Greenhithe Bridge Watermain Duplication and Causeway

Technical Report A – Earthworks, Erosion and Sediment Generation

16/07/2015

Watercare
An Auckland Council Organisation

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EXECUTIVE SUMMARY

The following Technical Report presents an Erosion and Sediment Control Plan (ESCP) which was developed to support resource consent application for Watercare Services Limited's Greenhithe Bridge Watermain Duplication and Causeway project. It provides a range of mitigation measures to manage the potential adverse environmental effects caused by the proposed earthworks.

As with any project involving earthworks, the proposed works introduces potential for elevated sediment generation. Given that works will take place in close proximity to and within the Coastal Marine Area which increases the risk of adverse environmental effects, the issue of erosion and sediment control has been investigated. The issue of erosion and sediment falls under the statutory control of Council , hence this ESCP was developed using AC's own guidelines, along with other local documents.

Seven construction elements were identified and construction methodologies developed in related documents as presented in the *Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment* report (AEE). This ESCP discusses each of the seven work areas and how best to address the issue of erosion and sedimentation. It is recognised that the construction methodology presented in the AEE may differ to that proposed by the Contractor at the time of construction. Therefore a tool box of erosion and sediment control measures which can be applied to most construction methodologies is also presented. The Contractor is expected to produce a more detailed ESCP prior to the start of construction which will be in general accordance with the content of this ESCP.

An estimate of sediment yields is provided using the Universal Soil Loss Equation for appropriate construction site locations.

1 INTRODUCTION

URS New Zealand Limited (URS) has been commissioned by Watercare Services Limited (Watercare) to prepare an Erosion and Sediment Control Plan (ESCP) related to the construction of Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway project.

The project comprises:

- The construction of a new watermain on the northern side of the Greenhithe Bridge to duplicate the existing North Harbour 1 Watermain already located on the southern side of the bridge, and
- Widening along the northern side of the existing State Highway 18 motorway causeway to accommodate the new watermain, as well as wastewater pipelines and associated facilities which form part of Watercare's proposed Northern Interceptor project.

The proposed water and wastewater infrastructure is required in order to maintain water and wastewater service levels and to provide for future growth.

The proposed Greenhithe Bridge Watermain Duplication and Causeway project requires various resource consents under the Resource Management Act 1991 ("RMA"). This technical report provides specialist input for the *Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment* report ("the main AEE") report prepared by URS New Zealand and Jacobs New Zealand Limited which supports the resource consent application. The works described in the AEE have been considered in the technical assessment presented in this report.

This report provides the following:

- A brief overview of the proposed works (in Section 2);
- A description of the environmental baseline for the particular receiving environment(s) potentially affected by the project;
- A brief outline of the statutory framework relevant to erosion and sediment control;
- Description of the design philosophy used in the development of the ESCP;
- A general ESCP presenting a "tool box" of Erosion and Sediment Control Measures (ESCMs) ;
- Work Area specific ESCPs;
- Construction methodologies for Erosion and Sediment Control Measures, monitoring and maintenance recommendations; and
- Soil loss estimates using the Universal Soil Loss Equation.

The new watermain will eventually form part of Watercare's future North Harbour 2 Watermain project. The proposed widening of the motorway causeway will also incorporate wastewater pipelines and associated facilities which form part of Watercare's proposed Northern Interceptor project. Separate technical reports have or will be prepared for the future North Harbour 2 Watermain project and for the balance of the Northern Interceptor project.

2 GREENHITHE BRIDGE WATERMAIN DUPLICATION AND CAUSEWAY – PROPOSED WORKS

The proposed Greenhithe Bridge Watermain Duplication and Causeway works assessed in this report are the construction of:

- The proposed watermain from Station Street in Hobsonville, under the motorway to the coastal edge – this will involve open trenching from Station Street to the motorway, and trenchless construction under the motorway;
- Proposed causeway widening to accommodate the proposed watermain and wastewater pipelines – the proposed widening is approximately 860 metres in length and 15-50 metres in width along the northern side of the existing motorway causeway;
- The proposed watermain attached to the underside of the Greenhithe Bridge; and
- A proposed watermain cross connection chamber close to the eastern abutment of the Greenhithe Bridge.

The proposed works are described in detail in the AEE. Drawings 2010674.040 to 2010674.044, included in Appendix A show the proposed works along with measures that could be expected to be used on the GBWD and Causeway Project to mitigate potential environmental effects associated with sediment generation. It is noted that the appointed contractor will produce a more detailed ESCP prior to the start of construction which will be specifically aligned with their construction methodology. The Contractors' ESCP will be developed in general accordance with the content of this Technical Report and Auckland Council's Technical Publication 90 –Erosion and Sediment Control: Guidelines for Land Disturbing Activities in the Auckland Region.

3 ENVIRONMENTAL BASELINE

Construction activities disturb ground and expose bare earth which has the potential to significantly increase sediment generation potential if not properly managed. When disturbed ground and exposed earth are subject to interaction with water, either as rainfall, runoff or coastal action, soil is eroded away causing sediment generation. The sediment is typically transported in runoff and deposited in waterways which can have a variety of adverse environmental effects. Elevated sediment levels in waterways lead to degradation of aesthetic value, habitat alteration and changes to population of local flora and fauna.

An ESCP is required to ensure that construction works are carried out in such a way to minimise and mitigate the potential adverse effects on the environment, as much as practicable.
In this case the receiving environment is Auckland's Upper Waitemata Harbour. Suspended Solids levels measured at Brighams Creek and Hobsonville Jetty in 2011 were mean concentrations of 8.8.mg/l and 3.1 mg/l respectively. Auckland Council's water quality target for suspended solids is less than 25 mg/l for marine waters.[1]

[1] Walker, J and Vaughan, M (2013). Marine water quality annual report: 2011. Auckland Council technical report, TR2013/031

4 STATUTORY FRAMEWORK

Sediment control in the Auckland region falls under the responsibility of the Auckland Council. The Council addresses the issue of sediment discharge in "**The Auckland Regional Plan: Sediment Control**".

Given the proposed location of the works they will occur within a "Sediment Control Protection Area" (SCPA). The relevant definition under the Regional Plan is as follows:

- 100 metres either side of a foredune or 100m landward of the coastal marine area (whatever is the more landward of mean high water springs);

Given that the area of proposed earthworks will exceed 0.25 ha^2 and involve in excess of 100m of trenching or tracking, they will be a Restricted Discretionary Activity. The key matters over which discretion will be exercised are summarised below:

- Techniques used to restrict or control sediment being transported from the site and the effects or impacts of sediment on water quality from the techniques chosen, including the practicality and efficiency of the proposed control measures;
- The proportion of the catchment which is exposed;
- The proximity of the operation to the receiving environment;
- The concentration and volume of any sediment that may be discharged;
- The time during which the bare earth surface is exposed;
- The time of year when the activity is undertaken;
- The duration of the consent;
- Monitoring the volume and concentration of any sediment that may be discharged

The proposed earthworks would be considered as for the purpose of installing 'network utilities' and under the PAUP earthworks includes open trenching and trenchless methods which result in soil disturbance. The relevant clauses of the PAUP include:

- 3H.4.2.1.1 (Activity Table – Earthworks – Zones)
- 3H.4.2.1.2 (Activity Table – Earthworks – Overlays)
- 3I.6.1.1 (Activity Table – Drainage, Reclamation and Declamation)
- 3I.6.1.2 (Activity Table – Depositing and disposal of material)

The proposed earthworks trigger the need for consent under various requirements including those associated with Heritage Area, Coastal Protection Yard and a Significant Ecological Area. Statutory Assessment is provided in Chapter 8 of this AEE.

5 SITE DESCRIPTION

The works are located on and around the Greenhithe Bridge in Greenhithe and Hobsonville, Auckland. Much of the works will take place in the Coastal Marine Area (CMA) or on land within close proximity to the CMA. The CMA is predominantly tidal mudflats supporting mangrove growth. The land on which construction will take place is generally steep and drains to the CMA. Currently the land is stabilised with grass cover and rock armour on foreshore.

6 DESIGN PHILOSOPHY

This ESCP has been developed to control erosion and sediment generation associated with the Greenhithe Bridge Watermain Duplication and Causeway so that adverse effects on the environment are minimised. This ESCP is intended to be read in conjunction with Drawings 201674-040 to 2010674-044 (included in Appendix A) which show the proposed alignment for the Greenhithe Bridge

Watermain Duplication and Causeway and potential arrangement of Erosion and Sediment Control Measures ("**ESCMs**").

A description of construction methodology is included in Volume 1, Section 2.3.4 of the AEE which outlines the project works and options for construction. This ESCP has been developed in response to the proposed construction methodology.

The ESCP was developed taking into account industry best practice and in particular, Auckland Council, Erosion and Sediment Control, Guidelines for Land Disturbing Activities, Technical Publication 90 ("**TP90**").

The contractor will develop and implement a site specific ESCP generally in line with this outline ESCP and TP90. Construction elements discussed in the document are subject to change. A final ESCP will be prepared once the Contractor is appointed and construction method confirmed.

Adverse effects on the environment are minimised using the two approaches Erosion Control, and Sediment Control;

- Erosion Control aims to prevent or minimise the generation of sediment from the site. Lower sediment loads place less demand on sediment control devices and lower the risk of adverse environmental impacts in case of device failure.

- Sediment Control aims to manage sediment once it is generated. This is usually achieved by installing devices to capture and retain sediment before it enters receiving environments causing adverse environmental impacts.

This ESCP is presented in the form of a "tool box" of ESCMs which allows the Contractor to select appropriate measures based on site conditions.

6.1 Reference Documents

The following documents were referenced in the preparation of the ESCP;

- Auckland Regional Council, Erosion and Sediment Control, Guidelines for Land Disturbing Activities, Technical Publication 90 (TP90);
- Auckland Council, Best Management Practice: Catchpit protection;
- Auckland Council, Best Management Practice: Dewatering;
- Auckland Regional Plan: Sediment Control.

7 CONSTRUCTION ELEMENTS

Seven major Construction Elements (CE) for the project have been identified as listed below:

1) Causeway widening and extension and installation of new pipes within the causeway;
2) Connection pipe between NH1 and the new watermain – west end;
3) New watermain connection to the Greenhithe Bridge; and
4) Watermain transition structure at the west end of the Greenhithe Bridge;
5) Connection between NH1 and the new watermain – east end;
6) West end valve chambers; and
7) Scour chamber

All CEs are likely to have implications for erosion and sediment generation and are discussed in greater detail in the following sections. Discussion of construction methodology is kept to a minimum and the reader is directed to the construction methods described in Volume 1, Section 2.3.4 of the AEE if greater detail is required.

8 GENERAL EROSION AND SEDIMENT CONTROL PLAN

Actual site conditions may vary from the information available at the time is ESCP was prepared. Hence a general “tool box” of ESCMs are presented below. The contractor will review and apply the proposed ESCMs as appropriate.

8.1 Source Control

The table below outlines possible source controls to either eliminate or minimise erosion and sediment generation.

Table 8-1 Source Control

Source/Activity	Source Control Measure
General site management. • Check the weather forecast and plan accordingly if there is to be heavy rainfall/wind; • Stabilise work areas with high sediment generation potential by placing geotextile and covering with clean hardfill or other approved method; • Regularly sweep or remove any accumulated sediment associated with the works; and • Stabilise disturbed ground as soon as possible. • Use water carts to minimise wind distribution of sediments.	
• Stockpiled soil	• Where possible, spoil to be stored uphill of trench so that any sediment laden runoff will be captured by trench; • Cover with tarpaulin/polythene/geotextile during wet/windy weather; • Stockpiles to be located at the lowest point of the site just before the ESCM; • Plan works so that stockpiled soil is returned the trench before wet weather; and • Avoid stockpiling of soil on site if possible or where required select a suitable site away from catchpits, open drains or surface water.
• Sediment transport due to runoff from external catchments entering the construction site.	• Construct diversion bunds/channel to divert runoff from external catchments entering site; and • Use clean water diversions (e.g. sandbags) where there is steep terrain uphill of the trench to reduce the volume of water requiring management.
• Dewatering.	• Where possible, allow water collected in trench to settle before dewatering; • When decanting or using a pump, skim from the surface to avoid suction of accumulated sediment; • Monitor and moderate pump rate to minimize scour; and • Identify a legal point of discharge. **Dewatering to Ground** • Decant or pump water to a grassed or vegetated area well away from receiving environments. • Pump through geotextile or a filter bag which will act as a filter and will reduce the amount of sediment to clean up. • Make sure that the rate of flow does not exceed the ground's capacity for the water to soak in (e.g. no ponding or runoff). • Make sure that there is no scouring at the pump outlet. • Remove any accumulated sediment at the end of each day (The above source control measures relating to trench

Source/Activity	Source Control Measure
	dewatering are extracted from “Auckland Council, Best Management Practice: Dewatering”
• Erosion due to runoff travelling over reinstated ground	• Do not remove ESCMs until the establishment of the surface.

8.2 Erosion and Sediment Control Measures

The table below outlines possible ESCMs.

Table 8-2 Erosion and Sediment Control Measures

Erosion and Sediment Control Measure	Application
• Stabilised entrance	• Install at egress points for construction outside of the carriageway.
• Wheel wash	• Install at egress points to construction site.
• Silt fence	• Erect around stockpiles and lay down areas to prevent transport of sediment; and • Erect between roadside swale/channel and edge of seal to prevent sediment entering channel.
• Super silt fence	• Erect on the banks of receiving waters into which sediment laden runoff may discharge.
• Diversion channel/bund	• Install to divert runoff from external catchments entering site.
• Level spreader	• Install at outlet of diversion bunds/channels.
• Sand logs/coir logs/hay bales	• Use in carriageway to divert clean water from construction site where there is steep terrain uphill or unfavourable carriageway crossfall.
• Catchpit/Stormwater inlet protection	• Install sand logs/coir logs in series upstream of the catch pit/stormwater inlet to act as check dams; • Cover catchpit grate and inlet with geotextile to filter sediment laden runoff before discharge into stormwater network; and • Other proprietary catchpit protection systems.
• Geosynthetic Erosion Control system (“**GECS**”)	• Install hessian cloth on batter slopes; • Install low permeability synthetic such as polypropylene liner to base of diversion channel/bunds.
• Bio-degradable mats	• Install on cut/fill batters until vegetation is established
• Sedimentation tank (“**ST**”)	• Route dewatering discharge to ST to remove sediment • Add flocculants if insufficient retention time is available.
• Filter sock	• Attach to dewatering discharge hose from ST before

Erosion and Sediment Control Measure	Application
	discharge to stormwater network.
• Hydroseed	• Hydroseed any backfilled areas as soon as possible.
• Floating silt curtain	• Install away from toe of causeway widening works, leaving sufficient room for construction activities.

9 CONSTRUCTION ELEMENT SPECIFIC EROSION AND SEDIMENT CONTROL

The following section describes in detail appropriate ESCMs for each specific CE. In addition to the specific ESCMs detailed in the section below, each CE will implement the appropriate ESCMs from Table 8.1 and 8.2 above.

Refer to Volume 1, Section 2.4.3 of the AEE for detailed construction methodologies for each CE.

9.1 CE 1 Causeway widening and extension and installation of new pipes within the causeway

The existing causeway will be widened by approximately 15m along its current alignment on the western side of Greenhithe Bridge which equates to distance of approximately 860m. A 150m long trapezoidal tab will be constructed near the centre of the causeway which will extend a further 35m beyond the proposed causeway widening taking the total width to a maximum of 50m.

The causeway will be constructed in cells, which create areas that are separated from coastal waters, with construction activities being undertaken within a single cell at any given time. Cells will be formed by constructing erosion stabilised bunds and piers. Any sediment generated from filling activities or fines on imported material will be retained within the cell.

Sediment generation is anticipated to occur mostly during the excavation of the trench and the construction of the bund and piers to form the construction cells. Excavation of the weak marine mud and placement of fill material disturbs sediment which, if not retained, will be washed out to sea. Likewise, any fines transported on fill material used to construct the bunds and piers will also need to be retained.

Lime Cement Mixing or mudcrete are two alternative options for the construction of the shear key at the base of the bund. Both options involve excavator mounted apparatus introducing stabilising material into the insitu mud then mixing. The construction activities can result in locally generated particulates which can enter receiving waters if not intercepted.

A Floating Silt Curtain ("**FSC**") will be deployed prior to the commencement of any works and remain in place until the site is fully stabilised. The FSC will fully encircle the worksite with the aim of intercepting as much sediment as practical and thus minimising discharges to the coastal marine area (CMA).

In addition, two super silt fences will be erected, in series, land side of the silt curtain to also intercept sediment. Special attention will be paid in the selection of the super silt fences to ensure they can withstand coastal wave action without failure.

Rock armour will be placed progressively on the seaward wall of the causeway to prevent erosion by wave action. The existing armour wall may be stripped and reinstalled on the new section provided that appropriate specifications are met. Unlike the other ESCMs discussed, rock armour will remain in place permanently.

Imported fill material can also be a source of sediment. Where the final surface is to be grassed, hydroseeding will be used to stabilise the exposed areas. Hydroseeding is preferred over traditional grass seeding as the thick slurry used in hydroseeding forms a barrier between exposed fill and water thereby minimising erosion. Areas not intended to be grassed will be stabilised by means of geosynthetic, aggregate, coir mattresses or other method subject to the approval process. The Contractor will select a method taking into account stabilisation effectiveness, ease of implementation/operation and cost. The causeway will be stabilised progressively as each section of the causeway is completed. Furthermore, a super silt fence will be erected along the hinge point of the causeway to capture sediment washed off from the causeway surface.

Management and protection of the existing stormwater culverts must also be considered as these will continually inundate the bunded area. Any water requiring pumping from the site will be routed through a ST before discharge to receiving waters. STs will typically require the addition of flocculation agents to allow sediment to settle in the relatively short detention time available.

The ESCMs will remain in place a sufficient length of time to allow sediment to settle to the seabed. Once settled, the sediment will be removed from the seabed via vacuum truck, dug out using an excavator or other appropriate means.

Monitoring of the above ESCMs is critical to ensure that they are functioning as intended. Both the FSC and super silt fences should be checked daily and after adverse weather conditions for any damage or sediment release. Should any damage or sediment release be observed, repairs will be effected immediately. Depending on the severity of actual or potential sediment release, works may need to be temporarily halted until repairs are made to the ESCMs.

9.2 CE 2 Connection pipe between NH1 and the new watermain – west end

The pipe connecting the new watermain to NH1 at the western end of the causeway will be pipe jacked under SH18 between temporary jacking and receiving pits. The ground around the jacking and receiving pits is likely to be disturbed by moving plant and machinery thereby making it susceptible to erosion. Sediment will also be generated when the pit is excavated, when sheet piles are installed and from the movement of excavated material to a removal truck. The close proximity of these sites to water bodies requires robust sediment management. Clean water diversions may be implemented if necessary, but at this stage the anticipated runoff volumes entering from upstream catchments is relatively low thus clean water diversions are unlikely to be necessary. If excess runoff is found to enter the work site during construction, clean water diversions will be constructed. Super silt fences will be erected downstream to intercept sediment laden runoff leaving the site.

The site access track may also be a source of sediment generation if not properly managed. The access will be designed with a surface treatment that minimises erosion and sediment generation. Super silt fences will be erected along the full length on the downstream side of the road.

Any areas of ground which will be subject to disturbance by construction activities will be stabilised as soon as practicable.

Vehicles can transport sediment on wheels and can spill spoil while in transit. It is recommended that wheel washes be installed as appropriate. The contractor will monitor truck filling to ensure no

overfilling and develop processes to reduce soil losses during loading. Where required lockage tailgates will be provided to minimise leaching of silt laden water from saturated excavated material.
Any works that encroach on the CMA will be carried out with a careful focus on mitigating adverse environmental effects. All works that have high sediment generation potential, such as sheet pile driving, will be carried out in a dry environment as far as practical. Where the work zone is within the tidal area, the same ESCMs used in the causeway widening will be applied (refer to earlier sections).

Dewatering may be required to remove ground water from the trench and receiving/jacking pits. Any pumped water will at a minimum be routed through a pre-treatment device such as a Sediment Tank (ST) to reduce sediment levels as discussed in CE 1.

Spoil will be kept clear of the access track and covered, stabilised or disposed offsite to minimise sediment entrainment.

9.3 CE 3 New watermain connection to the Greenhithe Bridge

Two construction methodologies are considered for attaching the new pipeline to the underside of the bridge deck as listed below:

1. Install piece by piece using overhead access
2. Launching the pipe (downhill) from the Eastern end

Option 1 does not disturb ground hence no erosion and sediment control is required. However Option 2 will require erosion and sediment control.

The eastern abutment slopes with a gradient in excess of 14% and is in close proximity to the CMA. Any sediment generated will enter into the CMA if not intercepted. Super silt fences or method with equivalent effectiveness will be erected along the downstream side of the site and the access track to intercept sediment.

9.4 CE 4 Watermain transition structure at the west end of the Greenhithe Bridge

The construction of the watermain transition structure will take place on the extended causeway. Construction of the causeway at this location will form part of the overall causeway works but, from a sediment generation perspective, is discussed in greater detail in the following section.

Due to the depth of water at the location, construction of the causeway will be by end tipping material into the sea (see section 2.3.4.1 of AEE for further description of methodology). Sediment generation is most likely to occur from the disturbed seabed caused by the end tipping of rock and from fines entrained in the material being tipped.

Sheet piling is another option for construction of the causeway at this point. Sheet piles will be used to enclose a working area from the sea which will allow for dry working condition. With this option, sediment generation will occur when the sheet piles are initially driven into the sea bed. Once the sheet piles are in, the dry working conditions result in relatively little sediment generation.

With either construction option, a FSC will encompass the work site in a similar arrangement to CE 1. A super silt fence will be erected around the top edge of the causeway to manage any sediment

generated from works on the causeway. The same monitoring and maintenance regime will be implemented as CE 1.

Any tipped rock will be “clean” with as little fines content as possible to minimise fines being introduced into the sea. This approach has been successfully implemented during the SH16 Causeway construction between Waterview and Te-Atatu.

9.5 CE 5 Connection between NH1 and the new watermain – east end

CE 5 and CE 2 share sufficiently similar construction methodologies and are located in a similar location from and erosion and sediment control perspective and therefore ESCMs are recommended as previously described for CE 2. Refer to CE 2 for further information.

A lay down and work area will be provided for construction of the chamber. The lay down area will be stripped and stabilised.

9.6 CE 6 West End Valve Chambers

The construction activities for this construction element are located in the jacking and receiving pit as CE 2. The erosion and sediment control issues are identical and are not discussed further.

9.7 CE 7 Scour Chamber

The construction activities for this work front are located adjacent to the proposed valve chambers CE 2. The erosion and sediment control issues are identical and are not discussed further.

10 EROSION AND SEDIMENT CONTROL MEASURES CONSTRUCTION METHODOLOGY

The following section provides a general construction methodology for ESCMs discussed in Section 8 and 9 of this ESCP. Note that sand logs/coir logs/hay bales and filter socks are not discussed further in this section as their function and construction is sufficiently discussed in Table 8.2.

The detailed design and construction information can be found in TP90 for all measures described in this section except for wheel wash, and ST (which will be constructed to manufacturers specifications). All ESCMs will need to be modified onsite to suit site conditions and works will be carried out in accordance with TP90.

The details of the ESCMs are shown in the drawings 2010674.040 to 2010674.044. These drawings include for reference, diagrams sourced from TP90 and other Auckland Council publications.
Should any discrepancies arise between design and methodology presented in TP90 and this ESCP, then the more stringent design will be applied onsite.

10.1 Stabilised Entrance

A Stabilised Entrance is a bed of aggregate material on geotextile located at the entrance/exit of a construction site which acts to remove sediment accumulated on vehicle wheels thereby reducing the amount of sediment leaving the site. Due to the nature of this project, a stabilised entrance is only suitable in areas where the pipeline is installed in areas outside of the carriageway.

Construction Methodology for Stabilised Entrance

1. Determine suitable access/egress to construction site
2. Clear entrance point of vegetation and provide smooth surface
3. Provide drainage to sediment control measure
4. Place geotextile and aggregate

10.2 Wheel Wash

A Wheel Wash sprays pressurized water on to the wheels of vehicles entering and exiting the construction site to remove any sediment collected on the wheel. The water used for cleaning will be collected by the Wheel Wash machine and be filtered. If no collection/filtering system is available, used water will be diverted to a ST. Where access to pressurised water is not available, an appropriate alternative method will be available.

It is recommended that a wheel wash will be located at the entrance and exit of major construction sites and locations that are at high risk from experiencing adverse effects from sediment and erosion.

10.3 Silt Fence/Super Silt Fences

A silt fence is comprised of a length of geotextile embedded into the ground and held upright via attachment to waratahs or similar. Silt Fences intercept, filter and temporally impound sheet runoff so that sediment may settle before reaching receiving waters.

Super silt fences are similar to silt to fences but are significantly more robust than silt fences and able to be used in larger catchments with lower likelihood of failure. Super silt fences are recommended for use around the CMA due to their greater effectiveness.

Construction Methodology for Silt Fence/Super Silt Fences

1. Identify where sediment laden runoff can enter receiving water
2. Mark out alignment to intercept all sediment laden runoff
3. Erect Silt Fence/Super Silt fence giving consideration to the arrangement of returns to ensure that runoff does not by pass the fence.
4. If Super Silt Fence is likely to intercept high velocity flows, construct a series of check dams upstream of the Super Silt Fence

10.4 Diversion Channel/Bund

Diversion channel/bunds direct upstage runoff away from the construction site which reduces the volume of water entering the construction site thereby reducing erosion.

Construction Methodology for Diversion Channel/Bund

1. Identify where clean runoff from external catchments enters the construction site
2. Mark out alignment of channel/bund to intercept runoff and convey to a legal point of discharge
3. Check if underground utilities will be affected
4. Install level spreader at discharge point to reduce any scour

5. Install rip rap protection at outlet
6. Excavate channel and/or construct bund
7. If gradient of channel is greater than 2%, install geosynthetic material to base of channel to prevent scour or construct rock check dams.

10.5 Level Spreader

A level spreader is installed at the outlet of a diversion channel/bund to convert a concentrated flow to a sheet flow. Sheet flow is less erosive than concentrated flow.

Construction Methodology for Level Spreader

1. Identify suitable location to install level spreader
2. Install rip rap protection where level spreader will discharge
3. Install level spreader including the geotextile and timber/metal level edge
4. Connect to diversion channel

10.6 Catchpit Protection/Inlet Protection

Catchpit protection aims to prevent sediment entering the stormwater network via inlets. The term catchpit protection is used to collectively refer to the following measures;

- Placement of sand socks/coir socks/hay bales in the channel, upstream of the catchpit and around the edge of the catchpit, to function as check dams and filter media. (A height of 1 sand sock is normally sufficient to prevent overtopping on a normal catchpit. For a sag catchpit, stack sand socks to a height greater than the ponding level of runoff)
- Covering of grate and inlet with geotextile to filter runoff
- Placement of aggregate on top of geotextile as another filter mechanism

10.7 Geosynthetic Erosion Control Systems (GECS)

GECS are geosynthetic materials applied to the base of channel or batters to prevent erosion. The GECS acts as a mat and keeps the soil particles in place when runoff is conveyed in the channel. In this project, GECS will be applied to diversion channels/bunds where gradient is greater than 2% or any steep batter where erosion may be an issue.

Construction Methodology for Geosynthetic Erosion Control Systems (GECS)

1. Identify diversion channels with gradient greater than 2%
2. Install GECS as per the manufactures specifications

10.8 Bio-degradable Mats

These are used to prevent loss of seedbed and to promote vegetation establishment where vegetation alone will be sufficient for site protection once established.

Install on cut/fill batter slopes as per the manufacturers specifications

10.9 Sediment Tank

A sediment tank is typically a large metal tank into which dewatering water is discharged. Sediment in the water is settled out and the clean water is discharged to a legal point of discharge. The tank may be equipped with baffles and other apparatuses to aid in the settling of sediment. The addition of flocculants will aid in settling.

Sediment tanks require regular maintenance and monitoring to ensure that the desired level of sediment removal is achieved. Maintenance may include removal of accumulated sediment and monitoring to ensure no short circuiting of the flow path occurs.

10.10 Hydroseeding

Hydroseeding refers to the application of seed, fertilizer and paper or wood pulp with water in the form of slurry, sprayed over the area to be vegetated. Hydroseeding allows for rapid establishment of vegetation (grass) as well as providing instant rain drop protection. Grassed areas reduce erosion through mechanical restraint of soil by the root system, reducing flow velocity, providing rain drop protection and retaining sediment. For maximum erosion protection, hydroseeding will be carried out as soon as trench is backfilled (in grassed areas only).

Construction Methodology for Hydroseeding

1. Remove any debris from hydroseeding area to leave clean soil
2. Scarify soil to improve retention of the hydroseeding slurry
3. Apply hydroseeding slurry
4. Water as necessary

10.11 Floating Sediment Curtain

A floating sediment curtain may be placed in the sea to control sediment during construction of the causeway widening. This ESCM consists of a float tube or similar with a geotextile “curtain” hanging underneath. The float allows this ESCM to rise and fall with the tide. The geotextile extends to the sea floor and is weighted down with a ballast chain contained within a sleeve at the base of the geotextile. Means of anchoring the device varies between manufacturers. The geotextile is permeable which allows water to pass through while retaining sediment.

In order to effectively control sediment, a floating sediment curtain will extend the full length of active construction site and prevent water from bypassing the device. The floating sediment curtain will be positioned as close to the works as possible while allowing sufficient room for construction activities.

Construction Methodology

A generalised construction methodology is presented but the construction of floating sediment curtains require specialist input from the manufacturer. Any construction on site will be as per manufacturer’s specification.

1. Mark out alignment of floating sediment curtain
2. Install anchor poles to tie load line to (each end of construction site)
3. Pull floating sediment curtain between anchor poles and attach
4. Remove accumulated sediment at low tide

11 UNIVERSAL SOIL LOSS EQUATION

The Universal Soil Loss Equation (USLE) is a model used to estimate sediment yields from earthwork sites. The USLE was developed in the USA but is increasingly used in New Zealand. It should be noted that the USLE is not calibrated for New Zealand’s environment and the values produced by it may not be a true reflection of soil loss under site conditions.

The USLE is only applicable to works on land with exposed ground and estimates soil loss caused by rainfall. The USLE has only been applied to CE 1, 2 5 and 6.

The USLE takes into account a number of factors when determining soil loss including:

- Rainfall;
- Exposed ground area;
- Soil composition;
- Site slope;
- Ground cover; and
- The effectiveness of the ESCM

Work Area	Total Soil Loss (Tonnes)
CE 1	0.426
CE 2	0.016
CE 6	0.073
CE 5	0.162

It should be noted that the USLE is highly dependent on the actual area and duration of land disturbance. Site occupation duration is extracted from the construction methodology presented in the AEE and site areas are estimated from the construction drawings.

CE 2 and CE 6 are assumed to have a combined work area of 1200m^2 (200m^2 and 1000m^2 respectively) and be occupied for 80 days. For the application of the USLE, the work area is assumed to have exposed ground for one month after which the ground will be stabilised for the remaining 50 days. Access tracks have been excluded from the estimate as alignment is yet to be determined.

CE 1 differs from a typical earthworks site in that all the exposed earth is a result of the infill which consists predominantly of sandy material. Only the flat surface of the causeway has been considered in the equation as the seaward wall is intended to be progressively covered with armour rock which practically removes sediment generation potential. Unlike the other two CEs considered, CE 1 will likely be stabilised progressively instead of stabilising at the end of works. Therefore the earlier sections of the causeway will remain stabilised for much longer than the final sections of the causeway. To take this factor into consideration, an average duration of stabilisation was assumed to be 90 days with 30 days of exposed ground with a work area of 17,000m^2. In reality, ground can be fully stabilised in less than 90 days, particularly where hydroseeding is used (as in this case). As a result the soil loss estimate presented is conservative.

CE 5 is assumed to have a work area of 750m^2 and be occupied for 50 days. For the application of the USLE, the site is assumed have exposed ground for one month, after which the ground will be stabilised for the remaining 20 days.

The majority of sediment generation occurs when exposed ground is left unstabilised thus rapid stabilisation is key to reducing sediment generation. It is unlikely that a work site will be left completely exposed without stabilisation for an extended length of time of up to a month. Thus the volumes of soil loss calculated by the USLE are likely to be conservative estimates.

12 DECOMMISSIONING AND SITE STABILISATION

As works are completed at each CE, decommissioning of the sediment control devices will be required. In this regard care should be taken to remove and dispose of any accumulated sediment. All areas used for sediment control measures will be reinstated to existing after decommissioning.

ESCM will be decommissioned only after there is no potential for erosion or sediment generation as a result of pipe construction activities.

13 MONITORING AND MAINTENANCE

All erosion and sediment control measures will be inspected on a regular basis. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will then be undertaken. A visual inspection of adjacent water ways will be performed after a rainfall event. All erosion and sediment control measures will be maintained in accordance with TP90 and Auckland Council Best Management Practice guidance documents.

14 RECOMMENDATIONS & CONCLUSIONS

Construction works on the Greenhithe Bridge Watermain Duplication and Causeway will or have the potential to result in increased soil erosion and sediment generation thus a variety of erosion and sediment controls are presented to minimise adverse effects on the environment. The Contractor will need to prepare a more detailed ESCP reflecting their specific construction methodology and incorporating appropriate measures presented in this report. With appropriate controls in place, it is anticipated effects on the environment will be less than minor.

APPENDIX A EROSION AND SEDIMENT CONTROL PLAN DRAWINGS

PROPOSED NORTHERN INTERCEPTOR ALINGMENT

CE 5.
NH2 PIPELINE TO NH1 PIPELINE CONNECTION–EAST END COMBINED CHAMBER. REFER 201674.041 FOR EROSION AND SEDIMENT CONTROL MEASURES.

CE 3.
CONNECTION OF NH2 PIPELINE TO UNDERSIDE OF THE GREENHITHE BRIDGE DECK.

PROPOSED NORTHERN INTERCEPTOR ALINGMENT

CE 4.
HYDRAULIC THRUST BLOCK THE WESTERN BRIDGE ABUTMENT.

GREENHITHE BRIDGE (UPPER HARBOUR BRIDGE)

DN 1200 CLS PIPELINE (NH2).

EXISTING DN 910 CLS WATERMAIN (NH1).

CE 1.
WIDENING OF EXISTING CAUSEWAY.

SUPER SILT FENCE ON HINGE POINT OF CAUSEWAY WIDENING.

2no. SILT FENCES CONSTRUCTED IN SERIES

CE 7.
NH1/NH2 PIPELINE HIGH RATE SCOUR CHAMBER.

CONSTRUCTION ACCESS

CE 6.
WEST END OPTION 3B NH2 VALVE CHAMBER. REFER 201674.041 FOR EROSION AND SEDIMENT CONTROL MEASURES.

CE 2.
PIPE CONNECTION NH2–NH1. REFER 201674.041 FOR EROSION AND SEDIMENT CONTROL MEASURES.

STATE HIGHWAY 18

NOTES

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHOWN ON LOCALITY PLAN SHALL BE CONSTRUCTED AS PER AUCKLAND REGIONAL COUNCIL TECHNICAL PUBLICATION NO. 90 (TP90) OR THE MANUFACTURES SPECIFICATION REFER TO DRAWING 2010674.043 TO 2010674.044 FOR DETAILS.
2. THIS LOCALITY PLAN SHALL BE READ IN CONJUNCTION WITH TECHNICAL REPORT A – EARTHWORKS AND SEDIMENTATION
3. THE EROSION CONTROL MEASURES SHOWN ON THE LOCALITY PLAN SHALL BE SUPPLEMENTED AND/OR SUPERCEDED AS REQUIRED BY A SITE SPECIFIC EROSION AND SEDIMENT CONTROL PLAN.
4. ALL CONSTRUCTION SITES TO HAVE STABILISED ENTRANCES.
5. ALL CATCHPITS WHICH RECEIVE SEDIMENT LADEN RUNOFF TO HAVE CATCHPIT INLET PROTECTION.
6. ACCESS TRACK ALIGNMENT TO BE DETERMINED ON SITE

LEGEND:
- NH2 ALIGNMENT
- NIH1 ALIGNMENT
- NORTHERN INTERCEPTOR ALIGNMENT
- SUPER SILT FENCE
- FLOATING SILT CURTAIN
- CAUSEWAY WIDENING

CONSENT

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GREENHITHE BRIDGE WATERMAIN DUPLICATION
EROSION AND SEDIMENT CONTROL ARRANGEMENT
EROSION AND SEDIMENT CONTROL LOCATION PLAN

CAD FILE 2010674.098	DATE 02.12.14
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CE 7.
SCOUR CHAMBER.

CONSTRUCTION ACCESS

CE 6.
WEST END OPTION 3B NH2
VALVE CHAMBER.

CE 2.
PIPE CONNECTION NH2–NH1.
JACKING PIT AREA. JACKING
PIT NOT SHOWN.

DN 810 CLS PIPE TO BE
PIPE JACKED IN DN 1200
SLEEVE

STATE HIGHWAY 18

CE 6.
WEST END OPTION 3B NH2
VALVE CHAMBER.

CE 2.
PIPE CONNECTION NH2–NH1.
RECEIVING PIT AREA.
RECEIVING PIT NOT SHOWN.
WORK AREA HATCHED

NH2–NH1 CROSS CONNECTION
DN 810 CLS PIPE LINE TO
BE OPEN TRENCHED

WORK SITE ARRANGEMENT TO
BE CONFIRMED. SUPER SILT
FENCE SHALL EXTEND ALONG
THE DOWNSTREAM SIDE OF
THE WORK SITE INCLUDING
ACCESS TRACK.

NOTES

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6. ACCESS TRACK ALIGNMENT TO BE DETERMINED ON SITE

LEGEND:
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- NIH1 ALIGNMENT
- NORTHERN INTERCEPTOR ALIGNMENT
- SUPER SILT FENCE
- FLOATING SILT CURTAIN
- CAUSEWAY WIDENING

CONSENT

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Watercare

GREENHITHE BRIDGE WATERMAIN DUPLICATION
EROSION AND SEDIMENT CONTROL ARRANGEMENT
WA 1, 2 & 3 EROSION AND SEDIMENT CONTROL LOCATION PLAN

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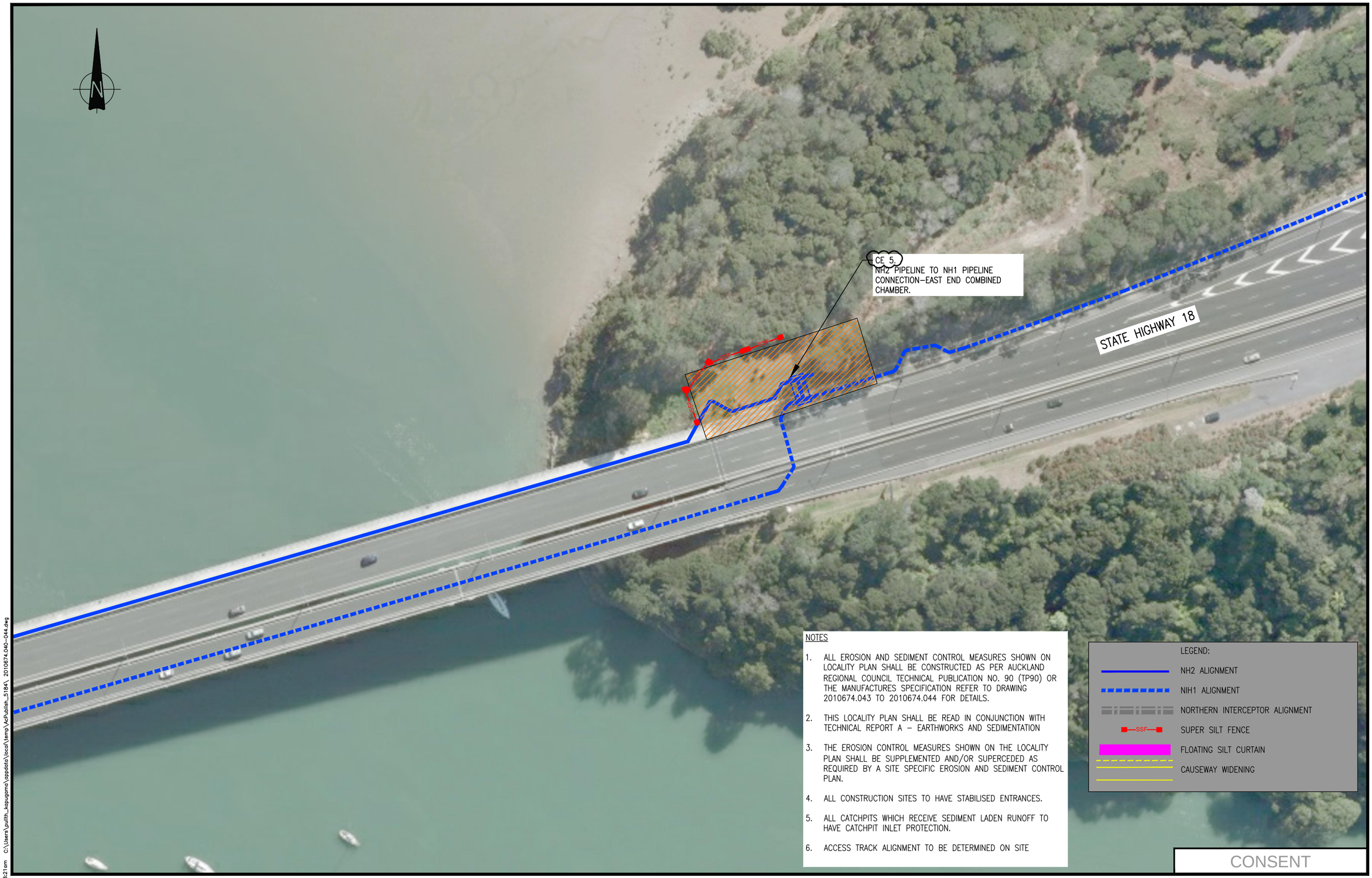

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6. ACCESS TRACK ALIGNMENT TO BE DETERMINED ON SITE

LEGEND:

- NH2 ALIGNMENT
- NIH1 ALIGNMENT
- NORTHERN INTERCEPTOR ALIGNMENT
- SSF — SUPER SILT FENCE
- FLOATING SILT CURTAIN
- CAUSEWAY WIDENING

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GREENHITHE BRIDGE WATERMAIN DUPLICATION
EROSION AND SEDIMENT CONTROL ARRANGEMENT
WA 7 EROSION AND SEDIMENT CONTROL LOCATION PLAN

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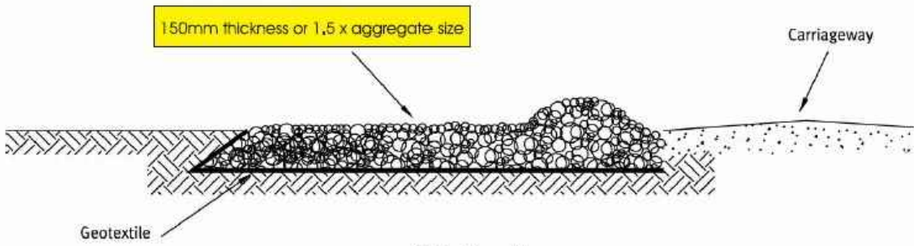
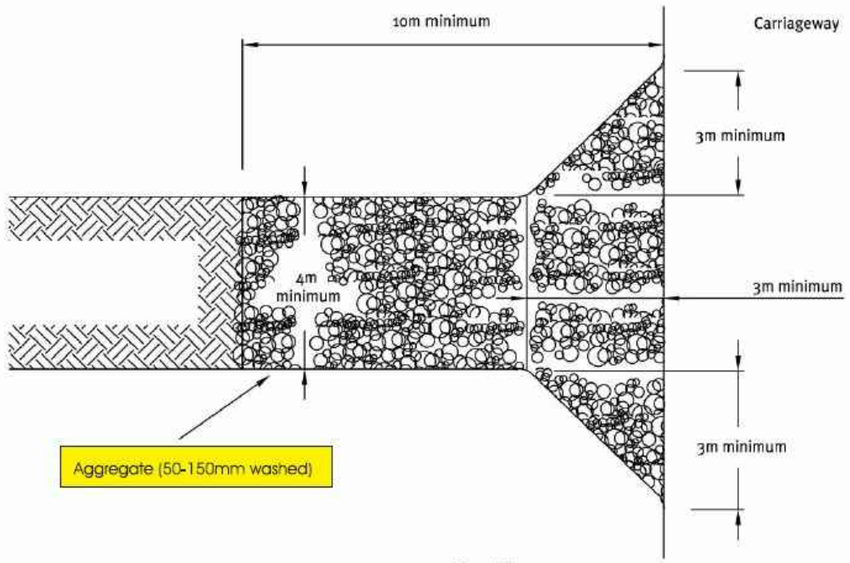


Side Elevation

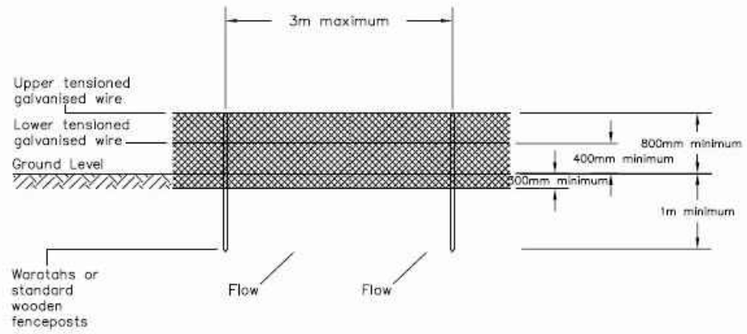


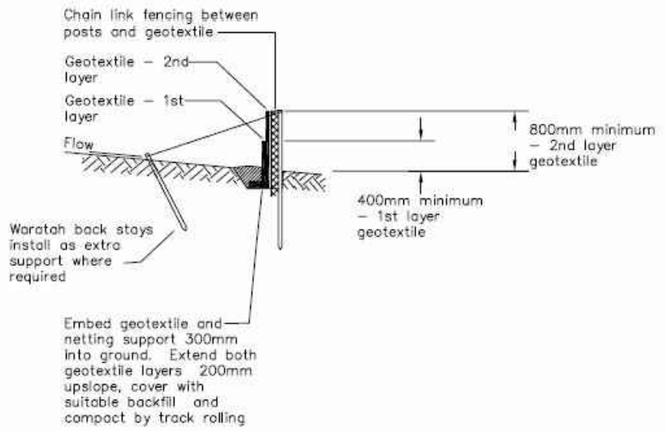
Plan View

STABILISED ENTRANCE
SCALE. N.T.S

Aggregate Range	50 – 150mm washed aggregate
Thickness	150mm minimum or 1.5 x aggregate size
Length	10m minimum length recommended
Width	4m minimum

STABILISED ENTRANCE DETAIL
SCALE. N.T.S





SUPER SILT FENCE ARRANGEMENT
SCALE. N.T.S

Slope %	Slope Lenght (m) (maximum)	Super Silt Fence Length (m) (maximum)	Spacing of Returns (m)
0-10	Unlimited	Unlimited	60
10-20	60	450	50
20-33	30	300	40
33-50	30	150	30
>50	15	75	20

SUPER SILT FENCE DESIGN CRITERIA

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Watercare

GREENHITHE BRIDGE WATERMAIN DUPLICATION
EROSION AND SEDIMENT CONTROL ARRANGEMENT
STABILISED ENTRANCE AND SUPER SILT FENCE DETAIL

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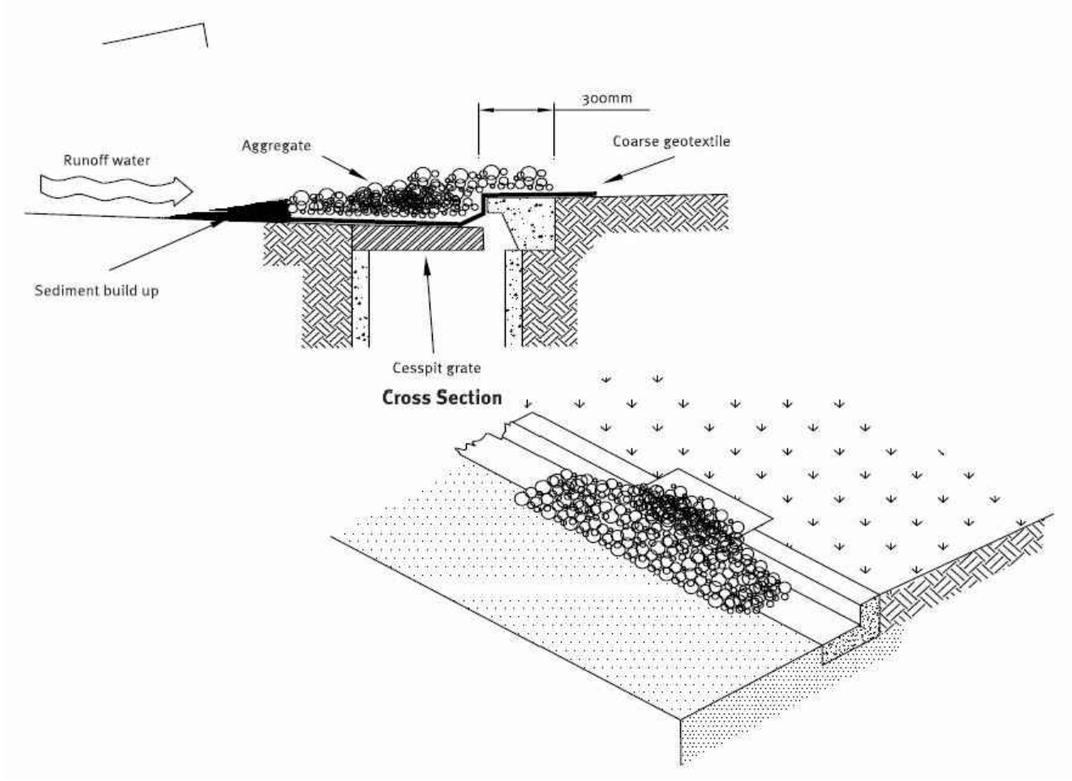
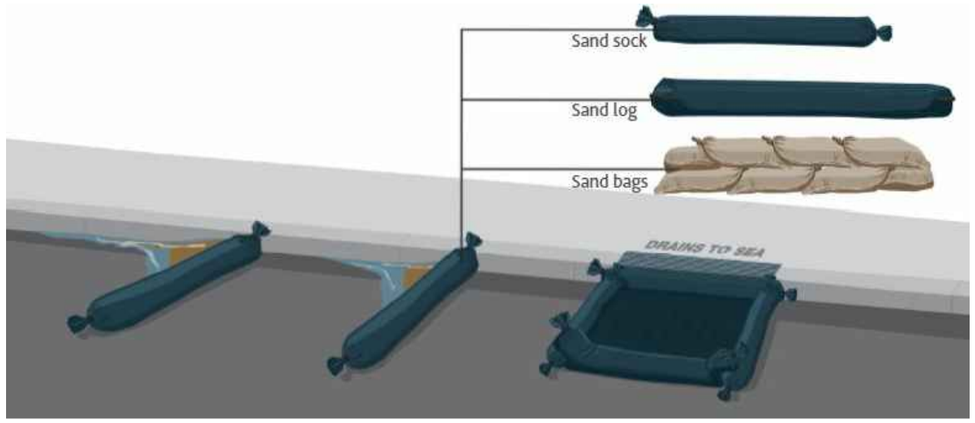
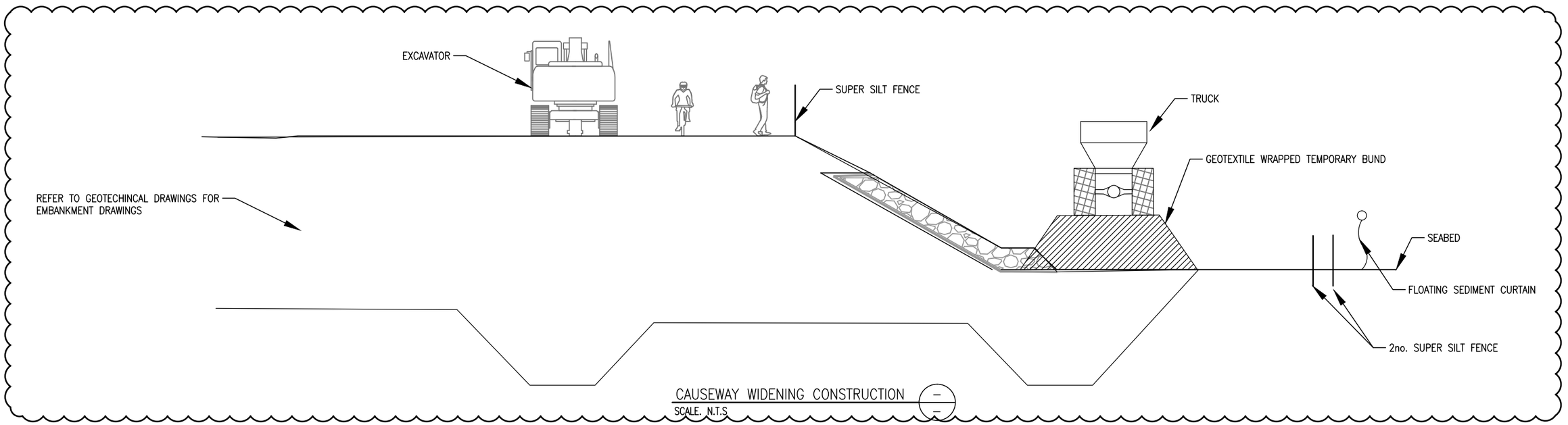


STORMWATER INLET PROTECTION
SCALE. N.T.S



CATCHPIT PROTECTION ARRANGEMENT
SCALE. N.T.S



CAUSEWAY WIDENING CONSTRUCTION
SCALE. N.T.S

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GREENHITHE BRIDGE WATERMAIN DUPLICATION
EROSION AND SEDIMENT CONTROL ARRANGEMENT
CATCHPIT PROTECTION, RUNOFF DIVERSION BUND AND CAUSEWAY WIDENING ARRANGEMENT

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