IN THE MATTER OF the Fast-track Approvals Act 2024 ("FTAA")

AND

IN THE MATTER OF an application for approvals by **NZ Transport Agency Waka Kotahi** to construct, operate and maintain the State Highway 1 Wellington Improvements project

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STATE HIGHWAY 1 WELLINGTON IMPROVEMENTS PROJECT
TECHNICAL REPORT #17
EROSION AND SEDIMENT CONTROL ASSESSMENT

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1. INTRODUCTION

1. My full name is Robert Alan Van de Munckhof. I have assessed the potential sediment effects and associated environmental effects associated with the construction of the proposed works.

2. In undertaking my assessment I have relied on the following experts and reports:

    i. Marcus Cameron in relation to Marine ecology effects of discharges to the Marine Environment (Technical Report #12 Marine Ecology Assessment)

    ii. Josh Markham in relation to freshwater, wetland and terrestrial ecology effects of discharges to those environments (Technical Report #10 Terrestrial Ecology Assessment and #11 Freshwater and Wetland Ecology Assessment)

    iii. The Constructability Report – For Consenting, prepared by HoffCon.Pro for NZ Transport Agency Waka Kotahi (NZTA)

    iv. Design Memo: Tunnel Design and Construction, SH1WI-DES-00-TUN-MEM-00001

    v. Spoil Disposal Strategy Memorandum, SH1WI-DES-00-GEO-MEM-00002; and

    vi. Technical Report #15 Stormwater Assessment, SH1WI-DES-00-DNG-RPT-001

Qualifications and experience

3. I am a Technical Director and Principal Environmental Engineer at Tonkin + Taylor. I have over 20 years' experience in stormwater, sediment and environmental management and have been employed as a specialist in environmental management at T+T since 2005.

4. I hold a Bachelor of Engineering (Chemicals and Material) from Auckland University and am a member of Engineering New Zealand and a New Zealand Branch Committee member of the Environmental Institute of Australia and New Zealand.

5. I have undertaken erosion and sediment control and construction works effects assessments for a wide range of projects throughout New Zealand. In particular, I prepared:

    i. The stormwater and sediment assessment and reporting for the proposed Auckland Regional Landfill, including presentation of evidence at both the Council Hearing and Environment Court on sediment effects

    ii. The sediment and water quality assessment and reporting for the Southern Landfill extension in Wellington, including presentation of evidence at the Council Hearing on sediment effects from the proposed construction of the landfill and on-going sediment discharges during operation

    iii. The Industrial and Trade Activity Environmental Management Plans for the City Rail Link construction works which addressed construction level effects associated with the project including management of hazardous substances and contaminants (including pH); and

    iv. Site wide erosion and sediment control assessments and management frameworks for on-going construction activities for the New Zealand Defence Force at the Whenuapai Airbase, Papakura Army Base and Devonport Naval Base. This included preparation of technical assessments of sediment effects to support resource consent applications and development of Erosion and Sediment Control Management Plans for each site to cover on-going earthworks associated with construction activities

Code of conduct

6. I confirm that I have read the code of conduct for expert witnesses contained in the Environment Court Practice Note 2023. This assessment has been prepared in compliance with that code, as if it were evidence being given in Environment Court proceedings. In particular, unless I state otherwise, this assessment is within my area of expertise and I have

not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Project description

7. As described in Part B of the substantive application, the State Highway 1 Wellington Improvements is a Road of National Significance (RoNS) project that aims to enhance over 5 km of SH1 in Wellington City. Key features include duplicates of the Terrace and Mount Victoria tunnels, a redesigned Basin Reserve layout, and upgrades along SH1 from north of the Terrace Tunnel to the intersection of Cobham Drive and Evans Bay Parade (the Project). The Project seeks to improve SH1 efficiency and reliability, relieve highway bottlenecks, support local access, and enable public transport growth.

8. The stormwater works for the Project include the installation of new stormwater infrastructure and the upgrade of existing systems in targeted areas. The works are proposed to manage runoff from newly created impervious surfaces, with a focus on providing stormwater treatment to improve water quality where practicable recognising existing constraints.

Scope of assessment

9. My assessment addresses the following matters:
   i. The methodology I have used to assess the effects of the Project
   ii. The existing environment
   iii. The nature of the works and potential for sediment generation and discharge
   iv. The proposed management methods
   v. Effects of sediment from the Project during construction
   vi. Proposed monitoring
   vii. Recommended measures to avoid, remedy or mitigate adverse effects

Assumptions and exclusions in this assessment

10. This assessment has relied on the following documents:
    i. The Constructability Report – For Consenting, prepared by HoffCon.Pro for NZTA
    ii. Design Memo: Tunnel Design and Construction, SH1WI-DES-00-TUN-MEM-00001
    iii. Spoil Disposal Strategy Memorandum, SH1WI-DES-00-GEO-MEM-00002; and
    iv. Stormwater Assessment, SH1WI-DES-00-DNG-RPT-001

11. The scope of the assessment has been limited to construction effects associated with the discharge of sediment laden water associated with earthworks and the discharge of tunnel water comprising groundwater associated with the tunnel construction.

12. The assessment has not considered:
    i. Effects of dust from earthworks and stockpiling (these matters are addressed by the Air Quality Assessment (Technical Report #18))
    ii. Discharge of water from the tunnels during operation and in the event of a fire (these matters are addressed in the Stormwater Assessment (Technical Report #15)); or
    iii. The effects of stormwater during the operational phase of the Project (these matters are addressed in the Stormwater Assessment)

2. EXECUTIVE SUMMARY

Existing environment

13. The Project area is located within a highly modified urban environment that has been influenced by extensive historical development. The existing receiving environment includes established stormwater networks that discharge to Lambton Harbour and Evans Bay. The surrounding environment is characterised by impervious surfaces with limited natural drainage and vegetation.

14. The Project comprises multiple construction sections including the duplication of the Terrace and Mt Victoria Tunnels, reconfiguration of the Basin Reserve roading network, and modifications to the existing SH1 route. Construction activities will include bulk earthworks, slope stabilisation, piling, trenching and tunnelling, each of which has the potential to generate sediment-laden runoff. Construction will be undertaken within confined working areas, often adjacent to existing infrastructure and residential and commercial land uses.

Potential adverse effects without mitigation

15. I have assessed that the potential adverse effects of the Project without mitigation include:

    i. Discharge of sediment laden water to Lambton Harbour and Evans Bay associated with bulk earthworks, stockpiling of spoil and handling of tunnel spoil and sediment laden groundwater; and

    ii. Discharge of construction stormwater with potential elevated pH associated with grouting, piling and stabilisation works

Proposed measures to avoid, remedy or mitigate adverse effects, including conditions

16. To minimise the discharge of sediment and contaminants from the proposed construction and earthworks, a comprehensive Erosion and Sediment Management Plan (**ESMP**) is recommended to manage erosion and sediment generation. Site-specific Erosion and Sediment Control Plans (**SSESCPs**) will also be prepared for the Terrace and Mt Victoria Tunnels, Basin and the Cut associated with the Eastern Connections.

17. I recommend that the following specific measures should be outlined in the above plans:

    i. Installation of conventional sediment control devices such as sediment retention ponds and silt fences where practicable

    ii. Use of containerised treatment systems with pH adjustment and chemical dosing to manage tunnel water and surface runoff from areas where insufficient space is available for conventional devices

    iii. Ongoing monitoring of sediment-laden discharges to ensure compliance with the Greater Wellington Regional Council (**GWRC**) discharge limit of 100 g/m³

18. Based on the application of best-practice erosion and sediment control methods and adherence to the ESMP and SSESCPs, the potential effects from sediment discharges are expected to be low. The proposed approach aligns with the objectives and policies of the GWRC Natural Resources Plan, including Objective O37 and Policy P36, which seek to minimise sediment-laden runoff and reduce sedimentation rates in receiving environments.

3. ASSESSMENT FRAMEWORK

Planning context

19. GWRC's Natural Resources Plan for the Wellington Region sets out the objectives, policies and rules for the management of sediment from earthworks activities.

20. In particular Objective O37 seeks to ensure that the amount of sediment-laden runoff entering water is minimised. In addition to the high level objective, Policy P36 seeks to restore the ecological health and significant values of Wellington Harbour by managing activities to reduce sedimentation rates to meet the water quality, aquatic ecosystem health and mahinga kai objectives in the plan. While these ecological matters are specifically addressed in the Marine Ecology Assessment, the policy provides clear direction to reduce sedimentation rates.

21. Therefore, the objective and policy provide clear directions to ensure that the potential discharge sediment is minimised as far as practicable.

22. The provisions of Proposed Plan Change 1 provide more explicit direction in terms of managing sediment laden water from construction. This is done through Policy WH.P29 which seeks to manage the risk of sediment discharges from earthworks by requiring the use of good management practices and in accordance with the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region (2021), limiting the amount of land disturbed at any time, designing and implementing earthworks with knowledge of the existing environmental site constraints, specific engineering requirements and implementation of controls to limit the discharge of sediment to receiving environments.

23. Policy WH.P30 which applies to earthworks over an area greater than 3,000 m^2 specifies specific limits for the discharge of sediment of 100 g/m^3 where the discharge is to coastal water and the stormwater network and requires the use of the GWRC Erosion and Sediment Control Guide to achieve the standard.

24. Policy WH-P31 is for earthworks over 3,000m^2 in area to be shut down between 1st June and 30th September (Winter shutdown). While the overall earthworks area across the Project exceeds 3,000 m^2, this is spread across a number of different individual work areas. Complying with WH-P31 would require each work area to remain below 3,000 m^2. This is likely to be achievable across a large proportion of the Project except for the Tunnel Portal works and the Trench. While the areas may exceed 3,000 m^2, the works are managed by containerised treatment systems which enables monitoring and demonstration of compliance with the discharge limits prior to discharge. This provides a high level of control of sediment runoff and ensures that even if the area limit is exceeded the risk of increased sediment discharges over the winter periods is still low.

25. In addition, the discharge of the tunnel water during construction comes under (operative) permitted activity Rule R91 subject to the following key matters:

    i. The concentration of total suspended solids in the discharge shall not exceed 50g/m3 where the discharge enters a site or habitat identified in Schedule C (mana whenua)[1], Schedule F1 (rivers/lakes), Schedule F4 (coastal sites) or Schedule H1 (contact recreation) or 100g/m3 where the discharge enters any other water; and

    ii. The discharge shall not give rise to the following effects after the zone of reasonable mixing: a change in the pH of ±0.5pH unit, the production of conspicuous oil or grease

[1] It is noted that within the Lambton Harbour receiving environment, northwest of the Clyde Quay Wharf is a mapped Schedule C4 site of significance to Taranaki Whānui ki te Upoko o te Ika a Maui named Te Aro Pa

films, scums or foams, or floatable or suspended materials, or any conspicuous change in the colour or visual clarity

26. While the discharges from the works ultimately discharge into the coastal environment containing a Schedule C4 site, the discharge is to the stormwater system first and therefore will be subject to mixing within the stormwater network, ensuring the risk of sediment and pH exceeding the limit at the stormwater outlet to the marine environment is low. Therefore, the lower discharge limit of 50 g/m^3 is not directly applicable to the proposal. While this is the case, I note that the Marine Ecology Assessment is recommending monitoring at the receiving environment and if this identifies a potential impact, then the lower discharge limit (50 g/m^3 vs 100 g/m^3) could be applied at the point of discharge to the stormwater system.

27. These provisions have been used to support the approach to the assessment.

NZTA technical publications or guidance documents

28. The NZTA has developed guidelines for the management of erosion and sediment control for State Highway Infrastructure[2]. These were developed prior to the GWRC Guide (noted above) that was prepared in 2021 and is based off the Auckland Council's Erosion and Sediment Control Guide (GD05) prepared in 2016 which is an update of the previous guidance TP90 (1999, and 2007 update). While not explicitly stated, the development of the NZTA guidelines followed the same approaches as TP90. Therefore, in terms of this assessment, the approach and methodology outlined in the GWRC Guide has generally been followed over the NZTA guidelines.

29. While the GWRC Guide is being applied, it is noted the GWRC Guide is designed primarily for earthworks projects where large areas of earthworks are open where issues such as slope stability and erosion and works within and around streams are key risks. This compares to this Project which is within a confined urban environment with the scale of earthworks significantly smaller than normal state highway construction and therefore the experience on other projects of a similar scale such as the City Rail Link in Auckland has also been considered in the assessment approach.

[2] Erosion and Sediment Control Guidelines for State Highway infrastructure, Construction Stormwater Management, NZ Transport Agency, September 2014

4. ASSESSMENT METHODOLOGY

Introduction

30. This section describes the methodology used to assess the potential effects of the Project on the environment.

Guidance and scope

31. As outlined above, the assessment has been undertaken following the approaches outlined in the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities. This sets out the potential approaches to minimise erosion and manage sediment.

Approach to assessing effects

32. The management of erosion and sediment control during construction typically follows a toolbox approach where an overall management framework is developed which identifies a range of tools that can be applied during specific works. This toolbox is then used to develop site specific plans for each stage or area of works.

33. The toolbox typically includes controls or management methods based on three key factors:
    - i. Implementation of erosion control measures to minimise or avoid generation of sediment
    - ii. Implementation of sediment control measures to minimise the discharge of sediment from the works
    - iii. Both visual and discharge monitoring, to confirm the effectiveness of the measures and to ensure measures adapt to minimise the generation and discharge of sediment

34. Overall, the approaches used to manage erosion and sediment control are well understood and therefore the controls outlined within the toolbox are common across most projects and works with the key focus being on ensuring the right controls recommended are implemented for each stage and type of works being undertaken.

35. The approach to this assessment is less focused on identifying the various approaches that could be utilised as these are already described in detail in the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities guidance document, but in understanding whether there are site and work specific aspects that might drive certain approaches to manage sediment or require a greater level of management than normally undertaken.

36. To inform this approach, I have undertaken the assessment based on a risk based approach taking into consideration the following factors to identify the appropriate level of controls for each of the different works areas:
    - i. The nature and sensitivity of the receiving environment to sediment effects
    - ii. The scale and extent of earthworks to identify the potential sediment generation
    - iii. Any site-specific constraints or works that introduce specific risks

5. EXISTING ENVIRONMENT

Introduction

37. Considering the potential effects of discharges of sediment from the proposed Project needs to consider the nature of the receiving environment and sensitivity to increases in sediment discharges.

38. In understanding the sensitivity of the receiving environment to potential effects of sediment discharges I have relied on the ecological assessment undertaken, and will discuss the receiving environment only in terms of potential sensitivity to sediment effects.

Receiving environment

Topography and surrounding landuse

39. The Project is located within the existing urban environment and road corridor. The topography along the route is generally a mix of flat land and gentle slopes. The works surrounding the tunnel portals will comprise steep sided slopes with any runoff directed to the existing road corridor.

40. The Project is highly constrained with works being undertaken in close proximity to a range of existing landuses including residential and commercial activities.

Geology and hydrogeology

41. The Project traverses typical Wellington geomorphology with (in general) the two tunnels and their approaches located in the upthrown faulted greywacke rock blocks forming higher ground and the other scheme sections located within or traversing lower lying valleys infilled with surficial materials like alluvium, colluvium and marginal marine soils.

42. Historic groundwater investigations have reported variable groundwater levels across the Project footprint. The below list provides an indication of groundwater levels at various locations within the Project:

    i. Terrace Tunnel: 15 – 20 m above the tunnel crown in the central section
    ii. Basin Reserve: West of the Basin towards Memorial Park Ridge 2 – 4 m below ground level (bgl), in the Basin Reserve and Cambridge Terrace valley 0 – 2 m bgl
    iii. Mount Victoria Tunnel: 20 m above the tunnel crown in the central section
    iv. Ruahine Street: East of Ruahine Street 2.5 m bgl, west of Ruahine Street 4.5 m bgl

Existing stormwater network

43. Sediment from the Project will discharge (following treatment, as discussed below) into the existing stormwater system and flow into the receiving environments at the various outfalls (see Figure 1 and Figure 2). Construction stormwater will discharge into either Evans Bay or Lambton Harbour.

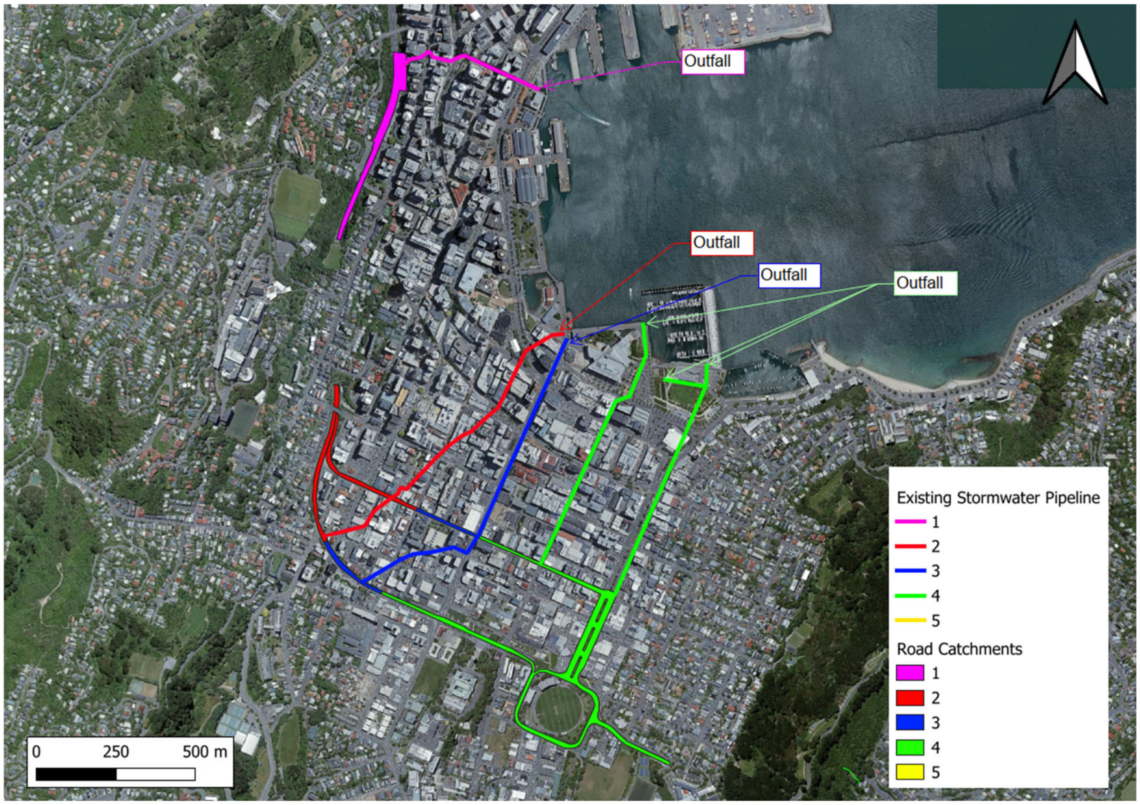

Figure 1 - Stormwater pipelines and outfalls discharging from the works area to Lambton Harbour

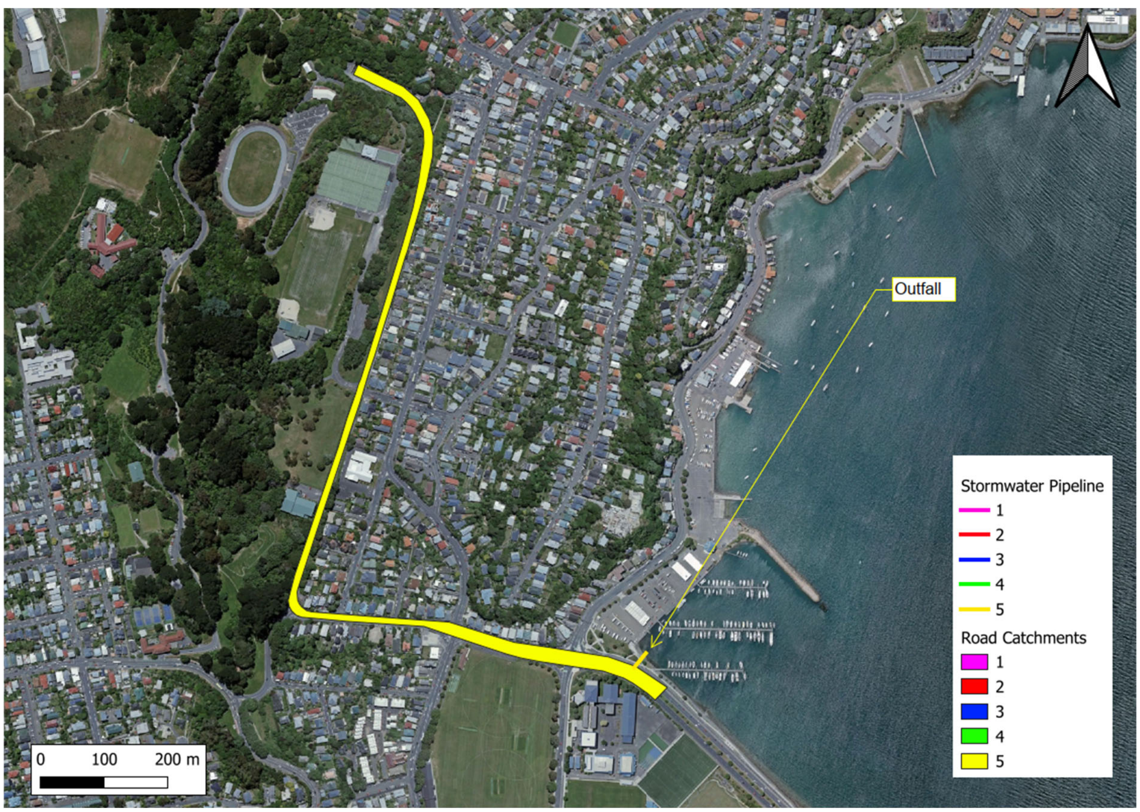

Figure 2 - Stormwater outfall discharging from the works area to Evans Bay

Marine and freshwater environments

44. Sediment from the Project will discharge into the existing stormwater system and flow into the receiving environments at the various outfalls. Construction stormwater will discharge into either Evans Bay or Lambton Harbour. The marine habitat values of both Evans Bay and Lambton Harbour are assessed in the Marine Ecology Assessment prepared by Marcus Cameron of Tonkin+Taylor. A brief summary is outlined as follows.

45. Evans Bay is a U-shaped inlet located at the southern end of Wellington Harbour. Once connected to the Cook Strait through a channel that is now known as the Rongotai flats, the bay is nestled between the Miramar Peninsula and the suburbs of Hataitai and Kilbirnie. The bay is approximately 3.6 km in length and 1.4 km in width. It is a shallow, north facing embayment bordered with a tidal range between 0.7 – 1.3 m (EOS Ecology, 2013 and references therein).

46. Evans Bay is highly modified, with a marina, boat ramp, stormwater outlets, coastal protection and carparks. The area historically supported wetland and sublittoral flats which were lost to reclamation. The embayment supports mixed habitats, including soft sediment and gravel subtidal areas, as well as natural and artificial rocky shores. Historically, the Waipapa Stream entered the bay but is now piped, discharging stormwater from the Hataitai catchment. The Evans Bay culvert remains permanently subtidal, lined with dense mussel beds (primarily Mytilus edulis), and surrounded by boulders, cobbles, and fine sediments.

47. Lambton Harbour in Wellington hosts diverse marine habitats shaped by natural and urban influences. Subtidal zones feature soft sediments supporting over 50 benthic taxa, including polychaetes, bivalves, and crustaceans. Rocky shores, though limited, sustain mussels, barnacles, and algae. Despite pressures like sedimentation and contamination, benthic fauna show resilience. Sediments are highly polluted with heavy metals—copper, lead, and zinc—especially near stormwater outfalls, alongside organic pollutants like PAHs and DDT. Water quality assessments rate ecological impacts from wastewater as low. Sediment inputs from rivers and variable turbidity further influence the harbour's condition, though additional disturbances are expected to have minimal ecological impact.

48. The overall ecological value of marine habitats in Lambton Harbour has been assessed as Low due to the highly modified and degraded environment of the marina and waterfront while the ecological value of Evans Bay has been assessed as Moderate. Therefore, it is considered that Evans Bay has a higher sensitivity to sediment effects due to the higher ecological value, shallower environment with reduced mixing and species present that are likely to be sensitive to sediment effects. Conversely, Lambton Harbour is highly modified with a range of existing discharges and is deeper with greater mixing likely to occur and therefore has a lower sensitivity to sediment effects than Evans Bay. Potential issues with sedimentation of the marine environment are discussed below.

6. PROPOSED WORKS

49. The proposed Project works have been reviewed to understand the scale and nature of the works that may contribute to sediment generation or increased risk of other contaminants associated with sediment (e.g. elevated pH from grouting works).

50. The proposed works are described in the Constructability Report. This outlines that the works are broken up into five sections as follows:

i. Section 1 – Terrace Tunnel

ii. Section 2 – Te Aro Improvements

iii. Section 3 – Basin Reserve

iv. Section 4 – Mt Victoria Tunnel

v. Section 5 – Eastern Connections

Section 1

51. Section 1 comprises the duplication of the Terrace Tunnel including the widening of SH1 north and south of the tunnel and the extension of the Ghuznee Street overbridge as shown in Figure 3 and Figure 4. There will be three construction yards or laydown areas located at the Northern Portal, Clifton Carpark and at the Southern Portal. The Northern Portal Yard will house the majority of site facilities and be used to stockpile materials within a spoil shed and will have the treatment plant for groundwater from the tunnel excavation.

52. Bulk earthworks including excavation and slope stabilisation works will be required at both portal entrances. Overall proposed earthworks volumes are approximately 200,000 m^3 of cut associated with the earthworks and 60,000 m^3 of spoil associated with the tunnel construction. Excavated material will be carted off-site to approved disposal locations, although some limited stockpiling of materials may be required at the yards. Any sediment discharged from Section 1 will discharge to the existing stormwater systems after sediment control and ultimately discharge to Lambton Harbour.

53. In addition to the bulk earthworks, the tunnel construction will involve the removal of tunnel spoil and groundwater. Both spoil and groundwater will be removed via the northern portal where a treatment facility will be located to treat tunnel water prior to discharge to the stormwater system.

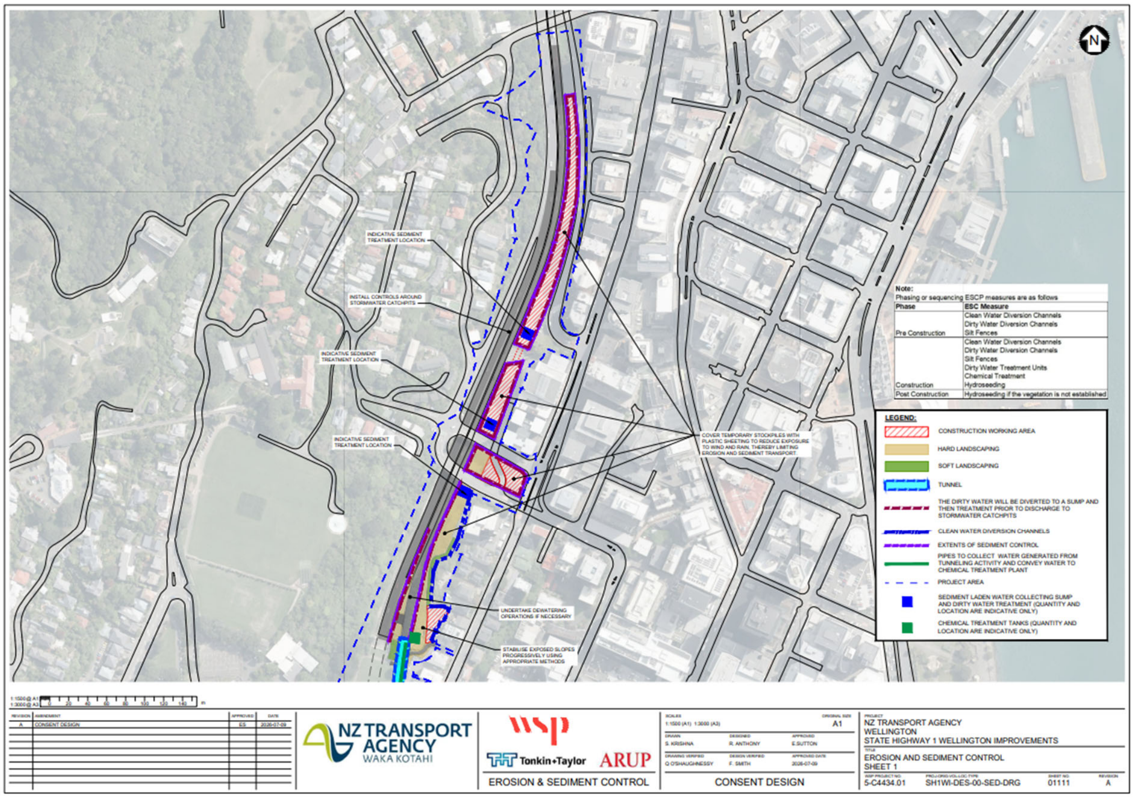

Figure 3 - Proposed earthworks footprint – Section 1

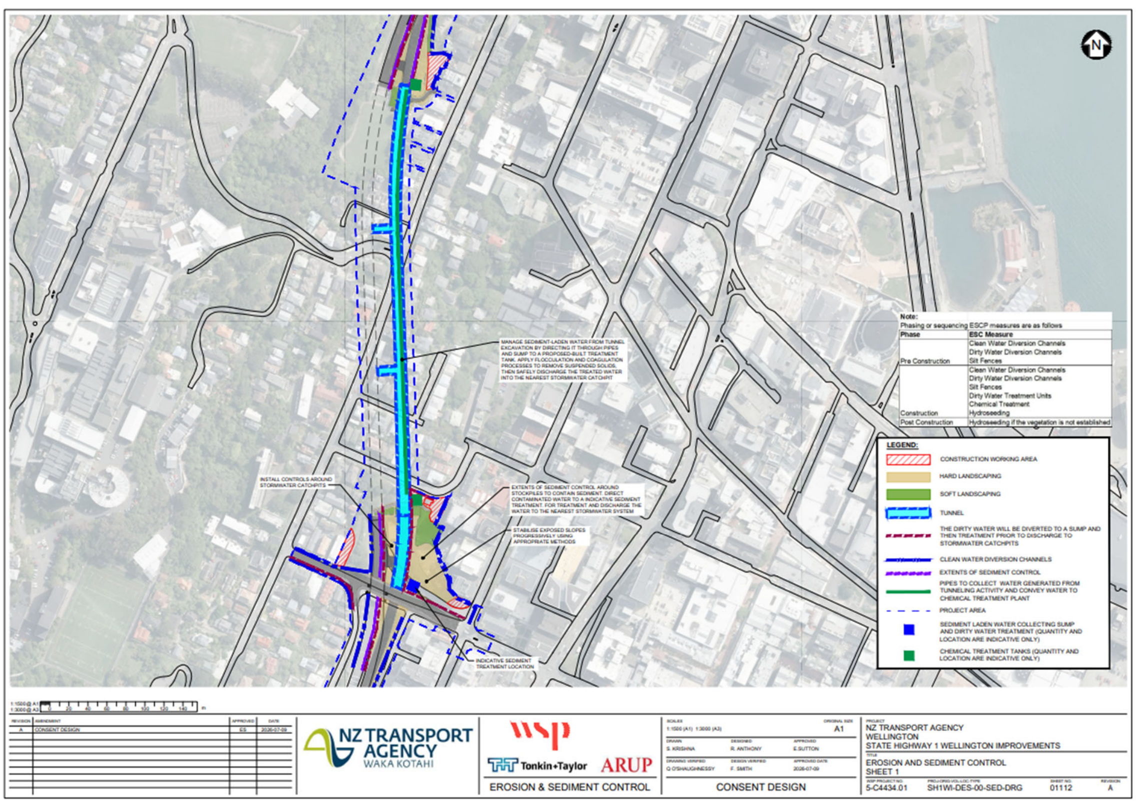

Figure 4 - Proposed earthworks footprint – Section 1

Section 2

54. Section 2 comprises reconfiguration of the existing SH1 route including reconfiguration of SH1 Vivian Street and SH1 Arthur Street as shown on Figure 5, Section 2 does not involve any bulk earthworks with the works limited to road construction activities within the existing road reserve.

55. There will be two construction yards located at Willis Street and Martin Square. These will be primarily laydown areas for the road construction activities.

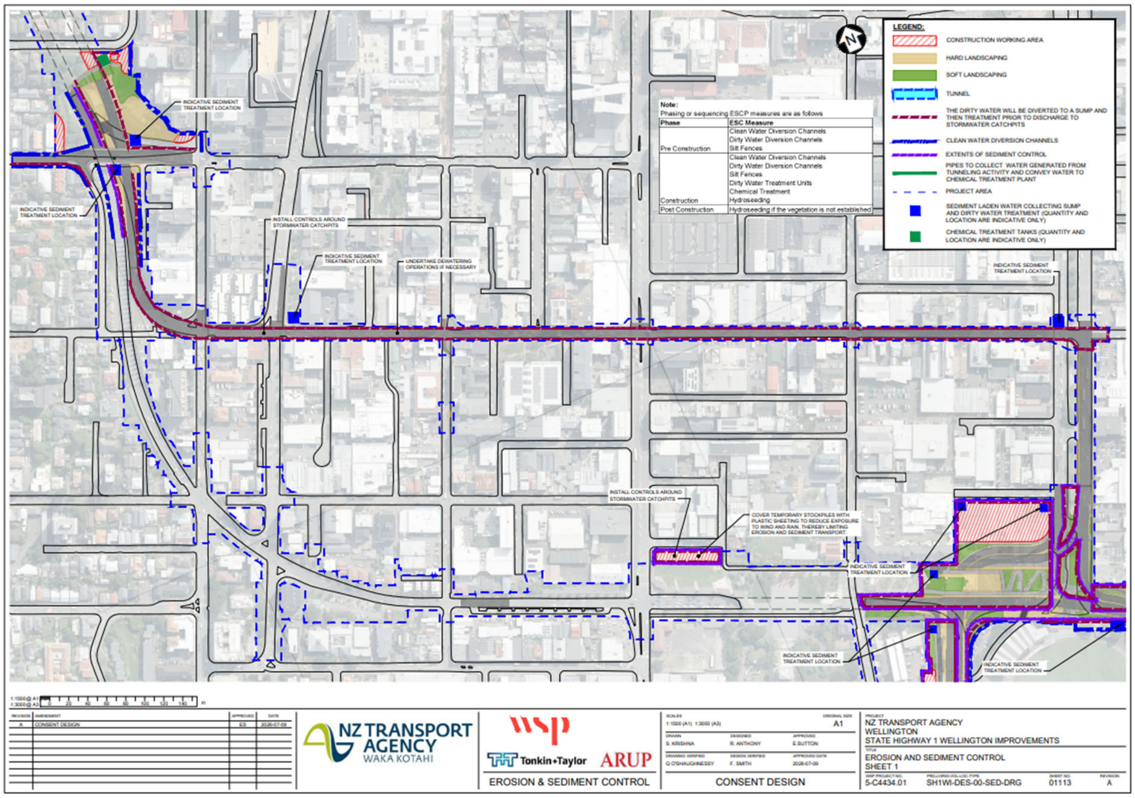

Figure 5 - Proposed earthworks footprint – Section 2

Section 3

56. Section 3 includes the reconstruction of the Basin Reserve roading network to achieve grade separation between SH1 traffic and north-south local road traffic as shown on Figure 6. Works includes the relocation of the Home of Compassion Creche, construction of new roadway and construction of a new trench.

57. The proposed works include both bulk earthworks for the excavation of the new trench, and ground improvements through the use of methods such as Cutter Soil Mixing and Secant Wall construction. The indicative overall volume of cut material is approximately 35,000 m^3. Therefore, the works will require the management of both sediment from earthworks and slurry water from ground improvements and Secant Wall construction. Any sediment and runoff during construction from Section 3 will discharge to the existing stormwater system after sediment control and ultimately discharge to Lambton Harbour.

58. There will be four construction yards located at Cambridge Terrace, Sussex Street and Ellice Street and a small area at Rugby Street. The Ellice Street yard will be limited in size and be used for the storage of materials.

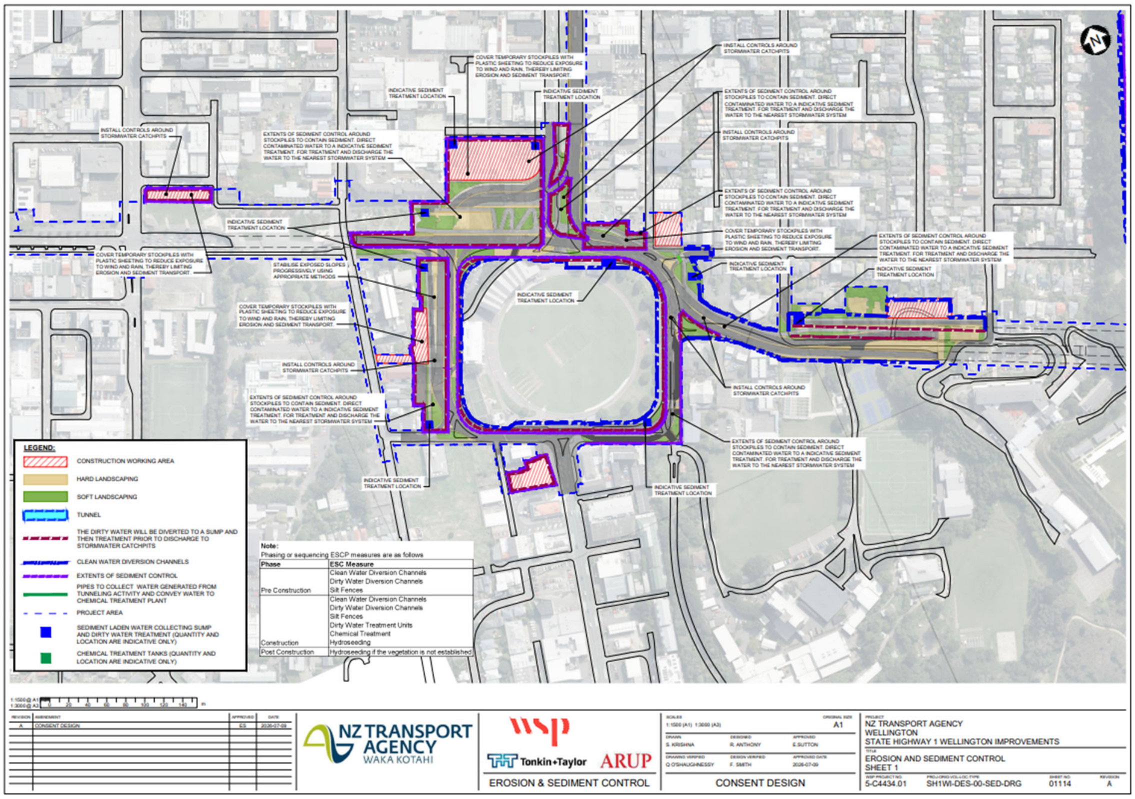

Figure 6 - Proposed earthworks footprint – Section 3

Section 4

59. Section 4 comprises the duplication of the Victoria Tunnel as shown on Figure 7. This includes works on creating the new Western and Eastern Portals and works to tie-in the new tunnels into the existing roadways.

60. The Western Portal will require excavation and the construction of retaining walls along the portal entrance as well as construction of a cut and cover tunnel along the start of the new tunnel route at the Western Portal side. The area surrounding the tunnel portals is steep with confined access. Runoff from Section 4 will drain to both Evans Bay for works on the Western Tunnel Portal and to Lambton Harbour for works on the Eastern Tunnel Portal. The eastern portal works will involve significant excavation including the construction of the new portal.

61. The new tunnel construction will be undertaken using a combination of roadheader construction and drill and blast. All tunnelling activities including spoil handling and water treatment will be undertaken via the western portal with a laydown area established on Paterson Street. There will be three construction yards located at the Western Portal, Eastern Portal and Taurima Street. The Western Portal Yard will be the primary site compound and will include stockpiling of spoil from the tunnelling works within an enclosed spoil shed and water treatment. Some stockpiling of cut material will take place in the Taurima Street yard.

62. While blasting is being undertaken, based on experience at both Mt Messenger Bypass and City Rail Link where blasting was undertaken, there are no additional contaminants anticipated beyond changes in pH and increased sediment that require additional controls or management subject to spoil being removed from site and no extended stockpiling of material is undertaken.

63. Overall indicative cut volumes are approximately 122,000 m^3 with 126,000 m^3 of tunnel spoil.

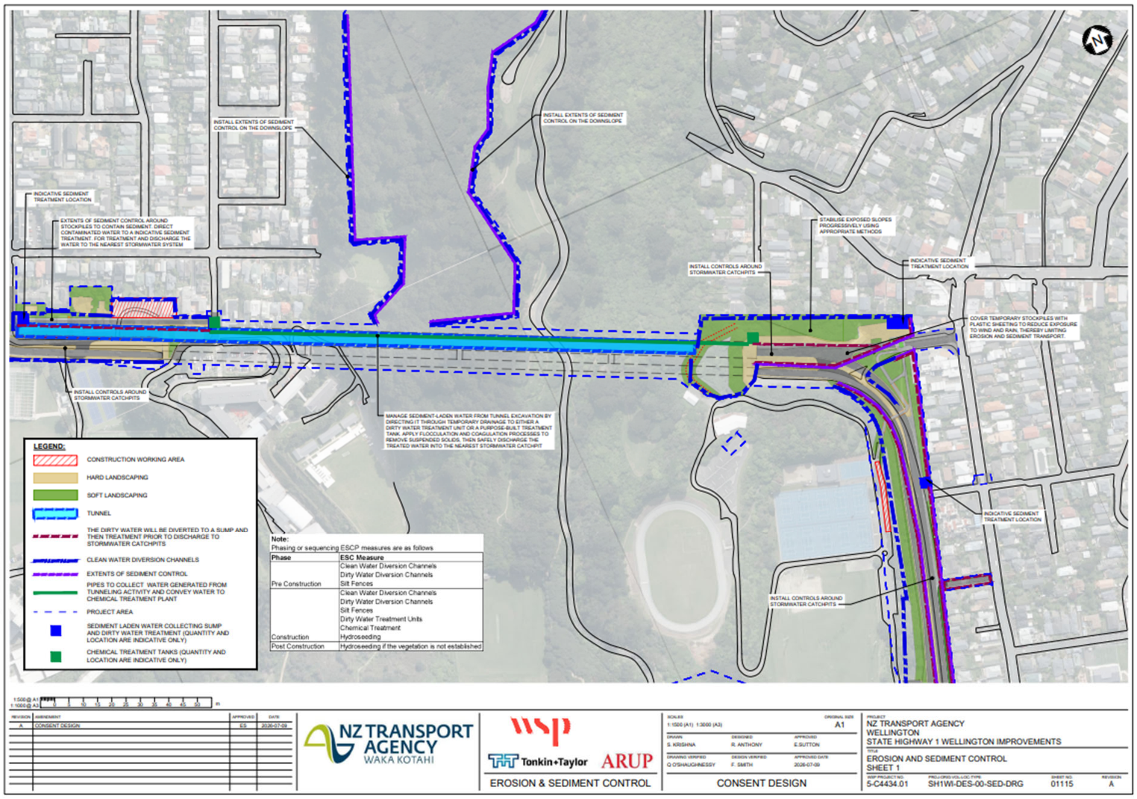

Figure 7 - Proposed earthworks footprint – Section 4

Section 5

64. Section 5 comprises widening of Wellington Road and Ruahine Street east of the Mt Victoria Tunnel to Evans Bay Parade. Earthworks will be required for the widening of the existing SH1 corridor from Ruahine Street to Cobham Drive. Earthworks will be required to remove excess material from the works with material carted off-site due to the lack of on-site storage. Retaining walls will also be required along Hataitai Park and toward Wellington Road which will be constructed using soil nails with shotcrete or mesh facing.

65. There will be three construction yards at Badminton Yard, Wellington Road and the Kilbirnie Yard located in Kilbirnie Park.

66. Runoff during construction (after sediment control) will drain to Evans Bay.

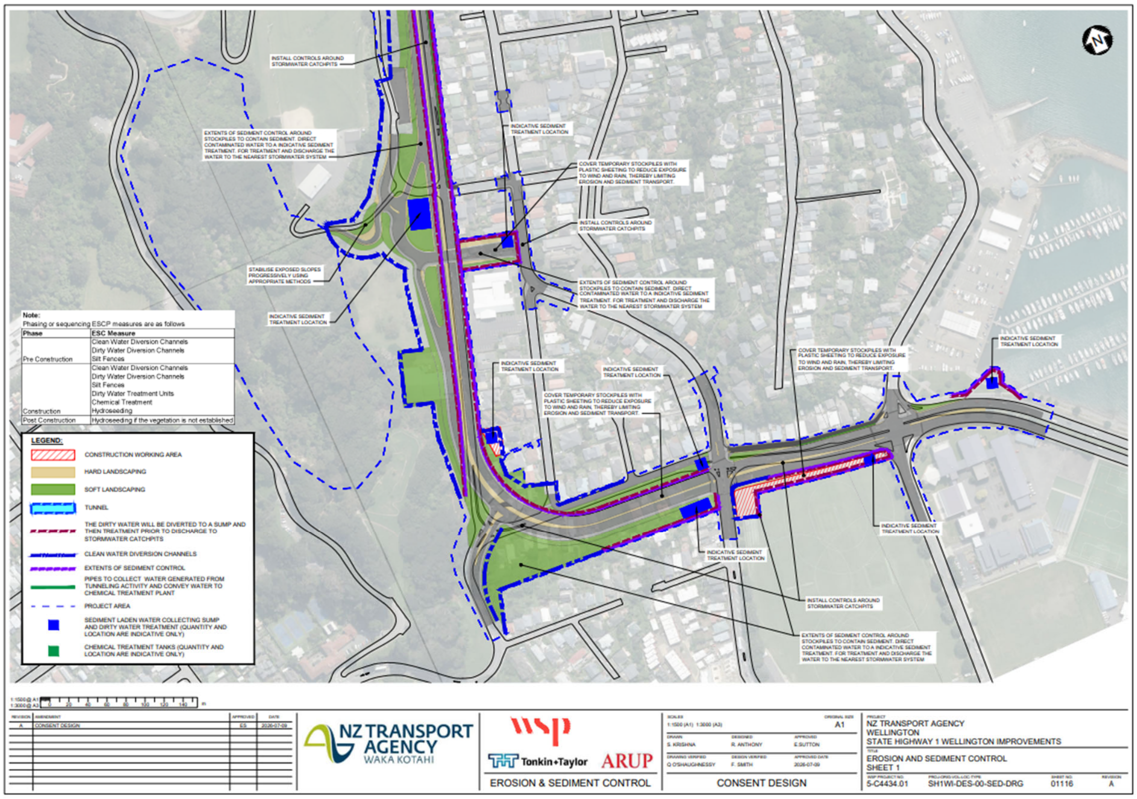

Figure 8 - Proposed earthworks footprint – Section 5

Overall extent and scale of proposed works

Table 1: Summary of proposed earthworks and potential hazards

Section	Key activities	Scale of earthworks and spoil	Associated activities	Potential hazards
1	Bulk earthworks including excavation for tunnel portals, slope stabilisation and tunnel spoil and water.	Significant cut required at tunnel portals. Largest volume of spoil across project.	Slope stabilisation, grouting, piling and retaining wall construction.	Sediment, high pH runoff
2	No bulk earthworks required			
3	Trenching activities and stabilisation works.	Moderate earthworkss with some trenching undertaken. Moderate volume of spoil.	Grouting, piling and retaining wall construction	Sediment, high pH runoff
4	Bulk earthworks including excavation for tunnel portals, slope stabilisation and tunnel spoil and water	Significant cut required including cut and cover tunnel. Large volumes of spoil.	Slope stabilisation, grouting, piling and retaining wall construction	Sediment, high pH runoff
5	Bulk earthworks to widen road, slope stabilisation works.	Some cut undertaken. Moderate volumes of spoil.	Slope stabilisation, grouting, piling and retaining wall construction	Sediment, high pH runoff

7. MEASURES TO AVOID, REMEDY OR MITIGATE ACTUAL OR POTENTIAL ADVERSE EFFECTS

Introduction

67. The key method to avoid or minimise effects is through the effective implementation of erosion and sediment control measures in accordance with an Erosion and Sediment Management Plan (**ESMP**) and site-specific plans (**SSESCPs**) developed for each stage of work.

68. Specific controls are also likely to be required for the management of spoil and the Basin Reserve and tunnel works due to nature and scale of the activities. These are discussed below.

69. In addition to the implementation of erosion and sediment control measures the following measures are recommended:

    i. Monitoring of discharges from sediment retention ponds (if applicable), and treatment systems prior to discharge; and

    ii. Contingency measures including:

        - In the event that the monitoring shows the required limits for sediment and pH are not met; and

        - In the event of unexpected or non-compliant discharges from the site which results in a discharge to the stormwater network

Erosion and Sediment Management Plan

70. An overall ESMP is recommended. This should be prepared based in general accordance with the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities. The ESMP will document the earthworks and sediment control procedures that will be required during the initial construction phases and set out the process for NZTA and its contractors to follow to developESMPs as individual work activities are planned.

71. The objective and purpose of the ESMP is to provide a site-specific framework for avoiding, minimising and managing erosion and sediment discharges from the proposed earthworks.

72. The ESMP should set out the following minimum requirements for all years of the Project including:

    i. The location and total area of earthworks, including catchment boundaries and contour information

    ii. Details of construction methods to be employed, including timing and duration

    iii. The volume of earthworks. This is to include details of the volumes to be excavated, stockpiled, re-used and disposed of off-Site

    iv. The location and types of erosion and sediment controls proposed

    v. Supporting calculations for erosion and sediment controls including for any proposed treatment systems

    vi. Staging of the earthworks, including details of progressive stabilisation of exposed areas for each stage

    vii. Key responsibilities for implementing and maintaining the controls detailed in the SSESCP during the Project

    viii. The location of Site entrance points and means to control tracking of dirt off-Site

    ix. The frequency and responsibility for monitoring the effectiveness of controls, downstream water quality, and the undertaking of any maintenance on controls

x. The details for decommissioning controls; and

xi. Contingency plans in case of unexpected sediment discharges during works, failure of sediment control structures and devices, and to respond to extreme weather events

73. The ESMP should also be supported by development of a SSESCP for the earthworks associated with each key area of work. These should outline the minimum requirements for management of sediment from the different works areas considering the site-specific circumstances.

74. Where sediment is to be managed through a water treatment plant, the ESMP should include a Construction Water Treatment Management Plan (**CWTMP**) that sets out:

i. Design details of the water treatment system, including:

- Optimum dosage details
- Water treatment design including design flows and capacity
- Proposed contingency discharge and storage volumes (particularly where no discharge to tradewaste is viable)

ii. Water discharge quality requirements

iii. Monitoring, maintenance, and contingency programme requirements

iv. Results of the initial chemical treatment trial to establish appropriate chemical dosing and establishment of the TSS and turbidity relationship

v. Spill contingency procedures; and

vi. Roles and responsibilities for the long-term operation and maintenance of the water treatment system

75. The ESMP should also include monitoring and regular inspections to provide a feedback loop to evaluate the performance of the erosion and sediment controls in place.

Spoil management

76. Due to the limited space available there is not anticipated to be any significant stockpiling of spoil or cut during the works. Minor stockpiling will be managed by ensuring it is located away from any stormwater inlets and overland flow paths with the use of sediment retention methods such as filter socks around the stockpiles.

77. Areas where more substantial stockpiling is required including where material is processed on-site such as crushing of tunnel spill, the stockpiles shall be located within the bunded areas and enclosed or covered with runoff draining to sediment treatment devices.

78. Provision for on-site spoil handling for the tunnel works is proposed with capacity for approximately 1,000 m^3 to 1,500 m^3 for each tunnel which equates to approximately 2 days' storage. The spoil storage areas should be enclosed to avoid both dust and runoff during rainfall events.

Basin Reserve works

79. The Basin Reserve works involve a range of activities, with the main bulk earthworks associated with the construction of the trench which will involve removal of spoil, slope stabilisation and piling works and grouting.

80. During the trench works, where possible water will be allowed to pond within the trench, and sediment laden water pumped out to a sediment treatment device or a sediment retention pond where sufficient space is available. It is generally anticipated that water will be pumped to portable sediment treatment devices (such as a portable silt buster) for treatment prior to

discharge. This allows for the treatment to be provided where and as necessary. In the event that the water has elevated pH due to grouting and piling works, water will be pumped to a treatment tank where pH adjustment can be undertaken prior to discharge.

81. For the remainder of the works, where bulk earthworks are not required (e.g. road building), localised sediment devices such as silt fences and bunds (earth and hotmix types) will be used to ensure clean water is directed away from any works, and sediment laden water is contained within the works areas.

Terrace and Mt Victoria Tunnels

82. The construction of the Terrace and Mt Victoria Tunnels will require bulk earthworks at the Portals at each of the tunnels as well as removal and management of spoil from the tunnelling works and the management of sediment laden groundwater.

83. The tunnel works will also require stabilisation of surfaces, with shotcrete (Sprayed concrete) typically utilised as well as in-site concrete for the tunnel lining. This can result in elevated pH from both tunnel water and runoff during rainfall.

84. It is expected based on experience at other tunnelling projects within New Zealand that the tunnel water will require specific treatment to reduce sediment and pH concentrations within the water. In addition to managing the tunnel water, spoil stockpiling and disposal will also require management of surface water runoff during the works.

85. In addition to sediment and pH requiring management, the potential for additional contaminants including those associated with the blasting (e.g. nitrates) and oils and greases from heavy equipment does exist, although provided no extended stockpiling of materials it is unlikely that these pose any increased risk compared to normal earthworks activities.

86. Due to the site constraints, it is anticipated that treatment for both the tunnel water and adjacent surface water catchments will be managed by a containerised treatment system which includes pH adjustment, and the addition of flocculant and coagulant to remove sediment. The system would include monitoring of the water within the system to optimise the dosing system and ensure any water discharged meets appropriate water quality triggers for both sediment and pH. An example of the type of system is shown in Figure 9 below.

87. I note that the use of containerised sediment treatment systems are not specifically outlined in the GWRC Erosion and Sediment Control Guide Document but in principle they apply the same approach as Sediment Retention Ponds and chemical treatment which rely on coagulants and flocculants to improve the efficiency of sediment retention devices and then detain runoff to settle out sediment. They have been utilised on a wide variety of earthworks and infrastructure projects which include tunnelling works including the Waterview Tunnel, City Rail Link and Mt Messenger Bypass and have been demonstrated to provide a high level of treatment and management of sediment laden water.

88. The extent of proposed working footprints for the Terrace and Mt Victoria Tunnels are shown on the attached plans in Annexure A.

Figure 9 - Example containerised sediment control treatment unit

Ground improvement works

89. Ground improvement works may be required where soft or liquefaction prone soils are present near surface with areas in particular around the bridge abutments and Sussex Street trench. Soil stabilisation is commonly undertaken using a Cutter Soil Mixing methodology where the in-situ soils are mixed with a cementitious slurry using a rotating cutter head or the use of jet grouting.

90. The works will require storage of cement, a batching plant and cement slurry handling systems. These areas will be required to be bunded to contain any contaminated water with the runoff diverted to treatment systems prior to discharge to the stormwater system. The contaminants are the same as those of other activities primarily consisting of sediment laden water and elevated pH. Therefore, the current proposed controls for managing runoff from the works areas are appropriate for managing the runoff from any ground improvement works required.

On-going monitoring

91. A construction monitoring plan should be developed which will set out the minimum monitoring requirements for the Project to be incorporated into the SSESCP for each works areas. The monitoring plan should include the following:

    i. Initial proposed limits for the discharge of sediment and pH from sediment retention and treatment devices to stormwater network inlets is as follows:

        - TSS – Maximum discharge limit of 100 g/m^3; and
        - pH – within the range of 6 to 9

    ii. While Sediment Retention Ponds may be used for the Basin Reserve works, it is anticipated that treatment will be provided within containerised systems, these shall be designed to include automated monitoring systems to avoid any discharges when the limits are not met

92. While the limit is set for TSS (as per the GWRC's Natural Resources Plan Change 1 requirements), continuous monitoring at treatment plants will be undertaken for turbidity. A relationship between TSS and turbidity will need to be established prior to works commencing to ensure that the turbidity monitoring is reflective of TSS concentrations to demonstrate that the proposed limits are being met.

93. The Marine Ecology Assessment also recommends monitoring to be undertaken within the marine area where stormwater discharges to the marine environment. In the event that this identifies evidence of potential effects associated with the discharges, then it is expected a review of the limits may be required to determine if a lower limit of 50 g/m^3 may be more appropriate to manage effects.

Contingency measures

94. In the event that the discharge limits cannot be met from the treatment systems, approval to discharge to the sewer system is being sought. This would enable an automated diversion to the sewer when there is insufficient capacity within the treatment system and the discharge limits for discharge to the stormwater system are not able to be met.

95. While provision is being sought, any discharge to the sewer system would be only during heavy rainfall where the capacity of the system is exceeded with no ability to hold water on-site or potential failure of the treatment system. The design of the systems should consider the appropriate level of storage to avoid the need to discharge to the sewer system and therefore, this is being proposed as a contingency measure only and no regular discharges to the sewer system are anticipated.

96. In the event that approval is not obtained to discharge to sewer, then sufficient additional capacity must be provided to enable additional storage which should be included in the design calculations required as part of the ESMP.

97. In the event of unexpected or non-compliant discharges, I recommend that further contingency measures be incorporated in the ESMP. This includes the following response actions:

   i. Initially, this will comprise a visual inspection and in-field monitoring to be undertaken within 24 hours of any non-compliance discharge
   ii. If this indicates evidence of any potential effects (e.g. evidence of deposition at the outlet, or visible sediment plume, then further grab samples will be collected for laboratory analysis and a Marine Ecologist will be contacted to provide further advise
   iii. Response actions may be required as recommended by the Marine Ecologist

98. The initial inspection and monitoring should include the following:

   i. Analysis for pH and turbidity using hand-held monitors
   ii. Visual inspection for any:
      - Change in colour or clarity at the point of discharge
      - Presence of any scums or foams; or
      - Any evidence of sediment deposition at the area surrounding the point of discharge

8. ASSESSMENT OF CONSTRUCTION EFFECTS

99. If not managed effectively, construction activities can result in the discharge of sediment laden water to the receiving environment. The effects of the Project on marine ecology are discussed in more detail in the Marine Ecology Assessment but, in summary, the key potential effects from sediment and construction water discharges include:

    i. Increased sediment deposition around the outfall and within the harbour which can smother existing species present, and change the nature of the habitat which can impact on the suitability for specific species (e.g. shift from hard bottom, rocky substrate to soft-bottom substrate)

    ii. Toxicity effects on marine species including fish due to the sediment resulting in the abrasion and clogging of fish gills; and

    iii. Changes in pH can result in toxicity effects on marine life including resulting in mortality

100. The bulk earthworks and associated construction activities including tunnel duplication, bulk earthworks, and slope stabilisation will generate sediment-laden runoff as well as having potential for high pH discharge.

101. Discharges of sediment laden water will discharge to the existing stormwater system which drains to either Lambton Harbour or Evans Bay, with Evans Bay identified as having an overall Moderate value and therefore sensitive to excess sediment. Discharges to Lambton Harbour will be to a highly modified environment with greater mixing due to the increased depth and therefore is less sensitive to sediment effects.

102. The relevant Objective and Policies of the Operative and Proposed Natural Resources Plan for the Wellington Region require application of best practice management methods to minimise the discharge of sediment from earthworks activities.

103. Through the effective implementation of the ESMP and SSESCPs prepared in general accordance with the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities Guide, the effects of sediment are expected to be low.

104. Key control measures that will be incorporated into the plans include the use of containerised treatment systems for tunnel and surface water management, progressive stabilisation of exposed ground, and targeted sediment retention controls (e.g. silt fences and filter socks).

105. The ESMP is also recommended to provide for on-going monitoring with management responses where monitoring identifies performance issues.

106. Overall, subject to adherence to the ESMP and SSESCPs, and the effective implementation of the recommended controls and monitoring procedures, the residual adverse effects from sediment discharges are assessed as low.

Summary of effects

107. A summary of the effects with and without mitigation is outlined in Table 2. This outlines that the overall level of effects of the discharge of construction water (including sediment and pH) is High with no mitigation in place.

108. Overall, subject to adherence to the ESMP and SSESCPs, and the effective implementation of the recommended controls and monitoring procedures, the residual adverse effects from sediment discharges are assessed as low.

Table 2: Summary of effects

Project Section	Scale of earthworks and spoil	Effects with no mitigation	Proposed effects management	Mitigated effects
Section 1	Significant cut required at tunnel portals. Largest volume of spoil across project.	High	Implementation of ESMP, SSESCP and CWTMP; Monitoring of discharges; Contingency Measures.	Low
Section 2	No bulk earthworks required	Low	Implementation of ESMP	Very low
Section 3	Moderate earthworks with some trenching undertaken. Moderate volume of spoil.	Moderate to High	Implementation of ESMP, SSESCP and CWTMP; Monitoring of discharges; Contingency Measures.	Low
Section 4	Significant cut required including cut and cover tunnel. Large volumes of spoil.	High	Implementation of ESMP, SSESCP, CWTMP; Monitoring of discharges; Contingency Measures.	Low
Section 5	Some cut undertaken. Moderate volumes of spoil.	Moderate to High	Implementation of ESMP , SSESCP and CWTMP; Monitoring of discharges; Contingency Measures.	Low

9. RESPONSE TO PRE-LODGEMENT FEEDBACK

109. A previous version of this report and the draft management plan were provided to GWRC. GWRC carried out an initial review and their comments included the following key issues following the pre-lodgment workshop held with GWRC and WCC:

i. Concern about the level of detail within the technical assessment and the lack of a draft Erosion and Sediment Control Management Plan to be included with the application which is the appropriate mechanism for setting out the specific detail for each stage of works

ii. Clarification around the use of turbidity vs Total Suspended Solids in terms of monitoring and link to the proposed consent conditions

iii. Clarification around the use of the water treatment plants in terms of:

- Contingency in the event of non-compliance (including if a permit to discharge to the wastewater network is not obtained)
- Minimum sizing of the treatment system; and
- Certification of the treatment systems due to lack of formal guidelines to rely on

iv. Clarification about the extent of works within each area

110. In response to the feedback received, the following changes have been made:

i. Section 6 has been updated to refer to the use of an ESMP and SSESCPs (a draft ESMP and SSESCP template (an appendix to the draft ESMP) are attached)

ii. Paragraph 91 outlines that a relationship between turbidity and TSS will be required prior to commencing works, this is also outlined in Section 6.3 of the draft ESMP

iii. Paragraph 95 specifically requires consideration of any additional storage capacity in the event that approval to discharge to tradewaste is not obtained. This is also included in the requirements for the Construction Water Treatment Management Plan required under Section 1.3 of the draft ESMP

iv. Section 1.3 of the draft ESCP outlines the specific requirements for the design and operation of any water treatment systems

v. In terms of the extent of works, the specific scale of any works is not known at this time, but the proposed approach requiring the preparation of SSESCPs for each section of work is considered appropriate to manage potential adverse effects from sediment

10. CONCLUSION AND RECOMMENDATIONS

Conclusions

111. The assessment has identified that the key effects are associated with the discharge of sediment laden water and the potential risk of elevated pH associated with stabilisation works and the tunnel construction. Excess sediment in the marine environment can smother habitats and change the character of the environment. Discharges with elevated pH can be toxic to marine organisms and increase the potential for certain metals to have a greater impact on growth limiting population densities.

112. The potential erosion and sediment effects from the State Highway 1 Wellington Improvements Project will be effectively managed through the implementation of a ESMP and detailed SSESCPs including any CWTMPs which will seek to minimise the discharge of sediment.

113. The greatest risk of effects are associated with the earthworks associated with the construction of the tunnel portals at the end of both tunnels and the trench within the Basin Reserve and the water from tunnel construction.

114. The ESMP and SSESCPs will be prepared in accordance with the GWRC Erosion and Sediment Control Guide for Land Disturbing Activities Guidance.

115. Overall, provided that the recommended measures and monitoring processes are effectively applied, the residual environmental effects from sediment discharges during construction are considered to be low.

Recommendations

116. I recommend that the earthworks design be carried out through the implementation of an overarching ESMP and SSESCPs in accordance with the GWRC Erosion and Sediment Control Guidance as relevant prior to the start of construction and update them as methodologies and staging are confirmed to provide a site-specific framework for avoiding, minimising and managing erosion and sediment discharges from the proposed earthworks.

117. To enable the ESMP and SSESCPs to be finalised and / or developed (in the case of the SSESCPs), I recommend the following further work:

   i. Confirmation of earthworks areas for each section
   ii. Calculation of estimated runoff volumes from each area of works is undertaken during rain events
   iii. Calculation of the volume of groundwater and tunnel water that is anticipated
   iv. Design of the water treatment systems for both the earthworks and tunnel water management (to be detailed in the CWTMP); and
   v. Confirmation of any other chemicals likely to be used during the tunnel construction and any slope stability works for consideration

118. The ESMP and SSESCPs including any CWTMPs including the design details for the water treatment systems should be reviewed by a Suitably Qualified Experienced Person with experience in water treatment and erosion and sediment control prior to works commencing in the associated area.

ANNEXURE A: Draft Erosion and Sediment Management Plan

REPORT

Tonkin+Taylor

State Highway 1 Wellington Improvements

Draft Erosion and Sediment Management Plan

Prepared for

NZ Transport Agency Waka Kotahi

Prepared by

Tonkin & Taylor Ltd

Date

August 2026

Job Number

1099348 v1.1

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Document control

Title: State Highway 1 Wellington Improvements – Draft Erosion and Sediment Management Plan					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
Mar. 26	1.0	Draft for client review	C. Dalziel M. Kahrilas	R. Van de Munckhof	J. Noering
Aug. 26	1.1	Draft for lodgement with FTAA application	C. Dalziel M. Kahrilas	R. Van de Munckhof	J. Noering

Distribution:

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1 Introduction

NZ Transport Agency Waka Kotahi (NZTA) are proposing the State Highway 1 (SH1) Wellington Improvements Project (the Project) to improve SH1 into Wellington City. The proposal includes the construction of improvements to SH1 within Wellington City, extending over 5 km through the city.

This draft Erosion and Sediment Management Clan (ESMP) has been prepared by Tonkin & Taylor Limited (T+T) on behalf of NZTA to support a fast track application.

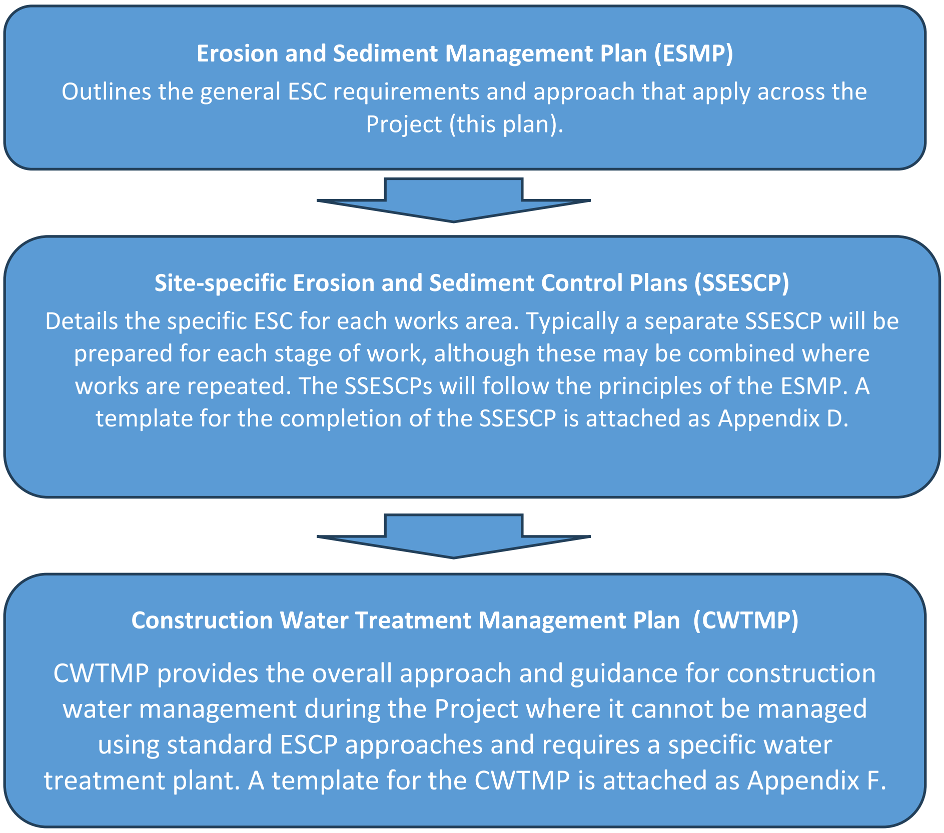
This report has been prepared in accordance with the T+T letter of engagement dated 23 July 2025[1].

1.1 Purpose

The purpose of this ESMP is to provide a high-level overview of the erosion and sediment control management framework, principles, and practices to be implemented by contractors throughout the Project. It has been developed in accordance with industry best practice and Greater Wellington Regional Council's *Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region* (GWRC ESC Guideline)[2].

The ESMP is part of a suite of plans that collectively ensure effective erosion and sediment control (ESC) across the Project. Key documents related to ESC are outlined in Figure 1.1.

Figure 1.1: Relationship between ESC Plans for the Project



[1] Tonkin & Taylor Limited (July 2025). Letter of Engagement, State Highway 1 – Wellington Improvements, Erosion and sediment control services.
[2] Greater Wellington Regional Council (February 2021). Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region. Accessed at: https://www.gw.govt.nz/assets/Documents/2022/03/Erosion-and-Sediment-Control-Guide-for-Land-Disturbing-Activities-in-the-Wellington-Region.pdf.

At the time of preparation, the detailed design is still being developed, and a contractor has not yet been appointed. The appointed contractor will updated this ESMP(version 1.0) to reflect the specific methodology, equipment, and operational controls proposed once the resource consent is granted with finalised conditions, and construction planning is finalised.

1.2 Site-Specific Erosion and Sediment Control Plan

Before beginning the construction of each Section, a site-specific erosion and sediment control plan (SSESCP) will be prepared. Each SSESCP will include the following information as appropriate to the scale, location and type of works within the Section it encompasses:

- Site description;
- Volume and duration of earthworks;
- Contact details for key personnel;
- Construction methodology detailing specific construction activities;
- Specific erosion and sediment control measures;
- ESCP drawings detailing the location of specific erosion and sediment control measures;
- Erosion and sediment control inspection checklist; and,
- Stormwater discharge monitoring locations.

Appendix D provides a template for the completion of the SSESCP for each Section.

1.3 Construction Water Treatment Management Plan

Where a water treatment plant is proposed to manage sediment laden water, a Construction Water Treatment Management Plan (CWTMP) will be required.

The CWTMP should outline:

- Design details of the water treatment system, including:
  - optimum dosage details;
  - water treatment design including design flows and capacity;
  - proposed contingency discharge and storage volumes (particularly if approval to discharge to tradewaste is not obtained).
- Water discharge quality requirements;
- Monitoring, maintenance, and contingency programme requirements;
- Results of the initial chemical treatment trial;
- Spill contingency procedures; and,
- Roles and responsibilities for the long-term operation and maintenance of the water treatment system.

Prior to commencement of earthworks to which a CWTMP applies, as-builts of treatment plant will be prepared and reviewed by the Project team to confirm that the structural control measures for that location/activity have been constructed in accordance with the CWTMP.

2 Environmental setting

The Project area is located in Wellington within a highly modified urban environment. Sediment discharges from the sites will discharge into the existing stormwater network which discharges into the existing receiving environment in Lambton Harbour and Evans Bay as shown in Figure 2.1 and Figure 2.2 respectively. Evans Bay is a shallow, north-facing embayment with limited tidal mixing and a history of reclamation and infrastructure development, while Lambton Harbour is deeper, highly urbanised, and subject to existing contamination from heavy metals and organic pollutants.

The surrounding environment is characterised by impervious surfaces with limited natural drainage and vegetation. The topography along the route consists of a mix of flat land and gentle slopes, with steep-sided slopes near tunnel portals as shown in Figure 2.3. Surrounding land uses include dense residential and commercial development, creating a constrained environment for managing runoff.

The Project traverses typical Wellington geomorphology with (in general) the two tunnels and their approaches located in the upthrown faulted greywacke rock blocks forming higher ground and the other scheme sections located within or traversing lower lying valleys infilled with surficial materials like alluvium, colluvium and marginal marine soils.

Historic groundwater investigations have reported variable groundwater levels across the Project footprint[3]. The below list provides an indication of groundwater levels at various locations within the Project:

- Terrace Tunnel: 15 – 20 m above the tunnel crown in the central section.
- Basin Reserve: West of the Basin towards Memorial Park Ridge 2 – 4 m below ground level (bgl), in the Basin Reserve and Cambridge Terrace valley 0 – 2 m bgl.
- Mount Victoria Tunnel: 20 m above the tunnel crown in the central section.
- Ruahine Street: East of Ruahine Street 2.5 m bgl, west of Ruahine Street 4.5 m bgl.

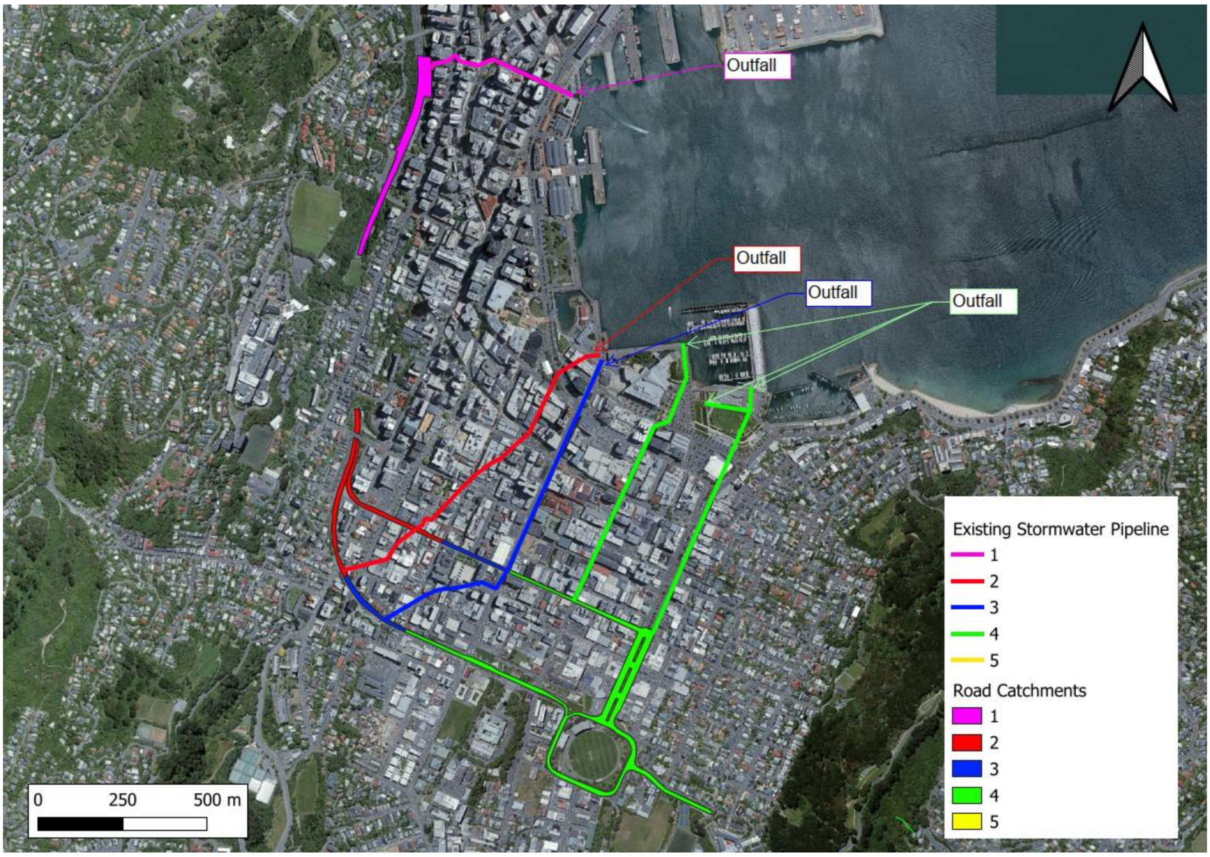


Figure 2.1: Stormwater pipelines discharging from the works area to Lambton Harbour.

[3] NZTA (January 2026). Design Freeze 2: Geotechnical Assessment Report.

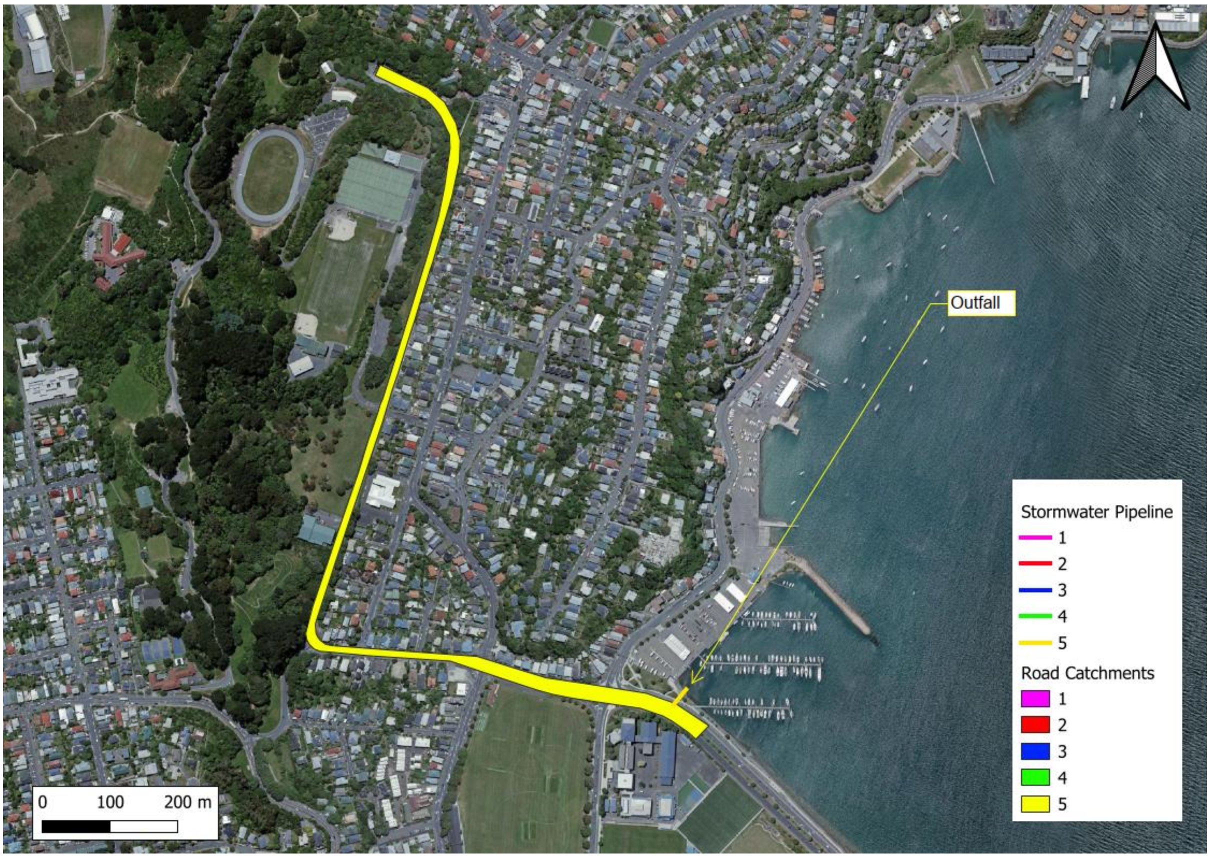


Figure 2.2: Stormwater pipelines discharging from the works area to Evans Bay.

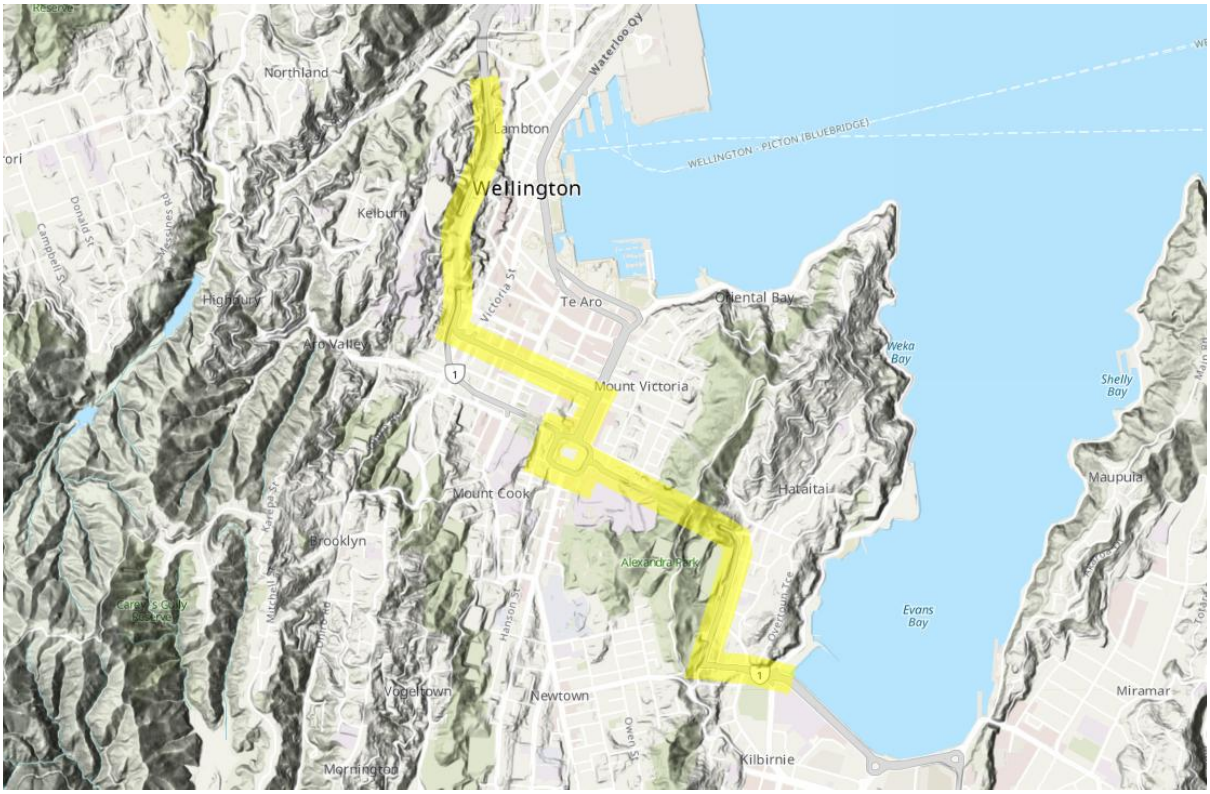


Figure 2.3: Topography in proximity to Project (approx. alignment in yellow). Source: T+T MapViewer.

3 Project description

The SH1 Wellington Improvements Project is a major infrastructure Project upgrade aimed at enhancing transport efficiency and access reliability through central Wellington. It focuses on improving strategic road corridors to support regional growth and reduce congestion along one of New Zealand's most critical transport routes.

The Project runs along SH1 from north of the Terrace Tunnel to the intersection of Wellington Road and Evans Bay Parade. The Project involves interface with the Wellington City Council (WCC) roading network, Basin Reserve, and the Wellington Town Belt. Parts of the Project include works adjacent to businesses and residential areas which may be affected by the construction works.

For the purposes of describing the potential construction activities, the Project has been separated into five stages shown in Figure 3.1 and listed below:

1. **Terrace Tunnel Duplication:** Terrace Tunnel duplication including widening of SH1 north and south of the tunnel, and extension or replacement of the Ghuznee Street overbridge.
2. **Te Aro Improvements:** Reconfiguration of Vivian Street and part of Karo Drive / Arthur Street (SH1) east of Cuba Street) to increase capacity of the SH1 route.
3. **Basin Reserve Improvements:** Reconstruction of the Basin Reserve roading network to achieve grade separation between SH1 traffic and north-south local road traffic.
4. **Mt Victoria Tunnel Duplication:** Duplication of the Mt Victoria tunnel.
5. **Eastern Connections:** Widening of Wellington Road, and Ruahine Street, east of the Mt Victoria Tunnel to Evans Bay Parade.

Throughout the Project, standard daytime works will be completed Monday to Saturday between 6:00 am and 6:00 pm. Night works will typically run from 6:00 pm to 6:00 am during tunnelling and as required. No works will be undertaken on Sundays or public holidays other than by exception.

The following sections describe each of the stages in further detail. Further detail including the timing, duration and construction methodology will be included in the SSESCP relevant to each Section.

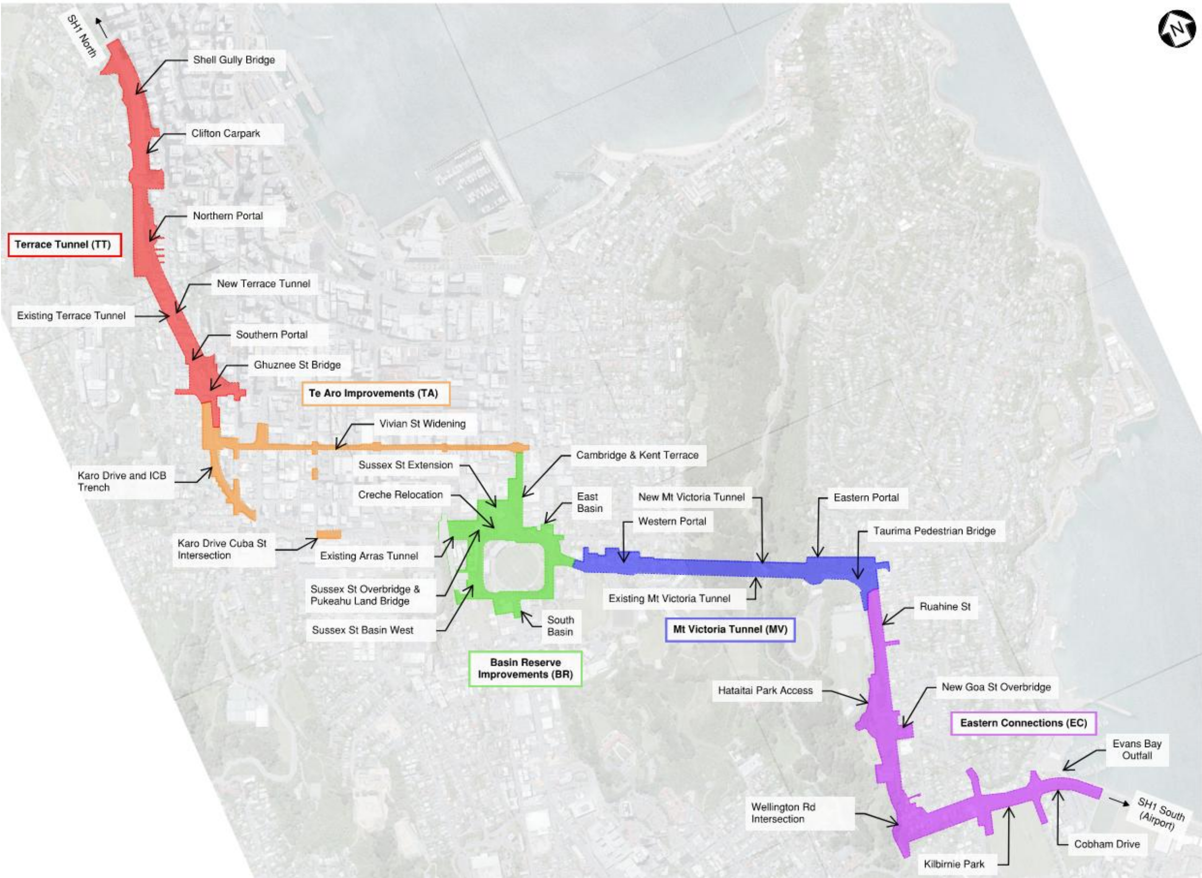


Figure 3.1: Stage overview. Source: WSP design documents.

3.1 Te Aro improvements

Table 3.1 outlines the description of works within the Te Aro improvements Section. This Section does not involve any bulk earthworks as only minor pavement resurfacing and vegetation clearance is required.

Table 3.1: Overview of Te Aro improvements Section

Works area	Description
Vivian Street widening	Staged reconstruction of the SH1 corridor through Te Aro to form two southbound lanes with kerb realignments, footpath upgrades and sequential intersection works.
Cuba Street intersection	Scope is limited to staged milling and resurfacing of the existing three-lane carriageway.

3.2 Terrace tunnel duplication

Table 3.2 outlines the description of works and scale of earthworks within the Terrace tunnel duplication Section. Works will involve approximately 79,600 m³ of cut to waste and 66,100 m³ of imported fill from offsite.

Table 3.2: Overview of Terrace Tunnel duplication

Works area	Description
Shell Gully	Works are confined to the existing bridge and road footprint to create an additional southbound lane. Works include narrowing shoulders, relocating the median, and replacing edge and median barriers. Some pavement remediation, vegetation trimming and potential drainage modifications.
Northern Terrace Tunnel Portal	Establish access via Kumutoto Lane/Clifton South Car Park, then complete staged cut batter excavations for the portal with anchors, facing panels, rock bolts and shotcrete. Export spoil via a managed haul route. Conclude with the SH1 tie-in and reinstatement/landscaping.
Northern Tunnel Services and Control Building	Within the northern portal work zone, construct the services/control building, deluge and fire pumps, stormwater treatment devices, maintenance accessways and utility connection.
Southern Terrace Tunnel Portal	From the disused off-ramp and the car park behind 184 Willis Street, undertake staged portal excavations with anchors, rock bolts and shotcrete. Establish a temporary service road for tunnel fit-out, and complete SH1/Vivian Street tie-ins. Limited access may also be used from MacDonald Crescent for vegetation clearance.
New Terrace Tunnel	Construct a new southbound tunnel parallel to the existing, advancing in stages predominantly from the northern portal. Export spoil and any intercepted groundwater via the northern portal. Build two cross passages and install systems.
Existing Terrace Tunnel	Once the new tunnel is operational, reconfigure the existing tunnel to two northbound lanes by removing the southbound lane, installing new barriers, making any required drainage modifications, constructing cross-passage portals, resurfacing, and integrating with the realigned SH1 and Shell Gully section.
Southern Terrace Tunnel Services	Deliver a new southern control building and new or modified systems, with deluge storage tanks near the northern portal and buried detention tanks at the southern portal or an alternative pump station with remote tanks near Willis Street.
Ghuznee Street Overbridge	Modify the Ghuznee Street Bridge to span the widened SH1 corridor. Two delivery options are proposed: • Staged replacement with a multi-span, prestressed hollowcore bridge on MSE wall abutments and median piers; or • Staged eastward extension by constructing a new eastern abutment, jacking/underpinning the existing abutment, and extending the deck in two phases.

3.3 Basin Reserve improvements

Table 3.3 outlines the description of works and scale of earthworks within the Basin Reserve improvements Section. Works will involve approximately 33,600 m^3 of cut to waste and 7,900 m^3 of imported fill from offsite.

Table 3.3: Overview of Basin Reserve improvements Section

Works area	Description
Home of Compassion Creche	Temporarily close the Category 1 masonry building and jack-and-slide the structure to a new position. Remove local vegetation/landscaping and possibly the Martin Square turning bay; provide new paved access and landscaping at the final location.
Strategic service realignment	Locate, expose, and reroute near-surface utilities ahead of secant walls and piling. Install new manholes.

33 kV connection	Install new high-voltage cables mainly by directional drilling between access shafts/joint bays. Complete short open cut tie-ins at endpoints.
900 mm brick sewer	Clear selected Sussex Street properties; construct a large-diameter (~1200 mm) interceptor from the Arras Tunnel end to the Rugby Street manhole using a mix of open cut and microtunnelling. Form a new deep manhole west of the works; expose the fragile brick barrel via careful hydro-vac, then connect/divert and decommission redundant sections.
Sewer rising main	Create a new pressure main connection from a new access chamber near Arras Tunnel toward the Sussex overbridge using trenchless methods under live SH1 where required. Install the new main from the Kent Terrace valve chamber to the new manhole/abutment zone.
700 mm stormwater main from Arras Tunnel	Divert the tunnel stormwater/deluge line ahead of Sussex trench piling.
Sussex Street extension (trench)	Demolish selected buildings and remove landscaping; maintain SH1 via a temporary two-lane on-ramp. Construct secant/contiguous pile walls, then excavate the roadway trench (up to ~9 m deep) with buried/permanent props and base drainage, apply facing to exposed walls, and complete pavement/fit-out.
SH1 Sussex Street Overbridge, Land Bridge and Active Modes Bridge	Construct bored pile abutments and build superstructures top-down using cranage; cast decks, barriers and backfills with conventional concrete operations.
Basin Reserve, Kent Terrace and Cambridge Terrace	Deliver staged pavement reconstruction, kerb realignments, utility relocations, new stormwater assets, and traffic management.

3.4 Mount Victoria tunnel duplication

Table 3.4 outlines the description of works and scale of earthworks within the Mount Victoria tunnel duplication Section. Works will involve approximately 143,200 m³ of cut to waste and 4,200 m³ of imported fill from offsite.

Table 3.4: Overview of the Mount Victoria tunnel duplication Section

Works area	Description
Western tunnel portal	Demolish residential buildings on Paterson Street; relocate services; establish access/laydown. Construct new portal; build multiple retaining systems (soldier pile, MSE, soil nail, cast-in-situ). Commission new tunnel services building. Complete portal formation, backfilling, pavement reconstruction, and finishes.
Eastern tunnel portal	Demolish buildings on Taurima Street; remove the existing services building. Undertake staged, top-down excavation of the portal face with rock anchoring and shotcrete; provide rockfall protection and traffic separation. Construct a cast-in-situ headwall and form the new portal; install a new prefabricated pedestrian bridge to Hataitai Park on piled/piers foundations; complete cladding/finishes and pavement/services tie-ins.
New tunnel construction	Construct the parallel Mt Victoria Tunnel by mechanical mined methods. All portal access, spoil handling, water treatment, and deliveries via the western portal with laydown on Paterson Street. Install secondary lining, pavement, lighting, safety and fire systems, and shared path fit-out.

Tunnel Services and Control Buildings	Build new control buildings above the western portal and near Taurima Street; install/upgrade tunnel systems. Construct new deluge water storage and runoff detention tanks and any required pump stations/pressure mains.
Existing tunnel modifications (incl. ventilation shafts)	Remove the existing north-side shared path and reroute ventilation/HV services to integrate with new systems at the western portal; upgrade ventilation due to loss of the shared-path plenum. After the new tunnel opens, close and refurbish the existing tunnel. Decommission vertical ventilation shafts via Town Belt access: demolish shaft buildings, locally excavate, install capping slabs, and backfill; make minor access track upgrades as needed.

3.5 Eastern connections

Table 3.5 outlines the description of works and scale of earthworks within the Eastern connections Section. Works will involve approximately 58,400 m^3 of cut to waste and 14,900 m^3 of imported fill from offsite.

Table 3.5: Overview of the eastern connections Section

Works area	Description
Ruahine Street to Cobham Drive	Widen SH1 from one to two lanes each way with median separation and intersection upgrades from the eastern Mt Victoria Tunnel portal to Evans Bay Parade. Works include earthworks, corridor realignment, soil-nailed retaining walls with shotcrete/mesh along Hataitai Park/Wellington Rd, and property clearance/demolition. Reconfigure Goa St with a cul-de-sac; fully reconstruct the Wellington Rd–Ruahine St intersection with signalised turning lanes; remove the Kilbirnie Park grandstand and realign the corridor south through the current Eastern Suburbs Cricket Club area; remove SH1 access from Moxham Ave and Walmar St and provide new cul-de-sacs. Corridor-wide works: pavement, drainage, footpaths, lighting, traffic signals, signage.

4 Implementation

4.1 Roles and responsibilities

NZTA is responsible for ensuring the works are undertaken in accordance with this ESMP. Table 4.1 details the responsibilities of NZTA and contractors throughout the Project.

Table 4.1: Roles and responsibilities

Role	Responsibilities
NZTA Project Environmental Manager Must be a suitably qualified and experienced person.	• Make this ESMP available to the contractors for the works; • Ensure the contractors undertake works in accordance with the ESMP; • Work with the contractors to assist in the identification of the appropriate erosion and sediment controls for the Project; • Review the SSESCP for each Section provided by the contractors; • Ensure the contractors implement and maintain the controls detailed in ESMP and SSESCP during the Project; • Maintain a record of all works, ESMP, SSESCP and compliance records; • Ensure inspections, monitoring and adaptive management are undertaken; and • Ensure compliance with resource consent conditions.
Contractor	• Prepare the SSESCP.

	• Make the SSESCP available to NZTA for review and approval. • Make the SSESCP available to all personnel working on the site. • Attend inductions, toolbox talks and training to manage ESC measures. • Report on all incidents involving ESC measure failures or required maintenance. • Ensure processes for managing erosion and sediment control are adhered to. • Ensure the works are undertaken in accordance with the ESMP. • Construction Manager (or equivalent) will perform inspections of works to assess compliance with the CWTMP including operation and maintenance of the chemical treatment system and daily monitoring. • The Environmental and Sustainability Manager (or equivalent) will develop, implement, and review environmental management systems including the CWTMP. • Undertake regular site inspections and audits to ensure compliance with the management plans.

4.2 Distribution

The following parties will be provided with this ESMP:

- NZTA;
- All main contractors undertaking works on site;
- GWRC; and
- WCC.

4.3 Review and update

This ESMP is subject to review and amendment during these works based on feedback and to reflect any improvements in procedures or as determined through construction. Any changes made will not reduce the level of controls unless there is good evidence for the change. Any substantive changes to this ESMP may be required to be approved by GWRC and/or WCC prior to implementation.

Revisions of the SSESCP are to be recorded within the document control and controlled copies distributed to NZTA, GWRC, WCC and all main contractors undertaking works on-site. A copy of this plan must remain on site at all times.

4.4 Complaints management

It is anticipated that the Project will have a project complaints procedure and register. All complaints will be registered and investigated following the appropriate procedure. A template a complaints register is included in Appendix A.

5 Erosion and sediment control

The following sections provide guidance on a general suite of erosion and sediment control practices to be implemented to minimise soil erosion and sediment yield from the site. Technical guidance for the selection, design and use of the erosion and sediment controls is provided in the GWRC ESC Guideline, where applicable.

5.1 Key principles and approaches

The GWRC ESC Guideline outlines key principles that apply to earthworks for this Project. These are summarised in the context of the Project as follows:

1. **Minimise disturbance:** Earth worked areas to be minimised to the greatest extent practicable and volumes to be the minimum necessary to achieve the design outcome. As the works are located within a constrained urban environment this will be a primary consideration.
2. **Stage construction:** Bulk earthworks to be staged in conjunction with construction sequencing within each Section of the Project to minimise the duration of exposure. Completed areas to be progressively stabilised. The constrained environment and scale of works means that the staging may not always be possible but should be considered to ensure smooth workflow with minimal public disruption.
3. **Protect slopes:** When working in sloped areas such as the tunnel portals, where practical, upslope “clean water” runoff to be diverted away from the exposed areas and final design stabilisation measures will be installed to immediately effectively stabilise the slopes.
4. **Protect receiving environments:** Inlets to the stormwater drainage network will be protected to ensure that sediment-laden water does not enter the receiving environments of Lambton Harbour and Evans Bay. Stockpiles will be located away from stormwater inlets and overland flow paths.
5. **Rapidly stabilise exposed areas:** As soon as practicable following the completion of works within each area, the final design stabilisation measure will be implemented.
6. **Install perimeter controls and diversions:** Where practical, the earthworks catchment will be minimised by diverting upslope clean water runoff away from the works area. Due to the constrained nature of the Project, this may not always be possible. During tunnel cuts and trenching, groundwater inflows are likely to be an additional water source to the exposed catchment. Stormwater catchments will be isolated with methods such as filter socks, bunding and silt fencing to prevent sediment-laden water from entering the stormwater network.
7. **Employ sediment retention devices:** Sediment retention devices will be used to capture runoff so that sediment can settle out and be retained on site. Due to the constrained nature of the site, typical sediment retention devices such as sediment retention ponds and decanting earth bunds are not practical and alternative measures such as water treatment systems are likely to be implemented. Flocculation is also likely to be required.
8. **Get trained and develop experience:** Environmental inductions and training to be provided to contractors .
9. **Adjust the ESCP as needed:** This ESMP and the SSESCPs are considered “live” documents. They will be reviewed routinely and updated during the course of the works to reflect changes associated with construction methodology and/or monitoring results.
10. **Assess and adjust your erosion and sediment control measures:** Erosion and sediment control measures will be inspected, monitored and maintained to maximise the ongoing efficiency of the measures and minimise adverse environmental effects.

Prior to the commencement of each Section, a SSESCP will be prepared that adopts the principles listed above. A template for the completion of a SSESCP is attached as Appendix D.

5.2 Activity specific considerations

Table 5.1 outlines the primary construction activities that will be occurring during the Project. For each identified activity, the table outlines key erosion and sediment control aspects that will be considered when selecting management measures and gives examples of management measures that will be adopted in the SSESCP. Note that this table is not exhaustive and does not include all potential considerations and management measures. All erosion and sediment control measures will be designed by suitably qualified and experienced professionals who are familiar with expected site conditions and proposed construction methodologies relevant to the Project works. The professional will be familiar with the topographical lay of the surrounding land.

Table 5.1: Activity specific considerations

General construction activity	Erosion and sediment control considerations	Specific erosion and sediment management measures
Construction site establishment (yards, access roads)	• Runoff from exposed soils and gravelled surfaces • Washdown water • Potential oil residues	• Perimeter silt fence/silt socks • Clean water diversions • Stabilised surfaces • Dust suppression
Construction of tunnel portals	• Steep topography • Large cut volume including rock excavation • High volume of machinery movements • Constrained area	• Divert upslope clean water away from the disturbed area. • Minimise and contain the disturbed area. • Ensure site entry/exit points are well maintained. • Water treatment system sized for anticipated volumes (including groundwater and tunnel water). • Protection of downslope stormwater inlets. • Progressively stabilise completed areas. • Effective spoil management. See details for specific activity.
Excavation of tunnels	• Large cut volume including rock excavation • High volume of machinery movements • 24/7 operation • Largely underground with limited area exposed to surface • Groundwater interception • Process water from drilling, grouting, washing and shotcrete	• Effective spoil management. See details for specific activity. • Separate clean/dirty water to the extent practicable. • Water treatment system sized for anticipated volumes.
Deep retained trench	• Large volume of cut material • Groundwater interception likely. • Water likely to be contained within depressions • Runoff from steep temporary excavation faces	• Divert upslope clean water away from the disturbed area. • Stage works to limit exposed area. • Proactively dewater depression. See details for specific activity. • Progressively stabilise completed areas. • Ensure site entry/exit points are well maintained. • Water treatment system sized for anticipated volumes.
Road widening requiring cuts and retaining walls.	• Major cut slopes generating spoil. • Retaining implemented to stabilise exposed cuts • Surface runoff over disturbed areas • Shallow groundwater interception	• Minimise and contain the disturbed area. • Progressively stabilise completed areas. • Protection of downslope stormwater inlets. • Effective spoil management. See details for specific activity.

General construction activity	Erosion and sediment control considerations	Specific erosion and sediment management measures
		• Water treatment system sized for anticipated volumes.
Construction of bridge foundations and abutments. Construction of buildings, tanks and plant platforms.	• Isolated areas of disturbance. • Moderate volume of earthworks. • Tanks require deep shored excavations, larger volumes. • Water likely to be contained within depressions. • Pile washout water. • Water from drill spoils.	• Divert upslope clean water away from the disturbed area. • Protection of downslope stormwater inlets. • Contain the disturbed area. • Water treatment system sized for anticipated volumes.
Utility diversions and drainage works	• Constrained area due to existing environment and associated requirements. • Distributed disturbance with low volume of earthworks. • Some deep pits and trenching. Water likely to be contained within depressions. • Short duration.	• Divert upslope clean water away from the disturbed area. • Protection of downslope stormwater inlets. • Where possible, backfill and compact trench within three days. • Progressive stabilisation. • Monitoring of weather forecast. Avoid opening trench if there is a risk of high rainfall. • Manage stockpiled material. See details for specific activity. • Manage discharges from cement and concrete use.
Pavement reconstruction, kerb and footpath realignment	• Limited earthworks and short duration. • Wide but shallow disturbance. • Works implement final design stabilisation measures.	• Manage discharges from cement and concrete use.
Groundwater control and dewatering	• Potential for groundwater inflows during cut works. • Groundwater can become sediment-laden if it comes in contact with exposed soil. • Variable water volumes dependent on climatic variations. • Limited space to treat water.	• Water treatment system sized for anticipated volumes, if required.
Spoil handling and stockpiling	• Potential for stockpiling throughout Project. • Large volumes during some stages. • Predominantly cut material to be exported from site.	• Minimise the duration of stockpiled spoil by removing excess spoil from the site as soon as possible. • Where possible, load excavated material directly onto trucks to be removed from site. • Place stockpiles away from stormwater inlets and overland flow paths.
Soil stabilisation	• Use of cement and grout for stabilisation.	• Manage discharges from cement and concrete use.

5.3 General erosion and sediment controls

Table 5.2 and Table 5.6 outline the key design criteria and maintenance requirements for the erosion and sediment control measures that may be implemented throughout the Project. These tables serve as a toolbox of controls that can be applied to each Project Section.

The control measures proposed are based on the controls and principles outlined in the GWRC ESC Guideline and industry best practice. All erosion and sediment controls will be installed and maintained in general accordance with the GWRC ESC Guideline, industry best practice or manufacturer instructions.

Indicative ESCP drawings showing how erosion and sediment controls and principles may be applied on site are attached as Appendix C. Note that these plans are subject to change following the appointment of a contractor. Where dirty water treatment units have been specified, there is the potential for additional units to be added to achieve the required retention and treatment capacity. Alternatively, a singular unit with a larger capacity could be installed.

Table 5.2: General erosion controls

Erosion controls	Key design criteria	Key maintenance required	Relevant section of the GWRC ESC Guideline
Clean water perimeter bunds and diversion channels	• Intercept and convey runoff away from the works area to stable outlets. Erosion damage potential is minimised by reducing the volume of water flowing over the site. • May be constructed from earth (stabilised), hotmix or sandbags. • Formally design diversions where catchments exceed 5 ha. Below this threshold use the standard clean water diversion arrangement. • Stabilised with no exposed surfaces. • Where design velocities exceed 1 m/sec, a channel liner (needle punched geotextile fabric) is required to prevent scour. • Outlets must discharge water so that the erosion hazard to down-slope lands is no greater than that in the pre-development condition, up to the design storm event. • Include appropriate energy dissipation structures at the outlet of all diversions.	• Unless otherwise specified, inspect weekly and after every rainfall for scour and areas where diversions may breach. Repair immediately, if required, to ensure that the design capacity is maintained. • Remove any accumulated sediment deposited in the diversion bund where there is a risk of overtopping due to a lack of freeboard. • Check invert and outlets to ensure that these remain free from scour and erosion. These points may require geotextile lining to avoid this effect. • Look for low spots, areas of water ponding, formation of tunnel gullies, sediment deposition and debris blockage. • Check for stabilisation cover and ensure full stabilisation cover remains where required. • Take particular care to protect against damage from earthmoving operations and reinstate the diversion if damaged.	E2.1
"Dirty water" diversion bunds	• Convey sediment-laden water within disturbed area and direct it to a sediment retention device to enable it to be treated. • May be constructed from earth (stabilised), hotmix or sandbags. • Formally design diversions where catchments exceed 5 ha. Below this threshold use the standard dirty water diversion arrangement. • Diversion gradients greater than 2% may need to be lined to minimise erosion.	As above for clean water perimeter bunds and diversion channels.	E2.2

	• Where practical, ensure a uniform grade along the invert of the diversion. • Outlets from all diversion must discharge to an appropriate sediment control device for treatment.		
Contour drains (cut-offs)	• Break overland flow draining down disturbed slopes by reducing slope length, thereby reducing the velocity and the erosive power of runoff. Temporary in nature. • Minimum compacted bank height of 250 mm and minimum total depth of 500 mm. • Longitudinal gradients not to exceed 2% (otherwise lining may be required). • Broad enough to create a low-profile bank so that large earth working machinery can safely cross (if this is not achievable, a dedicated crossing using a removable culvert can be used). • Parabolic or square shape profile preferred to avoid potential erosion typically associated with "V" profiles. • Must discharge to a diversion bund. • Outlets may need to be lined with geotextile or other suitable material to prevent erosion. • No individual drain will have more than 0.5 ha draining into it.	• Repair or reinstate contour drains if damaged by machinery movement. • Inspect contour drains weekly and repair as necessary. • Check the outfall for erosion and repair if required. It may be necessary to install a temporary flume or provide geotextile.	E2.3
Check dams	• Reduce the velocity of concentrated flows. • Constructed from loose rock, sandbags or silt socks. • Constructed with a 450 mm or 650 mm centre height at spacings determined in Table 5.3. • All check dams must incorporate a spillway to direct flows over the centre of the structure with the spillway elevation at least 150 mm to 200 mm lower than the crest of the structure • To be effective, place check dams so that the toe of the upstream dam is at the same elevation as the centre height (spillway level) of the downstream dam.	• Repair or reinstate the check dams if destroyed by machinery movement. • Inspect the check dams after rainfall or storms and repair as necessary. • Check if water is outflanking the structures and look for scouring around the edges of the check dams. If there is scouring, increase the centre height (spillway height) and/or turn up the edges of the structures. • If scour is occurring between check dams, then additional structures may need to be provided. • Check dams will be inspected for sediment accumulation after each significant rain event. Sediment will be removed	E2.4

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<tr>
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Table 5.3: Check dam spacing
<table>
<tr><th>Slope of site</th><th>Spacing (m) between dams with a 450 mm centre height</th><th>Spacing (m) between dams with a 650 mm centre height</th></tr>
<tr><td><2%</td><td>24</td><td>30</td></tr>
<tr><td>2 – 4%</td><td>12</td><td>15</td></tr>
<tr><td>4 – 7%</td><td>8</td><td>11</td></tr>
<tr><td>7 – 10%</td><td>5</td><td>6</td></tr>
<tr><td>>10%</td><td>Unsuitable</td><td>Unsuitable</td></tr>
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<td>when it reaches 40% of the original height or before this occurs.</td>
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<tr>
<td>Pipe drop structures and flumes</td>
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Convey a concentrated flow down a slope without causing erosion.
May be fabricated from needle-punched geotextile fabric, concrete, steel or plastic half-round pipes, rock, sandbags, lay-flat or construction ply.
Always use flumes/pipe-drop structures where slopes are steeper than 3:1 and where channelised surface runoff must be conveyed down the slopes.
The pipe-drop structure or flume will be impervious and must prevent water from flowing under the structure.
The height of the runoff diversion channel or bund (when measured from the invert) that is used to divert flows to the pipe-drop structure or flume must be at least 2× the pipe diameter or 2× the height of the flume.
The inlet to the flume or pipe will include a 1 m long stabilised entry apron (e.g. by using geotextiles) to minimise drawdown scour. This needs to be on at least a 3% grade.
The flume and pipe-drop structure will be extended beyond the toe of the slope being protected. The outfall will be appropriately protected with an energy dissipation device (e.g. geotextile, sand bags, rip-rap).

Pipe-drop structure
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Inspect the pipe-drop structure or flume weekly and after each rain event and immediately carry out any maintenance required.
Keep the inlet open at all times.
Check for evidence of water bypassing, undermining or overtopping the pipe-drop structure or flume.
Check for scour at the base of the pipe-drop structure or flume, or in the receiving downstream area. If eroded, repair damage and install additional energy dissipation measures.
If downstream scour is occurring, it may be necessary to reduce flows being discharged into the device unless other preventative measures are implemented.
Extend the length of the pipe-drop structure or flume as earthworks progress and repair and/or modify the pipe-drop structure or flume as required.
Keep pipe-drop structures or flumes in place until runoff has been controlled and all disturbed areas have been stabilised, or until permanent stormwater systems have been commissioned.
Make sure that the pipe-drop structures or flumes do not result in ponding onto inappropriate areas (e.g. active traffic lanes, material storage areas, etc.).

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	• Table 5.4 provides guidance on the maximum catchment area draining into a pipe-drop structure. For catchments larger than 1 ha, specific engineering design is required. • The pipe-drop structure will have: – A gradient no shallower than 3:1 – An inlet bank (made of compacted material) or wing walls at the inlet of the pipe that are a minimum of 2 × the height of the pipe-drop structure – Adequate provision for securing the pipe-drop structure to the slope. As a minimum, the pipe-drop structure is to be anchored every 4 m.		

Table 5.4: Sizing criteria for pipe-drop structures

Pipe diameter (mm)	Maximum catchment area (ha)
150	0.05
300	0.2
450	0.6
600	1
Specific design required	>1

Flumes

- Temporary flumes will be limited to the catchment areas outlined in Table 5.5. When contributing catchments exceed these thresholds, specific engineering design is required.
- The temporary flumes must provide:
  - An effective flume width of 1.5 m per ha of contributing catchment area.
  - Gradient no shallower than 3:1.
  - Minimum of 2 × height of the flume of compacted material of inlet bank or wing walls at the top of the flume.
  - Minimum of 300 mm deep cut-off trench at top of flume to avoid undercutting the fabric.

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– Minimum of 300 mm flume sidewall height (or flume depth).
• Geotextiles have maximum flow rate limitations; consult the manufacturer for proper selection.

Table 5.5: Sizing criteria for flumes
<table>
<tr><th>Catchment slope (%)</th><th>Maximum catchment area (ha)</th></tr>
<tr><td>>18%</td><td>2.5 ha</td></tr>
<tr><td><18%</td><td>5.0 ha</td></tr>
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<tr>
<td>Final design stabilisation</td>
<td>
• Following the completion of works, final design stabilisation measures will be implemented. These include but are not limited to:
– Pavement surfacing and road construction: Basecourse aggregate sealed with bitumen on carriageways, ramps, intersections and access roads.
– Concrete surfacing including shotcrete and structural wall facings: In situ and precast concrete for tunnel linings and portals, kerbs and footpaths and retained cut slopes. Secant pile walls and retaining wall facings also form stabilised surfaces.
– Gravel hardstand and maintenance surfaces: Compacted aggregate or gravel surfacing in maintenance access zones, beneath bridges, or on utility easements where permanent pavement is not required.
– Planting and landscaping: Completed in accordance with planting plan when developed.
</td>
<td>• Outside the scope of this ESMP.</td>
<td>N/A – best practice solution.</td>
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<td>Hydroseeding</td>
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• Designed to establish vegetation quickly on steep and/or inaccessible areas or on surfaces with no or minimal topsoil.
• May be used on cut or fill batters, landscaped medians, and reinstated ground around tunnels, portals, and bridge abutments.
• There are various hydroseed mixes that use soil ameliorants (substances that aid plant growth), paper or wood pulp. In some
</td>
<td>• Heavy rainfall can wash new hydroseeding away before vegetation is fully established. This is particularly evident on smoother hard surfaces and overland flow paths. Where vegetation establishment is unsatisfactory, the area will require re-application of hydroseed, or consideration will need to be given to other stabilisation techniques</td>
<td>E3.2</td>
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	circumstances, a binder is used to help seeds adhere to the soil surface. • Hydroseed mixes will vary greatly depending on the site-specific conditions and required outcome. Consultation with a hydroseeding contractor will be necessary to determine the seed mixes and application rates to achieve the required outcome. • Where hydroseeding is used as an erosion control measure, the area of coverage is not considered stabilised until an 80% vegetative grass cover has been established.	• Water hydroseeded areas as necessary to promote growth, taking care to avoid washing the hydroseed away. • Protect all re-vegetated areas from construction traffic and other activities such as the installation of drainage and utility services.	
Turfing	• Provide rapid stabilisation by the placement of vegetative cover to exposed areas. Provides instant results from a visual and erosion control perspective. • May be used on cut or fill batters, landscaped medians, and reinstated ground around tunnels, portals, and bridge abutments. • Take care to ensure that flow velocities travelling over the turfed area will not cause erosion or undercut the turf. In these circumstances, which often relate to steeper areas, turf reinforced with geotextiles will be considered. • The type of turf utilised needs to be suitable to the ground conditions and final use.	• Water daily during the first week of laying the turf, unless there is adequate rainfall. Continue watering as appropriate to maintain good growth until fully established. • Check to ensure that the turf is firmly rooted to the original ground surface. Do not mow the area until the turf is firmly rooted.	E3.3
Geotextiles and erosion control blankets	• Instantly reduce the erosion potential of the disturbed areas and/or reduce or eliminate erosion on critical sites. • For specific construction specifications, refer to the product information sheets supplied by the manufacturer. • In general, the minimum requirements for the various measures are as follows: **Non-woven geotextiles** • Temporary erosion control measure useful for surfaces receiving minor flows. Typical examples of their use include bund stabilisation, batter stabilisation, stockpile stabilisation, and low velocity channel stabilisation.	• Areas treated with temporary soil stabilisation will be inspected daily and after each rainfall event. • Areas treated with temporary soil stabilisation will be maintained to provide appropriate erosion control and reapplied or replaced on exposed soils when the area becomes exposed or exhibits visible erosion. The maintenance aspects to look for comprise: – Lifting geotextile caused by vegetation growing up under the fabric – Rilling caused by water flowing beneath the geotextile – Torn geotextile, missing pins or other damage caused by high winds, machinery or vandalism.	E3.5

	• The main advantage of non-woven geotextiles is their ability to cling to the exposed surface. Their main disadvantage is their relative low strength. Where a high strength geotextile is needed (for instance in high flows), a woven geotextile will be used. **Woven geotextiles** • Used in high flow situations such as channels and flumes and as the upper fabric layer for pond spillways. For this, the woven geotextile must meet the following properties: – Material will be a woven polypropylene fabric with a minimum wide width tensile strength ≥ 14 kN/m (AS, ASTM or ISO test methods allowed). – The fabric will comply with a flow rate under 100 mm head of < 20 l/m²/sec (AS, ASTM or ISO test methods allowed). – Retained strength at 500h UV = 70% Minimum (AS, ASTM or ISO test methods allowed). – Correct use/installation of geotextiles is critical to achieving the desired outcome of erosion control. – Geotextiles will be secured in place with ground staples, pins or sandbags and keyed into the tops of slopes and edges to prevent infiltration of surface water under the geotextile. – Particular care is needed to overlap and pin geotextiles in place. – In all circumstances, pin geotextiles down on a 500 mm (min) grid. This is critical to ensure an appropriate number of contact points with the underlying soil. It will also prevent wind from lifting the geotextile from the slope it is protecting. – Ensure that pins are suitable for the geotextile and soil type. **Plastic covers** • Used to prevent water from penetrating into the material covered (e.g. contaminated stockpiles, or stockpiles of material for reuse).	• Repair or replace any areas of geotextile damaged or dislodged in any way. If required, erect a temporary barrier and/or signage fencing to restrict uncontrolled movement of equipment and vehicles onto treated areas.	

	• Plastic sheeting will have a minimum thickness of 0.25 mm. It will be keyed in at the top of the slope and held firmly in place with sandbags or other weights placed no more than 3 m apart. • Seams are typically taped or weighted down their entire length with at least a 300 mm – 600 mm overlap of all seams. • Edges will be embedded a minimum of 150 mm into the soil.		

Table 5.6: General sediment controls

Sediment controls	Key design criteria	Key maintenance required	Relevant section of the GWRC ESC Guideline
Water treatment system	• Remove suspended solids, hydrocarbons and settable matter from surface water and groundwater so it is suitable for discharge into stormwater system. • To be appropriately sized for the volume and flow rate of water requiring treatment. • May include sediment tanks, mobile clarifiers and/or baffle tanks	• Selected water treatment system is to be operated and maintained in accordance with the design specifications. • Monitor discharged water to ensure it meets required stormwater discharge quality.	N/A – best practice solution
Allowing ponding within excavations	• Detain and attenuate runoff flows. • Details of the approximate volume of water that can be contained within the depression to be included.	• Inspect depressions at least once a week and after each rainfall. • Ensure more than 50% capacity remains within the excavations. If required, dewater excavations in accordance with the Construction Water Management Plan. • Clean out excavations before the volume of accumulated sediment reaches 20% of the total depression volume. • Clean out excavations with high capacity sludge pumps or with excavators, loading onto sealed top trucks or to a secure area.	N/A – best practice solution
Coagulant and flocculant treatment	• Used to improve the efficiency of sediment retention devices. • Batch treatment to be built into water treatment system to support its function. • Chemical treatment to be completed in accordance with a Chemical Treatment Management Plan. • Bench testing is required to determine product and dosing for site soil.	• Operate and maintain the selected chemical treatment system in accordance with design specifications. • Monitor discharged water to ensure it meets required stormwater discharge quality.	F2.0

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<td>Stabilised entranceways and laydown areas</td>
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Prevent site access points and high traffic areas from becoming sources of sediment and assist in minimising dust generation and disturbance of road frontage by providing a defined entry and exit point.
Stabilised entranceways will be located at the permanent site entry/exit point.
Ensure the stabilised entrance drains back onto site. A speed hump can be used for this purpose.
Entry/exit points and laydowns will either be stabilised with concrete or compacted gravel.
Concrete to be used in high volume trafficked areas of the site to provide a durable and stable surface. In lower volume areas, compared gravel will be used.
Where compacted gravel is used at entry/exit points the design specifications in Table 5.7 will be met.

Table 5.7: Stabilised entranceway specifications
<table>
<tr><th>Design parameter</th><th>Specification</th></tr>
<tr><td>Aggregate size</td><td>50 – 150 mm washed aggregate</td></tr>
<tr><td>Minimum thickness</td><td>150 mm</td></tr>
<tr><td>Minimum length</td><td>10 m</td></tr>
<tr><td>Minimum width</td><td>4 m</td></tr>
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Inspect weekly and after each rainfall event for general maintenance requirements.
Maintain the stabilised entranceway in a condition to prevent sediment from leaving the construction site.
After each rainfall, inspect any structure used to trap runoff from the stabilised entranceway and clean out as necessary.
Add further aggregate as necessary when mud blockage becomes evident or when aggregate thickness is not to specification.
Remove sediment from sealed pavements by sweeping or vacuuming as necessary.
Do not wash any sediment into the stormwater system or any watercourse.
Supplementary street sweeping at regular intervals on adjacent roads may still be required in association with stabilised entranceways.

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<tr>
<td>Silt fences</td>
<td>

Detain runoff flows so that deposition of transported sediment can occur through settlement.
Ensure silt fence height is 600 mm above ground level and 200 mm below ground level.
Maximum slope lengths, spacing of returns and angles for silt fences are shown in Table 5.8.
Locate supporting posts/waratahs for silt fences 2–4 m apart with support provided by a tensioned wire (2.5 mm HT) along the top of the silt fence.
Where a strong woven fabric is used in conjunction with a wire support, the distance between posts can be up to 4 m. Double the silt fence fabric over and fasten to the wire with silt fence clips at 500 mm spacings.

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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 waratahs, overtopping, outflanking, undercutting, and leaking joins in fabric.
Make any necessary repairs as soon as identified.
As the geotextile material becomes clogged with sediments, this will result in increased duration of ponding. Therefore, careful

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	• Ensure supporting posts/waratahs are embedded a minimum of 400 mm into the ground. • Always install silt fences along the contour (at a break in slope). Where this is not possible, or where there are long sections of silt fence, install short silt fence returns Projecting up-slope from the silt fence to minimise the concentration of flows. Silt fence returns will be a minimum 2 m in length and can incorporate a tie-back. They are generally constructed by continuing the silt fence around the return and doubling back, eliminating joins. • Join lengths of silt fence by doubling over fabric ends around a waratah or by stapling the fabric ends to a batten and butting the two battens together. • Install silt fence returns at either end of the silt fence, Projecting up-slope to a sufficient height to prevent outflanking. • In catchments of more than 0.3 ha, the use of silt fences requires careful consideration of specific site measures. Other control measures may be better, such as a super silt fence. • Where water may pond regularly behind the silt fence, provide extra support for the silt fence with tie-backs from the silt fence to a central stable point on the upward side. Extra support can also be provided by stringing wire between support stakes and connecting the filter fabric to this wire. • As a minimum, the silt fence cloth must meet the following criteria for geotextile fabric: – Wide width tensile strength ≥ 14 kN/m minimum (AS, ASTM or ISO test methods allowed) – Retained strength at 500h UV = 70% minimum (AS, ASTM or ISO test methods allowed) – Opening size (EOS) = 0.2–0.4 um (AS, ASTM or ISO test methods allowed). **Table 5.8: Silt fence design criteria** Slope steepness (%) / Slope length (m) (maximum) / Spacing of returns (m) / Silt fence length (m) (maximum) Flatter than 2% / Unlimited / N/A / Unlimited 2 – 10% / 40 / 60 / 300 10 – 20% / 30 / 50 / 230	cleaning of the silt fence geotextile with a light broom or brush may be appropriate. • Remove sediment when bulges occur or when sediment accumulation reaches 20% of the fabric height. • Remove sediment deposits as necessary (prior to 20% of fabric height) to continue to allow for adequate sediment storage and reduce pressure on the silt fence. • Dispose of sediment to a secure area to ensure that it does not discharge to the receiving environment.	

	<table><tr><td>20 – 33%</td><td>20</td><td>40</td><td>150</td></tr><tr><td>33 – 50%</td><td>15</td><td>30</td><td>75</td></tr><tr><td>> 50%</td><td>6</td><td>20</td><td>40</td></tr></table>		

Super silt fences	• Detain runoff flows so that deposition of transported sediment can occur through settlement.
	• Ensure super silt fence height is 800 mm above ground level.
	• Maximum slope lengths, spacing of returns and maximum silt fence lengths are shown in Table 5.9.
	• Always install super silt fences along the contour (at a break in slope). Where this is not possible, or where there are long sections of super silt fence, install short silt fence returns Projecting up-slope from the silt fence to minimise the concentration of flows. Silt fence returns will be a minimum 2 m in length and can incorporate a tie-back. They are generally constructed by continuing the silt fence around the return and doubling back, eliminating joins.
	• Join lengths of silt fence by doubling over fabric ends around a waratah or by stapling the fabric ends to a batten and butting the two battens together.
	• Install silt fence returns at either end of the silt fence, Projecting up-slope to a sufficient height to prevent outflanking.
	• When considering super silt fence installation for larger catchments (greater than 0.5 ha) as in Table 5.9, carefully consider the specific site conditions and other alternative control measures available.
	• Base the length of the super silt fence on the limits shown in Table 5.9.
	• Where the ends of the geotextile fabric come together, overlap, fold and staple the fabric ends to prevent sediment bypass.
	• The geotextile fabric must meet the following requirements:
	  – Wide width tensile strength ≥ 14 kN/m minimum (AS, ASTM or ISO test methods allowed)
	  – Retained strength at 500 h UV = 70% minimum (AS, ASTM or ISO test methods allowed)
	  – Opening size (EOS) = 0.2–0.4 um (AS, ASTM or ISO test methods allowed)
	• Super silt fence wire mesh will consist of a knotted or welded wire mesh. The knotting or welding process will not leave any shape or protruding objects
		Same as above for silt fences.	F1.4

<table>
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<td>that may damage the super silt fence fabric when installed. The wire mesh must meet the following requirements:
– Wire diameter = 1.5 mm minimum
– Mesh aperture = 100 mm maximum
– Mesh height = 1 m minimum
– Coating = Galvanised or zinc coated.

Table 5.9: Super silt fence design criteria
<table>
<tr><th>Slope steepness (%)</th><th>Slope length (m) (maximum)</th><th>Spacing of returns (m)</th><th>Super silt fence length (m) (maximum)</th></tr>
<tr><td>0 – 10%</td><td>Unlimited</td><td>60</td><td>Unlimited</td></tr>
<tr><td>10 – 20%</td><td>60</td><td>50</td><td>450</td></tr>
<tr><td>20 – 33%</td><td>30</td><td>40</td><td>300</td></tr>
<tr><td>33 – 50%</td><td>30</td><td>30</td><td>150</td></tr>
<tr><td>> 50%</td><td>15</td><td>20</td><td>75</td></tr>
</table>
</td>
<td></td>
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<tr>
<td>Silt socks</td>
<td>• Temporarily impound sediment-laden runoff, slowing the flow rate and allowing sediment to settle out of the water.
• Ensure that an appropriately sized silt sock is used (see design criteria in Table 5.10 and Table 5.11).
• Ensure the compost medium used in the silt sock is free from contaminants and meets the specification in Table 5.12.
– Bark specification: Use 2–10 mm chip. Ensure bark is free from contaminants.
– Sawdust specification: Do not use treated wood sawdust. Ensure sawdust is free from contaminants.
– Straw specification: Ensure straw is free from weed seeds and contaminants.
– General specifications for sock media: The filter medium will be clean and free from contamination.
• The material used to fill the sock will depend on the application. For example, if the sock is to be used as a filter, a porous material such as rocks or wood bark will not be effective.</td>
<td>• Silt socks will be inspected regularly and after each rainfall event to ensure sediment control efficiency is maintained.
• Accumulated sediment greater than 20% of the height of the silt sock will be removed, or another silt sock placed on top of the existing silt sock to maintain adequate sediment control.
• Reuse of silt socks is possible provided the integrity of the sock and fill media is maintained.</td>
<td>F1.5</td>
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Table 5.10: 300 mm diameter silt sock

Slope steepness (%)	Slope length (m) (maximum)	Spacing of returns (m)
<2%	100	N/A
2 – 10%	40	30
10 – 20%	30	25
20 – 33%	10	10
33 – 50%	5	10
> 50%	2	5

Table 5.11: 400 mm diameter silt sock

Slope steepness (%)	Slope length (m) (maximum)	Spacing of returns (m)
<2%	150	N/A
2 – 10%	60	30
10 – 20%	40	25
20 – 33%	20	10
33 – 50%	10	10
> 50%	5	5

Table 5.12: Specifications for compost

Parameter	Unit of measure	Specification
pH	pH units	5.0 – 8.5
Moisture content	% wet weight basis	>60
Organic matter content	% dry weight basis	25 – 100
Particle size	% passing a selected mesh size, dry weight basis	50 mm 99% passing; 10 mm 30 – 50% passing (or 50 – 70% retained); maximum 50 mm

Stormwater inlet protection	• Intercept and filter sediment-laden runoff before it enters reticulated stormwater system.	• Maintenance will vary according to the type of inlet protection.	F1.6

	• Complete blocking of the stormwater system must be avoided, as this will divert flows during heavy rain and may cause other devices to become overwhelmed and/or create flooding hazards. • The height of catchpit protection within live road environments must be less than the kerb height so that runoff does not cause local flooding and/or direct flows to other nearby catchments. • A series of low sandbag check dams can be installed up the gutter from the catchpit to act as a series of small sediment traps. Check dams require a spillway lower than the kerb to ensure that runoff does not encroach onto the berm area and cause scouring. They will comprise up to six sandbags laid end to end, with no gaps, in an arc away from the kerb and up the road to create a series of impoundment areas. This measure is only suitable for very small catchment areas. • A silt sock can be placed around the inlet to act as a small sediment trap immediately up-slope of the catchpit. The silt sock needs to completely 'ring fence' the catchpit. This measure is only suitable for very small catchment areas.	• Inspect daily and after rainfall events. • Beware of blockages and leaks that may affect performance. • Check to see if flows have been diverted away from the device and what, if any, damage has been caused. • Clean all accumulated sediments immediately. • Repair and modify any problems immediately. • Remove devices as soon as works are complete.	

5.4 Chemical treatment

5.4.1 Overview

Flocculation (the chemical treatment) may be used to improve the efficiency of sediment retention devices, particularly where silt or clay soils are expected at the Project site or where a higher standard of treatment is required.

In each CWTMP that specifies chemical treatment (flocculation) of treatment systems, the CWTMP will include:

- Specific design details of the chemical treatment system;
- Monitoring maintenance (including post-storm) and contingency programme;
- Details of optimum dosage (including catchment specific soil analysis and assumptions, and consideration of any environmental effects);
- Where it is considered necessary, procedures for carrying out an internal treatment trial; and,
- Details of the personnel that will hold responsibility for the maintenance of the chemical treatment system and the organisational structure which will support the system.

Preliminary testing will be undertaken on soils from the Project area to demonstrate if chemical flocculation is likely to be required. Based on the results, the chemical flocculants and methodologies suitable for the Project will be determined. An overview of the flocculation methods will be outlined once the bench testing is completed, and specific details will be provided in the relevant CWTMPs. The overall chemical treatment framework may be updated in this CWTMP as soil bench testing becomes available.

5.4.2 Flocculation methods

Flocculants typically come in three forms, liquid, solid and powder:

- Liquid flocculant can be added to construction runoff flowing into a sediment treatment device via rainfall activated systems or via manual batch dosing to contained water in the treatment device. Suitable for variable flows.
- Flocculant supplied as a solid brick or block, secured in a wire cage, can be placed at a point of turbulence that will have the greatest contact with concentrated construction runoff. Suitable for concentrated low to moderate flows.
- Powder flocculant is placed into geotextile socks. These socks can be pinned to the ground and dispersed construction runoff can be directed through the sock or they can be placed within diversion channels.
- Preliminary testing of flocculants will be carried out on soil samples collected at the Project site.

6 Inspections and monitoring

6.1 Rainfall monitoring

During works, contractors will regularly monitor the weather forecast for significant rain events. A significant rain event is defined as ≥25 mm in 24 hours or ≥15 mm in 1 hour.

Within 12 hours following a significant rainfall event, the erosion and sediment controls will be inspected, subject to health and safety requirements in accordance with Section 6.2.

6.2 Erosion and sediment control inspection and maintenance

Erosion and sediment control inspections will be undertaken by an experienced and appropriately qualified person to ensure they are functioning as intended and meet the requirements given in Table 5.2 and Table 5.6 at all times during works and until the site is stabilised.

Inspections will occur weekly and within 12 hours following significant rain events, subject to health and safety requirements.

A record of inspections will be maintained, showing the date and time of any inspection and the date, time and description of any maintenance and repair undertaken.

Any actions that are identified as part of an inspection including maintenance of devices, sediment removal and repairs will be carried out within 24 hours, or as soon as safely practical. If an inspection identifies a sediment-laden discharge across the boundary of the site, the discharging water will be sampled using the method outlined in Section 6.3 and the contingency measures outlined in Section 6.4 will be implemented.

6.3 Stormwater discharge monitoring

Stormwater discharge monitoring will be undertaken at:

- The outlets of any water treatment plants; and,
- In the event of an unexpected or non-compliant discharges across the boundary of the site.

The location and frequency of regular sampling of treated water discharged from devices will be specified in the SSESCPs.

Monitoring will be a combination of continuous monitoring where appropriate (e.g. on containerised treatment systems) and grab samples.

Where grab samples are taken, they should be placed on ice immediately after collection and deliver them to an International Accreditation New Zealand (IANZ) accredited laboratory for testing. Results will be compared to the trigger levels given in Table 6.1.

If laboratory results show one or more of the parameters exceed the provided trigger levels, then the contingency measures outlined in Section 6.4 will be completed.

Table 6.1: Stormwater quality monitoring trigger levels

Parameter	Trigger level
Total suspended solids*	100 mg/L
pH	5.5 – 9.0

Note: *Turbidity can be used as an alternative to total suspended solids if a relationship between the two can be formed using laboratory testing.

6.4 Contingency measures

If at any time during construction, there is a failure of discharge of sediment-laden water to the stormwater system, the following actions will be taken:

- Immediate cessation of the activity causing the discharge;
- Complete a visual inspection for any:
  - Change in colour or clarity at the point of the discharge;
  - Presence of any scums or foams; or,

  - Any evidence of sediment deposition at the area surrounding the point of discharge.
- Complete stormwater discharge monitoring in accordance with Section 6.3. If the results of this monitoring indicate effects, then further grab samples will be collected for laboratory analysis and a Marine Ecologist will be contracted to provide further advice.
- Complete the environmental incident form attached as Appendix B;
- Notify GWRC within 12 hours of the incident occurring; and,
- Complete response actions which may be required as recommended by the Marine Ecologist.

Works within the affected catchment will only recommence when actions have been undertaken to ensure the cause of the incident is resolved.

7 Applicability

This management plan has been prepared for the exclusive use of our client NZ Transport Agency Waka Kotahi, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this management plan as part of an application for resource consent (and other approvals) via the Fast-track Approvals Act 2024 and that the Environmental Protection Authority, an expert consenting panel, Greater Wellington Regional Council and others invited to comment on the application will use this management plan for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Caitlin Dalziel Environmental Consultant	Jan Noering Project Director

....

Miranda Kahrilas
Environmental Engineer

CAID
https://nztransportagency.sharepoint.com/sites/extronssh1wip-grp365/shared documents/02 pre-implementation/06. consenting & ftaa legal/specialists/specialist reports/erosion and sediment control/20260806_sh1_wellington_high-level_escp_final.docx

Appendix A Complaints register

Instructions

Complete this form for all complaints received related to works on site.

Date and time	Date: __/__/____ Time: __:__ hours
Summary of complaint? Provide a brief and factual description of the complaint, including relevant details such as: · The nature of the complaint and how it was received (e.g. phone, email, in person). · The activity, event, or circumstance that led to the complaint.	
Location of the issue? Include address, landmarks, features, nearest street, etc. Include proximity to relevant area of affected parties. Maps and plans can be attached.	
Complainant details (if provided)	Name: Address: Mobile phone number: Email:
What immediate actions/control measures were taken to rectify the cause of the complaint?	
Responded to complainant with outcome of investigation? Provide a response to the complainant, acknowledging the receipt of the complaint and detailing corrective actions undertaken to resolve the cause of the complaint.	Yes ☐ No ☐
Details of person writing this report	Name: Organisation: Mobile phone number: Signature: Date:
Details of Project manager/site supervisor	Name: Organisation: Mobile phone number: Signature: Date:

Appendix B Environmental incident form

Instructions

Complete this form for all environmental incidents that cause sediment-laden water or other contaminants to leave the site. Once completed submit to Greater Wellington Regional Council at info@gw.govt.nz. Call GWRC immediately on 0800 496 734 for any serious or ongoing incidents that cannot be brought under immediate control.

Date and time	Date: __/__/____ Time: __:__ hours
Description? Provide a brief and factual description of what happened during the incident, include relevant details such as: • The activity being undertaken when the incident occurred. • The estimated distance to nearest stormwater inlet. • The estimated distance to the nearest sensitive receiver. Sketches/diagrams/photos may be referenced and appended to this report to aid in the description of the incident.	
Exact location of incident? Include address, landmarks, features, nearest street, etc. Maps and plans can be attached.	
Estimated quantity or volume of material discharged or causing incident?	
Who identified the incident?	Contractor □ Council □ Community □ Other □
What immediate actions/control measures were taken to rectify or contain the incident?	
What initial corrective action will be taken to prevent similar incidents recurring in the near future?	
Has GWRC been notified?	Yes □ No □
Details of person writing this report	Name: Organisation: Mobile phone number: Signature: Date:
Details of Project manager/site supervisor	Name: Organisation: Mobile phone number: Signature: Date:

Appendix C Indicative ESCP drawings

Appendix D SSESCP template

Document control

Title: State Highway 1 Wellington Improvements – Draft Site-specific Erosion and Sediment Control Plan Template					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
Mar. 26	1.0	Draft for client review	C. Dalziel	R. Van de Munckhof	J. Noering

Distribution:

NZ Transport Agency Waka Kotahi	1 PDF copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

Table of contents

1 Introduction

NZ Transport Agency Waka Kotahi (NZTA) is constructing the State Highway 1 (SH1) Wellington Improvements Project (the Project) to improve SH1 into Wellington City. The Project includes improvements to SH1 within Wellington City, extending over 5 km through the city. The Project is separated into five Sections of works.

This site-specific erosion and sediment control plan (SSESCP) has been prepared by [insert author/organisation] on behalf of NZTA.

The purpose of this SSESCP is to detail the specific erosion and sediment controls and associated maintenance and monitoring measures required during the construction of the [insert Section name] of the Project. The location of the [insert Section name] within the wider Project is shown in Figure 3.1.

This SSESCP is part of a suite of plans that collectively ensure effective erosion and sediment control (ESC) across the Project. Key documents related to ESC are outlined in Table 1.1.

Table 1.1: Key documents related to ESC for the Project

Document	Purpose
High-level Erosion and Sediment Control Plan (ESMP)	Outlines the general ESC requirements that apply across the Project.
Site Specific Erosion and Sediment Control Plans (SSESCP)	Details the specific ESC for each works area. Typically, a separate SSESCP will be prepared for each stage of work, although these may be combined where works are replated. The SSESCPs shall follow the principles of the ESMP.
Water Treatment Management Plan (CWTMP)	CWTMP provides the overall approach and guidance for construction water management during the Project where it cannot be managed using standard ESCP approaches and requires a specific water treatment plant.

This SSESCP has been developed in accordance with industry best practice and Greater Wellington Regional Council's (GWRC) *Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region*[4]. It should be read in conjunction with the ESMP.

2 Site description

Write a site description outlining the following details relating to the area within the Section and in proximity to it:

- Location within the wider Project, include the area (m^2) of the Section;
- Topography of the land;
- Types of land uses, include the zoning as defined in the Wellington City District Plan;
- Stormwater inlets; and,
- Notable features such as significant trees, historical buildings, schools.

[4] Greater Wellington Regional Council (February 2021). Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region. Accessed at: https://www.gw.govt.nz/assets/Documents/2022/03/Erosion-and-Sediment-Control-Guide-for-Land-Disturbing-Activities-in-the-Wellington-Region.pdf.

Include a figure of the Section area.

3 Proposed development

Include a description of works occurring within the Section. This will include details of all construction activities with the potential to generate sediment.

Complete the table below to summarise the volumes of earthworks to occur within the Section.

Outline the expected duration of works, this include all time taken to prepare the site works until stabilisation of the completed works surfaces is achieved.

Table 3.1: Volume of earthworks

Earthworks description	Volume (m^3)
Cut to waste	
Cut to fill	
Imported fill from off site	

4 Implementation

4.1 Roles and responsibilities

Table 4.1 details the responsibilities and contact details of key roles within the Section.

Table 4.1: Roles and responsibilities

Role	Responsibilities	Contact details
Contractor	• Prepare the SSESCP. • Make the SSESCP available to NZTA for review and approval. • Make the SSESCP available to all personnel working on the site. • Attend inductions, toolbox talks and training to manage ESC measures. • Report on all incidents involving ESC measure failures or required maintenance. • Ensure processes for managing erosion and sediment control are adhered to. • Ensure the works are undertaken in accordance with the ESMP. • Construction Manager (or equivalent) will perform inspections of works to assess compliance with the CWTMP including operation and maintenance of the chemical treatment system and daily monitoring. • The Environmental and Sustainability Manager (or equivalent) will develop, implement, and review environmental management systems including the CWTMP.	Name: Phone: Email:

	• Undertake regular site inspections and audits to ensure compliance with the management plans.	
NZTA Project Environmental Manager Must be a suitably qualified and experienced person.	• Mak this ESMP available to the contractors for the works; • Ensure the works are undertaken in accordance with the ESMP; • Work with the contractors to assist in the identification of the appropriate erosion and sediment controls for the Project; • Review the SSESCP for each Section provided by the contractors; • Ensure the contractors implement and maintain the controls detailed in ESMP and SSESCP during the Project; • Maintain a record of all works, ESMP, SSESCP and compliance records; • Ensure inspections, monitoring and adaptive management are undertaken; and • Ensure compliance with resource consent conditions.	Name: Phone: Email:

4.2 Distribution

The following parties will be provided with this SSESCP:

- NZTA;
- All main Contractors undertaking works on site;
- GWRC; and
- Wellington City Council (WCC).

4.3 Review and update

This SSESCP is subject to review and amendment during these works based on feedback and to reflect any improvements in procedures or as determined through construction.

Revisions of the SSESCP are to be recorded within Table 4.2 and controlled copies distributed to NZTA, GWRC, WCC and all main contractors undertaking works on-site. A copy of this plan must remain on site at all times.

Update Table 4.2 with revision details.

Table 4.2: Document control table

Date	Version	Description	Prepared by	Reviewed by

4.4 Complaints management

Record all complaints and investigate them using the register attached to the ESMP. Acknowledge receipt and outline corrective actions to the complainant.

5 Construction methodology

The following section describes the construction methodology for the Section. Refer to Section 6 for further details on the erosion and sediment control measures to be implemented throughout this method.

Outline the construction method for the works. This should detail the stages of construction in chronological order and focus on the methods used in each stage. The sequence should include the following:

- Erosion and sediment control installation;
- Erosion and sediment control certification by an appropriately qualified and experienced person;
- Staging;
- Progressive stabilisation; and,
- Decommissioning.

6 Erosion and sediment controls

6.1 Activity specific considerations

During this Section the general activities given in Table 6.1 will be completed. Table 6.1 includes the erosion and sediment control considerations and specific management measures that will be adopted whilst these activities are being undertaken.

Look at the general construction activities in Table 6.1 and remove any that are not relevant to this Section. Add any additional activities that are being completed within the Section. Add or elaborate on any considerations or management measures.

Table 6.1: Activity specific considerations

General construction activity	Erosion and sediment control considerations	Specific erosion and sediment management measures
Construction of tunnel portals	• Steep topography • Large cut volume • High volume of machinery movements • Constrained area	• Divert upslope clean water away from the disturbed area. • Minimise and contain the disturbed area. • Ensure site entry/exit points are well maintained. • Water treatment system sized for anticipated volumes. • Protection of downslope stormwater inlets. • Progressively stabilise completed areas. • Effective spoil management. See details for specific activity.
Excavations of tunnels	• Large volume of cut material • High volume of machinery movements • 24/7 operation	• Effective spoil management. See details for specific activity. • Implementation of CWTMP.

	• Largely underground with limited area exposed to surface • Groundwater interception	
Deep retained roadway trench	• Large volume of cut material. • Groundwater interception likely. • Water likely to be contained within depression.	• Divert upslope clean water away from the disturbed area. • Stage works to limit exposed area. • Proactively dewater depression. See details for specific activity. • Ensure site entry/exit points are well maintained.
Construction of bridge foundations and abutments, buildings, tanks, plant platforms, retaining and slope stabilisation system	• Isolated areas of disturbance.	• Divert upslope clean water away from the disturbed area. • Protection of downslope stormwater inlets. • Contain the disturbed area.
Utility diversions and drainage works	• Constrained area due to existing environment and associated requirements. • Isolated disturbance with low volume of earthworks. • Short duration.	• Divert upslope clean water away from the disturbed area. • Protection of downslope stormwater inlets. • Where possible, backfill and compact trenches within three days. • Progressive stabilisation. • Monitoring of weather forecast. Avoid opening trenches if there is a risk of high rainfall. • Manage stockpiled material. See details for specific activity. • Manage discharges from cement and concrete use.
Pavement reconstruction, widening, kerb and footpath realignment	• Limited earthworks and short duration. • Works implement final design stabilisation measures.	• Manage discharges from cement and concrete use.
Groundwater control and dewatering	• Potential for groundwater inflows during cut works. • Groundwater can become sediment-laden if it comes in contact with exposed soil. • Variable water volumes dependent on climatic variations. • Limited space to treat water.	• Implementation of CWTMP.
Spoil handling and stockpiling	• Potential for stockpiling throughout Project. • Large volumes during some Sections. • Predominantly cut material to be exported from site.	• Minimise the duration of stockpiled spoil by removing excess spoil from the site as soon as possible. • Where possible, load excavated material directly onto trucks to be removed from site. • Place stockpiles away from stormwater inlets.

6.2 Specific erosion and sediment controls

Based on the activities discussed in Table 6.1, the erosion and sediment control measures outlined in Table 6.2 and Table 6.7 will be implemented during the construction of this Section. In the tables below, delete the erosion and sediment controls that are not going to be implemented in this Section.

The location of the specified erosion and sediment controls in relation to the works is shown in the ESCP sheet/s attached as Appendix X.

Prepare and attach ESCP sheet/s. These should be prepared by an appropriately qualified person and include the following information:

- Extent of soil disturbance;
- The locations and where appropriate design of erosion and sediment controls;
- The contributing catchments;
- Areas of cut and fill;
- All stormwater inlets;
- Site boundaries;
- Contour lines; and,
- Any other relevant information.

All erosion and sediment controls will be installed and maintained in general accordance with industry best practice and/or the Guideline.

Table 6.2: Erosion controls

Erosion controls	Key design criteria	Key maintenance required	Relevant section of the Guideline
Clean water perimeter bunds and diversion channels	• Intercept and convey runoff away from the works area to stable outlets. Erosion damage potential is minimised by reducing the volume of water flowing over the site. • Calculate the size of the catchment draining to each “clean water” diversion channel or bund. If this area is > 5 ha then formally design the control in accordance with the design specifications of the Guideline. Include calculation and dimensions in this SSESCP. If catchment is < 5 ha then specify that the standard clean water diversion arrangement will be used. • May be constructed from earth (stabilised), hotmix or sandbags. Stabilised with no exposed surfaces. [Detail what stabilisation method will be used]. • Outlets must discharge water so that the erosion hazard to down-slope lands and waterways is no greater than that in the pre-development condition, up to the design storm event. • Include appropriate energy dissipation structures at the outlet of all diversions. [Detail what energy dissipation method will be used].	• Unless otherwise specified, inspect weekly and after every rainfall and during periods of prolonged rainfall for scour and areas where diversions may breach. Repair immediately, if required, to ensure that the design capacity is maintained. • Remove any accumulated sediment deposited in the diversion channel where there is a risk of overtopping due to a lack of freeboard. • Check invert and outlets to ensure that these remain free from scour and erosion. These points may require geotextile lining to avoid this effect. • Look for low spots, areas of water ponding, formation of tunnel gullies, sediment deposition and debris blockage. • Check for stabilisation cover and ensure full stabilisation cover remains where required. • Take particular care to protect against damage from earthmoving operations and reinstate the diversion if damaged.	E2.1
“Dirty water” diversion bunds	• Convey sediment-laden water within disturbed area and direct it to a sediment retention device to enable it to be treated. • Calculate the size of the catchment draining to each “dirty water” diversion channel or bund. If this area is > 5 ha then formally design the control in accordance with the design specifications of the Guideline. Include calculation and dimensions in this SSESCP. If catchment is < 5 ha then specify that the standard dirty water diversion arrangement will be used.	As above for clean water perimeter bunds and diversion channels.	E2.2

	• Is the longitudinal gradient of the “dirty water” diversion channel greater than 2%? If so, the control needs to be lined. Specify the stabilisation method that will be used. • Where practical, ensure a uniform grade along the invert of the diversion. • Outlets from all diversion must discharge to an appropriate sediment control device for treatment. [Specify what the receiving sediment control device is].		
Contour drains (cut-offs)	• Break overland flow draining down disturbed slopes by reducing slope length, thereby reducing the velocity and the erosive power of runoff. Temporary in nature. • Minimum compacted bank height of 250 mm and minimum total depth of 500 mm. • Is the longitudinal gradient of the contour drain greater than 2%? If so, the control needs to be lined. Specify the stabilisation method that will be used. • Broad enough to create a low-profile bank so that large earthworking machinery can safely cross (if this is not achievable, a dedicated crossing using a removable culvert can be used). [Specify is removable culverts will be used]. • Parabolic or square shape profile preferred to avoid potential erosion typically associated with "V" profiles. • Must discharge to a diversion channel. • Outlets may need to be lined with geotextile or other suitable material to prevent erosion. [Specify if contour drains will be lined, if so, detail what stabilisation method will be used]. • No individual drain should have more than 0.5 ha draining into it. [Calculate the size of the catchment draining to each contour drain to ensure this criteria is met].	• Repair or reinstate contour drains if damaged by machinery movement. • Inspect contour drains during rainfall or storms and repair as necessary. • Check the outfall for erosion and repair if required. It may be necessary to install a temporary flume or provide geotextile.	E2.3
Check dams	• Reduce the velocity of concentrated flows. • Constructed from loose rock, sandbags or silt socks. [Specify what material will be used].	• Repair or reinstate the check dams if destroyed by machinery movement. • Inspect the check dams after rainfall or storms and repair as necessary.	E2.4

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Specify the centre hight of the check dams based on the depth of the channels they will be constructed in. Refer to Table 6.3 to determine the appropriate spacing to be used, detail this.
All check dams must incorporate a spillway to direct flows over the centre of the structure with the spillway elevation at least 150 mm to 200 mm lower than the crest of the structure
To be effective, place check dams so that the toe of the upstream dam is at the same elevation as the centre height (spillway level) of the downstream dam.

Table 6.3: Check dam spacing
<table>
<tr><th>Slope of site</th><th>Spacing (m) between dams with a 450 mm centre height</th><th>Spacing (m) between dams with a 650 mm centre height</th></tr>
<tr><td><2%</td><td>24</td><td>30</td></tr>
<tr><td>2 – 4%</td><td>12</td><td>15</td></tr>
<tr><td>4 – 7%</td><td>8</td><td>11</td></tr>
<tr><td>7 – 10%</td><td>5</td><td>6</td></tr>
<tr><td>>10%</td><td>Unsuitable</td><td>Unsuitable</td></tr>
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Check if water is outflanking the structures and look for scouring around the edges of the check dams. If there is scouring, increase the centre height (spillway height) and/or turn up the edges of the structures.
If scour is occurring between check dams, then additional structures may need to be provided.
Check dams should be inspected for sediment accumulation after each significant rain event. Sediment should be removed when it reaches 40% of the original height or before this occurs.

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<td>Pipe drop structures and flumes</td>
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Convey a concentrated flow down a slope without causing erosion.
May be fabricated from needle-punched geotextile fabric, concrete, steel or plastic half-round pipes, rock, sandbags, lay-flat or construction ply.
Always use flumes/pipe-drop structures where slopes are steeper than 3:1 and where channelised surface runoff must be conveyed down the slopes.
The pipe-drop structure or flume should be impervious and must prevent water from flowing under the structure.
The height of the runoff diversion channel or bund (when measured from the invert) that is used to divert flows to the pipe-drop structure or flume must be at least 2× the pipe diameter or 2× the height of the flume.

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Inspect the pipe-drop structure or flume weekly and after each rain event and immediately carry out any maintenance required.
Keep the inlet open at all times.
Check for evidence of water bypassing, undermining or overtopping the pipe-drop structure or flume.
Check for scour at the base of the pipe-drop structure or flume, or in the receiving downstream area. If eroded, repair damage and install additional energy dissipation measures.
If downstream scour is occurring, it may be necessary to reduce flows being discharged into the device unless other preventative measures are implemented.

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	• The inlet to the flume or pipe should include a 1 m long stabilised entry apron (e.g. by using geotextiles) to minimise drawdown scour. This needs to be on at least a 3% grade. • The flume and pipe-drop structure should be extended beyond the toe of the slope being protected. The outfall should be appropriately protected with an energy dissipation device (e.g. geotextile, sand bags, rip-rap). **Pipe-drop structure** • Specify the catchment area draining to each pipe-drop structure and the pipe diameter to be used based on Table 6.4. • The pipe-drop structure should have: – A gradient no shallower than 3:1. [Specify minimum gradient]. – An inlet bank (made of compacted material) or wing walls at the inlet of the pipe that are a minimum of 2 × the height of the pipe-drop structure. [Specify the height of the pipe-drop structure]. – Adequate provision for securing the pipe-drop structure to the slope. As a minimum, the pipe-drop structure is to be anchored every 4 m.	• Extend the length of the pipe-drop structure or flume as earthworks progress and repair and/or modify the pipe-drop structure or flume as required. • Keep pipe-drop structures or flumes in place until runoff has been controlled and all disturbed areas have been stabilised, or until permanent stormwater systems have been commissioned. • Make sure that the pipe-drop structures or flumes do not result in ponding onto inappropriate areas (e.g. active traffic lanes, material storage areas, etc.).	

Table 6.4: Sizing criteria for pipe-drop structures

Pipe diameter (mm)	Maximum catchment area (ha)
150	0.05
300	0.2
450	0.6
600	1
Specific design required	>1

Flumes

• Specify the catchment area draining to each flume and the catchment slope based on Table 6.5. If the contributing

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<td>catchments exceed these thresholds, specific engineering design will be required.

The temporary flumes must provide:

An effective flume width of 1.5 m per ha of contributing catchment area. [Specify flume width].
Gradient no shallower than 3:1. [Specify minimum gradient].
Minimum of 2 × height of the flume of compacted material of inlet bank or wing walls at the top of the flume. [Specify height of the flume and height of inlet bank or wind walls at the top of the flume].
Minimum of 300 mm deep cut-off trench at top of flume to avoid undercutting the fabric.
Minimum of 300 mm flume sidewall height (or flume depth).

Geotextiles have maximum flow rate limitations; consult the manufacturer for proper selection. [Specify if geotextiles will be used and add in details as required].

Table 6.5: Sizing criteria for flumes
<table>
<tr><th>Catchment slope (%)</th><th>Maximum catchment area (ha)</th></tr>
<tr><td>>18%</td><td>2.5 ha</td></tr>
<tr><td><18%</td><td>5.0 ha</td></tr>
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<tr>
<td>Stabilised entranceways</td>
<td>
Prevent site access points and high traffic areas from becoming sources of sediment and assist in minimising dust generation and disturbance of road frontage by providing a defined entry and exit point.
Stabilised entranceways should be located at the permanent site entry/exit point.
Ensure the stabilised entrance drains back onto site. A speed hump can be used for this purpose.
Entry/exit points and laydowns will either be stabilised with concrete or compacted gravel. [Specify what will be used in this Section].
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<td>
Inspect weekly and after each rainfall event for general maintenance requirements.
Maintain the stabilised entranceway in a condition to prevent sediment from leaving the construction site.
After each rainfall, inspect any structure used to trap runoff from the stabilised entranceway and clean out as necessary.
Add further aggregate as necessary when mud blockage becomes evident or when aggregate thickness is not to specification.
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- Concrete to be used in high volume trafficked areas of the site to provide a durable and stable surface. In lower volume areas, compared gravel will be used.
- Where compacted gravel is used at entry/exit points the design specifications in Table 6.6 should be met.

Table 6.6: Stabilised entranceway specifications

<table>
<tr><th>Design parameter</th><th>Specification</th></tr>
<tr><td>Aggregate size</td><td>50 – 150 mm washed aggregate</td></tr>
<tr><td>Minimum thickness</td><td>150 mm</td></tr>
<tr><td>Minimum length</td><td>10 m</td></tr>
<tr><td>Minimum width</td><td>4 m</td></tr>
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- Remove sediment from sealed pavements by sweeping or vacuuming as necessary.
- Do not wash any sediment into the stormwater system or any watercourse.
- Supplementary street sweeping at regular intervals on adjacent roads may still be required in association with stabilised entranceways.

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<td>Final design</td>
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- Following the completion of works, final design stabilisation measures will be implemented. These include but are not limited to:
  - Pavement surfacing and road construction: Basecourse aggregate sealed with bitumen on carriageways, ramps, intersections and access roads.
  - Concrete surfacing including shotcrete and structural wall facings: In situ and precast concrete for tunnel linings and portals, kerbs and footpaths and retained cut slopes. Secant pile walls and retaining wall facings also form stabilised surfaces.
  - Gravel hardstand and maintenance surfaces: Compacted aggregate or gravel surfacing in maintenance access zones, beneath bridges, or on utility easements where permanent pavement is not required.
  - Planting and landscaping: Completed in accordance with planting plan when developed.

[Specify what will be used in this Section].

</td>
<td>Outside the scope of this ESMP.</td>
<td>N/A – best practice solution.</td>
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<td>Hydroseeding</td>
<td>

- Designed to establish vegetation quickly on steep and/or inaccessible areas or on surfaces with no or minimal topsoil.

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- Heavy rainfall can wash new hydroseeding away before vegetation is fully established. This is particularly evident on

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<td>E3.2</td>
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	• May be used on cut or fill batters, landscaped medians, and reinstated ground around tunnels, portals, and bridge abutments. [Specify what medium hydroseeding will be applied to in this Section]. • There are various hydroseed mixes that use soil ameliorants (substances that aid plant growth), paper or wood pulp. In some circumstances, a binder is used to help seeds adhere to the soil surface. [Specify if a binder will be used]. • Hydroseed mixes will vary greatly depending on the site-specific conditions and required outcome. Consultation with a hydroseeding contractor will be necessary to determine the seed mixes and application rates to achieve the required outcome. [Include details of hydroseeding contractor to be used as well as seed mix and application rate details]. • Where hydroseeding is used as an erosion control measure, the area of coverage is not considered stabilised until an 80% vegetative grass cover has been established.	smoother hard surfaces and overland flow paths. Where vegetation establishment is unsatisfactory, the area will require re-application of hydroseed, or consideration will need to be given to other stabilisation techniques • Water hydroseeded areas as necessary to promote growth, taking care to avoid washing the hydroseed away. • Protect all re-vegetated areas from construction traffic and other activities such as the installation of drainage and utility services.	
Turfing	• Provide rapid stabilisation by the placement of vegetative cover to exposed areas. Provides instant results from a visual and erosion control perspective. • May be used on cut or fill batters, landscaped medians, and reinstated ground around tunnels, portals, and bridge abutments. [Specify what medium hydroseeding will be applied to in this Section]. • Take care to ensure that flow velocities travelling over the turfed area will not cause erosion or undercut the turf. In these circumstances, which often relate to steeper areas, turf reinforced with geotextiles should be considered. • The type of turf utilised needs to be suitable to the ground conditions and final use. [Specify the type of turf that will be used].	• Water daily during the first week of laying the turf, unless there is adequate rainfall. Continue watering as appropriate to maintain good growth until fully established. • Check to ensure that the turf is firmly rooted to the original ground surface. Do not mow the area until the turf is firmly rooted.	E3.3
Geotextiles and erosion	• Instantly reduce the erosion potential of the disturbed areas and/or reduce or eliminate erosion on critical sites.	• Areas treated with temporary soil stabilisation should be inspected daily and after each rainfall event.	E3.5

control blankets	• For specific construction specifications, refer to the product information sheets supplied by the manufacturer. [Include construction specifications from manufacturer]. • In general, the minimum requirements for the various measures are as follows: Include the headings relevant to this Section from the below: **Non-woven geotextiles** • Temporary erosion control measure useful for surfaces receiving minor flows. Typical examples of their use include bund stabilisation, batter stabilisation, stockpile stabilisation, and low velocity channel stabilisation. • The main advantage of non-woven geotextiles is their ability to cling to the exposed surface. Their main disadvantage is their relative low strength. Where a high strength geotextile is needed (for instance in high flows), a woven geotextile should be used. **Woven geotextiles** • Used in high flow situations such as channels and flumes and as the upper fabric layer for pond spillways. For this, the woven geotextile must meet the following properties: – Material should be a woven polypropylene fabric with a minimum wide width tensile strength ≥ 14 kN/m (AS, ASTM or ISO test methods allowed). – The fabric should comply with a flow rate under 100 mm head of < 20 l/m²/sec (AS, ASTM or ISO test methods allowed). – Retained strength at 500h UV = 70% Minimum (AS, ASTM or ISO test methods allowed). – Correct use/installation of geotextiles is critical to achieving the desired outcome of erosion control. – Geotextiles should be secured in place with ground staples, pins or sandbags and keyed into the tops of slopes and edges to prevent infiltration of surface water under the geotextile.	• Areas treated with temporary soil stabilisation should be maintained to provide appropriate erosion control and reapplied or replaced on exposed soils when the area becomes exposed or exhibits visible erosion. The maintenance aspects to look for comprise: – Lifting geotextile caused by vegetation growing up under the fabric – Rilling caused by water flowing beneath the geotextile – Torn geotextile, missing pins or other damage caused by high winds, machinery or vandalism. Repair or replace any areas of geotextile damaged or dislodged in any way. If required, erect a temporary barrier and/or signage fencing to restrict uncontrolled movement of equipment and vehicles onto treated areas.	

	– Particular care is needed to overlap and pin geotextiles in place. – In all circumstances, pin geotextiles down on a 500 mm (min) grid. This is critical to ensure an appropriate number of contact points with the underlying soil. It will also prevent wind from lifting the geotextile from the slope it is protecting. – Ensure that pins are suitable for the geotextile and soil type. **Plastic covers** • Used to prevent water from penetrating into the material covered (e.g. contaminated stockpiles, or stockpiles of material for reuse). • Plastic sheeting should have a minimum thickness of 0.25 mm. It should be keyed in at the top of the slope and held firmly in place with sandbags or other weights placed no more than 3 m apart. • Seams are typically taped or weighted down their entire length with at least a 300 mm – 600 mm overlap of all seams. • Edges should be embedded a minimum of 150 mm into the soil.		

Table 6.7: Sediment controls

Sediment controls	Key design criteria	Key maintenance required	Relevant section of the Guideline
Water treatment system	• Remove suspended solids, hydrocarbons and settable matter from surface water and groundwater so it is suitable for discharge into stormwater system. • To be appropriately sized for the volume and flow rate of water requiring treatment. • Detail the water treatment system to be used. Include calculations for the volume of water requiring treatment and the treatment rate of the selected device. Outline where the system will discharge to and contingency measures for water if there is insufficient capacity.	• Selected water treatment system is to be operated and maintained in accordance with the design specifications. [Include maintenance details provided by supplier]. • Monitor discharged water to ensure it meets required stormwater discharge quality.	N/A – best practice solution
Allowing ponding within excavations	• Detain and attenuate runoff flows. • Specify the approximate volume of water that can be contained within the depression.	• Inspect depressions at least once a week and after each rainfall. • Ensure more than 50% capacity remains within the depressions. If required, dewater depressions in accordance with the CWTMP. • Clean out depressions before the volume of accumulated sediment reaches 20% of the total depression volume. • Clean out depressions with high-capacity sludge pumps or with excavators, loading onto sealed top trucks or to a secure area.	N/A – best practice solution
Coagulant and flocculant treatment	• Used to improve the efficiency of sediment retention devices. • Batch treatment to be built into water treatment system to support its function. • Chemical treatment to be completed in accordance with a Chemical Treatment Management Plan (CTMP). Attach CTMP to this plan.	• Selected chemical treatment system is to be operated and maintained in accordance with the design specifications. • Monitor discharged water to ensure it meets required stormwater discharge quality.	F2.0
Silt fences	• Detain runoff flows so that deposition of transported sediment can occur through settlement.	• Inspect silt fences at least once a week and after each rainfall.	F1.3

	• Ensure silt fence height is 600 mm above ground level and 200 mm below ground level. • Specify the slope length, spacing of returns and angle for the silt fences based on Table 6.8. • Locate supporting posts/waratahs for silt fences 2–4 m apart with support provided by a tensioned wire (2.5 mm HT) along the top of the silt fence. • Where a strong woven fabric is used in conjunction with a wire support, the distance between posts can be up to 4 m. Double the silt fence fabric over and fasten to the wire with silt fence clips at 500 mm spacings. • Ensure supporting posts/waratahs are embedded a minimum of 400 mm into the ground. • Always install silt fences along the contour (at a break in slope). Where this is not possible, or where there are long sections of silt fence, install short silt fence returns projecting up-slope from the silt fence to minimise the concentration of flows. Silt fence returns should be a minimum 2 m in length and can incorporate a tie-back. They are generally constructed by continuing the silt fence around the return and doubling back, eliminating joins. • Join lengths of silt fence by doubling over fabric ends around a waratah or by stapling the fabric ends to a batten and butting the two battens together. • Install silt fence returns at either end of the silt fence, Projecting up-slope to a sufficient height to prevent outflanking. • Specify the size of the catchment that the silt fence is servicing. If the catchment is greater than 0.3 ha consider additional or alternative controls. • Where water may pond regularly behind the silt fence, provide extra support for the silt fence with tie-backs from the silt fence to a central stable point on the upward side. Extra support can also be provided by stringing wire between support stakes and connecting the filter fabric to this wire. • As a minimum, the silt fence cloth must meet the following criteria for geotextile fabric: – Wide width tensile strength ≥ 14 kN/m minimum (AS, ASTM or ISO test methods allowed) – Retained strength at 500h UV = 70% minimum (AS, ASTM or ISO test methods allowed)	• Check for damage including rips, tears, bulges in the fabric, broken support wires, loose waratahs, overtopping, outflanking, undercutting, and leaking joins in fabric. • Make any necessary repairs as soon as identified. • As the geotextile material becomes clogged with sediments, this will result in increased duration of ponding. Therefore, careful cleaning of the silt fence geotextile with a light broom or brush may be appropriate. • Remove sediment when bulges occur or when sediment accumulation reaches 20% of the fabric height. • Remove sediment deposits as necessary (prior to 20% of fabric height) to continue to allow for adequate sediment storage and reduce pressure on the silt fence. • Dispose of sediment to a secure area to ensure that it does not discharge to the receiving environment.	

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<td>– Opening size (EOS) = 0.2–0.4 um (AS, ASTM or ISO test methods allowed).

Table 6.8: Silt fence design criteria
<table>
<tr><th>Slope steepness (%)</th><th>Slope length (m) (maximum)</th><th>Spacing of returns (m)</th><th>Silt fence length (m) (maximum)</th></tr>
<tr><td>Flatter than 2%</td><td>Unlimited</td><td>N/A</td><td>Unlimited</td></tr>
<tr><td>2 – 10%</td><td>40</td><td>60</td><td>300</td></tr>
<tr><td>10 – 20%</td><td>30</td><td>50</td><td>230</td></tr>
<tr><td>20 – 33%</td><td>20</td><td>40</td><td>150</td></tr>
<tr><td>33 – 50%</td><td>15</td><td>30</td><td>75</td></tr>
<tr><td>> 50%</td><td>6</td><td>20</td><td>40</td></tr>
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<tr>
<td>Super silt fences</td>
<td>• Detain runoff flows so that deposition of transported sediment can occur through settlement.
• Ensure super silt fence height is 800 mm above ground level.
• Specify the slope length, spacing of returns and angle for the silt fences based on Table 6.9.
• Always install super silt fences along the contour (at a break in slope). Where this is not possible, or where there are long sections of super silt fence, install short silt fence returns Projecting up-slope from the silt fence to minimise the concentration of flows. Silt fence returns should be a minimum 2 m in length and can incorporate a tie-back. They are generally constructed by continuing the silt fence around the return and doubling back, eliminating joins.
• Join lengths of silt fence by doubling over fabric ends around a waratah or by stapling the fabric ends to a batten and butting the two battens together.
• Install silt fence returns at either end of the silt fence, Projecting up-slope to a sufficient height to prevent outflanking.
• Specify the size of the catchment that the silt fence is servicing. If the catchment is greater than 0.5 ha consider additional or alternative controls.
• Outline that the length of the super silt fence meets the limits shown in Table 14 of the Guideline.
• Where the ends of the geotextile fabric come together, overlap, fold and staple the fabric ends to prevent sediment bypass.</td>
<td>Same as above for silt fences.</td>
<td>F1.4</td>
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- The geotextile fabric must meet the following requirements:
  - Wide width tensile strength ≥ 14 kN/m minimum (AS, ASTM or ISO test methods allowed)
  - Retained strength at 500 h UV = 70% minimum (AS, ASTM or ISO test methods allowed)
  - Opening size (EOS) = 0.2–0.4 um (AS, ASTM or ISO test methods allowed)
- Super silt fence wire mesh shall consist of a knotted or welded wire mesh. The knotting or welding process shall not leave any shape or protruding objects that may damage the super silt fence fabric when installed. The wire mesh must meet the following requirements:
  - Wire diameter = 1.5 mm minimum
  - Mesh aperture = 100 mm maximum
  - Mesh height = 1 m minimum
  - Coating = Galvanised or zinc coated.

Table 6.9: Super silt fence design criteria

<table>
<tr><th>Slope steepness (%)</th><th>Slope length (m) (maximum)</th><th>Spacing of returns (m)</th><th>Super silt fence length (m) (maximum)</th></tr>
<tr><td>0 – 10%</td><td>Unlimited</td><td>60</td><td>Unlimited</td></tr>
<tr><td>10 – 20%</td><td>60</td><td>50</td><td>450</td></tr>
<tr><td>20 – 33%</td><td>30</td><td>40</td><td>300</td></tr>
<tr><td>33 – 50%</td><td>30</td><td>30</td><td>150</td></tr>
<tr><td>> 50%</td><td>15</td><td>20</td><td>75</td></tr>
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<tr>
<td>Silt socks</td>
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- Temporarily impound sediment-laden runoff, slowing the flow rate and allowing sediment to settle out of the water.
- Specify the size of the silt sock to be used based on the design criteria in Table 6.10 and Table 6.11.
- Specify the medium used in the silt sock (bark, sawdust or straw) and ensure this is free from contaminants and meets the specification in Table 6.12.
  - Bark specification: Use 2–10 mm chip. Ensure bark is free from contaminants.

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- Silt socks should be inspected regularly and after each rainfall event to ensure sediment control efficiency is maintained.
- Accumulated sediment greater than 20% of the height of the silt sock should be removed, or another silt sock placed on top of the existing silt sock to maintain adequate sediment control.

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- – Sawdust specification: Do not use treated wood sawdust. Ensure sawdust is free from contaminants.
- – Straw specification: Ensure straw is free from weed seeds and contaminants.

Table 6.10: 300 mm diameter silt sock

Slope steepness (%)	Slope length (m) (maximum)	Spacing of returns (m)
<2%	100	N/A
2 – 10%	40	30
10 – 20%	30	25
20 – 33%	10	10
33 – 50%	5	10
> 50%	2	5

Table 6.11: 400 mm diameter silt sock

Slope steepness (%)	Slope length (m) (maximum)	Spacing of returns (m)
<2%	150	N/A
2 – 10%	60	30
10 – 20%	40	25
20 – 33%	20	10
33 – 50%	10	10
> 50%	5	5

Table 6.12: Specifications for compost

Parameter	Unit of measure	Specification
pH	pH units	5.0 – 8.5
Moisture content	% wet weight basis	>60
Organic matter content	% dry weight basis	25 – 100

- Reuse of silt socks is possible provided the integrity of the sock and fill media is maintained.

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<td><table><tr><td>Particle size</td><td>% passing a selected mesh size, dry weight basis</td><td>50 mm 99% passing; 10 mm 30 – 50% passing (or 50 – 70% retained); maximum 50 mm</td></tr></table></td>
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<tr>
<td>Stormwater inlet protection</td>
<td>• Intercept and filter sediment-laden runoff before it enters reticulated stormwater system.
• Complete blocking of the stormwater system must be avoided, as this will divert flows during heavy rain and may cause other devices to become overwhelmed and/or create flooding hazards.
• The height of catchpit protection within live road environments must be less than the kerb height so that runoff does not cause local flooding and/or direct flows to other nearby catchments. [Specify the maximum height of the catchpit protection].
• Specify the type of catchpit protection, options include low sandbag check dams and silt socks. Select the appropriate text from the bullets below.
– A series of low sandbag check dams can be installed up the gutter from the catchpit to act as a series of small sediment traps. Check dams require a spillway lower than the kerb to ensure that runoff does not encroach onto the berm area and cause scouring. They should comprise up to six sandbags laid end to end, with no gaps, in an arc away from the kerb and up the road to create a series of impoundment areas. This measure is only suitable for very small catchment areas.
– A silt sock can be placed around the inlet to act as a small sediment trap immediately up-slope of the catchpit. The silt sock needs to completely ‘ring fence’ the catchpit. This measure is only suitable for very small catchment areas.</td>
<td>• Maintenance will vary according to the type of inlet protection.
• Inspect daily and during and after rainfall events.
• Beware of blockages and leaks that may affect performance.
• Check to see if flows have been diverted away from the device and what, if any, damage has been caused.
• Clean all accumulated sediments immediately.
• Repair and modify any problems immediately.
• Remove devices as soon as works are complete.</td>
<td>F1.6</td>
</tr>
</table>

7 Inspections and monitoring

7.1 Rainfall monitoring

A telemetered rainfall monitoring station will be installed on site prior to works commencing to provide real-time continuous rainfall intensity and volume data which is able to be observed online by Project personnel. [Specify the location of this monitoring station, include coordinates and proximity (m) to works area].

During works, Contractors will regularly monitor the weather forecast for significant rain events. A significant rain event is defined as ≥25 mm in 24 hours or ≥15 mm in 1 hour.

Within 12 hours following a significant rainfall event, the erosion and sediment controls will be inspected, subject to health and safety requirements in accordance with Section 7.2.

7.2 Erosion and sediment control inspection and maintenance

Erosion and sediment control inspections will be undertaken by an experienced and appropriately qualified person to ensure they are functioning as intended and meet the requirements given in Table 6.2 and Table 6.7 at all times during works and until the site is stabilised.

Inspections will occur weekly and within 12 hours following significant rain events, subject to health and safety requirements.

Inspections will be recorded in Appendix E. Any actions that are identified as part of an inspection including maintenance of devices, sediment removal and repairs will be carried out within 24 hours, or as soon as safely practical. If an inspection identifies a sediment-laden discharge across the boundary of the site, the discharging water should be sampled using the method outlined in Section 7.3 and the contingency measures outlined in Section 7.4 should be implemented.

7.3 Stormwater discharge monitoring

Stormwater discharge monitoring will be undertaken at:

- The outlets of all discharging sediment retention devices; and,
- In the event of an unexpected or non-compliant discharges across the boundary of the site.

[Specify the names and locations of the water treatment devices with potential to discharge].

[Specify the frequency of regular sampling from discharging water treatment devices].

Samples will be analysed for the parameters given in Table 7.1. The samples will be placed on ice as soon as possible after collection and delivered to an IANZ accredited laboratory for testing. Results will be compared to the trigger levels given in Table 7.1.

If laboratory results show one or more of the parameters in exceedance of the trigger levels, then the contingency measures outlined in Section 7.4 should be completed.

Table 7.1: Stormwater quality monitoring

Parameter	Trigger level
Total suspended solids*	100 mg/L
pH	6.0 – 9.0
Dissolved aluminium	0.15 mg/L

Total petroleum hydrocarbons (TPH)	15 mg/L

Note: *Turbidity can be used as an alternative to total suspended solids if a relationship between the two can be formed using laboratory testing.

7.4 Contingency measures

If at any time during construction, an unexpected or non-compliant discharge occurs, the following actions will be taken:

- Immediate cessation of the activity causing the discharge;
- Complete a visual inspection for any:
  - Change in colour or clarity at the point of the discharge;
  - Presence of any scums or foams; or,
  - Any evidence of sediment deposition at the area surrounding the point of discharge.
- Complete stormwater discharge monitoring in accordance with Section 6.3. If the results of this monitoring indicate effects, then further grab samples will be collected for laboratory analysis and a Marine Ecologist will be contracted to provide further advice.
- Complete the environmental incident form attached to the ESMP;
- Notify GWRC within 12 hours of the incident occurring; and,
- Complete response actions which may be required as recommended by the Marine Ecologist.

Works within the affected catchment will only recommence when actions have been undertaken to ensure the cause of the incident is resolved.

8 Applicability

This management plan has been prepared for the exclusive use of our client NZ Transport Agency Waka Kotahi, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this management plan and other approvals) via the Fast-track Approvals Act 2024 and that the Environmental Protection Authority, an expert consenting panel, Greater Wellington Regional Council and others invited to comment on the application will use this management plan or the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Caitlin Dalziel Environmental Consultant	Jan Noering Project Director

CAID
https://nztransportagency.sharepoint.com/sites/extronssh1wip-grp365/shared documents/02 pre-implementation/06. consenting & ftaa legal/specialists/specialist reports/erosion and sediment control/20260806_sh1_wellington_high-level_escp_final.docx

Appendix E Inspection record

Edit inspection record below to include only the items relevant to the specific erosion and sediment controls to be used in this Section. Add additional monitoring requirements as needed.

Inspection time and date	
Inspector	
Weather over last 7 days (incl. peak rainfall (mm))	
Photos taken? (File refs)	

Control inspection item	**Status (Y/N/NA)**	**Corrective action**	**Person responsible**	**Due date**	**Completed (date/initials)**
"Clean water" and "dirty water" diversion channels and bunds					
Design capacity maintained; no signs of scour or potential breach.					
Accumulated sediment removed where freeboard is reduced (overtopping risk).					
Invert and outlets free of scour/erosion; install geotextile lining if recurring.					
No low spots, ponding, tunnel gullies, sediment build-up, or debris blockage.					
Stabilisation cover present and intact where required.					
Protected from earthmoving; any damage reinstated promptly.					
Contour drains (cut-offs)					
Intact and correctly graded; machinery damage repaired/reinstated.					
Outfall stable; no erosion. Temporary flume or geotextile installed if needed.					
Functioning during wet periods without overtopping or bypass.					
Check dams					

Dams in place and stable; machinery damage repaired/reinstated.					
No outflanking; no scour around edges. Raise spillway and/or turn up edges if needed.					
No scour between check dams; add additional structures if scour noted.					
Sediment level below 40% of original dam height; remove if ≥40% (or earlier if needed).					
Pipe drop structures and flumes					
Inlet open/clear at all times.					
No bypassing, undermining, or overtopping observed.					
No scour at base or downstream; install/upgrade energy dissipation if needed.					
If downstream scour present, reduce inflow unless other controls are implemented.					
Length extended to match current earthworks; repairs/modifications completed as needed.					
Still required and in place until runoff is controlled or permanent systems commissioned.					
No ponding onto traffic lanes, storage areas, or other inappropriate areas.					
Stabilised entranceways					

Entranceway prevents sediment tracking off site.					
Runoff traps intact and cleaned out after rain.					
Aggregate added where mud blockage evident or thickness below specification.					
Adjacent sealed pavements clean (swept/vacuumed); no washing sediment to stormwater/watercourses.					
Supplementary street sweeping scheduled/performed if required.					
Hydroseeding					
Coverage intact; no washouts on smooth/hard surfaces or flow paths. Reapply or use alternative stabilisation where establishment is poor.					
Watering as needed without dislodging hydroseed.					
Protected from construction traffic and utility/drainage works.					
Turfing					
Watering adequate (daily during first week after laying; then as needed until established).					
Turf firmly rooted to subgrade; mowing deferred until firmly rooted.					
Joints tight; no slips, bare spots, or significant weeds/pests.					
Geotextiles and erosion control blankets					

Coverage continuous/effective; reapply/replace where soils are exposed or erosion visible.					
No lifting from vegetation growth beneath fabric.					
No rilling from water flowing beneath fabric.					
Fabric intact; no tears; pins/staples present; no wind/machinery/vandalism damage.					
Barriers/signage in place to prevent equipment/vehicle traffic over treated areas, if needed.					
Water treatment system					
Operate and maintain selected system per design/specifications (include supplier maintenance details).					
Monitor discharged water meets required stormwater discharge quality.					
Coagulant and flocculant treatment					
Operate and maintain chemical treatment system per design/specifications.					
Monitor discharged water meets required stormwater discharge quality.					
Silt fences					
Inspect at least weekly and after each rainfall.					
Check for rips/tears/bulges, broken support wires, loose stakes, overtopping, outflanking,					

undercutting, and leaking joins; repair immediately.					
If ponding duration increases (geotextile clogging), lightly broom/brush fabric where appropriate.					
Remove sediment when bulges occur or when accumulation reaches 20% of fabric height (or earlier to maintain storage and reduce pressure).					
Dispose of removed sediment to a secure area preventing discharge to receiving environment.					
Silt socks					
Inspect regularly and after each rainfall event to maintain efficiency.					
Remove accumulated sediment when >20% of sock height, or place a second sock on top to maintain control.					
Reuse only if sock and fill media integrity is maintained.					
Stormwater inlet protection					
Confirm daily and post-rain inspections are occurring; beware of blockages and leaks that may affect performance.					
Check for diverted flows or damage; clean accumulated sediment immediately; repair/modify problems immediately.					
Remove devices as soon as works are complete.					

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Appendix F Draft Construction Water Treatment Management Plan

Placeholder only

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