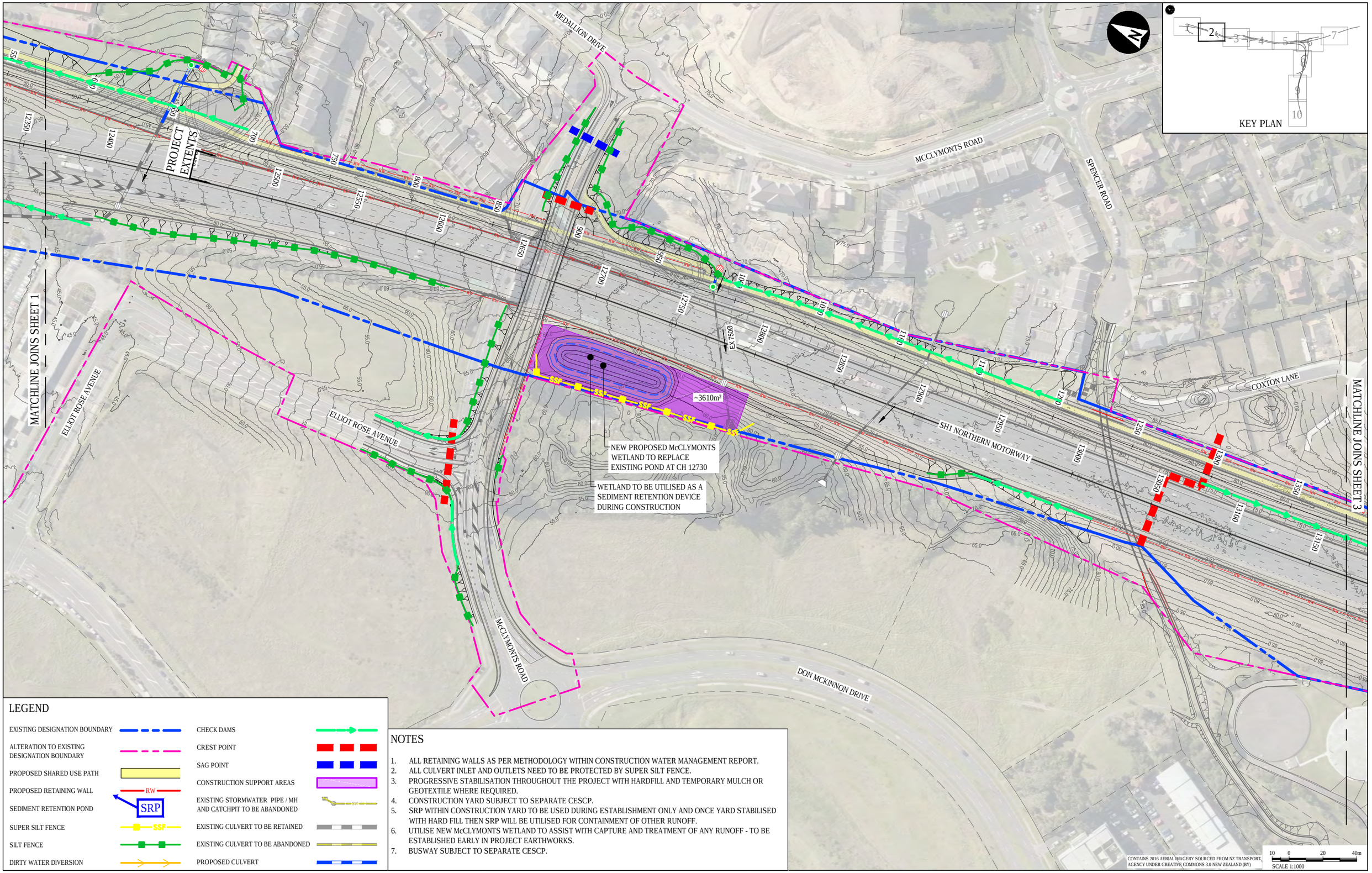
PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 1

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1601	B



LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. CONSTRUCTION YARD SUBJECT TO SEPARATE CESCP.
5. SRP WITHIN CONSTRUCTION YARD TO BE USED DURING ESTABLISHMENT ONLY AND ONCE YARD STABILISED WITH HARD FILL THEN SRP WILL BE UTILISED FOR CONTAINMENT OF OTHER RUNOFF.
6. UTILISE NEW McCLYMONTS WETLAND TO ASSIST WITH CAPTURE AND TREATMENT OF ANY RUNOFF - TO BE ESTABLISHED EARLY IN PROJECT EARTHWORKS.
7. BUSWAY SUBJECT TO SEPARATE CESCP.

RidleyDunphy environmental & planning consultants

aurecon

CLIENT: NZ TRANSPORT AGENCY WAKA KOTAHI

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APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

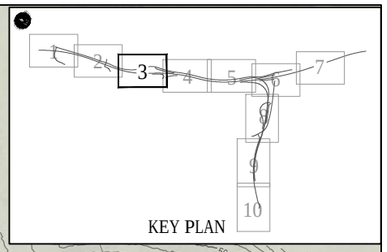
TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 2

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1602	B

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. CONSTRUCTION YARD SUBJECT TO SEPARATE CESCP.
5. SRP WITHIN CONSTRUCTION YARD TO BE USED DURING ESTABLISHMENT ONLY AND ONCE YARD STABILISED WITH HARD FILL THEN SRP WILL BE UTILISED FOR CONTAINMENT OF OTHER RUNOFF.
6. UTILISE NEW ATTENUATION BASIN AT CH 13900 DURING EARTHWORKS IN THIS LOCATION - UTILISE AS A SEDIMENT RETENTION POND.
7. BUSWAY SUBJECT TO SEPARATE CESCP.

KEY PLAN



MATCHLINE JOINS SHEET 2

RATHMILLEN

COLLISTON RISE

GREVILLE ROAD

~12285m²

SRP

UTILISE BASIN AS SEDIMENT RETENTION POND AS REQUIRED

SH1 NORTHERN MOTORWAY

PROPOSED GREVILLE WETLAND

~14333m²

SRP

GREVILLE ROAD

ALBANY EXPRESSWAY

MATCHLINE JOINS SHEET 4

CONTAINS 2014 AERIAL IMAGERY SOURCED FROM NZ TRANSPORT AGENCY UNDER CREATIVE COMMONS 3.0 NEW ZEALAND (BY)

10 0 20 40m
SCALE 1:1000

LEGEND

- EXISTING DESIGNATION BOUNDARY
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- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
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- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

RidleyDunphy environmental & planning consultants

aurecon

CLIENT: NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
A	19.09.16	PRELIMINARY ISSUE	G. MOORE
B	30.11.16	ISSUED FOR CONSENT	G. RIDLEY

SCALE	1:1000
SIZE	A1
DRAWN	V. SMITH
DESIGNED	G. RIDLEY (EXTERNAL)
CHECKED	M. DUNPHY (EXTERNAL)

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT	NORTHERN CORRIDOR IMPROVEMENTS
TITLE	CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 3

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1603	B

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. CONSTRUCTION YARD SUBJECT TO SEPARATE CESCP. CONSTRUCTION YARD TO BE MANAGED THROUGH A SILT FENCE AND ASSOCIATED STABILISED ENTRANCE WAY.
7. BUSWAY SUBJECT TO SEPARATE CESCP.
8. WORKS ASSOCIATED WITH LANDFILL SUBJECT TO SEPARATE CESCP.
9. CH 14450 TO CH 14150 (WESTERN EXTENT) WILL UTILISE THE NEW ATTENUATION BASIN (CH 14100) AS A SEDIMENTCONTROL DEVICE.

KEY PLAN

CH 2200 TO CH 2520 TO BE SUBJECT TO SEPERATE ROSEDALE CONTAMINATION MANAGEMENT PLAN

SILT FENCE AS REQUIRED

~5194m²

PROPOSED GREVILLE NB OFF-RAMP DRY BASIN

ALL WORKS IN THESE LOCATIONS TO UTILISE PROPOSED GREVILLE NB OFF-RAMP DRY BASIN FOR SEDIMENT RETENTION

MATCHLINE JOINS SHEET 5

MATCHLINE JOINS SHEET 3

TRITON DRIVE
ROSEDALE ROAD
DALLAN PLACE
ARRENWAY DRIVE
SH1 NORTHERN MOTORWAY
OTEHA VALLEY STREAM
TAWA DRIVE
MIRO PLACE
TITOKI PLACE
COWLEY PLACE

LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

10 0 20 40m
SCALE 1:1000

RidleyDunphy environmental & planning consultants
aurecon
NZ TRANSPORT AGENCY WAKA KOTAHI

CLIENT

REV	DATE	REVISION DETAILS	APPROVED
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B	30.11.16	ISSUED FOR CONSENT	G. RIDLEY

SCALE	1:1000
SIZE	A1
DRAWN	V. SMITH
DESIGNED	G. RIDLEY (EXTERNAL)
CHECKED	M. DUNPHY (EXTERNAL)

PRELIMINARY
NOT FOR CONSTRUCTION

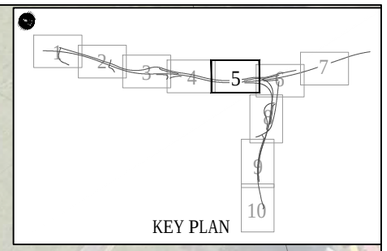
APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT	NORTHERN CORRIDOR IMPROVEMENTS
TITLE	CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 4

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1604	B

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. BUSWAY SUBJECT TO SEPARATE CESCP.
5. WORKS ASSOCIATED WITH FILLING WITHIN ROSEDALE TREATMENT POND SUBJECT TO METHODOLOGY WITHIN CWMR AND ALSO SEPARATE CESCP.
6. TWO NEW WETLANDS ON EASTERN EXTENT OF WORKS TO BE UTILISED AS A SEDIMENT RETENTION POND DURING WORKS IN THESE LOCATIONS AS NECESSARY.
7. STREAM CHANNEL WORKS ON SOUTHWESTERN EXTENT OF ROSEDALE POND 1 TO BE SUBJECT TO SEPARATE CESCP.



NEW PROPOSED WETLAND CONSTRUCTED OVER EXISTING POND AT SAME LOCATION. STORMWATER DESIGN TO BE REFINED TO MINIMISE PROPERTY IMPACTS. WETLAND REQUIRED TO MANAGE MOTORWAY RUNOFF. SUBJECT TO SEPERATE CESCP

SPECIFIC METHODOLOGY WITH CWR

SPECIFIC METHODOLOGY WITH CWR

WETLAND CAN BE UTILISED AS A SEDIMENT RETENTION DEVICE DURING CONSTRUCTION

MATCHLINE JOINS SHEET 4

MATCHLINE JOINS SHEET 6

ARRENWAY DRIVE

SH1 NORTHERN MOTORWAY

COWLEY PLACE

LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

10 0 20 40m
SCALE 1:1000

RidleyDunphy environmental & planning consultants

aurecon

CLIENT: NZ TRANSPORT AGENCY WAKA KOTAHI

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1:1000	A1

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PRELIMINARY
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DATE 12/12/2016
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J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 5

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1605	B

LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. BUSWAY SUBJECT TO SEPARATE CESCP.
5. SH1 TO SH18 RAMP SUBJECT TO SEPARATE METHODOLOGY.
6. CHEMICAL TREATMENT REQUIRED FOR ALL SEDIMENT RETENTION PONDS AS PER CWMR.
7. CONSTRUCTION YARD SUBJECT TO TOPSOIL STRIPPING AND STABILISATION WITH HARD FILL - PROTECTED BY SUPER SILT FENCE DURING WORKS.

KEY PLAN

MATCHLINE JOINS SHEET 5

MATCHLINE JOINS SHEET 7

MATCHLINE JOINS SHEET 8

CONSTELLATION DRIVE

SH1 NORTHERN MOTORWAY

EXISTING SH18 UPPER HARBOUR

SUNSET ROAD

PROJECT EXTENTS

PROJECT EXTENTS

SRP

~58359m²

CONTAINS 2016 AERIAL IMAGERY SOURCED FROM NZ TRANSPORT AGENCY UNDER CREATIVE COMMONS 3.0 NEW ZEALAND (BY)

SCALE 1:1000

RidleyDunphy environmental & planning consultants

aurecon

NZ TRANSPORT AGENCY WAKA KOTAHI

CLIENT

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DESIGNED: G. RIDLEY (EXTERNAL)

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DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 6

DRAWING No. | PROJECT No. | WBS | TYPE | DISC | NUMBER | REV
250310 – 3PRE – 3DES – DRG – 1606 – B

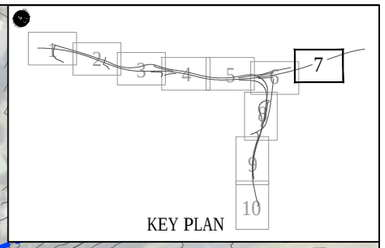
LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. ISOLATED WORKS SUBJECT TO SEPARATE CESCP AS REQUIRED.

KEY PLAN



CONTAINS 2016 AERIAL IMAGERY SOURCED FROM NZ TRANSPORT AGENCY UNDER CREATIVE COMMONS 3.0 NEW ZEALAND (BY)

10 0 20 40m
SCALE 1:1000

RidleyDunphy environmental & planning consultants

aurecon

CLIENT

NZ TRANSPORT AGENCY WAKA KOTAHI

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APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 7

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1607	B

LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

KEY PLAN

CARRIBEAN DRIVE

PROJECT EXTENTS

EXISTING SH18 UPPER HARBOUR HIGHWAY

BARBADOS DRIVE

MATCHLINE JOINS SHEET 6

CATCHMENT 3 - 24077m²

SRP

PROPOSED WETLAND TO MANAGE STORMWATER RUNOFF FROM EXISTING SH18 UPPER HARBOUR HIGHWAY AND MOTORWAY RAMPS

CATCHMENT 2 - 16936m²

CATCHMENT 3 - 8990m²

NEW PROPOSED WETLAND TO REPLACE EXISTING AUCKLAND COUNCIL CONSTELLATION POND

~2730m²

MATCHLINE JOINS SHEET 9

SH18 UPPER HA

CONTAINS 2016 AERIAL IMAGERY SOURCED FROM NZ TRANSPORT AGENCY UNDER CREATIVE COMMONS 3.0 NEW ZEALAND (BY)

SCALE 1:1000

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. CHEMICAL TREATMENT REQUIRED FOR ALL SEDIMENT RETENTION PONDS AS PER CWMR.
5. NEW WETLAND IMMEDIATELY NORTH OF SH18 TO BE UTILISED FOR SEDIMENT RETENTION POND.
6. MAIN CONSTRUCTION YARD SUBJECT TO TOPSOIL STRIPPING AND STABILISATION WITH HARD FILL - PROTECTED BY SUPER SILT FENCE DURING WORKS.
7. STREAM CHANNEL WORKS TO BE SUBJECT TO SEPARATE CESCP.
8. PAUL MATTHEW'S BRIDGE SUBJECT TO SEPARATE CESCP.
9. PAUL MATTHEW'S CONSTRUCTION YARD - PROTECTED BY SUPER SILT FENCE DURING WORKS.

RidleyDunphy environmental & planning consultants

aurecon

CLIENT

NZ TRANSPORT AGENCY WAKA KOTAHI

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SCALE	SIZE
1:1000	A1

DRAWN: V. SMITH

DESIGNED: G. RIDLEY (EXTERNAL)

CHECKED: M. DUNPHY (EXTERNAL)

PRELIMINARY
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APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 8

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1608	B

LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
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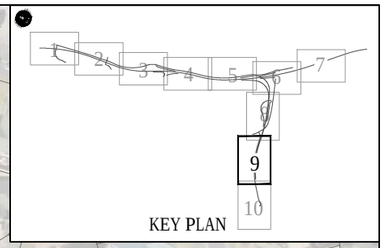
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. ISOLATED WORKS SUBJECT TO SEPARATE CESCP AS REQUIRED.

KEY PLAN



WETLAND CAN BE UTILISED AS A SEDIMENT RETENTION DEVICE DURING CONSTRUCTION

NEW PROPOSED WETLAND TO MANAGE SH18 RUNOFF. SUBJECT TO CWR AND SEPARATE CESCP

SH18 UPPER HARBOUR HIGHWAY

BLUEBIRD CRES

UNSWORTH DRIVE

MATCHLINE JOINS SHEET 8

MATCHLINE JOINS SHEET 10

PROJECT EXTENTS

PROJECT EXTENTS

SATURN PLACE

ALEXANDRA CREEK

PAUL MATTHEWS ROAD

OMEGA STREET

WILLIAM PICKERING DRIVE

CONTAINS 2016 AERIAL IMAGERY SOURCED FROM NZ TRANSPORT AGENCY UNDER CREATIVE COMMONS 3.0 NEW ZEALAND (BY)

SCALE 1:1000

RidleyDunphy environmental & planning consultants

aurecon

NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
A	19.09.16	PRELIMINARY ISSUE	G. MOORE
B	30.11.16	ISSUED FOR CONSENT	G. RIDLEY

SCALE	SIZE
1:1000	A1

DRAWN: V. SMITH

DESIGNED: G. RIDLEY (EXTERNAL)

CHECKED: M. DUNPHY (EXTERNAL)

PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 9

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1609	B

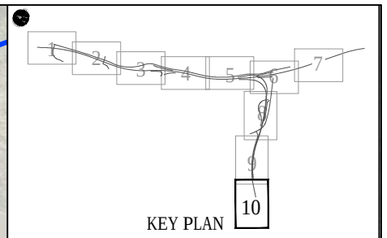
LEGEND

- EXISTING DESIGNATION BOUNDARY
- ALTERATION TO EXISTING DESIGNATION BOUNDARY
- PROPOSED SHARED USE PATH
- PROPOSED RETAINING WALL (RW)
- SEDIMENT RETENTION POND (SRP)
- SUPER SILT FENCE (SSF)
- SILT FENCE
- DIRTY WATER DIVERSION
- CHECK DAMS
- CREST POINT
- SAG POINT
- CONSTRUCTION SUPPORT AREAS
- EXISTING STORMWATER PIPE / MH AND CATCHPIT TO BE ABANDONED (SW)
- EXISTING CULVERT TO BE RETAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED CULVERT

NOTES

1. ALL RETAINING WALLS AS PER METHODOLOGY WITHIN CONSTRUCTION WATER MANAGEMENT REPORT.
2. ALL CULVERT INLET AND OUTLETS NEED TO BE PROTECTED BY SUPER SILT FENCE.
3. PROGRESSIVE STABILISATION THROUGHOUT THE PROJECT WITH HARDFILL AND TEMPORARY MULCH OR GEOTEXTILE WHERE REQUIRED.
4. ISOLATED WORKS SUBJECT TO SEPARATE CESCP AS REQUIRED.

KEY PLAN



MATCHLINE JOINS SHEET 9

ALEXANDRA STREAM TRIBUTARY

ALBANY HIGHWAY

SH18 UPPER HARBOUR HIGHWAY

PROJECT EXTENTS

BUSH ROAD

WILLIAM PICKERING DRIVE

2127.648

2100

2050

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10 0 20 40m
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CLIENT: NZ TRANSPORT AGENCY WAKA KOTAHI

REV	DATE	REVISION DETAILS	APPROVED
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APPROVED
DATE 12/12/2016
J. HIND
J. HIND

PROJECT: NORTHERN CORRIDOR IMPROVEMENTS

TITLE: CONCEPTUAL CONSTRUCTION WATER MANAGEMENT PLAN SHEET 10

DRAWING No.	PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
	250310	3PRE	3DES	DRG	1610	B

Appendix E
Sediment Retention Pond Sizing

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Northern Corridor Sediment Retention Pond Sizing Calculations (To be Confirmed through CESCPs)

SRP Sizing NZTA Guideline

Step 1 Northern Corridor

Step 2 Less than 6 months duration

Step 3 HIRDS data for 10 year 1 hour duration based on stream and river discharge – 95% risk

Rainfall Intensity of 36.3mm

Step 4 Site soils Clay less than 10 % slope – C Factor of 0.65

Step 5 Assume for illustration purpose 1 ha site

Step 6 Rational Formula

	Rain	C Factor	Area	m/sec
0.00278	36.3	0.65	1	0.0656

Step 7 Storage Volume

0.0656 multiply by 3600 seconds equates to a volume of **236m^3 per ha**

SRP Sizing - Technical Publication Number 90

3% criteria **300m^3 per ha**

Appendix F
Clean and Dirtywater Diversion Sizing

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DWD Diversion Sizing Spreadsheet

Project:	**Northern Corridor**		
Calculations By:	**Graeme Ridley**	**Date:**	**27/10/2016**
Checked By:		**Date:**	
Element:	**Dirty Water To SRPs - Based on Max Catchment Area of 5ha - All DWD to be confirmed through CESCP Process**		

Step 1 -

C=	0.65		Clay Less than 10%
I =	56	mm	HIRDS Data (100yr 60min Intensity)
A =	5	ha	(Catchment Drawings)

Q =	0.506	m^3/s	Design Flow Required
Q =	505.96	l/s	Design Flow Required

$$Q = .00278CiA$$

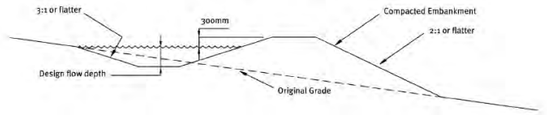
Step 2 - Determine Diversion Drain Sizing

Cross Section Area =	0.28	m^2
Top Width =	1.1	m
Hydraulic Radius =	0.196	
Capacity =	0.667	m^3/s
Design Flow =	0.506	m^3/s

b=	0.3	m
d=	0.4	m
e=	0.4	m (e=d)
Z=	1	

Chanel Slope =	2.00%
n =	0.020

Figure 8-5.
Cross section of Dirty Water Diversion



Channel	**OK: Channel Capacity > Design Flow**

Actual Channel Dimensions Required - Including 300 mm Freeboard

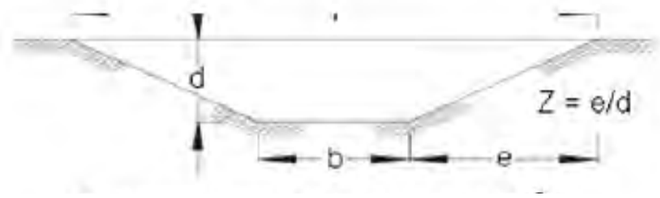
b=	0.3	m
d=	0.7	m
e=	0.7	

Check For Channel Full Velocity (Check against Table 8-4)

V=	2.38	m/s	V = Q / A

Lining Not Required

$$Q = \frac{A\,R^{2/3}\,S^{1/2}}{n}$$



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Clean Water Diversion Sizing Spreadsheet

Project:	**Northern Corridor**		
Calculations By:	**Graeme Ridley**	**Date:**	**27/10/2016**
Checked By:		**Date:**	
Element:	**Clean Water Diversions - For Runoff from Exixting SH Surface(based on 100m length) - To be adjusted once CESCP confirmed on site**		

Step 1 -

C=	0.9		Road Surface
I =	56	mm	HIRDS Data (100yr 60min Intensity)
A =	0.1	ha	(Catchment Drawings)

Q =	0.014	m^3/s	Design Flow Required
Q =	14.01	l/s	Design Flow Required

$$Q = .00278CiA$$

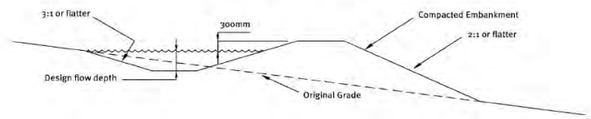
Step 2 - Determine Diversion Drain Sizing

Cross Section Area =	0.013125	m^2
Top Width =	0.25	m
Hydraulic Radius =	0.042	
Capacity =	0.014	m^3/s
Design Flow =	0.014	m^3/s

b=	0.1	m
d=	0.075	m
e=	0.075	m (e=d)
Z=	1	

Chanel Slope =	2.00%
n =	0.016

Figure 8-5.
Cross section of Dirty Water Diversion



Channel	**OK: Channel Capacity > Design Flow**	

$$Q = \frac{A\,R^{2/3}\,S^{1/2}}{n}$$

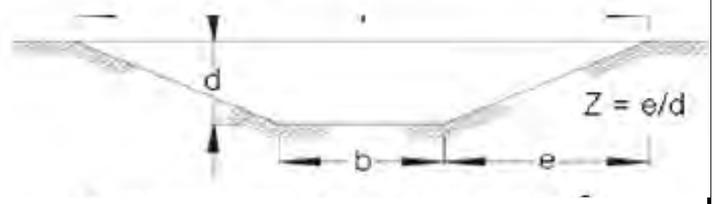
Actual Channel Dimensions Required - Including 300 mm Freeboard

b=	0.1	m
d=	0.375	m
e=	0.375	m

Check For Channel Full Velocity (Check against Table 8-4)

V=	1.07	m/s	V = Q / A

Lining Not Required



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Appendix G
TP90 Principles of Land Disturbance

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2.2 Factors Influencing the Erosion Process

The main factors influencing soil erosion are climate, soil characteristics, topography, ground cover and evapotranspiration.

Climate

Climate affects erosion potential both directly and indirectly. The direct relationship arises from the action of rain - a driving force of erosion - where raindrops dislodge soil particles and runoff carries them away. The annual pattern of rainfall and temperature change, by and large, determines the extent and growth rate of vegetation. This is critical, because vegetation is currently the most important form of erosion control used on Land Disturbing Activities in Auckland.

The Auckland Region receives about 1200 mm of rainfall annually, with average monthly rainfalls being greatest throughout the winter period. Summer has the greatest rainfall variability, some summers being very dry, others wet.

Intense cyclonic storms during summer also create many erosion problems, with a large amount of rain falling within a short time period. Erosion and sediment control for all Land Disturbing Activities must be planned accordingly.

Soil Characteristics

Four soil characteristics are important in determining soil erodibility:

- *Soil texture* refers to the particle sizes making up a particular soil and their relative proportions. Sand, silt and clay are the three major soil particle classes. Auckland soils tend to have a high content of fine sands and silts, which are the more erodible fractions of the soil. The clay content also creates difficulty as once mobilised, it is very difficult to settle out. This is due to the small nature of individual particles and the tendency for clay particles to repel each other, thus keeping them in suspension.
- *Organic matter* improves soil structure and increases permeability, water holding capacity and soil fertility.
- *Soil permeability* refers to the ability of the soil to allow air and water to move through the soil. Soils with a higher permeability produce less runoff at a lower rate than soils with low permeability. Engineered fills have a very low permeability, resulting in increased levels of potentially erosive runoff.
- *Soil structure* is the degree that soil particles are arranged into aggregates. A granular structure is the most desirable in both agricultural and erosion control terms. When the soil surface is compacted or crusted, water tends to run off rather than infiltrate. Erosion potential increases with increased runoff.

Topography

Slope length and slope angle are critical factors in erosion potential because they play a large part in determining the velocity of runoff. Long continuous slopes allow runoff to build up velocity and to concentrate flow. This produces rill and gully erosion.

The shape of a slope also has a major bearing on erosion potential. The base of a slope is more susceptible to erosion than the top because runoff arriving there is moving faster and is more concentrated. However, deposition may occur at the base of concave slopes where slope angle diminishes.

Ground Cover

Ground cover includes vegetation and surface treatment such as mulches and geotextiles. Vegetation is without question the most effective long term form of erosion control for protecting surfaces that have been disturbed. Vegetation shields the soil surface from the impact of falling rain, slows the velocity of runoff, holds soil particles in place and maintains the soil's capacity to absorb water.

Evapotranspiration

The Auckland Region has a fairly frequent rainfall during the winter, but due to high evapotranspiration and a minimum of rainfall in the summer period, soil moisture levels are often so low that irrigation or watering is needed to achieve the moisture levels needed for plant growth. Evapotranspiration rates and the number of days of soil moisture deficit vary across the region. Careful consideration needs to be given to evapotranspiration when attempting to establish a vegetative cover and prevent erosion.

These "Ten Commandments," summarise the ten principles to follow when preparing an Erosion and Sediment Control Plan.

1. Minimise Disturbance

Fit land development to land sensitivity.

Some parts of a site should never be worked and others need very careful working. Watch out for and avoid areas that are wet (streams, wetlands, springs), have steep or fragile soils or are conservation sites or features.

Bear in mind the *minimum earthworks strategy (low impact design)* – ideally, only clear areas required for structures or access.

Show all Limits of Disturbance on the Erosion and Sediment Control Plan (E&SCP). On site, clearly show Limits of Disturbance using fences, signs and flags.

2. Stage Construction

Carrying out bulk earthworks over the whole site maximises the time and area that soil is exposed and prone to erosion. "Construction staging", where the site has earthworks undertaken in small units over time with progressive revegetation, limits erosion.

Careful planning is needed. Temporary stockpiles, access and utility service installation all need to be planned. Construction staging differs from sequencing. Sequencing sets out the order of construction to contractors.

Detail both construction staging and sequencing in the E&SCP.

3. Protect Steep Slopes

Existing steep slopes should be avoided. If clearing is absolutely necessary, runoff from above the site can be diverted away from the exposed slope to minimise erosion. If steep slopes are worked and need stabilisation, traditional vegetative covers like topsoiling and seeding may not be enough – special protection is often needed.

Highlight steep areas on the E&SCP showing Limits of Disturbance and any works and areas for special protection.

4. Protect Watercourses

Existing streams, watercourses and proposed drainage patterns need to be mapped. Clearing is not permitted adjacent to a watercourse unless the works have been approved by the Auckland Regional Council. Where undertaken, work that crosses or disturbs the watercourse

Map all watercourses and show Limits of Disturbance and protection measures; show all practices to be used to protect new drainage channels; and indicate crossings or disturbances and associated construction methods in the E&SCP.

5. Stabilise Exposed Areas Rapidly

The ultimate objective is to fully stabilise disturbed soils with vegetation after each stage and at specific milestones within stages. Methods are site specific and can range from conventional sowing through to straw mulching. Mulching is the most effective instant protection.

Clearly define time limits for grass or mulch covers, outline grass rates and species and define conditions for temporary cover in the case of severe erosion or poor germination in the E&SCP.

6. Install Perimeter Controls

Perimeter controls above the site keep clean runoff out of the worked area – a critical factor for effective erosion control. Perimeter controls can also retain or direct sediment laden runoff within the site. Common perimeter controls are diversion drains, silt fences and earth bunds.

Detail the type and extent of perimeter controls in the E&SCP along with design parameters.

7. Employ Detention Devices

Even with the best erosion and sediment practices, earthworks will discharge sediment laden runoff during storms. Along with erosion control measures, sediment retention structures are needed to capture runoff so sediment generated can settle out. The fine grained nature of Auckland soils means sediment retention ponds are often not highly effective. Ensure the other control measures used are appropriate for the project and adequately protect the receiving environment.

Include sediment retention structure design specifications; detailed inspection and maintenance schedules of structures and conversion plans for permanent structures, in the E&SCP.

8. Get Registered

A trained and experienced contractor is an important element of an E&SCP. These people are responsible for installing and maintaining erosion and sediment control practices. On-site staff certified through the Auckland Regional Council Industry Education Programme can save project time and money, by identifying threatened areas early on and putting into place correct practices.

Contact Auckland Regional Council about registration. Include arrangements for a pre-construction meeting, regular inspection visits (including a pre-wintering meeting), and final inspection.

9. Make Sure the Plan Evolves

An effective E&SCP is modified as the project progresses from bulk earthworks to developed individual lots. Factors such as weather, changes to grade and altered drainage can all mean changes to planned erosion and sediment control practices.

Update the E&SCP to suit site adjustments in time for the pre-construction meeting and initial inspection of installed erosion and sediment controls, and make sure it is regularly referred to and available on site.

10. Assess and Adjust

Inspect, Monitor and Maintain Control Measures

Assessment of controls is especially important following a storm. A large or intense storm will leave erosion and sediment controls in need of repair, reinforcement or cleaning out. Repairing without delay reduces further soil loss and environmental damage.

Assessment and adjustment is an important erosion and sediment control practice – make sure it figures prominently in the E&SCP.

Assign responsibility for implementing the E&SCP and monitoring control measures as the project progresses.

The following are the main types of Land Disturbing Activities undertaken in the Auckland Region and these are discussed in these Guidelines.

- Trenching
- Watercourse works
- Cleanfills
- Small sites and permitted activities
- Earthworks
- Roading
- Quarries and vegetation removal

The following is a brief summary of key considerations for minimising adverse environmental effects of these activities that are not found in the detailed description of erosion and sediment control measures in Part B.

Trenching

Trenching, usually for installing utility services, often happens towards the end of the bulk earthworks phase of a project. The following points need to be considered when trenching.

- The project needs to be undertaken in appropriately sized stages such that the area exposed can be fully stabilised within an acceptable time frame.
- If trenching impacts on existing erosion and sediment control measures that are part of the overall development, those measures should be reinstated as soon as possible. Contingency measures should be put in place until the original measures are reinstated or replaced.
- All trenching operators working within a larger site must be familiar with the overall Erosion and Sediment Control Plan for the site and must comply with this approved plan.
- Independent erosion and sediment control measures detailed in these Guidelines should be employed for the trenching operation.
- Topsoil and subsoils should be stockpiled separately adjacent to the trench so that at the completion of the operation, these soils can be replaced in the appropriate order and vegetation established.
- When trenching through overland flow paths, give special consideration to the diversion of any flows, which may occur during trenching, as well as reinstating and stabilising the overland flow path.

Works Within a Watercourse

Works within a watercourse should be avoided wherever possible, with all alternatives considered beforehand. Where watercourse works are unavoidable, they will create sedimentation downstream, so the following points should be carefully considered when undertaking these works.

- Have all alternatives been considered?
- Install a stabilised diversion so that works can be undertaken in the dry and reinstate the streamflow only after these areas have been appropriately stabilised. If a diversion is not a viable option, then ensure the alternative options are fully considered.
- Carry out works during a dry time of the year when stream flows are low and the likelihood of a storm is low.
- Keep the duration of works short.
- Identify instream values so as to avoid critical periods such as fish spawning periods.
- Consider the direct short and long term impacts of culverts or instream structures and install appropriately designed fish-pass provisions.
- Be sure to inform all downstream users, for example water-users, of potential downstream sediment discharges.

Cleanfills

Cleanfills dispose of unwanted fill material which may contain some other material as in the definition of cleanfill provided in Part A of these Guidelines.

Land Disturbing Activities associated with cleanfills range from haul roads and access areas to tip faces and dumping areas. Several controls are needed for adequate erosion and sediment control on such sites and the following points should be carefully considered when undertaking such operations:

- The cleanfill operator needs to ensure that material being accepted for the cleanfill fits within the ARC's definition. In cases where it doesn't, the operator must reject such loads, which will then need to be transported to an approved landfill.
- Erosion and sediment controls should be installed

in accordance with these Guidelines and appropriate maintenance undertaken.

- As a cleanfill operation is considered to be a land disturbing activity, each operation should be assessed for any necessary consents within the *Proposed Regional Plan: Sediment Control.*
- Staging of cleanfill operations is critical and a programme of progressive stabilisation of all cleanfill sites should be part of each operation.

Small Sites and Permitted Activities

After the bulk earthwork phase of an earthworks operation, individual developers start house construction. This is the phase of small site developments which is considered permitted activities under the *Proposed Regional Plan: Sediment Control.* The cumulative impact from small sites is considered to be considerable and in some areas may cumulatively discharge as much sediment as the initial development itself. Often at this stage of the proposal, stormwater systems are in place and there are no, or minimal, erosion and sediment controls on the site. This results in sediment discharging through an efficient conveyance system (the stormwater system) directly to the receiving environment.

The following points need to be considered when undertaking small site development:

- The developer should be fully aware of the permitted activity thresholds within the *Proposed Regional Plan: Sediment Control* and the conditions it specifies.
- Erosion and sediment controls should be installed either on an individual site-by-site basis or a combination of the sites, in accordance with these Guidelines or the *Small Site Guidelines for Earthworks in the Auckland Region.*
- Stormwater runoff from small sites needs careful planning in terms of the location of roof downpipes so that runoff across bare sites does not scour soils.
- Areas of exposed soils should be stabilised upon completion of earthworks, including topsoil and subsoil stockpiles, lawn areas and accessways.
- The site should be isolated from the subdivision's road system using silt fences to intercept flow from the site, with a Stabilised Construction Entrance (see Part B, Section 1.8) of to provide site entry and exit.

Earthworks

Earthworks include a wide range of activities from cleanfilling operations (defined above) through to earthworks associated with industrial, commercial and residential developments. The *Proposed Regional Plan: Sediment Control* defines the thresholds for resource consent requirements for earthworking activities. Earthworks have a major potential to generate large amounts of sediment, and if not controlled appropriately, can lead to large sediment discharges. Planning of these developments is critical to ensure that the activity is undertaken appropriately, and in a controlled manner to avoid unnecessary impacts on receiving environments. The "Ten Commandments" outline the critical features of an earthworks operation. The following are further key points contractors need to be aware of when undertaking earthworks operations.

- It is important to comply with the specific requirements of the resource consent when undertaking earthworks operations.
- Emphasis should be placed on erosion control, rather than sediment control, because preventing sediment generation is the best means of preventing sediment discharge from earthworks sites.
- Always produce an Erosion and Sediment Control Plan (E&SCP) for an earthworks operation. Be sure that all parties involved with the operation, including subcontractors, are familiar with and have access to a current copy of this Plan.
- Always update the E&SCP with major variations on the site and be sure these variations have the appropriate approvals. Keep this up-to-date version in the site office at all times.
- Plan ahead and undertake consultation with necessary parties as required. Get approvals and start the operation early to avoid last minute delays and the need to keep working into the undesirable wetter months.
- Install appropriate controls in accordance with the approved E&SCP and be sure that the design specifications are appropriate for the operation.

- Install subsurface drainage as required (to an agreed methodology) to divert subsurface cleanwater past control structures and areas of disturbance as appropriate.

Roading

Like trenching, the linear nature of roading poses challenges for erosion and sediment control. Measures need to be carefully planned to ensure controls are successful. Often the operation can be undertaken sequentially, stabilising worked areas as they are completed. This minimises the total sediment generating area of the proposal and helps prevent unnecessary road maintenance.

The following are some key points to consider when working through a roading proposal.

- Provide enough room for effective erosion and sediment control measures. Often the road corridor itself can involve the whole designation area and no room remains for such controls. Where space is a constraint, make sure that the erosion and sediment controls are approved and will give the necessary protection to downstream receiving environments.
- Incorporate stormwater design into the E&SCP. This removes the need to revisit the area to install stormwater systems and the unnecessary extra earthworks that their construction would require.
- Keep the areas of road corridor exposed at any one time to a limit that can be practically stabilised with hardfill or by vegetative means, to minimise the exposed area at risk.
- When crossing watercourses, look for alternative routes and alternative designs and implement the option which provides the best environmental alternative.
- Control all upslope catchment runoff, diverting clean water around or safely through the area of disturbance.

Quarries and Vegetation Removal

Measures in these Guidelines are suitable for quarry and vegetation removal operations. However, the long term nature of many quarries and the clearfelling of whole catchments during vegetation removal operations mean that some special erosion and sediment control measures need to be implemented. Careful planning of such operations is thus critical. The key areas where attention is required are discussed in detail in Part B of these Guidelines and should be read in conjunction with the other erosion and sediment controls also detailed.

Appendix H
Project Construction Zone Assessment

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Project Construction Zone Assessment – Construction Water Management

Reference to the construction zones within the following is in reference to the zones as shown within **Appendix A**. Further reference should also be made to **Appendix D** which contains the conceptual construction water management plans.

1.1 Construction Zone 1 (SH1 SH18 Interchange)

This area of works is illustrated in the erosion and sediment control drawings Sheets 5, 6 and 8 in **Appendix D**. The area of earthworks within this zone covers approximately 10.5ha and is effectively a “traditional” earthworks operation with cut and fill activities.

In the northern extent of this construction zone, a super silt fence will be established below the proposed fill batter from the existing SH1. The silt fence will be extended around the footprint of the new wetland feature. In addition, silt fencing will be established to manage smaller and isolated fill locations. This wetland feature is located on a drainage channel which will be filled. The conditions of consent will require the relocation of any native fish located in this drainage channel (for example, eels). This would involve the temporary diversion of flows and fish recovery prior to works commencing. Once established, the wetland will be utilised as a temporary sediment retention device during construction.

The development of the construction support area to the south will include areas such as hard stand surfaces, storage of materials and office facilities. This location is approximately 5.8ha. Construction works within this area will include a mix of earthworks associated with the construction of the Project as well as construction support area activities. As a result, the area will be a mix of hardstand and exposed earth. The construction support area itself is illustrated on Sheets 6 and 8.

The earthworks associated with the construction of the road include both cut and fill operations which are managed through the provision of three sediment retention ponds augmented with two new permanent wetlands to also act as construction-related sediment retention devices. Dirty water diversion channels will direct flows to these devices. The sizing of the sediment retention ponds is to be based on the calculations within **Appendix E** with the catchment areas identified and confirmed within the drawings. Flocculation treatment of the ponds will occur as set out in Section 9.8 of this report.

All sediment retention pond devices will, where practicable, flow to grass environments which then in turn will discharge freshwater environments. These grass environments act as buffer zones and will assist with “polishing” any discharge that results.

Silt fences will be established for small catchments that cannot be diverted to the sediment retention pond facilities.

Construction Zone 1 also includes the establishment of a stormwater wetland (approximately Chainage 950) located where some existing drainage channels exist, with these required to be diverted around the works location during establishment. These works will be subject to a specific CESCP which includes a risk assessment.

The methodology will involve the following process:

- The existing culvert in this location is to be abandoned, and then upsized/extended on a different alignment towards the proposed wetland feature. All upstream flows will be able to be diverted through this new culvert installation.
- The new culvert will be installed prior to the abandonment of the existing culvert to allow for the establishment of a “dry environment” which in turn will allow for the establishment of the

proposed high-level dry pond. During construction the culvert will be extended to beyond the earthworks boundary to allow for works to occur. This culvert system will take flows from up to the 1 in 100 year rain event.

- The existing channels in the area generally take local grassed catchment flows, except for the main channel which takes flow from the existing culvert. All existing channels will be reclaimed as part of the process.

Progressive stabilisation will also occur within this zone. This will consist of hard fill and temporary mulching and it is assessed that any surface that is not worked for a 10 day period be stabilised on a temporary basis. The construction support area will be stabilised progressively with hard fill on establishment.

The sediment retention ponds, and associated runoff diversion channels, will remain in place for the life of the construction support area. The location will operate as a hard stand area with a hard fill stabilised surface. At all times a stabilised entranceway will be in place allowing safe and "clean" access to the site.

Check dams will also be established in various locations within this zone as shown in **Appendix C** of this report. The check dams will provide velocity checks and treatment.

1.2 Construction Zone 2 (SH18 to Constellation)

This area of works is illustrated in the erosion and sediment control drawing numbers Sheets 6, 8, 9 and 10. The area of earthworks within this zone covers approximately 10.5ha in total.

The majority of the work within this zone will be managed through the use of swales and check dams with these located at the base of cut batters which are also subject to progressive stabilisation. Some isolated areas of silt fence will also be required.

Immediately east of Paul Matthews Road a construction support area is to be established over an area of 2,730m^2. The establishment of the construction support area may involve some earthworks activity and a super silt fence will be used to treat any construction related runoff.

One new proposed wetlands will be established to the south of SH18 (at either approximate chainage 1500 and 2000) with these to be the subject of a separate CESCP. Once established the device will act as a temporary sediment retention ponds during the construction period.

No works will occur within Alexandra Creek within this construction zone.

Further west to Unsworth Drive and Albany Highway the use of isolated check dams in swales and silt fences will occur with progressive stabilisation a key element of erosion control.

Retaining walls to be established will be undertaken in general accordance with the methodologies outlined in Section 7.3. This importantly includes management of pH levels from concrete works associated with the retaining wall installation. At all times, the retaining wall construction activities will be undertaken from hard stand stabilised areas. Any spoil generated through this activity will be disposed of offsite and if required to be stockpiled will be done so on a temporary basis only within the contributing catchments of the sediment retention devices within the construction support areas.

1.3 Construction Zone 3 (SH1 Northbound)

This area of works is illustrated in the erosion and sediment control drawing Sheets 3, 4, 5 and 6. The area of earthworks within this zone covers approximately 13.9ha.

The majority of the work within this zone will be manged through the use of swales and check dams with these located at the base of cut batters which are also subject to progressive stabilisation. Some isolated areas of silt fences are also required.

Three construction support areas are proposed within this zone and will be established as outlined in Section 7.10. Earthworks activities within the construction support areas will be managed using sediment retention ponds as described below.

For the construction support area located at chainage 13700, the new stormwater management pond to be established in the northern extent of the location will be utilised as a sediment retention pond if possible. This new wetland is located on the upper area of this site and as such will have limited value during construction but will assist in providing some treatment capacity. Dirty water diversions will direct all runoff to a proposed new sediment retention pond which will have capacity for the full 1.43ha area.

At chainage 14100, a new attenuation basin is to be established with the works to the south of this basin to Rosedale Road to be diverted to the device which will act as a temporary sediment retention device. The sizing of these sediment retention ponds are to be based on the calculations within **Appendix E**. Flocculation treatment of these ponds will also apply as set out in Section 9.8 of this report

This zone includes the construction works required to widen the causeway between the Rosedale Wastewater Treatment Plant ponds. The details of the proposed works are outlined in Section 7.8 of the report. Construction of the widened causeway is likely to involve an external 1:1.5 batter slope although the final design is subject to detailed design. The outer batter face will be lined with non-erosive rock material and effectively will act as a coffer dam such that an isolated work area is created that is separate to the main body of the pond environment. Sediment discharge will be managed to a level that will ensure Watercare's discharge consents are not compromised.

Within this zone, a cut and cover methodology will be used whereby the road widening activity will be stabilised within a short period of time with either aggregate as part of the final surface preparation or geotextile on a temporary basis prior to forecast rain events. This approach allows for a simple construction methodology while also ensuring that risk of sediment discharge is minimised. Where necessary isolated sections of silt fence will be established and will be detailed within the CESCPs to be developed and certified by Auckland Council.

Cleanwater diversions will be established between the edge of the existing motorway alignment and works area and will be directed to discharge at points beyond the works location. This effectively replicates the existing surface drainage and diverts flows around the specific area of works as they progress.

At the base of cut batters check dams will be established. These will be in the form of a rock check dam (in accordance with the NZTA Guideline) or, more likely, in the form of filter socks. These filter socks will incorporate flocculants and will allow a treatment train along this swale location while also reducing the longitudinal grade and erosion potential. In addition, this location will be subject to ongoing and progressive stabilisation.

Retaining walls and culvert extensions are to be established as shown on the drawings and will be undertaken in general accordance with the methodologies outlined in Section 9.2 and 9.3.

1.4 Construction Zone 4 (SH1 Southbound)

This area of works is illustrated in the erosion and sediment control drawings in **Appendix D** (Sheets 3, 4, 5 and 6). The area of earthworks within this zone covers approximately 11.2ha.

The majority of the work within this zone will be managed through the use of swales and check dams with these located at the base of cut batters which are also subject to progressive stabilisation. Some isolated areas of silt fence are also required.

At chainage 1950 (Greville Road), a construction support area is to be established over an area of 12,285m^2 with this location also including a cycleway and a sediment retention pond. Dirty water diversions will direct all runoff to the sediment retention pond.

At chainage 2150 (Greville Road), a new operational stormwater device is to be established with the works in the vicinity to be diverted to this device during the construction period which will act as a temporary sediment retention device. The sizing of these sediment retention ponds are to be based on the calculations within **Appendix E**. Flocculation management treatment will also be provided.

A construction support area will be established at chainage 14500 over an area of approximately 5,149m^2. An existing hard stand area is likely to be utilised, and because of the existing impervious surface, no construction water management will need to be implemented in relation to this location. Provision for a silt fence is included in the erosion and sediment control drawings depending on how the contractor wishes to use the area.

From chainage 2200 to 2520, works will occur within the Rosedale Closed Landfill and contaminated material is expected to be encountered. The management of any runoff in this location requires specific management techniques to ensure capture and appropriate treatment and/or disposal of such runoff. This area is therefore excluded from this Report and is addressed within Assessment of Effects – Encroachment on Rosedale Landfill Report.

This construction zone also includes the widening of the causeway between the Rosedale Wastewater Treatment Plant ponds. Details of the methodology for these works is outlined in the section above in relation to SH1 Northbound.

A new stormwater wetland feature is proposed on the north eastern side of the Rosedale Wastewater Treatment plant ponds. This is stormwater wetland will be subject to a separate CESCP and will be utilised as a sediment retention pond during the earthworks phase. Dirtywater diversions will need to be established for this device.

From an erosion and sediment control perspective, this sector will rely on a cut and cover methodology whereby the road widening activity will be stabilised within a short period of time with either aggregate as part of the final surface preparation or geotextile on a temporary basis prior to forecast rain events. This allows for a simple construction methodology while also ensuring that risk of sediment discharge is minimised. Where necessary isolated sections of silt fence will be established and will be detailed within the CESCPs to be developed and certified through Auckland Council.

Cleanwater diversions will be established between the edge of the existing motorway alignment and works area and will be directed to discharge at points beyond the works location. This effectively replicates the existing surface drainage and diverts flows around the specific area of works as they progress.

At the base of cut batters check dams will be established. These will be in the form of a rock check dam or in the form of filter socks as set out in **Appendix C**. These filter socks will incorporate flocculant and will allow a treatment train approach along this swale while also reducing the grade and hence reducing potential erosion. In addition, this location will be subject to ongoing and progressive stabilisation to further reduce the potential for sediment entrainment.

Retaining walls and culvert extensions are to be established and will be undertaken in general accordance with the methodologies outlined in Sections 9.2 and 9.3.

1.5 Construction Zone 5 (SH1 Median)

The area of earthworks within this zone covers approximately 2.1ha in total as set out in **Table 3** above.

From an erosion and sediment control perspective, this zone will rely on a cut and cover methodology whereby the road widening activity will be stabilised within a short period of time with either aggregate as part of the final surface preparation or geotextile on a temporary basis prior to forecast rain events. This will rely on a weather watch approach using *www.metvuw.co.nz* and allows for a simple construction methodology while also ensuring that the risk of sediment discharge is minimised. Where necessary, isolated sections of silt fence will be established and will be detailed within the CESCPs.

Cleanwater diversions will be established between the edge of the existing motorway alignment and works area and will be directed to discharge at points beyond the works location. This effectively

replicates the existing surface drainage and diverts flows around the specific area of works as they progress.

1.6 Construction Zone 6 (Albany Park and Ride)

This area of works is illustrated in the erosion and sediment control drawing Sheet 1 and includes a bridge over SH1 to the Albany Bus Station. The area of earthworks within this zone covers approximately 0.9ha.

From an erosion and sediment control perspective, this sector will rely on a cut and cover and retaining wall methodologies whereby the activity will be stabilised within a short period of time with either aggregate as part of the final surface preparation or geotextile on a temporary basis prior to forecast rain events. The use of rain forecasting (*www.metvuw.co.nz*) will also assist this area of works and allow for management of activities such that high rainfall periods can be avoided. This allows for a simple construction methodology while also ensuring that risk of sediment discharge is minimised. Where necessary isolated sections of silt fence will be established and will be detailed within the CESCPs to be developed and certified by Auckland Council.

Retaining walls and culvert extensions are to be established as shown on the drawings and will be undertaken in general accordance with the methodologies outlined in Sections 9.2 and 9.3.

1.7 Construction Zone 7 (Busway and SUP – Albany to Greville)

This area of works is illustrated in the erosion and sediment control drawings Sheets 1, 2 and 3. The area of earthworks within this zone covers approximately 4.3ha.

This zone will rely on a cut and cover methodology whereby the road widening activity will be stabilised within a short period of time with either aggregate as part of the final surface preparation or geotextile on a temporary basis prior to forecast rain events. This allows for a simple construction methodology while also ensuring that risk of sediment discharge is minimised. Where necessary isolated sections of silt fence will be established and will be detailed within the CESCPs to be developed.

Cleanwater diversions will be established between the edge of the existing motorway alignment and works area and will be directed to discharge at points beyond the works location. This effectively replicates the existing surface drainage and diverts flows around the specific area of works as they progress.

At the base of any cut batters check dams will be established as shown on the erosion and sediment control plans. These will be in the form of a rock check dam or filter socks as per **Appendix C**. These filter socks will incorporate flocculant and will allow a treatment train along this swale while also reducing the grade and hence reducing erosion potential. In addition, this location will be subject to ongoing and progressive stabilisation.

At the northern extent of Zone 7, two new stormwater wetlands are to be established and used for sediment control during the construction period as a “back up” to the other erosion and sediment control measures to be utilised. These will be subject to separate CESCPs prior to establishment with the construction activity likely to include the use of super silt fence material on the lower side of the wetland earthworks.

McClymonts Road Bridge will be replaced within this zone which will be based on construction of the new bridge structure offline followed by the demolition of the existing structure. This will be undertaken in general accordance with the methodologies outlined in Section 9.5.

A construction support area at chainage 12750 will be established over an area of 3610m^2 and a permanent wetland pond will be established in this location. This wetland will also act as an impoundment device during the construction period with short term water controls achieved through the use of super silt fence implementation.

Retaining walls and culvert extensions are to be established as shown on the drawings and will be undertaken in general accordance with the methodologies outlined in Sections 9.2 and 9.3.

1.8 Construction Zone 8 (Busway and SUP Greville to Constellation)

This area of works is illustrated in the erosion and sediment control drawing Sheets 3, 4, 5 and 6. The area of earthworks within this zone covers approximately 7.26ha.

A cut and cover methodology will be used in this zone and the road widening activity will be stabilised within a short period of time with either aggregate as part of the final surface preparation or geotextile on a temporary basis prior to forecast rain events. This allows for a simple construction methodology while also ensuring that risk of sediment discharge is minimised. Where necessary isolated sections of silt fence will be established and will be detailed within the CESCPs to be developed.

Importantly these works will also utilise the erosion and sediment controls to be established within the SH1 Southbound zone (Zone 4).

Cleanwater diversions will be established between the edge of the existing motorway alignment and works area and will be directed to discharge at points beyond the works location. This effectively replicates the existing surface drainage and diverts flows around the specific area of works as they progress.

At the base of any cut batter check dams will be established. These will be in the form of a rock check dam or filter socks as per **Appendix C**. These filter socks will incorporate flocculant and will allow a treatment train along this swale while also reducing the grade and hence reducing potential erosion. In addition, this location will be subject to ongoing and progressive stabilisation

Retaining walls and culvert extensions are to be established as shown on the drawings and will be undertaken in general accordance with the methodologies outlined in Sections 9.2 and 9.3

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