RiverLink

RiverLink

Notices of Requirement for Designations and Applications for Resource Consent

Volume Four: Supporting Technical Reports

Technical Report #3

Construction Water Quality and Erosion and Sediment Control Plan

IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Resource consent applications under section 88, and Notices of Requirement under section 168, of the Act in relation to the RiverLink project
BY	**Waka Kotahi NZ Transport Agency** Requiring Authority **Greater Wellington Regional Council** Requiring Authority **Hutt City Council** Requiring Authority

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RIVERLINK
TECHNICAL ASSESSMENT # 3
CONSTRUCTION WATER QUALITY AND EROSION SEDIMENT CONTROL

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1. INTRODUCTION

1.1 Edryd Deiniol Breese.

1. My name is Edryd Deiniol Breese.

2. I am a Senior Environmental Management Consultant and Partner at Tonkin and Taylor Limited an Engineering and Environmental Consultancy.

3. The preparation of this report has been in collaboration with my colleague at Tonkin and Taylor Alistair Gordon a Civil Engineer.

4. I have been assisted by Gary Williams in river design and geomorphology, Andrew Whaley in construction methodology, Patrick Lees in aquatic ecology, Jacqui Bell in marine ecology, Dr Murray Wallis in environmental management, and Alistair Gordon in environmental/civil engineering. I have also consulted with Gregor McLean, GWRC's regulatory teams' expert erosion and sediment control advisor.

1.2 Qualifications and experience

5. I hold the qualifications of a Bachelor of Arts (University of Canterbury), Diploma of Natural Resources (Lincoln College), and a Masters of Business Administration (Massey University). I have also completed a post graduate course in Environmental Nuisances at the Environmental Technology Centre of the University of Manchester Institute of Science and Technology and completed the Auckland Regional Council's course on sediment control and flocculation.

6. I have over 40 years' experience working in the fields of environmental impact assessment and environmental management. This experience has included wind farms, geothermal power, mining, roading, river management, solid waste, hydroelectricity, and forestry projects. On these projects I have been involved in the following activities:

   i. the collection of baseline information to characterise the existing environment;

   ii. the preparation of the Assessment of Environmental Effects;

   iii. preparation of environmental management plans including Erosion and Sediment Control Management Plans;

   iv. the onsite environmental management of construction activities; and

   v. construction monitoring and auditing.

7. Relevant experience working on major projects in the Wellington Region includes:

   i. Environmental Quality Manager on behalf Juno Civil Limited for the Duplicate Paremata Bridge State Highway 1. I was responsible for the preparation of the Construction Environmental Management Plan and auditing of construction activities to ensure compliance with the plan.

   ii. Environmental Systems Manager on behalf of Higgins Contractors Limited for the four-laning of the rural and urban sections of State Highway 1 from the Weigh Station to Paremata Roundabout. I was responsible for the preparation of the Construction Environmental Management Plan and auditing of construction activities to ensure compliance with the plan.

   iii. Environmental Quality Systems Manager on behalf of Higgins Contractors Limited for the upgrading of State Highway 2 from Kaitoke to Te Marua. I was responsible

for the preparation of the Erosion and Sediment Control Plans and the Construction Environmental Management Plan, and auditing of construction activities to ensure compliance with these plans.

iv. Advisor to Fulton Hogan Limited for Wellington's Inner City Bypass. I was responsible for the preparation of the Erosion and Sediment Control Master Plan, the preparation of the Stage 1 Erosion and Sediment Control Plan and provision of advice on an as required basis.

v. Environmental Management Advisor to Meridian Energy for Project West Wind and Mill Creek at Makara. I was responsible for characterising the existing environment prior to construction, preparation of the Environmental Management Plan, assisted in the preparation of the Supplementary Environmental Management Plans, and auditing construction activities.

vi. Environmental Manager for the establishment of construction activities for the Haywards interchange on SH1 for Downer Construction. This included the preparation of Erosion and Sediment Control Management Plans.

vii. Environmental Manager for Fletcher Construction for the establishment of the Peka to Otaki expressway. This role required oversight of the preparation of all environmental management plans and monitoring plans. I still act as a reviewer of Environmental Monitoring Reports.

viii. Environmental Manager for the Memorial Park Alliance and Mt Messenger Alliance. I have responsibility for ensuring compliance with designation and resource consent conditions.

ix. Environmental advisor to GWRC for resource consents to discharge to the Te Awa Kairangi from the Te Marua waste water treatment plant, increase the water take from the Te Awa Kairangi, and Te Awa Kairangi flood management activities consents.

1.2.1 Code of Conduct

8. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. 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.

1.2.2 Purpose and scope of assessment

9. The purpose of this assessment is to determine and address the potential for erosion and sediment generation associated with construction of the RiverLink Project. My assessment addresses the following matters:

i. description of the baseline water quality, related to sediment transportation process and turbidity, in the existing environment;

ii. the potential for construction activities to cause erosion and generate sediment discharges into the receiving environment;

iii. the potential adverse effects of erosion and sediment discharges into the receiving environment;

iv. identification of opportunities and best practise measures for avoidance, minimisation and/or mitigation of erosion and sediment discharges; and

v. preparation of an overarching (draft) Erosion and Sediment Control Plan (ESCP), example Site Specific Erosion and Sediment Control Plan (SSESCP),[1] Chemical Management Plan (CMP), and proposal of consent conditions.

10. I have visited the site on a number of occasions including a site visit on 24/02/21 with GWRC erosion and sediment control specialist Gregor McLean and Project geomorphologist Gary Williams.

11. Discussions were carried out with the following experts:

    i. Andrew Whaley (civil engineer) about construction methodologies and best practise;

    ii. Patrick Lees (ecologist) about aquatic ecology and effects of sediment on biodiversity;

    iii. Dr Jacqui Bell (ecologist) about marine ecology and effects of sediment on biodiversity;

    iv. Gary Williams (river engineer) about sediment processes and geomorphology; and

    v. Dr Murray Wallis (environmental scientist) about environmental management practises.

12. The following supporting information is attached to this report:

    i. Appendix A – Draft Erosion and Sediment Control Plan;

    ii. Appendix B – Draft Site Specific Erosion and Sediment Control Plan – Example for Riverbank Construction; and

    iii. Appendix C – Draft Chemical Management Plan

2. EXECUTIVE SUMMARY

2.1 Scope

13. This technical assessment considers the potential for erosion and generation of sediment discharges during the construction phase of the RiverLink Project and considers associated potential adverse effects. It outlines recommended measures to avoid and minimise erosion and sediment generation and to avoid, remedy or mitigate any adverse effects.

2.2 Existing Environment

14. The existing environment can be characterised as four distinct areas:

    i. the Eastern Hutt city centre and environs – which includes car parks and commercial and domestic properties;

    ii. the Western Transport Corridor - which includes State Highway 2 (SH2), Melling intersection, Petone to Melling rail link, Melling Railway Station, and a combination of commercial and domestic properties;

    iii. the Te Awa Kairangi – the area between the East and West stopbanks which includes the active river channel, riverbed and grassed and treed floodplains and Tirohanga Stream; and

    iv. the downstream Te Awa Kairangi and Te Whanganui-a-Tara/Wellington Harbour.

[1] The intention is that the full suite of SSESCPs will be prepared post-consenting.

2.3 Existing water quality

15. During low and normal flows, the Te Awa Kairangi runs predominantly clear with very little sediment transport. The majority of sediment transport, be that material bouncing along the bed or floating in suspension, occurs during flood events. As a result, the water quality of the river is a function of the 650 km^2 contributing catchment and becomes affected by sediment in temporary and sporadic events which vary in duration, magnitude and location depending on the nature of contributing rainfall events. For example, a one-year Annual Return Interval (ARI) flow event can generate suspended sediment concentrations of 780 mg/L (Cameron, 2016).

16. In addition to naturally occurring flood events, river water quality has been and continues to be influenced by flood protection works and various discharges into the river. The flood protection works include extraction of bed material, construction of edge erosion protection and channel reprofiling. The majority of these activities are undertaken under a granted Resource Consent for maintenance works.

17. Water quality in tributaries to the West of the Project area, including the Tirohanga Intersection Stream has been assessed based on inferences from similarly steep hill catchments, which consist of a mix of vegetated bush and residential development. The annual sediment load is estimated to be between 6-26 m^3. Water quality is typically clear during median and low flows but becomes affected by sediment and road runoff during rainfall events.

18. There are a number of storm water channels pipes on both the east and west side of the Te Awa Kairangi which discharge into to the river. These discharges are either pumped or gravity feed through pipes, some of which have flap gates to prevent back flow during high river levels. Limited data is available to assess water quality at the outlets of the stormwater network.

2.4 Assessment undertaken

19. The assessments undertaken included the following:

    i. review of all proposed construction activities to determine potential for erosion and sediment discharges.

    ii. identification of potential adverse effects of erosion and sediment discharges on the receiving environments.

    iii. identification of opportunities to avoid, minimise or mitigate erosion and sediment discharges and best practice guidance.

20. The outcome from the above assessment processes include:

    i. this report; and

    ii. preparation of a Draft ESCP and example draft SSESCP and supporting documentation.

2.5 Potential adverse effects

21. Potential adverse effects relate to:

    i. Discharge of sediment which has an adverse effect on water quality, the aquatic habitat and biodiversity.

    ii. Discharge of sediment which has an adverse effect on the natural form and character of the Te Awa Kairangi Mouth, Petone Beach and Te Whanganui-a-Tara/Wellington Harbour.

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

22. Measures proposed to address those potential adverse effects are:

    i. Preparation of an overarching ESCP based on current best practice guidance documents in order to:

        a. avoid, minimise or mitigate erosion and sediment discharges associated with construction activities as much as possible; and

        b. follow the established ESC principles to avoid, minimise, treat, monitor, and adapt to erosion and sediment discharges.

    ii. meet objectives O24 and O25 of the Proposed Natural Resources Plan (PNRP) and the relevant policies and rules of the Regional Policy Statement, the PNRP and the existing regional plans.

    iii. Preparation of SSESCPs to address individual construction elements.

    iv. Minimisation of the area of disturbance of all activities areas through staging and rapid stabilisation. This includes undertaking construction activities in a staged and confined manner with sufficiently small footprint and durations.

    v. Removing or capping areas of silts and clays with potential for sediment generation within the river corridor.

    vi. Minimising the requirement to work in the river channel through a progressive staging approach and where possible working in the dry.

    vii. Avoidance of works in the River Corridor during time periods sensitive to the ecological value of the River. Where avoidance is not possible site specific measures will be considered as part of the SSESCP preparation to minimise adverse effects.

    viii. Where possible, bunds will be installed in the river channel to create areas of standing water which are separate from flowing water. This provides two benefits:

        a. reduces the ability for flow to generate sediment; and

        b. prevents the downstream transport of sediment.

    ix. Treatment of sediment discharges from construction activities outside the River Corridor using structural devices and chemical treatment where reasonably practicable.

    x. Monitoring, using continuous turbidity sensors and grab sampling, to ensure ESC measures meet the Project performance criteria and to deploy adaptive management measures to encourage innovative construction techniques and continuous improvement of ESC measures.

xi. Regular review of monitoring information and updating the ESCP and SSESCPs as required.

xii. Adhering to proposed conditions of consent for the duration of the Project.

2.7 Summary of effects

23. Provided the measures to avoid, remedy or mitigate adverse effects outlined above are followed, the actual and potential adverse effects of erosion and sediment discharges can be managed to a negligible or low level with any actual or potential effects restricted to short term effects within the construction period.

3. PROJECT DESCRIPTION

3.1 Introduction

24. A full project description is available in the Assessment of Environmental Effects Report ("AEE"). The following section relies on excerpts of the AEE relevant to my assessment of effects.

25. The Project is the design, construction, operation and maintenance of RiverLink. Key components of the project are as follows:

    i. Upgrade and raising of existing and construction of new stopbanks on both sides of Te Awa Kairangi between Ewen Bridge and Mills Street;

    ii. Instream works between the Kennedy Good and Ewen Bridges to re-align, deepen and widen the active river channel;

    iii. The replacement of the two signalised at-grade intersections of SH2/Harbour View Road/Melling Link and SH2/Tirohanga Road with a new grade separated interchange;

    iv. Construction of an approximately 215 m long and up to 7 span road bridge with a direct connection across the River from the new interchange to Queens Drive;

    v. Removal of the existing Melling Bridge;

    vi. Changes to local roads;

    vii. Changes to the Melling Line rail network and supporting infrastructure;

    viii. Construction of an approximately 177 m long and 4 span pedestrian/cycle bridge over the River;

    ix. Construction of a promenade located along the stopbank connecting with future development, running between Margaret Street and High Street. This includes new steps and ramps to facilitate access between the city centre and the promenade;

    x. Integration of infrastructure works with existing or future mixed-use development

    xi. Associated works including construction and installation of culverts, stormwater management systems, signage, lighting, network utility relocations, landscape and street furniture, pedestrian/cycle connections and landscaping within the project area.

3.2 River works

26. The project requires full re-shaping of the riverbed to set the channel shape and establish a new natural meander pattern suitable for a widened channel. The re-shaping requires the removal of gravel and vegetation across the full extent of the river corridor between Kennedy Good and Ewen Bridges. As described in more detail in Technical Assessment No. 5 Geomorphology Report, the overall purpose of the river works is to:

    i. increase the standard of flood protection along the Project length between Kennedy-Good and Ewen Bridges; and

    ii. achieve a better balance between the natural behaviour of the river and the measures used to manage the river, which require intervention through maintenance activities. In particular, the Project aims to contain natural sediment deposition which requires removal to the upper reach of the Project, improve bank protection against erosion, and minimise the sediment maintenance requirements in the lower reach. The reach locations are shown below in Figure 1.

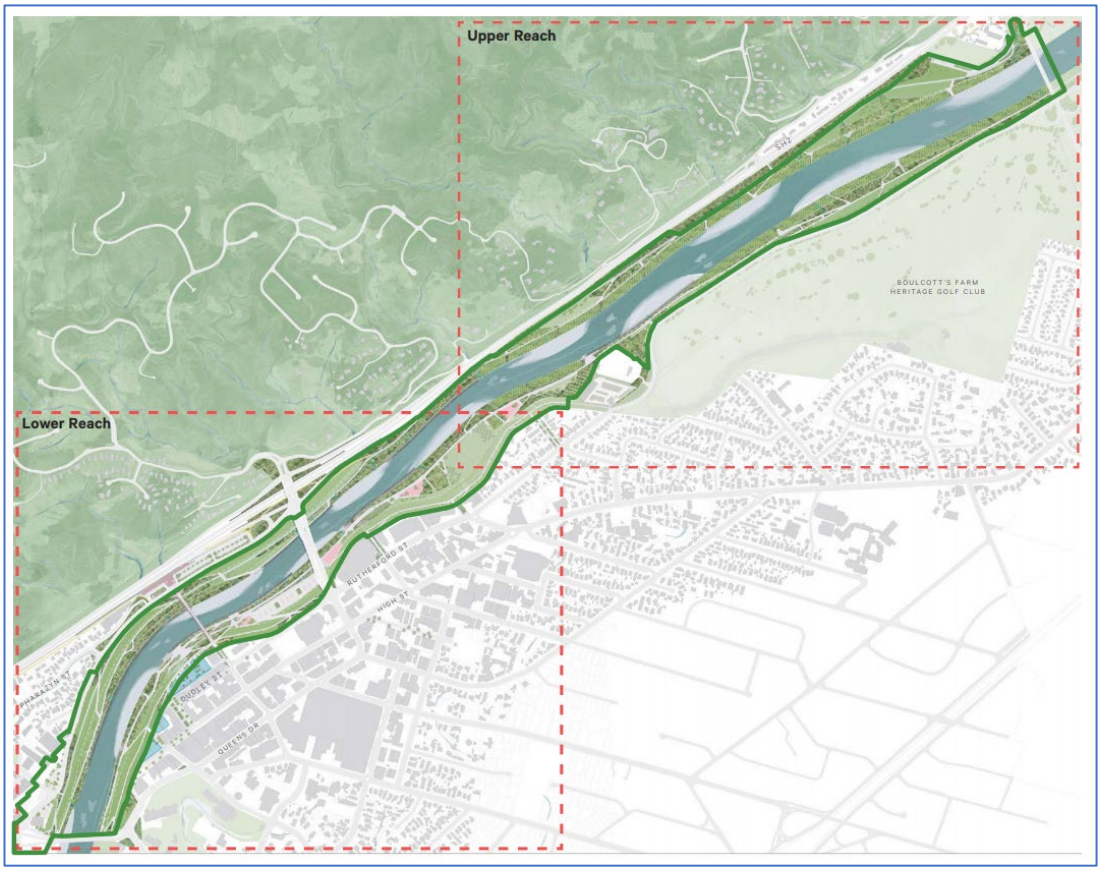

Figure 1: Upper and lower reaches of the Project

27. River widening, reprofiling, and permanent bank edge stabilisation works are considered part of the wider Project earthworks. While described in more detail in the Construction Methodology, they will be undertaken in eight separate stages which will occur concurrently to the six stages of earthworks described below.

3.3 Earthworks

28. Earthworks including excavation and filling, reuse of onsite material, removal of waste material and importing material are proposed across the project. While described in more detail in the Construction Methodology, earthworks will be undertaken in six stages associated with various Project activities but separate from river widening, reprofiling, and permanent bank edge stabilisation works are considered part of the wider Project earthworks.

29. Earthworks are associated with removing the existing stopbanks, widening of the river bed, establishment of berms and stopbanks, raising the land on the western side of the river to achieve design levels for the new interchange and supporting infrastructure and the realigned rail line, and for ground improvement works across the project. Excess or surplus cut material will be stockpiled within the river corridor for re-use across the project as required, it is estimated stockpiles will have a maximum height of 2.5 m.

4. TERMINOLOGY

30. Te Awa Kairangi corridor can be described by a sub-set of terms and definitions. For the purpose of this assessment the River Corridor definitions are outlined in Table 1, Figure 2 and Figure 3.

Table 1. River Corridor Definitions

Term	Definition
Berm	The area of land between the river bed and inner toe of the stopbank.
Dry beach	Area of the river bed not covered by water at any particular time.
Flowing channel	Area of the river bed covered by flowing water at any particular time
River corridor	Area of land between the top of the left and right stopbanks. Broadly this includes (1) the river bed; and (2) the land area between any river bed and the stopbank adjacent to the river bed; and (3) where there is no stopbank the area of land adjacent to the river bed from Melling Bridge to Moonshine Bridge, the land area between the river bed and State Highway 2 (but not including State Highway 2), other than any residential activity area identified in the Operative District Plan for Hutt City.
River bed	The area of land which the waters of the river cover at its fullest flow without overtopping its banks.
River channel	Area of the river bed covered by water at any particular time.
Standing water channel	Area of the river bed where water is separated from the flowing channel by a structure (typically a bund or barrier) and is no longer flowing.

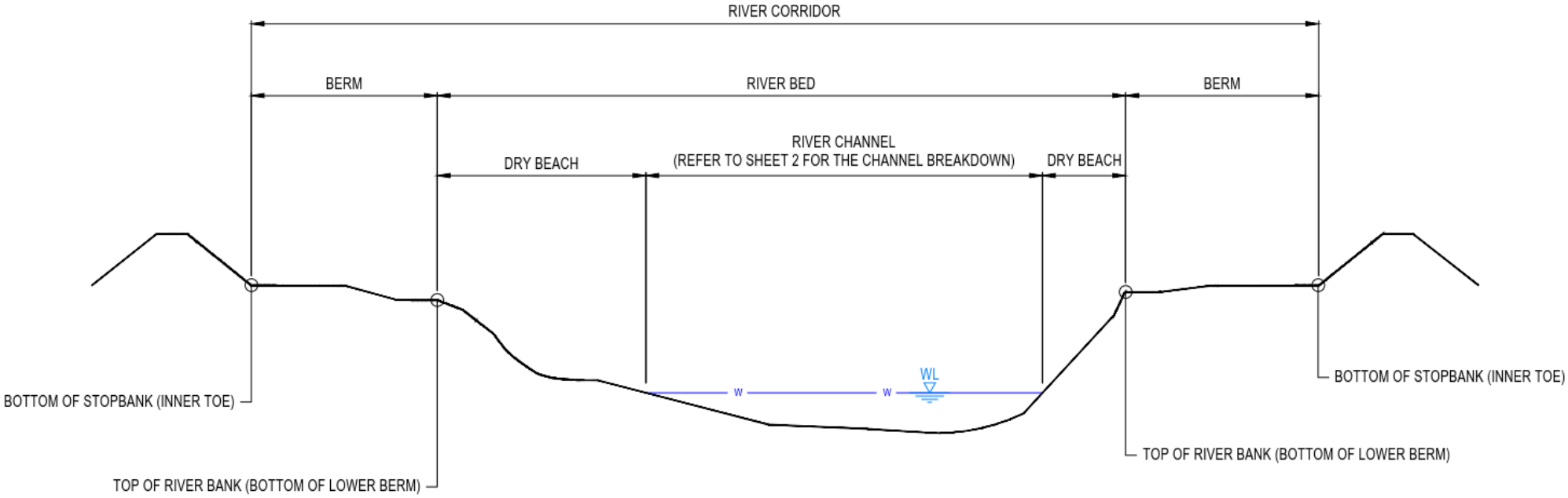

Figure 2. River corridor definitions

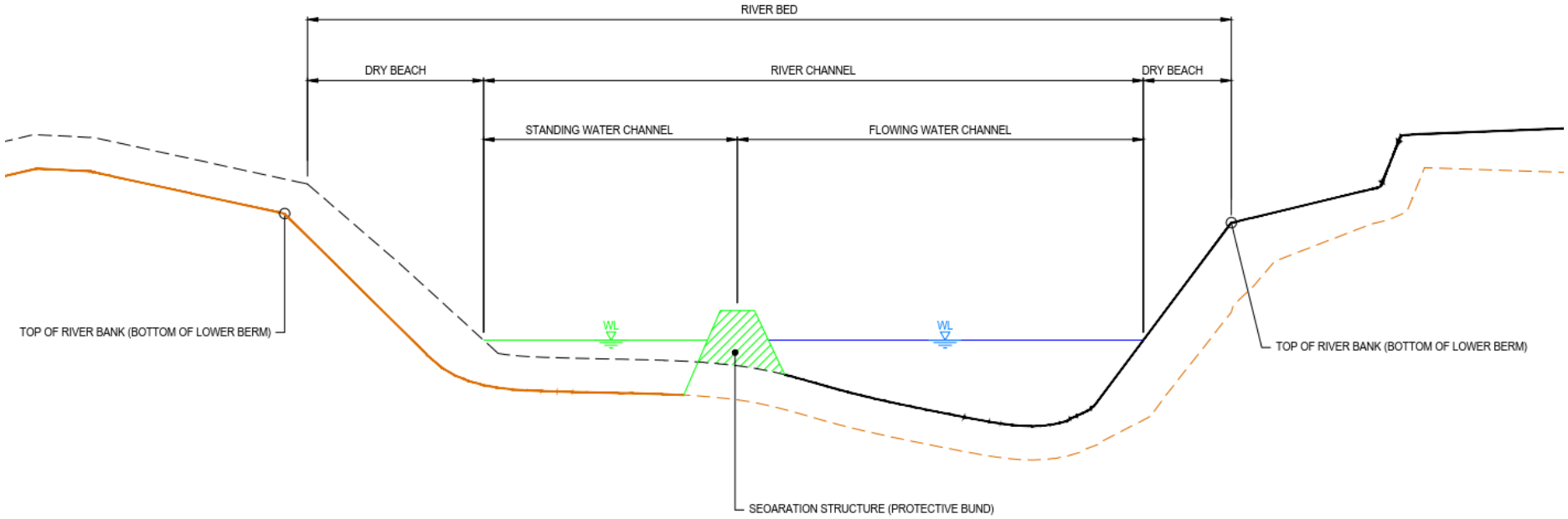

Figure 3. River bed definitions (during works)

5. EXISTING ENVIRONMENT

5.1 Planning and policy context

31. The following national statutory and non-statutory documents apply to this aspect of the Project:

    i. Resource Management Act 1991 ("RMA");

    ii. National Policy Statement for Freshwater Management 2020; and

    iii. Resource Management (National Environmental Standards for Freshwater) Regulations 2020.

32. The following regional and district level statutory and non-statutory documents apply to aspects of the Project relevant to erosion and sediment control:

    i. Regional Policy Statement;

    ii. PNRP;

    iii. Regional Freshwater Plan;

    iv. Regional Soil Plan;

    v. Regional Plan for Discharges to Land; and

    vi. Hutt River Flood Management Plan.

33. The statutory and non-statutory documents referred to above are discussed further in Section 10 of this assessment.

5.2 Physical and Human Environment

34. The RiverLink Project area impacts on four distinct areas: the Eastern Hutt city centre, the Western Transport Corridor, the Te Awa Kairangi, and the Downstream Te Awa Kairangi and Te Whanganui-a-Tara/Wellington Harbour. These four areas are distinguished on the basis of the nature of proposed activities and potential for impacts. The areas are shown on Figure 4 and are described separately below.

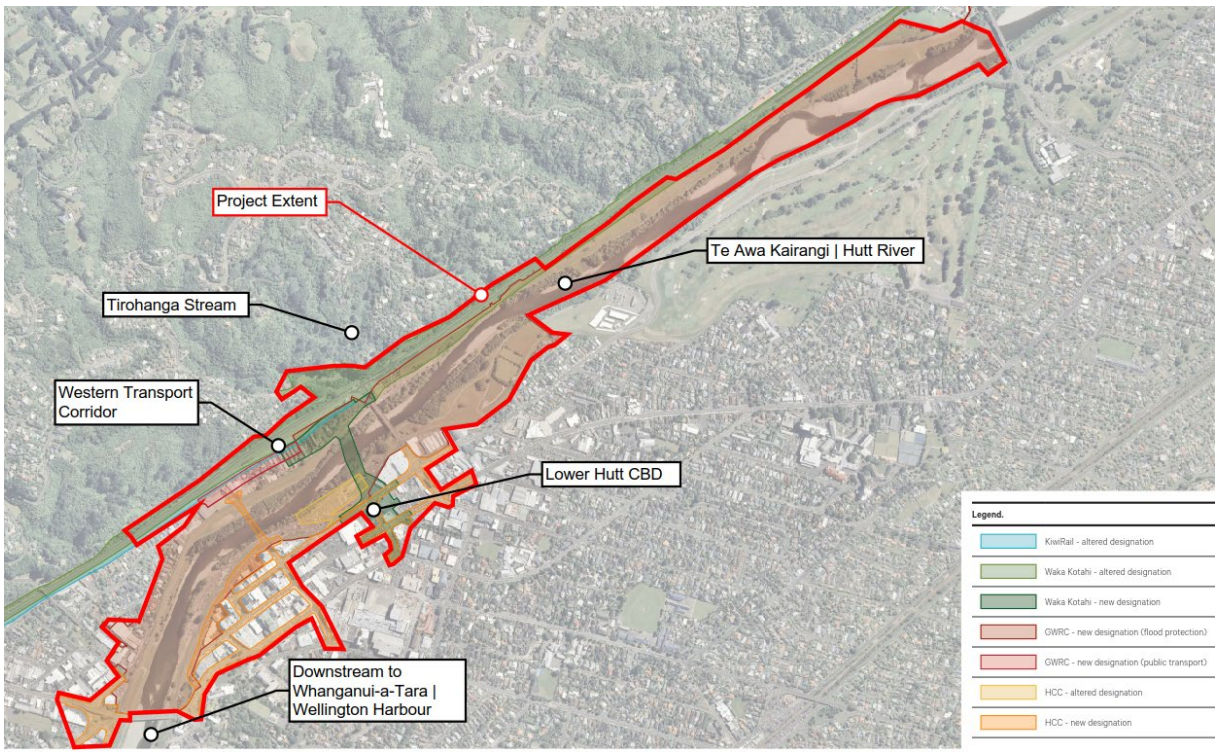

Figure 4. Activity areas of the RiverLink Project

5.3 Eastern Hutt city centre

35. The Eastern Hutt City centre is situated to the east of the existing stopbanks and includes the Lower Hutt city centre and commercial properties.

36. The surface water drainage in this area is characterised by a low-gradient urban catchment (Refer Figure 5). A gravity-fed pipe network drains stormwater from the urban catchment directly into the Te Awa Kairangi. This network discharges a majority of the urban stormwater through an open channel and into the River upstream of the Ava bridge. There are three smaller urban catchments which discharge directly into the River between the Melling and Ewen bridges, and one small urban catchment which discharges upstream of the Melling Bridge.

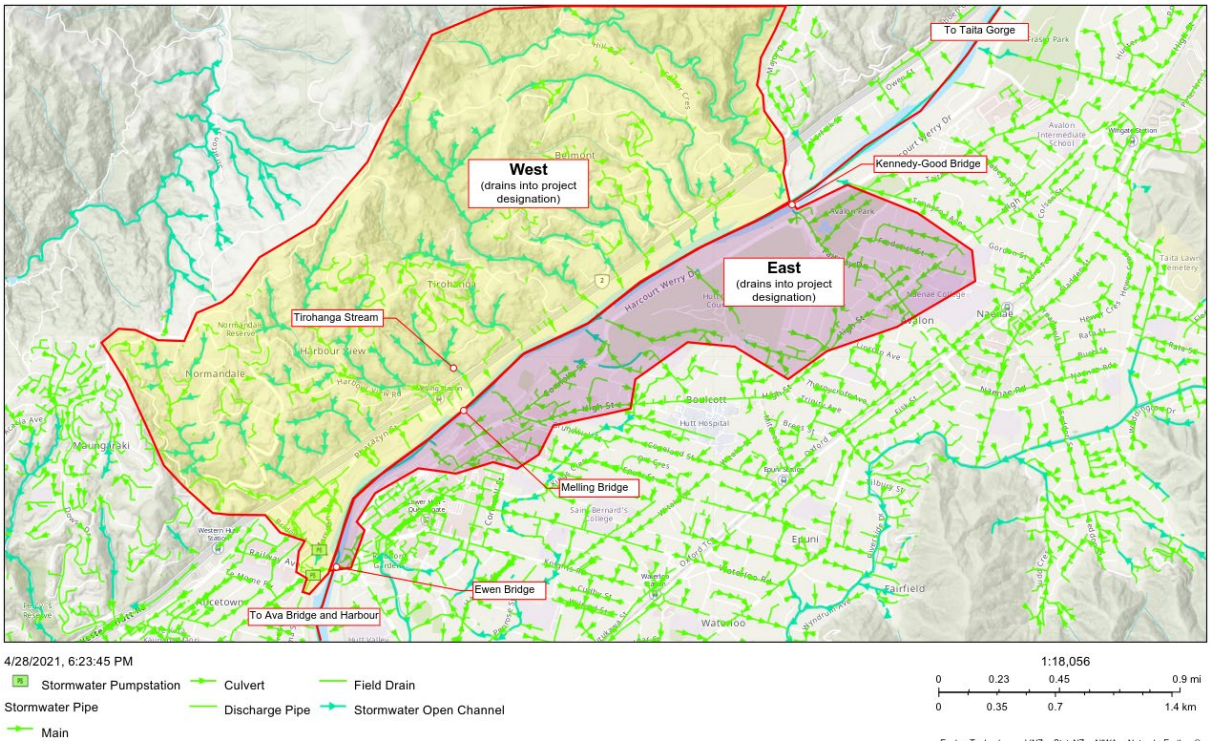

Figure 5. Drainage network catchments. Source: Wellington Water GIS 27/04/21

5.4 Western Transport Corridor

37. The Western Transport Corridor is situated to the west of the existing stopbank. Land use in the corridor includes:

    i. State Highway 2 (SH2);

    ii. the Melling Intersections;

    iii. Marsden Street commercial and domestic property area;

    iv. Pharazyn Street commercial and domestic property area; and

    v. Petone to Melling Rail link, Melling Railway Station.

38. The surface water drainage in this area is characterised by a steep, semi-developed catchment which transitions into a low-gradient urban area before draining into the Te Awa Kairangi (refer to Figure 5). The low-gradient portion is traversed by the SH2/rail transport corridor and a sequence of domestic and commercial development positioned between the Transport Corridor and the River. Stormwater from the hill country drains towards the river through a series of open channel, which are then piped under the Transport Corridor/urban area before discharging into Te Awa Kairangi.

5.5 Geology and sediment type

39. The geology of the area influences the type of sediment which may become available for erosion and sediment discharge as a result of Project works. Material subject to potential erosion by construction activities ranges from sands, silts, clays, gravels and peats in the eastern and western area and coarse river gravels, cobbles, and sands within the River Corridor.

40. The geology and expected sediment types in this area are discussed in the Geotechnical Interpretative Report for the Project in more detail (Appendix C to the Technical Assessment #15 – Natural Hazards and Geotechnical. The key findings are summarised below:

    i. The geology of the area is characterised by the confluence of complex marine, river and seismic processes which have driven deposits of sediment into the Lower Hutt Basin, framed by the Wellington Fault and adjacent hill country.

    ii. The collective deposits are known as the Hutt Formation. Subsets of this formation relevant to the Project include Taita Alluvium overlying the Petone Marine Beds and Melling Peat formations.

    iii. The area is heavily modified by both the River and human processes which make it difficult to discern natural deposits from intentionally developed ones.

    iv. Both the Western Transport Corridor and Eastern Hutt city centre are characterised by the above geological description. The Te Awa Kairangi and downstream zone are also influenced by 'active' sediment transport processes within the River and Harbour themselves.

5.6 Contaminated land

41. The extent of potentially contaminated land is discussed in the Technical Assessment # 13 – Contaminated Land. In summary:

    i. There are 22 confirmed or potential contaminated sites which pose varying degrees of potential contribution to construction water quality effects.

    ii. Technical Assessment No. 13 – Contaminated Land identifies the type of land use activity, the Hazardous Activities and Industries List (HAIL) classification, location and level of risk of contamination to the surrounding environment for each site.

    iii. Further detail regarding the extent and type of contaminated land will be identified as part of the Detailed Site Investigations (DSI).

5.7 Te Awa Kairangi catchment overview

42. A detailed description of the Te Awa Kairangi catchment characteristics, geology and climate are outlined in Technical Assessment No. 5 – Geomorphology. In summary:

    i. The River is 56 km long with a catchment of approximately 650 km^2, originating in the Tararua Ranges and flowing southward between the Wellington fault and Hutt Valley Basin before discharging into Te Whanganui-a-Tara/Wellington Harbour.

    ii. The course of Te Awa Kairangi has undergone significant realignment, straightening and stopbank works at the hands of various drainage boards throughout the twentieth century. Extensive confinement has been built adjacent to Lower Hutt city centre to manage flood risks.

    iii. The geology, land use and climate of the catchment influences the baseline erosion conditions and inputs of sediment to the River. The current interglacial period has seen forestation of the catchment and a reduction in deposition of sediment in the mid to upper sections of the catchment.

    iv. The deposition zone of the River is geomorphologically defined between Kennedy-Good Bridge and the River Mouth. This is a result of the steep grade reduction at the Bridge as the River accommodate for sea-level control at the outlet.

v. The future climate is expected to bring warmer temperatures and higher intensity rainfalls which will likely increase sediment loads being transported and deposited down the river, giving rise to a wider natural channel form.

5.8 Te Awa Kairangi sediment transport

43. A detailed description of naturally occurring sediment transport processes of Te Awa Kairangi is outlined in Technical Assessment No. 5 – Geomorphology. In summary of that assessment and studies conducted by Opus (2010a-e) and Cameron (2016, 2018, and 2019):

    i. Sediment load is naturally occurring in the river.

    ii. The amount of sediment that is generated and carried is a function of flow (rainfall event), duration, and available sediment within the catchment. As a result there is significant variation between years.

    iii. The majority of the sediment load that is suspended primarily consist of sand.

44. Fluvial processes, the transport of sediment, and water quality are inextricably linked to the flow regime of the River. The energy of the flow regime determines the ability of the River to erode and transport the bed and bank material. Conversely, the size, density and geometry of sediment particles within the bed and banks determines the resistance of material to displacement and transportation. The interaction between the fluvial processes and bed material is complex and varies considerably with space and time. In practise, the point where flow shear stress acting on the bed exceeds the entrainment (resistance to motion) threshold of bed material is very difficult to calculate due to the variability in channel slope, geometry and bed material matrix along the reach of a river of stream.

45. The flow of the River is subject to substantial range and variability. Flow has been recorded at Taita Gorge since 1987 and is summarised on Table 2 below:

Table 2. Summary of flow record at Taita Gorge m^3/sec. Source Opus, 2010

Minimum	Mean	Maximum	Standard deviation	Lower quartile	Median	Upper quartile
1.6	24.8	1562	44.5	8	14.2	25.7

46. During low to normal flows sediment transport is typically limited and ambient water quality is clear with a turbidity ranging from 0.3-19 Nephelometric Turbidity Units (NTU)[2]

47. When flows increase the river becomes turbid and visually discoloured due to increased suspended sediment. For a one-year return period event, suspended solids concentrations can reach up to 780 mg/l. In smaller more frequent 'fresh' events, which occur about four times a year, suspended solids concentrations range from 100-400 mg/l (Cameron, 2016).

48. An example of elevated suspended solids during a 4 year annual return period flood can be seen in Figure 6.

[2] Evidence from GWRC turbidity data at Boulcott 2003-2020; the upper limit represents 90th percentile from 236 turbidity grab samples between 2003-2020, available from the GWRC environmental data portal.

Figure 6 Ava and Ewen Bridge in 2004 flood event. Source: Civil Defence Photo Library, Flood events 1995-2004

49. The annual sediment load in the lower reach ranges between 30,000 and 140,000 m^3/yr as shown in Figure 7.

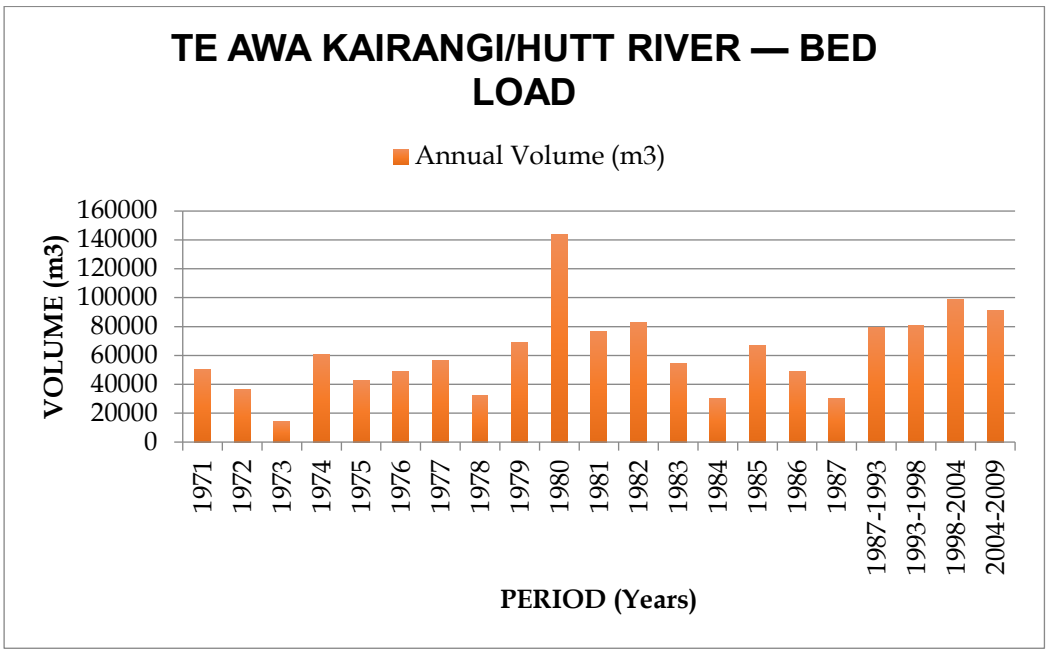

Figure 7 Bedload in Hutt (G Williams pers com 2021)

50. Sediment transport consists of 8% bedload motion (particles which roll and bounce along the base of the stream) and 82% suspended motion (particles suspended in the water column). Critically, the distance a sediment particle travels in both types of transport depends on whether flow energy remains high enough to sustain motion (Opus, 2010).

51. For the Te Awa Kairangi, sediment on the riverbed typically consists of an armouring layer of larger gravels and cobbles and a protected layer of finer material. Transport of the protective gravel layer as bedload does not occur often, with flow rates from 1987-2009 exceeding the upper and lower bedload entrainment threshold of 300 m^3/s and 200

m^3/s respectively, for larger and finer sediment respectively, a combined 1.1% of the time (Opus 2010).

52. As the slope of the River decreases towards the mouth, and river energy drops, so too does suspended sediment. As a result, the bed particles become increasingly finer closer to the Mouth.

53. Bed sediment in the Project area has been characterised by a Wolman Pebble Count conducted by Cameron (2018) at Melling Bridge. Bed material was found to have a D50 = 22 mm (which corresponds to a small cobble). Critically, the percentage of clay and silts was found to be 0% and the percentage of sands 10%. Figure 8 summarises substrate particle sizes.

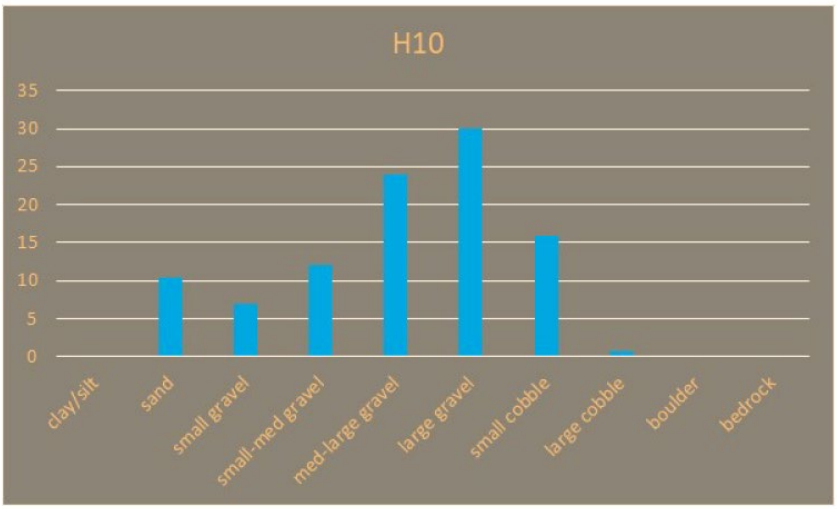

Figure 3-19: Mean percent cover values in ten substrate size classes at reach H10 (n=3)

Figure 8 Typical substrate particle sizes at Melling. Source: Cameron, D., 2018.

54. The D50 and size distribution of the existing substrate provides an indication of the susceptibility to erosion and resuspension. The fraction of the bed material which is suspectable to being suspended is predominately sand. Whilst the majority of the fines is sands there is some silts and clays deposited in the river corridor. This can be around vegetation used for bank protect or former backwater areas where silts and clays deposited.

55. There are numerous natural occurrences of erosion and sediment transport within the river corridor upstream of the Project. Figure 9 to Figure 11 provides a examples of erosion prone banks upstream of the Project.

Figure 9. Erosion prone bank and close up on material approximately 200 m upstream of Totara Park Road Bridge

Figure 10. Erosion prone bank and close opposite the Moonshine Hill Road and State Highway 2.

Figure 11. Erosion prone bank (upper bank) at Big Rock approximately 200 m downstream from the confluence point of Te Awa Kairangi and Te Marua River.

56. The net trend of natural erosion and sediment transport in the Project area is aggradation. In other words, sediment in the Project area is building up and accumulating over time (despite losses of bed sediment that occur via remobilisation during flood events and gravel excavation activities). Aggradation of material can restrict flow capacity, increase flood risk and create unfavourable river flow paths conducive to erosion in flood events.

57. In response to natural occurrences of erosion and sediment transport a range of river management activities within the Te Awa Kairangi are currently undertaken by GWRC Flood Protection, under Resource Consent WGN130264, a global consent for river maintenance and flood protection activities in Te Awa Kairangi and identified tributaries. The consent was granted in 2019 for a duration of 35 years and provides for the following activities:

i. construction, maintenance, repair and removal of structures and materials for river management purposes. Including elements such as:

   a) Stopbanks, banks and berms;

   b) Mechanical ripping of the riverbed;

   c) Construction of diversion channels (not generally used on Te Awa Kairangi);

   d) Recontouring and planting; and

   e) Maintenance of drains and clearing flood debris;

ii. temporary or permanent diversion of river flows;

iii. extraction of gravel from the riverbed using wet and dry methodologies; and

iv. discharge of sediment-laden stormwater resulting from the above river management activities.

58. Assessments of the ecological effects of river management activities under Consent WGN130264, have been undertaken by Mr David Cameron in 2016 and 2018 respectively. Regarding immediate sediment-related effects, Mr Cameron concluded in his 2016 assessment, titled *Effect of flood Protection Activities on Aquatic and Riparian Ecology in Hutt River,* that:

> *"Mechanical disturbance during low flows is likely to result in some settlement of fine sediment on the riverbed downstream of the works area, however this effect is relatively short lived in run and riffle habitat in the Te Awa Kairangi as water velocities during subsequent minor flood flows are sufficient to remove most of the fine sediment from the affected reach"*

5.9 Downstream Te Awa Kairangi and Harbour

59. The Te Awa Kairangi Mouth and Te Whanganui-a-Tara/Wellington Harbour function as the receiving environment for sediment when river energy is sufficient to transport sediment particles all the way to the Mouth. A detailed description of the River Mouth environment is outlined in Technical Assessment No. 8 – Marine Ecology.

60. Sediment particles being transported down the River settle out of the water column and accumulate at the River mouth. There are a number of factors which drive sediment accumulation at the Mouth:

    i. The gradient of the river becomes gentle as it approaches the harbour, slowing flow velocity and reducing the turbulent forces which kept particles in suspension. The result is sediment particles are allowed to settle under gravity.

    ii. The salt water from the Harbour influences the fate of suspended sediment in the fresh water because the saline water causes suspended sediment particles to flocculate (join together) and settle to the river and sea bed. The influence can range from the Mouth to 2.9 km upstream at Ewen Bridge.

61. In 2010, Opus conducted a report into the coastal sediment transport processes at the Te Awa Kairangi. It observed that a slight net aggradation was occurring despite historical and ongoing sediment extraction works. The report concluded that both the Mouth and Petone Beach environment change in response to the natural sediment transport processes within the River and that change was typically consistent over time.

62. Despite the forces which drive sediment accumulation at the Mouth, some particles enter the Harbour in the form of 'wash load'. The fate of wash load particles varies considerably depending on the concentration of sediment, wind characteristics, wave environment and magnitude of the driving flood event. Typically, wash load sediment settles on the Harbour floor, washes up on adjacent beaches or in some cases flows directly out of the Harbour entrance.

63. Due to the increase in flood risk which comes with the significant accumulation of sediment at the Mouth and Harbour, GWRC have been undertaking extraction of sediment at the mouth since 1997. Current extraction/deposition occurs at the Mouth and in the Harbour under Resource Consent WGN110149, which was issued in 2012 with a duration of 35 years. The following activities are within the scope of the current consent:

    i. Extraction of sediment from the River Mouth at a maximum rate of 60,000 m^3/yr. Over the last 5 years 130,291 m^3 has been extracted, well below the consented maximum.

    ii. Deposition of fine sediment at Petone Beach at a maximum rate of 11,700 m^3/yr. Over the last five years 13,140 m^3 has been deposited, well below the consented maximum.

    iii. Deposition of coarse sediment at a designated deposition zone in Wellington Harbour at a maximum rate of 11,700 m^3/yr. Over the last five years 19,915 m^3 has been deposited, well below the consented maximum.

    iv. Temporary suspension of sediment in the water column during extraction and deposition works.

    v. Monitoring of extraction/deposition volumes, Petone Beach, Wellington Harbour and Mouth bathymetry and sediment profiles, which to date has found a relatively constant rate of change across all three areas.

5.10 Tirohanga Intersection Stream and other tributaries

64. There are a number of tributaries of Te Awa Kairangi on the western hills adjacent to the Project area. The Tirohanga Intersection Stream has characteristics representative of tributaries and has been described in more detail.

65. The Tirohanga Intersection Stream is a small urban hillside stream with a catchment area of approximately 20 Ha. The Stream drains stormwater from residential dwellings and roads in the suburb of Tirohanga, down through a vegetated valley before crossing under Tirohanga Road and SH2 to the outlet in Te Awa Kairangi.

66. The land uses in the catchment influence the baseline erosion conditions of the Stream and inputs of sediment into the Te Awa Kairangi. The catchment is broken up into 4.5 Ha of residential urban area, 0.6 Ha of paved road catchment, and 14.5 Ha of steep vegetated hill area. The catchment and flow paths are shown on Figure 12 below.

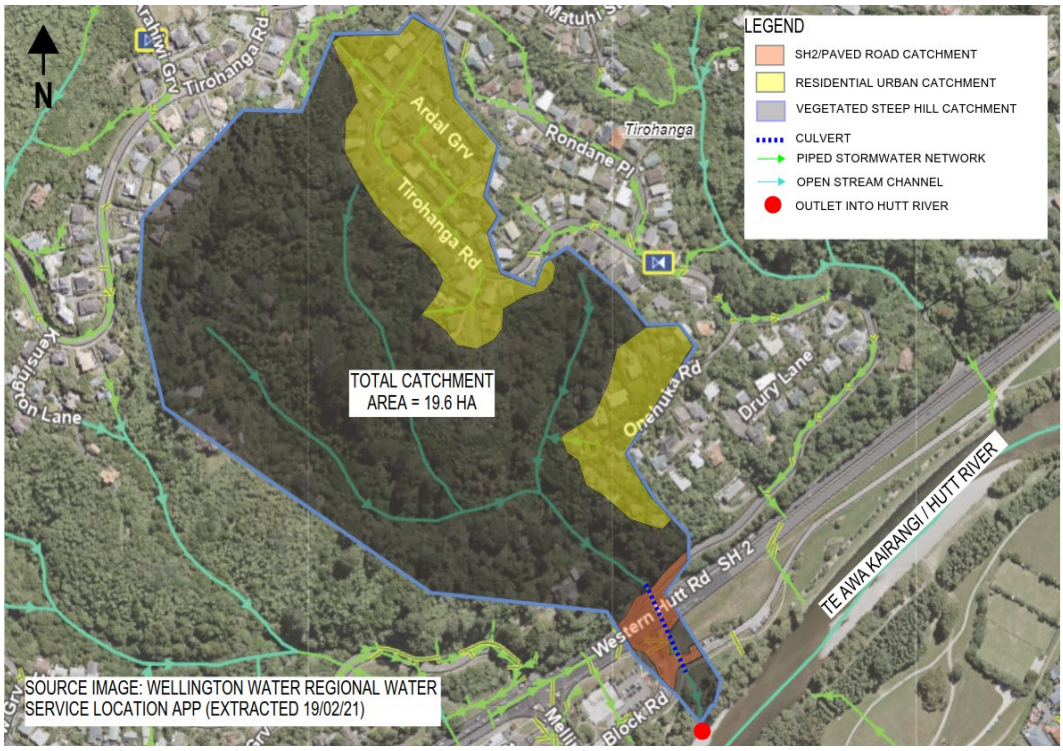

Figure 12. Tirohanga Intersection Stream catchment

67. No historical data or studies regarding water quality have been conducted on the Tirohanga Intersection Stream. However, data obtained from NIWA's NZ River Maps for similar adjacent catchments provides an inference as to the possible flow conditions and water quality upstream of SH2.

68. Table 3 summarises flow and water quality from three small hillside catchments immediately north of Tirohanga Intersection Stream.

Table 3. Summary of water quality data for Tirohanga Intersection and adjacent tributaries

Stream location	Catchment Area (Ha)	Median flow (L/s)	Mean annual low flow (MALF) (L/s)	Turbidity (NTU)	Suspended sediment load[1]
Tirohanga Stream	50	5.7	1.5	2.4	26 m^3/yr
Belmont Stream	85	9.8	2.6	2.0	26 m^3/yr
Unnamed stream at Wairere Road	23	2.3	0.5	2.3	6.7 m^3/yr

[1] Suspended sediment load in NZ River Maps is given in tonnes/yr. A specific gravity of 2650 kg/m^3 has been assumed to convert to annual volume suspended sediment load (m^3/yr).

69. SH2/Western Hutt motorway stormwater, which drains directly into the lower open channel reach of the Tirohanga Stream via a network of sumps and pipes, has potential to contribute additional sediment to the Stream. While no data for the water quality of this runoff is available, estimates for the 0.6 Ha area of SH2 in the catchment give a sediment load of 0.64 m^3/yr in addition to the load from the upper catchment[3].

70. Adjacent to the Tirohanga Intersection Stream there are a number of small streams and drains which feed into Te Awa Kairangi between the Melling Bridge and Ewen Bridge. The location of these stream and drains are shown on drawing A16-4381-C320 (Stormwater Overview) in Volume 5 of the Application. All these streams are the western side of the project. The names of these streams and their outlet numbers on the Te Awa Kairangi / Hutt River to the stream in a southerly direction from the Tirohanga Intersection Stream are as follows;

- Tirohanga drain outlet (no outlet number);
- Harbour view stream drain outlet (36b);
- Jubilee Park North Stream outlet (31); and
- Jubilee Park South Stream (outlet 27).

71. All of these small streams are characterised as having steep upper reaches to the west of the motorway with a good vegetative cover of exotic trees and regenerating native vegetation. The lower reaches the streams are piped from the motorway to the Hutt River. Storm water for the local road network is directed into this pipe network. The water is discharged to the Te Awa Kairangi / Hutt River through flap cap culverts or pumped.

72. In addition to these small streams, there are there four drain outlets on the western side (outlets 23, 33, 37 and 37c) and three drain outlets on the eastern side (outlets 24, 35 and 37) between the Tirohanga Intersection Stream and the Ewen Bridge.

73. These streams and drains have the potential to contribute additional sediment to Te Awa Kairangi. No data for water quality of the runoff is available. However, the amount is not considered significant given the combined catchment size in comparison to the Te Awa Kairangi.

6. ASSESSMENT METHODOLOGY

74. The methodology outlined below has been discussed with GWRC environmental regulators and representatives at meetings on 04/02/21 and 24/02/21.

75. The following assessment methodology has been used to assess the construction erosion and sediment discharge effects of the Project:

    i. review of the Existing Environment and water quality (as described above);

    ii. review of all proposed construction activities to determine the location, scale, and duration of activities;

    iii. an assessment of potential for erosion and generation of sediment discharges and the associated potential adverse effects;

    iv. the identification of measures to avoid, remedy or mitigate erosion or sediment discharges;

[3] Sediment loads from Table 5.5 of NZTA Stormwater Treatment for State Highway infrastructure and assuming a specific gravity of 2650 kg/m^3.

v. an assessment of remaining residual effect of sediment discharges;

vi. identification of suitable best practice guidance;

vii. preparation of a draft ESCP, example draft SSECP and supporting documentation; and

viii. identification of proposed Designation / Resource Consent conditions.

7. ASSESSMENT OF CONSTRUCTION EROSION AND SEDIMENT DISCHARGE EFFECTS

7.1 Construction activities and staging approach

76. For the purpose of my assessment, I grouped the construction activities on the basis of location. There are three construction zones which align with three of the four physical and human environment areas described in Section5 of this report:

    i. the Western Transport Corridor (western);

    ii. the Eastern Hutt city centre(eastern); and

    iii. the Te Awa Kairangi and tributaries.

77. Within each of those zones is a combination of a number of different infrastructural elements of the Project. The construction activities required to create these infrastructural elements vary with regard to the nature of the activity, location, extent and duration.

78. A detailed outline of activities and construction methodologies are outlined in the Project Construction Methodology outlined in section 5 of the AEE. The methodology adopts a staged approach, with six separate stages with concurrent staging of River works and bridge construction.

79. Works within the River Corridor footprint) will occur in eight stages which will take place concurrently to the six sequential stages proposed for stopbank and land-based works in the Eastern and Western zones.

80. River corridor works will typically be constructed according to the following:

    i. In eight consecutive stages moving from downstream to upstream;

    ii. Each stage will be approximately 500 m in lineal length;

    iii. Each stage will contain its own sub-set of sequencing for specific construction activities, which will be describe in SSESCPs; and

    iv. Rapid stabilisation will be implemented for the sequences within the stage itself. An entire stage will be stabilised before commencing the next stage.

81. The staged approach described above demonstrate that disturbance in the river bed and river channel will occur in:

    i. smaller segments of the total area which are spatially separate from one another; and

    ii. shorter and typically chronological time periods

82. While the total area of disturbance is very large (105 Ha) and the total project duration is long (indicative construction duration of four years) the implication of the staged approach is that individual construction activities will occur while the rest of the site area is stabilised. The potential effects of erosion and sediment control should therefore be considered in the context of the type of the activity (i.e. the nature of earthworks), its timing within the wider programme, the maximum open area which will be exposed, and the duration for which that area will be exposed for.

83. An overview on construction activities, along with estimates of the total extent (area, volume and duration) of earthworks for each activity, and the maximum open area, and associated duration of exposure are outlined in Table 4 below.

Table 4. Construction activity overview

Activity description	Disturbed land breakdown			
Stopbanks Stopbank construction works are to take place along both sides of the River. Works include: • Filling to form new stopbanks behind existing stopbanks or increase height of existing stopbanks. • Removal of stopbanks.		**Area[5]**	**Indicative Duration**	**Earthworks[4]**
	Total Extent	11.0 Ha	3 ½ years	113,600 m^3 of cut and 206,300 m^3 of fill.
	Maximum open area at any one time	2 Ha[1]	11 months[1]	To be determined by detailed design.
River widening and reprofiling Riverbed widening and reprofiling works are to take place across the full River length of the Project extent. Works include: • Widening the existing channel through extraction and fill of dry bed material and wet bed material where it cannot be avoided. • Reprofiling the existing channel through lowering and filling where required in wet bed material. Where possible this will be done in conjunction with general widening and the construction of riverbank erosion protection structures. Reprofiling and widening works are expected to result in net extraction of sediment. Suitable material will be stockpiled and used for other Project activities or removed as waste.		**Area[5]**	**Indicative Duration**	**Earthworks[4]**
	Total Project	30 Ha (approximately 12% of the total bed of Te Awa Kairangi)[6]	4 years	253,000 m^3 of cut and 43,000 m^3 of fill
	Staging approach and maximum open area at any one time	Conducted in 8 separate stages from downstream to upstream. Avg. area = 3.75 Ha (500 m reach x 75 m average width). 1.5% of the total bed of Te Awa Kairangi Bed for each stage.	6 months per year. Estimated 35-55 days to complete works for each year Maximum of 12 hours of disturbance per day.	30-60 % of works can be conducted in the dry or in standing water. Earthwork volumes in flowing water at any one time to be determined prior to lodgement
Riverbank protection structures, berms and planting Riverbank erosion protection works are to take place on both edges of the River, across the full length of the Project extent. Works include:		**Area[5]**	**Indicative Duration**	**Earthworks[4]**
	Total Project	42.3 Ha	4 years	270,000 m^3 of cut and 73,000 m^3 of fill.

Activity description	Disturbed land breakdown			
• Rip rap structures or vegetated edges will be constructed along the riverbanks both where widening is proposed and along the river edges which will remain in their current locations. • Rip rap structures will be constructed in dry and wet bed conditions depending on the proximity to the wetted channel and presence of dry beach zones. • Cut and fill will be sequenced to reduce the duration that work zones will be exposed to wet channel flow. • Creation of upper and lower berms and associated landscaping and planting.	**Staging approach and maximum open area at any one time**	Conducted in 8 separate stages from downstream to upstream. Avg area = 2.6 Ha per side (500 m reach x 52 m average width per bank)	6 months per year (tie into river reprofiling stages) Estimated 25-40 days to complete rip-rap rock walls (time limiting activities)	30-60 % of works can be conducted in the dry or in standing water. Earthwork volumes to be determine prior to lodgement
Roading Grade separated overpass, SH2, and local road realignments are to take place behind the western and eastern stopbanks in a series of isolated locations. Works include: • Ground improvements, formation of subgrades and construction of pavements. • Bulk earthworks to form road embankments, abutments and banks including the grade separated interchange • Culvert and drainage upgrades • Stormwater channel, treatment facilities, replacement, and realignment of three waters services and utilities.		**Area[5]**	**Indicative Duration**	**Earthworks[4]**
	Total Project	15 Ha	4 years	Refer to Section 5.8 in the Construction Methodology for volumes associated with roading stages
	Staging approach and maximum open area at any one time	5 Ha[2]	14 months[2]	Refer to Section 5.8 in the Construction Methodology for volumes associated with roading stages
Melling Line Station and rail realignment The new Melling Line station and rail realignment are to be constructed south of the current Melling Station. Works include: • Foundations and construction of the new station. • Formation (cut/fill) of the new section of rail track and tie into the existing rail alignment.	**Total project extent for this activity will occur in a single stage (i.e. the total project extent = the maximum open area)**	**Area[5]**	**Indicative Duration**	**Earthworks[4]**
		5 Ha[3]	12 months[3]	Refer to Section 5.8 in the Construction Methodology for volumes associated with roading stages
Bridges	**Total Project**	Melling Bridge works have a limited disturbed land footprint (approximately 1 Ha for piling and superstructure construction only).		

Activity description	Disturbed land breakdown	
Two River crossings are to take place; a new vehicle bridge at Melling and a new footbridge between the Ewen and new Melling Bridges. Works include: • Formation of in-river access for piling and construction of substructures (piers). This will be staged with bed extraction and edge protection works where possible. • Bridge super structure construction. • Earthworks to form the abutments (Note that footprints and earthwork volumes for this particular set of works are included as part of roading earthworks to construct the grade separated interchange and stopbank works).		Earthworks for abutments is included in stopbank and road works. Duration expected is 21 months. Footbridge works have a limited disturbed land footprint (approximately 0.5 Ha for piling and superstructure construction only). Earthworks for abutment is included in stopbank and road works. Duration expected is 14 months.
Material Processing The new stopbanks will be constructed using material won from the river widening and re-profiling. Also includes the transport of material to the processing plant which could include river crossing.	**Total Project**	65% of extracted material from river works is estimated to be suitable for use in stop bank construction and filling (approximately 594,500 m^3, refer to 'cut to fill' and 'cut to stockpile volumes in Section 1.7.3 in the Construction Methodology). Areas for material process will be stabilised. Processing will occur over 4 years as required.
Enabling works Enabling works are to take place across the full Project extent as required. Works include: • Further detailed site investigations (test pits, boreholes, trenching) • Demolition and removal of roads, structures vegetation and fences. • Establishment of site access, construction yards, tracks, temporary road realignments and fencing. • Protection/relocation of utilities. • Establishment of ESC controls.	**Total Project**	Varies depending on activity. Exact footprint and scale of enabling works to be specified in SSESCPs.

1 The maximum open area and associated duration of exposure for stopbanks has been taken from Stage 1 works, which is considered to be the worst-case scenario stage i.e. has the largest individual open area and longest duration of work out of all the six stages.

2 The maximum open area and associated duration of exposure for roading works has been taken from Stage 5 works, which is considered to be the worst-case scenario stage i.e. has the largest individual open area and longest duration of work out of all the six stages.

3 The maximum open area and associated duration of exposure for rail realignment and melling station relocation works has been taken from Stage 4 works. Stage 4 is the only stage within the entire project duration where this particular activity occurs.

4 Volumes estimate have been obtained from resource consent design. These values are subject to change during detailed design phase but are expected to be within 15% of the design.

5 Area have been estimated from scaled resource consent design drawings. These values are subject to change during detailed design phase but are expected to be within 15% of the design. 6 A conservative estimate only considering the main stem of the Hutt River has been used. This ignores the four main tributaries of the Hutt River. Estimate considered the river bed only.

84. The duration of construction activities in the river channel is an important consideration. Construction activities are broken down into stages to limit the areas of disturbance, these areas are further broken down into smaller, sequential work zones. Consider construction of a 370 m length of rip rap rock riverbank on the true right bank of Marsden Bend (just above Ewen Bridge). The rip rap riverbank will be constructed in 50 m sections (i.e. 50 m constructed and stabilised prior to commencing works on the next 50 m section. Table 5 shows the duration of rock rip rap construction and the time works occur in the river channel.

Table 5. Breakdown of a 370 m section rock rip rap riverbank construction and time spent in river channel

	Total activity area (m^2)[1]	Duration of activity (12 hr day)	Work zone area per day (m^2)	Duration in river channel (12 hr day)
370 m long Rock Rip Rap riverbank structure	370 m length x 10 m wide = 3700 m^2	1 day to complete 50 m long work zone 7- 10 days to complete total activity.	50 m length x 10 m wide = 500 m^2	2- 3 hours spent in the river channel for each day of works

1 The width of a rock rip armour bank is assumed to be 10 m for the purpose of this assessment. The width is to be confirmed in detailed design.

85. It is estimated that one year's worth of widening and reprofiling works (two of six stages with approximately 80,000 m^3) will take between 35 and 60 days of works in the river channel. While the maximum possible duration of disturbance is 12 hours, that actual duration of disturbance by machinery within the channel itself is likely to be between 3-6 hours.

7.2 Assessment of potential for erosion and sediment discharges

86. When a construction activity is carrying out disturbance of land, it has the potential to cause erosion and generate a discharge of sediment-laden runoff into Te Awa Kairangi in the following scenarios:

    i. Rainfall events.

    ii. Normal flow conditions: flow when the river is not in flood.

    iii. High flood flow conditions: water level is between the bottom of the lower berm and top of the lower berm.

    iv. Extreme flood flow conditions: water level is between the top of the lower berm and existing stopbanks.

87. Table 6 summarises the potential for sediment generation for Project activities.

Table 6. Potential cause for sediment generation from Project activities

Activity	Potential cause of sediment generation			
	Rainfall	Extreme flood flows	High flood flows	Normal flows
Key: ✓ - activity has the potential to generate erosion and sediment discharge. × - activity does not have potential to generate erosion and sediment discharges.				

Activity	Potential cause of sediment generation			
	Rainfall	Extreme flood flows	High flood flows	Normal flows
Te Awa Kairangi Corridor				
Enabling works				
River widening and reprofiling	×	✓	✓	×
Upper berm	✓	×	×	×
Lower berm	×	✓	×	×
Diversions	×	×	×	✓
Behind diversion/barrier	×	×	✓	×
In active channel	×	×	×	✓
Riverbank protection structures				
Away from channel edge	×	✓	×	×
Behind diversion / barrier	×	×	✓	×
In active channel	×	×	×	✓
Stopbanks				
New behind existing	✓	×	×	×
Removal of existing	✓	✓	×	×
Bridges				
River diversion	×	✓	✓	✓
Pier construction	×	✓	✓	✓
Superstructure	✓	×	×	×
Material Processing				
Carting to and from site	✓	×	×	✓
Processing	✓	✓	×	×
Eastern Zone				
Enabling works				
Construction yards	✓	×	×	×
Car Park removal	✓	✓	×	×
Bridges				
Abutments	✓	×	×	×
Roading	✓	×	×	×
Excavations	✓	×	×	×
Services	✓	×	×	×
Western Zone				
Enabling works				
Construction yards	✓	×	×	×
Access tracks	✓	×	×	×
Building removal	✓	×	×	×
Bridges				
Abutments	✓	×	×	×
Roading				
Temporary roads	✓	×	×	×

Activity	Potential cause of sediment generation			
	Rainfall	Extreme flood flows	High flood flows	Normal flows
Interchange	✓	×	×	×
Drainage upgrade/culvert works	✓	×	×	×
Melling Station and rail				
Rail line / carpark removal	✓	×	×	×
New station / carpark	✓	×	×	×

88. As can be seen in Table 6 rainfall events prevail as the primary conditions for sediment generation across the majority of the land based project activities. The River flow conditions influence sediment generation for the river bed works (and the Te Awa Kairangi flow is of course itself influenced by rainfall in the 650 km^2 catchment). The rainfall in the upper parts of the catchment in the Tararua Ranges can be quite different from the rainfall that will be experienced directly within the Project area.

7.3 Cement laden water

89. There is potential for the discharge of cement laden water from the site which has high pH and can result in ecological damage. To avoid this happening the ESCP requires the preparation of SSEMPs to identify if concrete is being used and the methods to avoid discharges and measures to be undertaken should a discharge occur.

90. The main activity using concrete will be the bridge construction and in particular the bridge piers. The potential for discharges of cement laden water is considered low due to the following:

    i. The pours are contained within a casing or boxing;

    ii. There is ability to control the volume of concrete to avoid over filling; and

    iii. There is ability to limit the free water in the mix.

91. In addition, the following measures are available depending on the location of the pour and its size:

    i. Bunding placed around the works to contain any excess water;

    ii. Provision for capture and storage of excess water and possible in situ treatment (to adjust pH); and

    iii. Provision of absorbent material such as dry sand or soil to absorb any excess water.

92. There will also be a prohibition on site for the washing down of concrete mixer trucks once they have delivered their load. This will be a contractual requirement on the providers of concrete.

8. ASSESSMENT OF POTENTIAL ADVERSE EFFECTS

93. The effect of sediment discharges is a function of the type, duration and footprint of associated works. Potential adverse effects of sediment discharges are linked to:

    i. impacts on the aquatic habitat and biodiversity of both the freshwater and saltwater bodies;

    ii. impacts on the form and character of the Te Awa Kairangi and Te Whanganui-a-Tara/Wellington Harbour; and

    iii. effects of sediment on the River and Harbour's habitat and biodiversity, which are discussed in the Project's Technical Assessment of Aquatic Ecology and Technical Assessment of Marine Ecology.

94. The generation of sediment occurs naturally during flood events. It is important to note that effects discussed in this assessment pertain to Project related erosion and sediment effects beyond ambient sediment transport processes. There are three situations for the generation of sediment: works in the active river, works in the floodplain (between stopbanks) which are engulfed by higher flood flows, and works outside the river corridor subjected to rainfall. Potential adverse effects for these three scenarios are outlined in the following sections.

8.1 Potential effects of activities in the river bed

95. Activities that involve the disturbance of the river bed material within flowing water (including, but not limited to, bed recontouring and wet gravel extraction, rock protection and vehicle crossing) will cause mobilisation of natural sand sediments from the bed into the water column.

96. Suspended sediment will be deposited downstream either within the River itself, as sediment particles settle in the water column, or at the Mouth, where the interaction between River and saltwater tidal flows causes particles to settle. Some suspended sediment may not settle at all and could be transported out into the waters of Whanganui-a-Tara/Wellington Harbour.

97. The nature of the sediment discharge will depend on whether the sediment is derived from recently reworked gravels and sands (i.e. that have been disturbed and re-deposited by flood events in the channel), or from disturbance of small pockets of silt and clays. These finer materials may be captured beneath vegetation along the river bank or in pockets in old buried river channels. Larger particles (sands, gravel) will tend to fall quickly out of suspension, but they can be carried some distance when the River energy is high, such as during flood events.

98. Most in-channel works in the lower river (from Taita Rock downstream) are within re-worked gravels, and discharge will show as a light-coloured silt.

99. The river bed of the Te Awa Kairangi/ Hutt River has an area of approximately 5,255 Ha. The estimated total footprint of works is 72 Ha to be undertaken over a Project duration of four years, of which approximately 30 Ha is river bed. On a stage by stage basis the footprint is approximately 3.75 Ha or 1.5% of the total footprint of the river bed.

100. Project activities, if no avoidance or minimisation measures are implemented have the potential to cause the following adverse effects:

   i. release of nutrients trapped in sediment resulting in a decrease of downstream water quality;

   ii. temporary visual discolouration;

   iii. deposition of sand and some silt and clays downstream;

   iv. impact aquatic habitat and biodiversity; and

   v. impact on the natural form and character of the River, Mouth and Harbour.

101. Measures to avoid and/or mitigate these potential effects are summarised in Section 9.

8.2 Potential effects of floods

102. Flood flow conditions in Te Awa Kairangi will see an elevation of the water level which, depending on the magnitude of this water level rise, has the potential to inundate and generate erosion in areas where works are taking place or have recently been completed.

103. In a flood event the source of sediment is the whole Te Awa Kairangi/ Hutt catchment of which the project area forms less than 0.15 of the catchment.

104. The velocities that create bed disruption and the movement of gravels are associated with flood events with a flow of between 200 – 300 m^3 /s and beyond (Opus, 2010).

105. For lesser flood events the areas of disturbance created by construction activities, that could generate sediment are restricted due to the staged nature of construction activities and progressive stabilisation.

106. As a result, it is expected that during a flood event, the effect of construction activities on water quality will be negligible relative to the natural sediment transport processes occurring throughout the entire river catchment during a flood event.

8.3 Potential effects during normal flows

107. In periods of normal or low flow there is potential for sediment generation from activities being undertaken in the river channel. These being reprofiling of the river and gravel extraction, removal and construction of rock rip rap and vehicle crossings. The effect of these activities is partly driven by the suspension of primarily sand sediment.

108. While observations of the bed substrate by Cameron (2018) and Williams in Technical Assessment No. 5 – Geomorphology indicates sand is the only fine sediment present, there may be unknown pockets of fine sediments (silts and clay) which may also become suspended during normal flows and give rise to effects associated with silts and clays.

109. As the river velocities associated with these flows is low the majority of suspended sediment will not travel as far as in a flood event. The effect of this will be increased turbidity only while the activity is being undertaken and the settling of some sediment downstream.

8.4 Potential effects of activities outside the River Corridor

110. As shown by Table 6 Activities outside of the River Corridor are only subject to erosion and sediment discharge during rainfall. Therefore, they have a much lower potential for erosion than activities in the river corridor which may also be subject to elevated water levels during flooding.

111. Typically, activities outside the River Corridor will take place in the Western Transport Corridor or in the Eastern Hutt city centre and environs. Runoff from construction activities will be discharged into the existing gravity pipe network and eventually into Te Awa Kairangi with potential to be transported to the River Mouth and Harbour.

112. Sediment discharges will introduce new sediment from beyond the boundary of the natural fluvial processes within the Te Awa Kairangi. Types of sediment discharge could range from topsoil to clays, silts, sands, gravels organic and contaminated particles depending on the location and specific construction activity.

113. The estimated total footprint of works outside the river corridor is 31.2 Ha to be undertaken over a Project duration of four years. Project activities, if no avoidance or minimisation measures are implemented have the potential to cause the following adverse effects:

    i. release of nutrients trapped in sediment resulting in a decrease of downstream water quality;

    ii. temporary visual discolouration;

    iii. deposition of fine sediment downstream;

    iv. impacts on aquatic habitat and biodiversity; and

    v. impacts on the natural form and character of the River, Mouth and Harbour.

114. Measures to avoid and/or mitigate these potential effects are summarised in Section 9 below.

9. MEASURES TO AVOID, REMEDY OR MITIGATE ACTUAL OR POTENTIAL ADVERSE EROSION AND SEDIMENT EFFECTS

115. The strategy for addressing the potential adverse effects of sediment discharges is:

    i. avoid the circumstances that generate sediment;

    ii. minimise the potential to generate sediment;

    iii. mitigate sediment discharges through treatment processes; and

    iv. monitor the performance of measures and adapt to improve management of erosion and sediment.

116. An overarching ESCP has been prepared to articulate the strategy to avoid, remedy or mitigate the potential effects of erosion and sediment discharges to the receiving environment. This has been prepared as a draft for consenting purposes and is to be updated alongside the construction contractor prior to any construction works commencing. The draft ESCP is attached in Appendix A.

117. SSESCPs will be prepared for particular construction activities to ensure measures are tailored to the location, unique constraints and different teams of people involved. An example of a SSESCP for Riverbank works is attached in Appendix B.

118. A Chemical Management Plan (CMP) has been prepared to set out the procedures and practise for use of chemical flocculant at structural treatment devices. The draft CMP is attached in Appendix C.

119. Both the ESCP and SSESCP are to be prepared in accordance with the following erosion and sediment control guidance documents:

   i. GWRC Erosion and Sediment Control Guide for Land Disturbing Activities (2021).

   ii. NZTA Erosion and Sediment Control Guidelines for State Highway Infrastructure (2014).

   iii. GWRC Code of Best Practice for River Management Activities (2019).

120. The Code of Best Practice was developed by GWRC flood protection in conjunction with Iwi, the Department of Conservation and Fish and Game.

121. Provisions are to be made for current and innovative best practise techniques, which go beyond the above guidance documents. All erosion and sediment control techniques and methods are to be reflected in the ESCP and any relevant SSESCP.

9.1 Core management measures

122. Details on the core measures to avoid, minimise and treat are outlined in the draft ESCP (Appendix A), SSESCP (Appendix B) and CMP (Appendix C).

123. A key element to minimising the potential for sediment generation is to undertake river reprofiling and widening works "in standing water". This involves using a separation structure (i.e. temporary bunds and diversions) to separate active earthworks from the flow of the River. The use of separation structures will be deployed as much as is practical within the river channel but is limited by constructability, which varies in difficulty across the river length. Table 7 provides an estimate of earthworks in the river channel in standing and flowing water.

Table 7. Estimate of in river earthworks in flowing and standing water.

Earthworks Scale	Cut		Fill	
	Project total	Average Per stage[2]	Project total	Average Per stage[2]
River bed total (m^3)[4]	253,000	31,500	43,000	5,400
"dry" river bed works[1]	164,500	20,500	19,500	2,500
"wet" River bed works (in flowing water)	62,000	7,800	14,200	1,800
"wet" River bed works (in standing water)[3]	26,500	3,300	7,000	900

1 Riverbed works in the dry are estimated to be approximately 65% for cut and 45% for fill of the total riverbed earthworks volumes for cut and fill respectively. This percentage was estimated using design cross sections and setting a representative water level equal to the 7-day mean annual low flow water level calculated for the post-development river profile. Works above this level are considered 'dry' works below are considered to be 'wet'.

2 Work volumes have been divided equally between 8 stages which coincide with the 8 500 m long disturbed reaches.

3 The use of protective bunds or structures in the wet to separate flowing and standing water has limited use. For the purpose of this assessment, it has been assumed 30% of wet works (both cut and fill) can be conducted behind a bund. The actual volume will be determined as part of the preparation of SSESCPs.

4 River works volumes have been estimated from the consent level design and may be subject to change during detailed design. Note that volumes exclude the rip rap rock fill material placed as permanent bank erosion structures.

124. Table 8 summarises the key measures proposed across the Project to ensure potential adverse effects are either negligible or low.

Table 8. Core management measures to avoid, mitigate and treat

Set	Measure	Residual effects
Measures for activities in the river channel and river bed		
Avoid/Monitor	Works are to be avoided when the River is below the minimum low flow specified in GWRC's Natural Resources Plan (1.2 m^3/s).	When flows are above the minimum threshold and works are allowed to proceed, larger coarse material) may be locally disturbed by works in flowing or standing water but are not expected to undergo significant transport. Discharges will be limited to fines (predominantly sand) and small gravels and will result in some temporary discolouration of the downstream water.
Avoid	Works will take place in general accordance with the time considerations set out in Appendix 7 of the Code of Best Practice for River Management Activities and SSESCPs will include specific effects management measures as outlined in the Code of Practice for River Management Activities.	Sediment discharges will be restricted during the time periods that are sensitive to aquatic habitat and biodiversity. For example: September – November is a sensitive time period for fish migration, and as a result the Freshwater Ecology Assessment (Technical Report #6) has recommended that consideration should be given to avoiding works within the flowing channel during this time frame. With high risk activities avoided, adverse effects will be negligible or low.
Minimise	Staging of works from downstream to upstream and in conjunction with adjacent river work activities where possible.	Overall disturbance will be reduced resulting in sediment generation from a disturbed restricted to a maximum of 500 m in length at a time. Completed downstream sections are protected from any upstream flows works which may have previously generated erosion and discharged sediment downstream.
Minimise	Works on the edge of the river channel will involve the construction of a temporary protective bund. Subsequent earthworks will take place completely in the dry or standing water behind the bunds. A maximum duration of 12 hr/day and two consecutive days of no works within every 7 days.	Sediment in standing water will pass through the bund as a groundwater flow where sediment particles will be intercepted and entrained by the bund before discharging into the adjacent flow. Monitoring results from similar activities (Cameron, D., 2019) which used protective bunds indicates the discharge is expected to: • Elevate turbidity above ambient during works behind the bund. • Return to the ambient range approximately 1 hour after works are stopped.

Set	Measure	Residual effects
Minimise	Works in flowing water will be restricted to: • A maximum worked reach of 500 m at one time. • A maximum duration of 12 hr/day • two consecutive days of no works within every 7 days.	Sediment discharges are expected to be generated while works are taking place. Monitoring results from similar activities (Cameron, D., 2019) indicates the discharge is expected to: • Significantly elevate turbidity above ambient during works behind the bund. • Return to ambient approximately 1 hour after works are stopped.
Minimise	The frequency and footprint of vehicle access to the wetted channel and crossing points will be minimised to reduce the generation of sediment. Vehicle trials will be conducted prior to construction to determine the vehicle type, speed, water depth, direction and lengths which minimise the generation of sediment.	Vehicles entering and crossing the River are expected to generate a sediment discharge. Monitoring results from similar activities (Cameron, D., 2016) indicates a discharge will elevate turbidity to a range of 10-20 NTU.
Minimise	Wet extraction of gravels is to be undertaken in general accordance with the Wet Extraction Methodology set out in the Code of Best Practice for River Management Activities or in a manner which have similar effects related outcomes. Details are to be provided in SSESCPs.	Sediment discharges are expected to take place while works occur. Monitoring results from similar activities (Cameron, D., 2016) indicates the discharge is expected to: • Elevate turbidity above ambient (ranging from 250 – 350 NTU) during works. • Return to ambient approximately 1 hour after works are stopped.
Minimise	Staging of works and rapid stabilisation to minimise the area of land that can generate sediment.	Sediment discharges will only be generated during rainfall events or flood events. The impacts from floods will be negligible compared to what happens naturally in the river.
Mitigate/treat	Silt fences will be deployed between the lower berms and stopbanks to intercept sediment laden sheet flow before it is allowed to concentrate and enter the River	The risk of any sediment discharges where silt fences are deployed is considered low. The impacts from floods will be negligible compared to what happens naturally in the river.

Set	Measure	Residual effects
Monitor/minimise	Short term stabilisation (rock armour, hardfill and geofabric) of surfaces in the lower berms will be undertaken to minimise generation of sediment when flood level and rainfall alert triggers are activated. Refer to Section 8 in the ESCP (Appendix A) for details.	The risk of significant effects of erosion and sediment discharge from inundated work areas on the channel edges and lower berms is reduced. The impacts from floods will be negligible compared to what happens naturally in the river.
Measures for activities outside the River Corridor		
Avoid	Major activities will be planned during periods of dry weather. Weather monitoring and forecasting details are outlined in Section 5 of the ESCP (Appendix A).	No erosion or sediment discharges and related effects are expected during dry weather.
Avoid	Sources of clean water, either as runoff or an existing waterbody will be temporarily diverted or protected from active earthwork sites.	No erosion and sediment discharges are expected to be generated as a result of clean water sources interacting with erodible surfaces.
Minimise	Staging of works and rapid stabilisation (e.g. adhesive hydroseeding and mulching) to minimise the area of land that can generate sediment.	Sediment discharges will only be generated during rainfall events. Smaller staged footprints will generate significantly reduced sediment concentrations relative to a fully opened site and will be easier to monitor and control.
Treat	Sediment treatment devices, such as sediment retention ponds (SRPs), container impoundment systems (CISs) and decanting earth bunds (DEBs) will be deployed to treat sediment before discharge into the River through existing stormwater networks.	Sediment treatment devices constructed in accordance with Waka Kotahi and GWRC best practice are expected to provide sufficient treatment such that the water quality of the final discharge has little to no effect on the receiving environment. Failure or reduction in treatment performance of a structural devices poses a risk of sediment discharge.
Treat	Interception of sediment-laden sheet flow will be deployed using silt fences to prevent the formation of concentrated dirty water flows.	Sediment concentrations where silt fences are deployed are expected to be significantly reduced by this method of treatment.

Set	Measure	Residual effects
Treat	Chemical treatment will be deployed when treatment performance of device needs to be improved.	Sediment concentrations contained in discharges are expected to be reduced by chemical treatment processes. Management of chemical spill and over-treatment risks is outlined in the CTP.
Monitor	Regular auditing and review of measure against performance criteria.	Poor performance or failure of ESC measures is identified and remedied to reduce the risk of unexpected discharges.
Monitor	Collection of a combination of continuous, discrete water quality sampling and ecological data. Data will be used to test ESC measures against performance criteria. Where results exceed acceptable trigger thresholds, the prevention of re-occurrence of adverse effects (if they occur) will be implemented through adaptive management procedures.	Discharges which occur outside of the performance criteria/consent conditions are identified, any related effects are assessed, and required measures to prevent re-occurrence are implemented.
Measures for activities producing cement-laden water		
Avoid	Contain and control pours and free water content of cement. No concrete vehicle wash down will be permitted.	No discharge of cement-laden water and no related effects anticipated.
Treat	Bunding placed around areas where excess water needs to be contained. Apply chemical treatment to adjust pH or use absorbent material to remove cement laden water.	Cement-laden water is contained and treated/remove prior to discharge so no related effects are anticipated.

9.2 Contaminated land procedures

125. The potential of effects on environmental receptors from contaminated land runoff ranges from minor to high as described in Technical Assessment No. 13 (Contaminated Land). The magnitude of the effect and type of remedial works depend on the extent, type of contaminant, and toxicity to receptors. The extent of contaminated land will be documented in the Detailed Site Investigation and remedial works in the Contaminated Land Site Management Plan. Examples of remedial works include, but are not limited to:

    i. encapsulation and burial of contaminated land in lined cells;

    ii. capping of contaminated land with linings and cleanfill; and

    iii. disposal of contaminated land to licensed landfill.

126. In terms of construction water quality associated with runoff from remedial works, typical ESC measures to reduce effects from contaminated land on the environment include but are not limited to:

    i. ESC measures to reduce erosion and detain sediments on site (for contaminants that are absorbed or attached to soil particles). These measures include bunding or use of container impoundments systems (CISs) to contain the stormwater so it can be treated and tested prior to discharge;

    ii. contaminant testing and chemical treatment of any dewatering and stormwater runoff;

    iii. staging works to take place when no rainfall is forecast; and

    iv. disposal of contaminated water which is unsuitable for site treatment to trade waste or to off-site disposal to provide an alternative to discharging into the natural environment.

9.3 Monitoring processes

127. Weather forecasts will be monitored routinely to identify climatic conditions which will result in rainfall on site and/or increase in river levels.

128. Flood response procedures will be prepared as part of the ESCP. Procedures could include but are not limited to:

    i. methods for monitoring rainfall forecast, rainfall depth and river flow levels;

    ii. trigger levels and alarm system details for ceasing works and removing plant and vehicles from the river corridor in anticipation of a flood event; and

    iii. methods for rapid stabilisation of any disturbed area within the floodplain.

129. When rainfall events (7mm/hr or 20 mm/24 hours) are forecast rainfall contingency measures, which are to be specified in the ESCP and SSESCPs, will be put in place. Typical rainfall measures include but are not limited to:

    i. temporary stabilisation using hardfill, geofabric and mulch;

    ii. formation of cut off bunds, contour drains to contain/separate dirty and clean water;

    iii. removal and wash down of plant;

    iv. surface roughening of slopes to minimise erosion potential; and

    v. flocculation of treatment devices.

130. Monitoring of River water quality will be undertaken during construction using continuous telemetered turbidity sensors installed on the piers of the Kennedy-Good, existing Melling, Ewen and Ava Bridges. Four bridge sites provide:

   i. an upstream reference point (Kennedy-Good Bridge) which indicates the quality of the water entering the site;

   ii. a mid-site measurement point (Existing Melling) which indicates water quality within the site; and

   iii. a downstream site (Ewen Bridge) which indicates the water quality following any sediment discharges from construction activities.

   iv. A further downstream site (Ava Bridge) which indicates water quality approximately 1000 m downstream of the Project.

131. A key expectation is that following work in the active river the river clears within 1 hour back to normal levels. This relationship has been established in assessments of ecological impact from River management activities by Cameron in 2016 and is summarised in Table 9.

Table 9. Turbidity and suspended solids monitoring in the Te Awa Kairangi during gravel extraction at Kennedy-Good Bridge on 28 Nov 2012. Source: Cameron, D. (2016)

Time	Bulldozer activity	Upstream		100m Down stream		500m down stream	
		Turbidity (NTU)	SS (mg/L)	Turbidity (NTU)	SS (mg/L)	Turbidity (NTU)	SS (mg/L)
16.10	Excavating gravel from river	6	1	175	90	47	29
16.35	Excavating gravel from river	5	2	306	207	102	51
17.00	No activity work ceased	6	1	52	180	84	100
17.35	No activity	4	1	13	782	64	17
18.00	No activity	5	1	7	1	8	1

132. Therefore, the purpose of the live data feed is to assess if core mitigation measures for active channel works allow the River to return to ambient clarity approximately 1 hour after completion of works and if necessary, modify measures to improve water quality during construction. Proposed turbidity triggers in Table 10below will act as the threshold to prompt investigation of the probable cause of exceedance and implementation of actions to improve ESC measures.

Table 10. Proposed Turbidity monitoring management triggers

Trigger type	Change in Turbidity	Action
Proactive trigger	10 % Difference between the control and downstream of work area outside construction period above a baseline 15 NTUs	Investigate probable cause of exceedance. Implement improvement to measures. Undertake field monitoring.

Trigger type	Change in Turbidity	Action
Management trigger	15 % Difference between the control and downstream of work area outside construction period above a baseline of 15 NTUs	Under actions for the proactive trigger AND undertake an ecological assessment of the effect of the exceedances in a report to GWRC

133. Should monitoring results demonstrate that core measures proposed in Table 10 are insufficient for managing effects, the following contingency measures are to be considered:

    i. Reduction of the maximum daily footprint.

    ii. Reduction of the maximum daily work period.

    iii. Installation of geofabric in the internal structure of protective bunds to filter sediment in groundwater flows between standing water and the main river flow.

    iv. Temporary armouring of exposed surfaces that generate sediment such as a lens of clay material or the removal of the material. This would involve grading excavated material and selecting larger material to be returned to provide a cover.

134. Should further monitoring following initial implementation demonstrate the actions are insufficiently mitigating effects, a formal adaptive management process, which includes mana whenua and GWRC will be triggered.

135. Ecological monitoring will be undertaken and is described in detail in Technical Assessment #6-Freshwater Ecology.

136. In addition to the continuous turbidity monitoring in the river grab samples will be taken from the immediate vicinity and downstream of works in the flowing and standing water. Samples will also be taken from discharges from sediment control devices and receiving waters from activities outside the river corridor. Where turbidity a minimum of 50 m downstream of reasonable mixing exceeds 170 NTU a management process will be triggered to identify the probable cause and improvement measures required to prevent re-occurrences.

137. It is proposed that an annual monitoring report be prepared using the water quality data described above and the monitoring information from freshwater and marine monitoring described in Technical Assessments No. 6 (Freshwater Ecology) and 8 (Marine Ecology). The report will:

    i. summarise the monitoring data;

    ii. identify any trends in the data compared to baseline information; and

    iii. recommend if required changes in work practices to minimise any adverse effects.

9.4 Small tributaries and drains

138. A number of small tributaries and drains cross the project area and discharge into Te Awa Kairangi. All streams and drains south of Tirohanga Stream have highly modified lower catchments. Their lower reaches from the west side of the motorway to the Te Awa Kairangi are piped. A number of modifications are proposed to these piped sections such as new culvert alignments or new discharge structures.

139. There is potential for sediment to be discharged to these water courses from activities adjacent to them such as earthworks or from modifications to the drains. The potential for sediment discharges from adjacent activities will be addressed in the relevant SSESCPs. The key factor in the construction of new culverts and discharge structures will be minimising the need to work in the water. This is achieved by creating the new structures out of the current alignment and diverting the water around the construction area. These measures will be detailed in the SSESCP prepared for the construction activity.

10. SUMMARY RATING OF EFFECTS

140. Table 11 summarises the rating for effects with and without ESC measures in place to demonstrate residual potential effects of sediment generation from Project activities. Rating levels have been defined as “negligible”, “low”, “moderate” and “high”.

Table 11. Summary rating of potential effects

Activity location	Adverse effect rating with no management measures	Adverse effect rating after management measures	Comment
Enabling works			
Outside road corridor (East and West)	Negligible	Negligible	Potential for generation of sediment is very small, contamination is possible. If required effects can reduced by implementation of ESC as per Appendix A-C
Within the floodplain	Low	Negligible	Potential for sediment generation is small. Minimisation of disturbance area and treatment (silt fences) can be used. Risk of flood inundation is low.
In the active channel	Low	Negligible	Potential of sediment generation is small, and minimisation of disturbance area can be used. Minor inundation is expected.
River widening and reprofiling			
Above river channel	Low	Negligible	Potential for sediment generation is small. Minimisation of disturbance area and stabilisation can be used. Risk of flood inundation is low.
In standing water	High	Low	Effects reduced by bunding off the work area where practicable, minimising working durations each day, and

Activity location	Adverse effect rating with no management measures	Adverse effect rating after management measures	Comment
			minimising the extent of disturbance.
In flowing channel	High	Low	Effects reduced by using best practice methodology as set out in GWRC Code of Practice for River Management Activities (2019) or similar, limited periods of work, live monitoring of sediment discharges, restricting the disturbed reach to maximum 500 m lengths, and bunding off work area where practicable to separate work area from flowing water (this may have limited application),
Riverbank protection structures			
Above river channel	Low	Negligible	Potential for sediment generation is small. Minimisation of disturbance area and stabilisation can be used. Risk of flood inundation is low.
Standing water	Moderate	Low	Effects reduced by bunding off the work area where practicable, minimising working durations each day, and minimising the extent of disturbance.
In flowing water	Moderate	Low	Effects reduced by bunding off the work area where practicable, minimising working durations each day, and minimising the extent of disturbance.
Stopbanks			
New behind existing	Negligible	Negligible	Potential for sediment generation is expected but contained behind existing banks. Minimisation of disturbed area and treatment can be used.
New in river corridor	Low	Negligible	Potential for sediment generation is expected. Risk of flood inundation low. Minimisation of disturbed area and treatment (silt fences) can be used.

Activity location	Adverse effect rating with no management measures	Adverse effect rating after management measures	Comment
Removal of existing	Low	Negligible	Potential for sediment generation is small. Risk of flood inundation low. Minimisation of disturbed area and treatment (silt fences) can be used.
Bridges			
River causeway	Low	Negligible	Sediment generation is expected but for a short duration. Risk of diversion causeway wash-out from flood is low.
Pier construction	Low	Negligible	Sediment generation is expected but for short duration. Minimisation of disturbed area can be used.
Superstructure	Negligible	Negligible	Potential for sediment generation is extremely low.
Material Processing			
Carting to and from site	Low	Negligible	Potential sediment generation from vehicle movements is small. Minimisation of disturbed area can be used through defined haul roads and stabilisation.
Processing	Low	Negligible	Potential sediment generation is very small. Any slurry to be disposed of offsite.
Eastern Hutt and city centre			
Construction yards	Negligible	Negligible	Potential for sediment generation is small. Surfaces will be un-stabilised for very short durations. Risk of flood inundation is low.
Car Park removal	Low	Negligible	Potential for sediment generation is expected. Effects reduced by implementation of ESC as per Appendix A-C..
Bridge abutments	Negligible	Negligible	Potential for sediment generation is small and contained behind stopbanks. Effects reduced by implementation of ESC as per Appendix A-C.

Activity location	Adverse effect rating with no management measures	Adverse effect rating after management measures	Comment
Roading excavations	Moderate	Negligible	Potential for sediment generation is expected. Effects reduced by implementation of ESC as per Appendices A-C.
Roading Services	Negligible	Negligible	Potential for sediment generation is very low.
Western Transport Corridor			
Construction yards	Low	Negligible	Potential for generation is small. Surfaces will be unstabilised for very short durations. Risk of flood inundation is low.
Access tracks	Low	Negligible	Potential for sediment generation is very small with surfaces to be stabilised.
Building removal	Low	Negligible	Potential for sediment generation is small. Contamination is possible. Effects reduced by implementation of ESC as per Appendices A-C.
Bridge abutments	Low	Negligible	Potential for sediment generation is small and contained behind stopbanks. Effects reduced by implementation of ESC as per Appendices A-C.
Temporary roads	Low	Negligible	Potential for sediment generation is expected. Effects reduced by implementation of ESC as per Appendices A-C.
Interchange	Moderate	Negligible	Effects reduced by bunding off works area.
Drainage upgrade	Low	Negligible	Potential for sediment generation is expected. Culvert to be constructed offline where practicable. Effects reduced by implementation of ESC as per Appendices A-C..
Melling Station and rail	Moderate	Negligible	Effects reduced by implementation of ESC as per Appendices A-C.
Rail line / carpark removal	Moderate	Negligible	Effects reduced by implementation of ESC as per Appendices A-C.

Activity location	Adverse effect rating with no management measures	Adverse effect rating after management measures	Comment
New station / carpark	Moderate	Negligible	Effects reduced by implementation of ESC as per Appendices A-C.

10.1 River widening and reprofiling:

141. Details for mitigation action of activities which have been identified by Table 11 to have an effect rating to shift from 'high' to 'low' or 'negligible' are set out below and discussed further in the ESCP (Appendix A).

142. The area of river widening and reprofiling works within the river channel is extensive. As per Section 8 of this report, the potential of effects of in-river sediment generation is moderate. Key measures will reduce the effects to low in the following ways:

    i. Avoiding work in low flow and ecologically sensitive seasons. If this is not possible special procedures will need to be adopted to avoid adverse effects. For example, ecological monitoring to identify the presence of nesting sites and the establishment of suitable buffer areas.

    ii. Conducting works in general accordance with 'best practice' methodologies set out in GWRC's Code of Practice for River Management Activities (2019) or other methods which result in the same environmental outcomes. These guidelines have been developed from observation and monitoring of such activities in the Te Awa Kairangi over the past five years. The guidelines have been widely consulted on with Iwi, The Department of Conservation, and Fish and Game.

    iii. Progressive staging from downstream to upstream (maximum disturbed active channel reach of 500 m at any one time) will minimise the area of disturbance and subsequently the volumes of sediment generation.

    iv. Daily work duration will be restricted to 12 hours per day with 2 consecutive work free days within every 7 days to allow the River to return to ambient water quality, relieving the aquatic habitat from sediment exposure every day.

    v. The use of bulldozers has proven successful in river widening and reprofiling work undertaken in Te Awa Kairangi for flood protection works. The reason for the success is that bulldozers allow large volumes of material to be quickly pushed out of the flowing river channel for subsequent removal or repurposing. Thus minimising the time for sediment generation. Large excavator's may be used to achieve a similar result regarding effects.

    vi. Temporary diversion and formation of protective bunds will minimise the extent of works carried out in flowing water. Generation of sediment from works behind bunds is substantially less than if works are in flowing water. Figure 13 shows a typical protective bund which would be used during construction. This may have limited application.

Figure 13 Protective bund in the Te Awa Kairangi during edge protection construction at Gibbons Street. Source: Cameron, 2019

10.2 Roading excavations

143. Potential effects of sediment discharge associated with roading excavations are moderate. Key measures will reduce effects to negligible in the following ways:

    i. avoidance of works in heavy rainfall events to reduce the generation of sediment from active areas;

    ii. progressive stabilisation to reduce the extent of disturbed surfaces and subsequent volumes of sediment generation;

    iii. Use of structure treatment devices (such as SRPs, DEBs and CISs); and

    iv. staging of permanent stormwater treatment installation at the beginning for the works period to provide a level of treatment which is higher than typical devices (e.g. sediment retention ponds and decanting earth bunds).

10.3 Rail sites, Melling Station and carparks

144. The potential effects of sediment discharge associated with rail realignment, station removal and construction of the new Melling station and carpark construction can be moderate. The key measures to reduce effects to negligible are as follows:

    i. avoidance of works in heavy rainfall events to reduce the generation of sediment from active areas; and

    ii. deployment of the contain, test, and treat process in the case where sites are contaminated.

145. Progressive stabilisation to reduce the extent of disturbed surfaces and subsequent volumes of sediment generation.

10.4 Contaminated sites

146. While potential effects of contaminated land runoff on environmental receptors range from high to low, the completion of the DSI and implementation of measures in both the ESCP (Appendix A) and Contaminated Land Site Management Plan reduce any potential effects to low.

10.5 Recommendations for consent conditions

147. I recommend a condition to implement an overarching ESCP, which identifies how all works shall be undertaken and should address:

    i. procedures for determining staging and sequencing of works;

    ii. responsibilities and contact details of all parties responsible for the operation and maintenance of all key erosion and sediment control structures;

    iii. methods for reviewing and amending the ESCP as required;

    iv. details of all principles, procedures and practices that will be implemented to undertake erosion and sediment control and minimise the potential for sediment discharge from the site;

    v. the design specification for all erosion and sediment control structures;

    vi. methods for decommissioning erosion and sediment control structures;

    vii. procedure for the preparation of Site-specific Erosion Sediment Control Plans; and

    viii. monitoring procedures and frequency.

148. I recommend a condition to implement SSESCPs be prepared for all works. SSESCPs should be prepared in accordance with the ESCP and should include:

    i. detailed description of the specific site activities and construction methodology;

    ii. identification of potential for erosion and sediment generation;

    iii. proposed methods of avoiding, minimising and treating sediment;

    iv. outline of sequencing of works and related ESC measures;

    v. drawings, to an appropriate scale, showing:

        (a) location of receiving environments, nearby waterways, and stormwater networks;

        (b) sequencing of ESC measures;

        (c) area and sections of cut and fill;

        (d) locations of stockpiles and haul roads;

        (e) all key ESC measures, including diversion channels;

        (f) boundaries and areas of catchments contributing to specific discharges; and

        (g) locations of specific points of discharge to the environment;

    vi. locations of specific points of discharge to the environment;

    vii. specifications for ESC measures and design calculations;

    viii. site management;

    ix. maintenance and inspection schedule;

    x. monitoring, trigger levels and reporting;

    xi. contingency measures, including response measures in heavy rainfall;

    xii. decommissioning methodology for erosion and sediment control measures;

    xiii. procedures for re-instating ESC measures at the end of each working day; and

xiv. roles and responsibilities.

149. I recommend a condition which requires that the ESCP and SSESCP be prepared in accordance with current versions of the following guidance where applicable:

    i. GWRC Erosion and Sediment Control Guide for Land Disturbing Activities;

    ii. Waka Kotahi Erosion and Sediment Control Guidelines for State Highway Infrastructure; and

    iii. GWRC Code of Practice for River Management Activities.

150. I recommend a condition which requires that flocculation be used on all treatment devices. A CTP should be a condition and could address:

    i. method and type of flocculant chemicals to be used (including alternative methods if that method is found to be ineffective after use on site);

    ii. details of dosage rates and deployment scenarios;

    iii. a chemical spill contingency plan; and

    iv. details of a monitoring programme including frequency of monitoring, parameters, and reporting of results.

151. I recommend a condition which requires disturbed areas to be rapidly stabilised upon the completion of works in accordance with stabilisation methods set out in the ESCP and/or SSESCP.

152. I recommend a condition which requires a monitoring regime in accordance with the ESCP. Monitoring should include:

    i. Installation of telemetered continuous turbidity sensors at the Kennedy-Good, Melling, Ewen, and Ava Bridges.

    ii. Grab sampling at treatment devices in response to rainfall trigger events upstream, at an outlet and downstream of the zone of reasonable mixing as far as access is practical.

    iii. Grab-sampling at an upstream control point above Kennedy-Good Bridge and within the flowing river channel during construction activities in the river channel where a work site is located more than 500 m upstream of a continuous monitoring location.

153. I recommend a condition which requires annual reporting on the performance of ESC measures. As a minimum, reports should address but not be limited to:

    i. results of water quality, freshwater and ecology monitoring;

    ii. performance of ESC structures;

    iii. improvements to ESC principles, procedures, practices and monitoring procedures; and

    iv. updates to the ESCP and/or SSESCPs.

    v. any occurrence of non-compliance with consent conditions, reasons for non-compliance and actions taken to prevent re-occurrences of non-compliance in the next year of construction.

    vi. Any changes to monitoring regimes, interim consent trigger, ESC practises, and construction programme and methodologies.

154. In the case of incidents related to construction water quality, such as spill or discharges which have acute effects, a condition would be useful to require an investigation of incidents and any action to prevent reoccurrence. Reporting of incidents should be sent to GWRC within a set time frame e.g. 5 or 10 days.

10.6 Surface water discharge conditions

155. I recommend a condition covering water quality limits linked to discharges from land-based activities outside the River Corridor. For example, discharges to surface water during construction should meet a performance target. The target requires total suspended solids (TSS) concentration below 100 mg/L for 80% of all discharge events.

156. I recommend a condition requiring monitoring of discharges from activities outside the River Corridor be undertaken in response to rainfall events (defined as 7 mm/hr or 20 mm in 24 hours). Providing access is practicable and safe for personnel, monitoring of TSS should be undertaken at:

    i. the outlet point of any ESC device or structure observed to discharge in the Rainfall event;

    ii. a location downstream the zone of reasonable mixing. This is minimum 50 m downstream of the outlet points; and a location upstream the outlet point location.

10.7 In river work conditions

157. I recommend a condition which explicitly requires in river works to be undertaken in general accordance with the current GWRC Code of Practice for River Management Activities or achieves a similar outcome.

158. I recommend a time restriction condition. It should be similar to the Code of Practice which requires a maximum works period in the river channel of 12 hours a day with two consecutive days of rest within every 7 days

159. I recommend a working length restriction of 500 m in the river channel as measured by the centreline of the river.

160. I recommend a condition relating to minimum flow above which works shall take place. This is defined as flow greater than the minimum flow set out in the PNRP of 1.2 m^3/s.

161. I recommend a condition requiring the storage of fuel to be outside the river corridor and all refuelling of vehicles to take place a minimum of 10 m away from the edge of the river channel.

162. I recommend a condition requiring all vehicles to have the exterior cleaned free of sediment prior to entering the floodplain.

163. I recommend a condition that a trial be undertaken to determine the best way to ford the Te Awa Kairangi / Hutt River which minimises the effects on the river. The trial should consider vehicle speed, number of vehicles crossing at one time, water depth, length of crossing and direction. The trial should commence prior to Construction Works commencing. The results of the trial should be submitted to GWRC within 1 month of the crossings starting. The recommendations of the trial should be implemented in ESCP and SSESCPs immediately.

11. ALIGNMENT WITH POLICIES, STRATEGIES AND OBJECTIVES

164. The Regional Policy Statement for the Wellington Region (2013) sets an over-arching framework for resource management issues in the region with the detailed policy direction provided through the regional and district plans. In the case of erosion and sediment control and effects on water quality, the policy direction falls under the regional plans, in particular the Appeals version of Proposed Natural Resources Plan (PNRP). A more fulsome assessment of the relevant objectives and policies in the proposed and operative plans and national policy statements is included in Chapter 11 of the AEE (Volume 2 of the Application).

165. Relevant objectives of the PNRP include Objective O24 (Water Quality) and Objective O25 (Biodiversity, aquatic ecosystem health and mahinga kai).

166. Objective O24 seeks that rivers, lakes, coastal waters and natural wetlands are suitable for contact recreation and Maori customary use by:

    i. maintaining water quality; or

    ii. improving water quality in fresh and coastal water with significant contact recreation and mana whenua values.

167. Under sub-section (b), the objective sets out a range of minimum water quality parameters. Water clarity, which is set at a minimum of 1.6 m, is the only parameter applicable to construction water quality and erosion and sediment control.

168. Once complete the river widening and reprofiling works will reduce erosion and sediment discharges that occur during a range of natural flows. However, during construction there are two temporary scenarios where the objective may not be met:

    i. during flood events where natural suspended sediment reduce water clarity below 1.6 m; and

    ii. during works in river channel which generate a sediment discharge that reduce water clarity below 1.6 m.

169. Despite temporary flood and construction reductions of water quality, overall the project will improve operational erosion protection and the natural form of the river resulting in net water clarity improvement and aligns Project activity with Objective O24.

170. Objective O25 seeks that biodiversity, aquatic ecosystem health and mahinga kai in fresh water and the coastal marine area are safeguarded such that water quality, flows, water levels and aquatic and coastal habitats are managed to maintain biodiversity, aquatic ecosystem health and mahinga kai.

171. This assessment demonstrates the Project aligns with Objective O25 insofar as potential effects of erosion and sediment discharges on the receiving environment are either negligible or low with a short term effect provided the proposed management measures are upheld.

172. Specifically, Project related sedimentation rates in downstream coastal waters align with O25 (b) Table 3.8 as construction related sediment discharges downstream of the designation are expected to be within an acceptable range of expected natural sedimentation rates. This is discussed in more detail in Technical Assessment No. 8 (Marine Ecology).

173. The effect of construction-related sediment discharges on biodiversity and habitat are discussed in further detail in Technical Assessment No. 6 (Freshwater Ecology) and Technical Assessment No. 8 (Marine Ecology).

12. CONCLUSION AND RECOMMENDATIONS

174. The Riverlink Project consists of a series of individual infrastructure activities which take place at different times throughout the project duration and vary spatially across different receiving environments.

175. The proposed works and the assessment of effects is based upon the following factors:

    i. That the river system is a dynamic environment which has significant periodic disturbances (floods) and that the river and its ecosystem recovers from this to return to same pre flood condition.

    ii. That these disturbances included changes to the river bed and loss aquatic flora and fauna.

    iii. That the suspended sediment in the river system is predominantly sand.

176. Te Awa Kairangi, which is the primary receiving environment, has its own fluvial and sediment transport processes which are driven by flood events. The magnitude of potential sediment discharges from Project activities forms a negligible proportion of the annual sediment load and variability.

177. As a result, I consider that potential adverse effects of erosion and sediment discharges will be either negligible or low and temporary with a duration equal to the indicative construction duration of four years provided:

    i. construction activities are conducted in a staged and confined manner with sufficiently small footprints and durations;

    ii. management plan procedures to avoid, minimise, treat, monitor, and adapt are prepared and followed;

    iii. monitoring and adaptive management procedures in management plans facilitate deployment of innovative construction techniques and specific actions; and

    iv. proposed consent conditions are complied with for the duration of the Project.

23 July 2021

Edryd Deiniol Breese

13. REFERENCES

Cameron, D. (2016) Effect of flood Protection Activities on Aquatic and Riparian Ecology in Hutt River. December 2016.

Cameron, D. (2016) Ecological Effects of Flood Protection Activities in the Hutt River – 2016 ADDENDUM

Cameron, D. (2018) Baseline Monitoring of Aquatic Habitat Quality and Fish Communities: 2017/2018.

Cameron, D. (2019) Gibbons Street Works, Hutt River: Ecological monitoring.

GWRC (2019) Code of Practice for River Management Activities Te Awa Kairangi / Wainuiomata Rivers.

GWRC (2021) Erosion and Sediment Control Guide for Land Disturbance Activities in Wellington Region

Opus (2010a) Hutt River Coastal Sediment Transport Processes and Beach Dynamics

Opus (2010b) Hutt River Mouth Sediment Input and Aggradation in the lower Hutt River

Opus (2010c) Hutt River Mouth Fluvial Sediment Transport

Opus (2010e) Hutt River Sediment Transport – Source to Beach

Rooper-Lindsay. J, Fuller. S.A, Hooson. S, Sanders. M.D, & Usler. G.T. (2018) Ecological Impact Assessment (EIA). EIANZ Guidelines for use in New Zealand. Terrestrial and freshwater ecosystems (2nd ed), Environmental Institute of Australia and New Zealand.

Appendix A – draft Erosion and Sediment Control Plan

RiverLink Pre-Implementation Planning/Design Services

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Erosion and Sediment Control Plan

29 July 2021

Revision	Status	Prepared by	Reviewed by	Approved by	Date
0	Draft	Alistair Gordon	Ed Breese	Chris Bauld	23/11/2020
0	Design Freeze #1 Draft	Alistair Gordon	Ed Breese	Ed Breese	01/02/2021
0	Design Freeze #2 Draft	Alistair Gordon	Ed Breese	Chris Bauld	29/04/2021
A	For Consent	Alistair Gordon	Ed Breese	Ed Breese	29/07/21

The Erosion and Sediment Control Plan is a living document and will be updated as the project progresses to account for changing construction environment and in response to monitoring information.

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1 Introduction

1.1 Purpose and scope

This Erosion and Sediment Control Plan (ESCP) has been prepared on behalf of Riverlink in support of the RiverLink Project in Lower Hutt. It describes the overarching erosion and sediment control (ESC) principles and procedures for the construction of RiverLink.

The RiverLink project will involve in-river and land-based works resulting in disturbance along Te Awa Kairangi | Hutt River and to the land East and West of the River. The Project seeks to minimise the impact on downstream water quality as much as practical during the works, and to ensure compliance with the Greater Wellington Regional Council (GWRC) Regional Plan, Consent and industry guidance.

The purpose of this ESCP is to demonstrate to Greater Wellington Regional Council (GWRC) and other stakeholders how RiverLink intends to comply with the requirements of the following documents;

- GWRC Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region, February 2021 (GWRC ESC Guidelines);
- Waka Kotahi New Zealand Transport Agency (Waka Kotahi) Erosion and Sediment Control Guidelines for State Highway Infrastructure, 2014 (Waka Kotahi ESC Guidelines);
- GWRC Code of Practice for River Management Activities (2019); and
- GWRC Consent Conditions (reference WGN100XXXX) dated XXXX.

This ESCP is part of a suite of documents relating to ESC for the project and should be read in conjunction with these related documents. These related documents are listed in Table 1.1 below.

Table 1.1: Riverlink ESC plans (plans proposed but not yet prepared noted in italics)

Reference	Report	Description
ESCP	Project Erosion and Sediment Control Plan [This report]	Describes the overarching erosion and sediment control (ESC) principles and procedures for project construction.
Technical assessment # 4	Technical assessment # 4 Construction water quality and erosion sediment control	The overall document which outlines the existing environment, potential for effects, mitigation and consent conditions and residual effects.
CTMP	Chemical Treatment Management Plan	Provides the process for managing flocculants on site and undertaking appropriate treatment of SRPs, DEBs and grit traps.
SSESCP – Riverbank construction (Reach A Example)	Site Specific Erosion and Sediment Control Plan – Construction of riverbank erosion protection structures	River Corridor activity Details the specific ESCs to be implemented for construction of riverbank erosion protection structures.
SSESCP – Riverbank construction (Reach B-H)	*Site Specific Erosion and Sediment Control Plan – Construction of riverbank erosion protection structures*	*River Corridor activity*

Reference	Report	Description
SSESCP – River widening and reprofiling	*Site Specific Erosion and Sediment Control Plan – River widening and reprofiling*	*River Corridor activity*
SSESCP – Bridge construction (in-river)	*Site Specific Erosion and Sediment Control Plan – Construction of bridge piers and superstructures*	*River Corridor activity*
SSESCP – Transport in River Corridor	*Site Specific Erosion and Sediment Control Plan – Transport of material within the river zone*	*River Corridor activity*
SSESCP – Bridge Demolition	*Site Specific Erosion and Sediment Control Plan – Bridge demolition*	*River Corridor activity*
SSESCP – Rail works	*Site Specific Erosion and Sediment Control Plan – New Melling Station and rail realignment*	*Land-based activity*
SSESCP – Road works	*Site Specific Erosion and Sediment Control Plan – Road construction*	*Land-based activity* *Roadworks for the grade separated overpass, SH2 and local roads*
SSESCP – Stopbanks	*Site Specific Erosion and Sediment Control Plan – Stopbank construction*	*Land-based activity and River Corridor activity*
SSESCP – Bridge construction (land)	*Site Specific Erosion and Sediment Control Plan – Bridge abutment and span construction*	*Land-based activity*
SSESCP – Building Demolition	*Site Specific Erosion and Sediment Control Plan – Building demolition*	*Land-based activity*
SSESCP – Landscaping	*Site Specific Erosion and Sediment Control Plan – Landscaping of floodplains*	*Land-based activity*

1.2 Project description

The RiverLink project combines a number of major infrastructure projects that include transport improvements, flood protection and inner city regeneration. A full Project Description can be found in the Project Assessment of Environmental Effects. Key components include:

a. Upgrade and raising of existing and construction of new stopbanks on both sides of Te Awa Kairangi/Hutt River between Ewen Bridge and Mills Street.

b. Instream works between the Kennedy Good and Ewen Bridges to re-align, deepen, and widen the active river channel.

c. The replacement of the two signalised at-grade intersections of SH2/Harbour View Road/Melling Link and SH2/Tirohanga Road with a new grade separated interchange.

d. Construction of an approximately 220 m long and up to 7 span road bridge with a direct connection across the River from the new interchange to Queens Drive.

e. Removal of the existing Melling Bridge.

f. Changes to local roads.

g. Changes to the Melling Line rail network and supporting infrastructure.

h. Construction of an approximately 175 m long and up to 4-3 span pedestrian/cycle bridge over the River.

i. Construction of a walking promenades located along the stopbank between Margaret Street and Andrews Avenue/High Street. This includes new steps and ramps to facilitate access between the CBD and the promenade.

j. Associated works including construction and installation of culverts, stormwater management systems, signage, lighting, network utility relocations, landscape and street furniture, pedestrian/cycle connections and landscaping within the project area.

1.3 Location

The RiverLink project extends approximately 3.9 km along Te Awa Kairangi | Hutt River in Lower Hutt, Wellington. The existing environment includes four distinct areas:

- East: the Lower Hutt Central Business District (CBD) and environs – which includes car parks and commercial and domestic properties;
- West: the Western Transport Corridor - which includes State Highway 2 (SH2), Melling intersection, Petone to Melling rail link, Melling Railway Station, and a combination of commercial and domestic properties;
- Project Extent: Te Awa Kairangi | Hutt River – the River Corridor between the East and West stopbanks which includes the river channel, riverbed and grassed and treed berms (refer to Appendix A for full river channel definitions) and Tirohanga Stream; and
- Downstream (south): the downstream River, Mouth and Te Whanganui-a-Tara | Wellington Harbour.

The project extent is indicatively shown below in Figure 1.1.

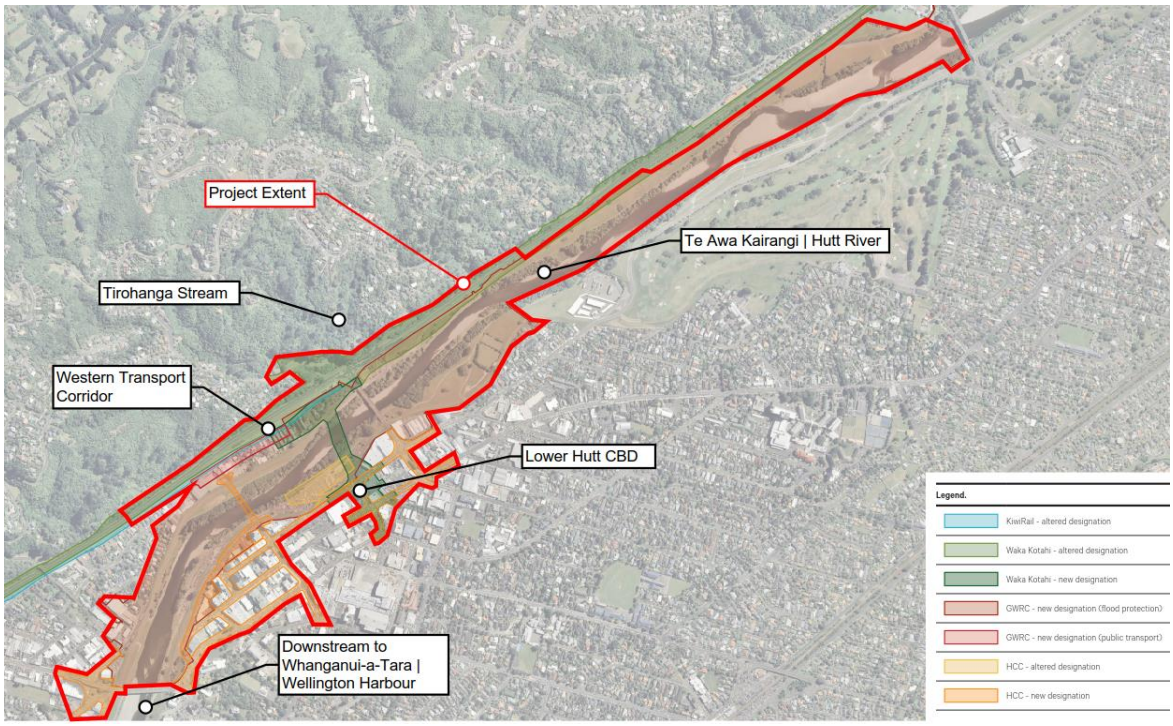

Figure 1.1: Indicative project extent

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2 Legislative requirements

2.1 Resource Consent WGN100XXXX

This ESCP has been prepared to meet conditions of Resource Consent WGN100XXXX.For ease of reference, Table 2.1 below identifies and demonstrates methods of compliance with ESC related conditions in Consent WGN100XXX.

Table 2.1: Consent condition requirements

Consent condition	Consent requirement	Comment/ where this is addressed
XX	XX	XX
XX	XX	XX
XX	XX	XX
XX	XX	XX
XX	XX	XX

2.2 GWRC ESCP requirements

Table 2.2 below lists where the ESCP requirements described in Section C1.4 of the Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region (February 2021) are addressed for ease of reference.

Table 2.2: ESCP requirements

ESCP requirements	Comment/ where this is addressed
Site description including soil, slope (contours at an interval suitable for design), and total site area	Section 1
Detailed programme of works which identifies:	
• Details of the construction period/dates/timeframes/methodologies	Section 4
• Details of any staging plans for disturbed areas	Appendix C
• The area of disturbance at each stage, including consideration of progressive stabilisation and minimisation of exposed soil	Appendix C
• Length of exposed roads, tracks and trenches	To be addressed in SSESCP for Transport in the River Corridor.
• Cut/fill volume details	Refer to RiverLink Construction Methodology
• Location and volumes details of any stockpiles	Refer to RiverLink Construction Methodology
• Extent and type of vegetation to be removed or planted	Appendix D
Drawings and description of ESC practices to be implemented	Section 5

ESCP requirements	Comment/ where this is addressed
Details of the receiving environment that the project drains into and the pathways and distance to these	Section 1
The methodology for implementing these control measures (considering any staging of the works)	Section 6
A programme detailing the frequency and methodology of any inspections, monitoring and maintenance of measures (including checks proposed during rainfall events)	Section 7
Emergency procedures to be implemented if there is an accidental untreated sediment discharge to surface water	Section 8

3 Plan administration

This section identifies how the ESC plans listed in Table 1.1: Riverlink ESC plans (plans proposed but not yet prepared noted in italics) will be updated, roles and responsibilities, and training. It is presumed all construction activities will be overseen by a principal contractor or alliance who will be responsible for environmental management of the project during construction. Construction activities may be undertaken a number of subcontractors engaged by the principal contractor or alliance.

3.1 Plan preparation

The preparation of ESC plans for certification by GWRC will be co-ordinated by the Environmental Manager. Once a plan has been certified by GWRC, the plan will be issued by the document control system and will become readily available to project staff and contractors.

3.2 Control of plans

Project ESC plans are controlled. If changes are made to these documents, in accordance with Condition XX each ESC plan will be submitted to the Manager, Consents Management, GWRC and the Compliance and Monitoring Officer, Hutt City Council (HCC) for review and certification.

A copy of all certified ESC documents will be kept on site (hard copy and electronically) for the Project and any GWRC, Waka Kotahi, HCC or other authorised stakeholder to review upon request.

3.3 Review and update of plans

Each ESC plan shall be reviewed annually and updated as required. The review shall address as a minimum;

- Changes in the construction programme;
- Changes in operational procedures; and
- Experience gained through site responses or stakeholder consultation.

ESC plans may also be reviewed in response to a specific incident, or on an as required basis. Any proposed amendments to the plans shall be submitted to the Manager, Consents Management, GWRC and the Compliance and Monitoring Officer, and HCC for approval prior to implementing.

Once approval for an amended plan is received, the new plan will be uploaded into the project document control system and the earlier version archived. An alert identifying the new plan will be sent to all parties involved with the implementation of the plan.

3.4 Roles & Responsibilities

Table 3.1 below identifies roles associated with erosion and sediment control for the project.

Table 3.1: Environmental Management Roles

Name	Organisation	Position	Responsibilities
TBC	TBC	Alliance Manager / Project Manager*	Overall responsibility for the Project. Authorises all design and contractual changes.
TBC	TBC	Environmental Manager*	Champions the adherence to ESC principles Overall responsibility for preparation and updating ESCP and SSESCPs.

Name	Organisation	Position	Responsibilities
			Inspection/audit of works to ensure compliance with ESCP, SSESCPs and consent conditions. Monitoring of performance of erosion and sediment control measures. Training (including induction for environmental aspects). Certification of erosion and sediment control measures (as required). Monthly reporting.
TBC	TBC	Construction Manager*	Overall responsibility for installation, operation and maintenance of erosion and sediment control measures.
TBC	TBC	Site Engineers / Supervisors*	Installation, operation and maintenance of erosion and sediment measures. Regular inspection.
TBC	TBC	Project ecologist	Review of draft plans. Monitoring and incident responses.
TBC	Greater Wellington Regional Council	Compliance and Monitoring Officer*	Approvals of ESCP and SSESCPs. Auditing to ensure consent conditions being met.
TBC	Hutt City Council	Compliance and Monitoring Officer*	Approvals of ESCP and SSESCPs (if required). Auditing to ensure consent conditions being met.
Various	Various	Project staff	An awareness of erosion and sediment requirements and to proactively report any concerns.

* Duties may be delegated

3.5 Training

All people working on the project will be required to undertake induction training. The induction training will include an introduction erosion and sediment control measures at a general level and the importance of these measures to minimise any adverse effects on the Te Awa Kairangi | Hutt River.

In addition to the induction training, special training will be held for those installing, operating and maintaining erosion and sediment control measures.

As part of the daily toolbox meeting for all construction activities, erosion and sediment control will be an agenda item where applicable. The meeting will be used to stress the importance of effective and efficient erosion and sediment control practices. These meetings are also structured to obtain feedback on the project and how to improve performance. Improvements to environmental management will be actioned by the site engineer or supervisor and the relevant PESC plans will be updated as per Section 3.3.

4 Construction methodology and staging

A full overview of construction methodology details is provided in the Project Construction Methodology. Key details relevant to the ESC approach are set out in the Sections below.

4.1 Staging philosophy

Construction is to consist of six separate stages, each with different location within the Project designation. The key drivers of the staged approach is to consider critical path elements, enabling flexibility and managing environmental effects to ensure any adverse effects are appropriately avoided, remedied or mitigated. The six stages are summarised in Table 4.1.

Table 4.1: Staging details

Stage	Description	Total open area (Ha)	Total duration
1	Pharazyn Street stopbank and realignment	13	11 months
2	Daly Street stopbanks, Melling pedestrian bridge and Pharazyn Street realignment	4.5	8 months
3	Melling Rail Station and Carpark	3.5	7 months
4	Melling interchange commencement and Pharazyn Street stopbank completion	5	11 months
5	Northbound Melling interchange and bridge	5	14 months
6	Melling Interchange on ramp and SH2 northbound	0.2	6 months
River corridor works including berms, bed widening and reprofiling and riverbanks. This excludes stopbanks. Reaches A – H.		72	6 month periods each year over 4 years
Melling Bridge construction		N/A	21 months

An indicative Staging plan is attached in Appendix C. A breakdown of earthwork volumes for each stage is provided in Section 1.7.3 of the Project Construction Methodology.

The individual Stages are expected to have work sequences within them which comprise of smaller open areas completed progressively within the stage duration. Details on sequencing within stages is provided in SSESCPs.

4.2 Construction duration

Construction is expected to occur over a four year period. The indicative construction programme is shown in the Project Construction Methodology. The six stages described in Section 6.1 are to occur concurrently with in-river works and construction of the Melling Bridge and pedestrian/cycle bridge.

5 Approach to erosion and sediment control management

5.1 Principles of erosion sediment control

The approach to erosion and sediment control is to:

AVOID - sediment generation

MINIMISE - sediment generation

TREAT - to remove sediment

MONITOR/ AUDIT – to confirm high performance

ADAPT – to ensure continuous improvement

5.1.1 Overview of avoidance

To achieve avoidance of the generation of sediment, the planning of construction activities needs to identify this an objective. Opportunities for avoidance can include:

- Identification of opportunities to ensure work areas are isolated from surface water drainage by the utilisation of clean water cut off drains, stream diversions to divert water from construction areas, this is known as working in the dry;
- Using periods of dry weather to complete construction activities; and
- Protection of disturbed surfaces with fabric covers.

5.1.2 Overview of minimisation

The opportunities for minimising sediment generation include;

- Minimising the area of disturbed land that can generate sediment by undertaking work in a staged fashion;
- Minimising the time an activity is undertaken;
- Prompt stabilisation of disturbed surfaces through the use of armour layers, hydroseeding, planting, and mulching; and
- Anticipating weather events.

5.1.3 Overview treatment

Where avoidance and/or minimisation measure are not sufficient to avoid the adverse effects of sediment discharges then treatment is required. A range of treatment options are available and are documented in GWRC and Waka Kotahi ESC guidelines. Proposed treatment methods are outlined in Section 5.4. Where new or innovative methods are used, design criteria and treatment performance calculations will be provided.

5.1.4 Overview monitoring / auditing

The monitoring of avoidance, minimisation and treatment measures is essential to determine the effectiveness of erosion and sediment control procedures. The audit role ensures the methods are being correctly applied. The information from monitoring and auditing helps inform the process of improvement.

5.1.5 Overview adaptation

The implementation of this ESCP the SSESCPs, the CTMP, the monitoring, and the auditing will establish a body of knowledge. Through the development of that knowledge the ESCP and SSESCPs may need to amended to drive continuous improvement of erosion and sediment management.

5.2 Core management measures

Identified core management measures set the base for ESC across the project site and be communicated with all site staff. Specifically, these are:

- All works:
  - Disturbed areas to be rapidly stabilised upon the completion of works;
  - Regular monitoring of ESC controls and water quality;
  - Regular implementation of improvement measures and reporting to GWRC); and
  - Investigation of incidents and identify any action(s) to minimise the risk of reoccurrence.
- Land-based activities:
  - Clean water diverted away from works areas;
  - Minimising working during wet weather periods;
  - Treat runoff from disturbed areas; and
  - Event based monitoring undertaken in response to rainfall events.
- In-river activities:
  - River works undertaken in accordance with the current GWRC Code of Best Practice for River Management Activities;
  - Manage hours of works through daily restrictions;
  - Manage extent of works by working in 500 m long disturb reaches at any one time;
  - Minimise the extent of work undertaken in flowing water through use of protective bund and working on dry beaches;
  - Refuelling to take place away from the edge of the active river channel;
  - All vehicles to have the exterior cleaned free of sediment prior to entering the floodplain;
  - Remove of pockets of silts/clays in the berms or stabilisation, using armour within the reiver bed; and
  - Plan and prepare for flood response.

5.2.1 Commentary on new methods

Should new methods be developed the following information will be provided:

- Design philosophy and criteria;
- Expected treatment performance;
- Drawings and calculations where applicable;
- Maintenance; and
- Decommissioning.

5.3 Summary of key implementation practises of GWRC Code of practise for River management activities

Section 10 of the GWRC Code of Best Practise for river management activities outline details of 'good management practises' for various river management activities. A summary of practise central to the avoid, minimise, treat, monitor, adapt philosophy are set out below:

Management of work durations and timing

- Manage hours of operation to ensure instream habitat has at least 12 hours of recovery time in every 24 hours, during which there is no in-river work;
- For work that extends over a longer timeframe, provide two consecutive work-free days in every seven to allow for ecosystem recovery wherever possible;
- Works in the River corridor shall be avoided during ecologically sensitive time periods as specified in the General Activities Constraint Calendar (For specific time frames refer Appendix 7 of the GWRC Code of Practise for river management activities, 2019). Where works cannot be avoided, Site Specific Effects Management Plans will be prepared as part of SSESCP preparation;
- Works in the flowing channel between 1 September – 1 December shall be avoided to allow for peak native migration. Refer to Technical Assessment #6 – Freshwater ecology for detail. Site specific effect management plan do not provide exemption from this seasonal restriction;
- Works in the flowing water shall cease during low flow periods (less than $1.2m^3/s$[1] as measured at GWRC Environmental monitoring site Hutt river at Taita Gorge Flow); and
- Work areas during peak instream recreational use (Saturdays, Sundays or public holidays between 1 December to 28 February) shall be minimised where possible.

Management of work extents

- Ensure that there is adequate provision for fish passage and/or relocation at all times during construction and maintenance work;
- Minimise the number of vehicle crossings and durations that vehicles and machinery spend in the flowing channel where possible; and
- Progressively stage works which occur out of the River and implement stabilisation as soon as possible.

5.4 Erosion and sediment control tool-box

A tool-box approach to the structural erosion and sediment controls will support the SSESCP approach set out in Section 6. A tool-box of measures is outlined on Table 5.1.

Table 5.1: Erosion and sediment control structural control tool-box

Measure	Purpose	Typical application
Water treatment		
Sediment retention ponds (SRPs)	Detain runoff flows so that deposition of transported sediment can occur through settlement.	Primary treatment device to treat runoff from bulk earthwork areas between 0.3 – 5 Ha. SRPs will be constructed in accordance with GWRC ESC Guidelines (2021).

[1] Refer GWRC Regional Freshwater Plan for the Wellington Region Table 6.1

Measure	Purpose	Typical application
		Refer to Section F1.1 of GWRC ESC guidelines for typical details.
Decanting earth bunds (DEBs)	Detain runoff flows so that deposition of transported sediment can occur through settlement.	Primary treatment device to treat runoff from bulk earthwork areas less than 0.3 Ha. DEBs will be constructed in accordance with GWRC ESC Guidelines (2021). Refer to Section F1.2 of GWRC ESC guidelines for typical details.
Silt fence/super silt fence	Detain runoff flows so that deposition of transported sediment can occur through settlement.	Treatment for sheet flows from active earthwork slopes, where it is not practical to use SRPs or DEB, and between slopes and waterbodies (e.g. the riverside toe of stopbank works). Silt fences/super silt fence will be installed in accordance with GWRC ESC guidelines (2021). Refer to Section F1.3 and F1.4 of GWRC ESC guidelines for typical details.
Container impoundment systems (CISs)	Detain runoff flows so that deposition of transported sediment can occur through settlement. Will be utilised where there is limited ability develop SRPs or DEBs. Can also be used to aid in treating runoff for pH.	Primary treatment device for runoff from bulk earthworks areas where it is not practical to construct a DEB or SRPs. May be used to treat runoff from contaminated sites and/or store runoff from contaminated sites prior to off-site disposal.
Sump/sediment pit	Intercept runoff flows from earthwork surfaces within dirty water diversion channels to allow heavier sediment particles to drop out and retain the maximum sediment onsite. Note these are not a primary sediment control device.	Pre-treatment device of flow in dirty water diversions prior to primary treatment devices. Unless stated otherwise in a SSESCP, sumps/pits are to be installed at 50 m intervals along dirty water diversions.
Chemical treatment	Flocculation will be used to improve the sediment removal efficiency of SRPs, DEBs and CIS's.	The use of flocculants is set out in the Chemical Treatment Management Plan.
Water diversion		
Dirty water diversions (DWDs)	Temporary drains which intercept and convey run-off from earthwork surfaces to sediment treatment measures.	DWDs along the perimeter of earthworks areas or which have a likely duration longer than 1 month with be constructed in accordance with GWRC ESC guidelines (2021). Stabilisation will be deployed as required depending on grade and soil type.

Measure	Purpose	Typical application
		Refer to Section E2.2 of GWRC ESC guidelines for typical details.
Clean water diversions (CWDs)	Intercept and convey runoff from upslope (non earth worked) catchments to stabilised ground.	All CWDs will discharge to a stabilised outlet and will be constructed in accordance with GWRC ESC guidelines (2021). Refer to Section E2.1 of GWRC ESC guidelines for typical details.
Contour drains/bunds	To intercept and slow down runoff over bare soil or erodible ground with a primary purpose to reduce overall slope lengths.	Contour drains will be used to intercept, slow and convey runoff from earthwork slopes into DWDs. Where contour drains convey clean water, they are to be constructed of non-erodible material and shall discharge to a stabilised outlet or CWD. Deployment of contour drains will be undertaken where possible, with guidance from GWRC ESC Guidelines (2021).
Pipe drop/flume structures	Convey a concentrated flow of clean or dirty surface runoff down a slope without causing erosion.	Drop structure or flumes will be used to convey clean or dirty water down unstabilised slopes with grade greater then 1V:3H to prevent scour of the slope and will discharge to a stabilised outlet for clean and dirty water alike. Drop structure/flumes will be constructed in accordance with GWRC ESC Guidelines (2021). Refer to Section E2.5 of GWRC ESC guidelines for typical details.
Rock check dams	To reduce the velocity of flow within the channel and prevent scour of the channel surface. Check dams also allow for some settlement of suspended solids within the channel.	Check dams will be used for temporary or permanent channels with slopes between 2-10% which have not been subject to specific design. Check dams will be installed in accordance with GWRC ESC Guidelines (2021). Refer to Section E2.4 of GWRC ESC guidelines for typical details.
Temporary stream diversion	Temporary practices used to convey stream water from above a construction activity to downstream of that activity	Require specific engineering design to convey the 5% annual exceedance probability event (no climate change adjustment factors) without scour.
Other controls (as required)		

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Measure	Purpose	Typical application
Stabilisation	The application of a "cover" over the exposed soil surface to achieve a stabilised surface and as a result minimise erosion from that surface.	Stabilisation will be used upon the progressive completion of earthwork areas. Stabilised is defined as resistant to erosion. This includes rock or aggregate surface, grass/vegetation (80% strike is required for adequate stabilisation), mulch or other methods which are sufficiently resistant to erosion.
Slash/mulch bunds	Provide a bund of mulch or slash during vegetation removal activities to assist with reduction of water runoff velocities (sheet flow) and to assist with the capture of any sediment.	May be used to temporary reduce water velocity and provide filtration of sediment from dirty sheet flow runoff from earthwork slopes. Mulch/slash bunds are not considered a treatment device.
Protective gravel bunds	Provides separation between flowing water and a working area in standing water	May be used within the river bed during riverbank work or channel widening/reprofiling. Specific requirements are to be set out in SSESCPs for Riverbank activities where this is proposed.
Filter sock/polymer filled socks	To temporarily impound sediment-laden runoff, slowing down the flow rate and allowing sediment to settle out of the water.	May be used on and around watercourses, short batter slopes and surrounding permanent drains and catch pits. Can be used as a secondary treatment device where diversion to a primary device (e.g. SRP or DEB etc) cannot be achieved.
Stabilised entrance ways	Stabilised pads at site entry and exit points to minimise sediment generation from these areas and also help to reduce dust generation and tracking of sediment to public roads.	To be used at entrances to construction compounds or identified site access points. Accessways are to be constructed in accordance with GWRC ESC Guidelines (2021). Refer to Section E2.6 of GWRC ESC guidelines for typical details.

6 SSESCPs

6.1.1 Activities requiring a SSESCP

SSESCPs are required to apply the ESC approach set out in Section 5 to the unique constraints of various construction activities including;

- In-river activities;
  - Construction of riverbank erosion protection structures;
  - River widening and reprofiling;
  - Construction of bridge piers and superstructures;
  - Transport of material within the river zone; and
  - Bridge demolition.
- Land-based activities
  - New Melling Station and rail realignment;
  - Road construction for the grade separated overpass, SH2 and local roads;
  - Stopbank construction;
  - Bridge abutment and span construction;
  - Building demolition; and
  - Landscaping of floodplains.

Refer Section 1.1 for the full list and status of the current and proposed SSESCPs.

6.1.2 SSESCP preparation

The preparation of the SSESCPs is an interactive process, which requires collaboration between the constructors, designers, environmental team and iwi. Avoidance, minimisation and treatment of potential erosion and sediment generation will be a consideration in the design phases and identification of the best construction methodology. Draft SSESCP plans will also be developed in consultation with iwi and the project ecologist prior to submission to GWRC and HCC for certification.

6.1.3 SSESCP content

The contents of the SSESCP will include:

- Detailed description of the specific site activities and construction methodology;
- Identification of potential sources for erosion and sediment generation;
- Proposed methods of avoiding, minimising and treating sediment;
- Outline of sequencing of works and related ESC measures; and
- Drawings showing:
  - Location of receiving environments, nearby waterways, and stormwater networks;
  - Sequencing of ESC measures;
  - Area and sections of cut and fill;
  - Locations of stockpiles and haul roads;
  - All key ESC measures, including diversion channels;
  - Boundaries and areas of catchments contributing to specific discharges; and
  - Locations of specific points of discharge to the environment

- Locations of specific points of discharge to the environment;
- Specifications for ESC measures and design calculations where required;
- Any specific site management measures to be implemented, including any seasonal restrictions;
- Maintenance and inspection/audit schedule;
- Monitoring, trigger levels and reporting;
- Contingency measures, including response measures in heavy rainfall;
- Decommissioning methodology for erosion and sediment control measures; and
- Procedures for re-instating ESC measures at the end of each working day.

7 Monitoring and reporting

7.1 Auditing

Where soil disturbances are being undertaken at any of the sites, audits will be undertaken:

- Fortnightly (once per two week period);
- In response to rainfall trigger events;
- In response to exceedances of continuous water quality monitoring triggers; and
- Prior to any extended works shutdown periods (such as the Christmas break).

A separate audit shall be undertaken for each SSESCP. This means that when more than one SSESCP is being implemented on site then separate audits shall be reported in individual templates.

Audits for a SSESCP may be combined, for instance an audit undertaken in response to a rainfall trigger event may also be the fortnightly audit.

Audit results will be submitted to GWRC no later than five (5) working days following the date of the audit.

An audit template example is provided in Appendix B.

7.2 Water quality monitoring

Details of water quality monitoring are set out in Table 7.1 below.

Table 7.1: Water quality monitoring details

	Land-based activities	In-river activities
Why	Land-based activities are expected to generate a discharge of runoff into Te Awa Kairangi |Hutt River and/or one of its tributaries in response to rainfall events.	In-stream activities are expected to disturb the river bed during works generating sediment. This will happen throughout the works rather than be driven by rainfall.
When	In response to rainfall events, as measured at GWRC Rainfall Monitoring Hutt River at Mabey Road Depot Rainfall (mm) will trigger the requirements for a site audit and water quality grab-sampling to assess the condition and effectiveness of sediment control measures: • 20 mm in 24 hours; or • A rainfall event with an intensity equal or greater than 7 mm/hr	Water quality monitoring will be undertaken continuously and using regular grab sampling at required locations twice a day (once during works and once 1 hour after works cease) for two weeks from commencing disturbance.

Sampling locations	Specific sampling locations will be detailed in SSESCPs. Typically, sampling locations include: • Outlet of primary treatment devices; • Upstream of outlet locations; and • Downstream of outlet locations beyond the zone of reasonable mixing (minimum 50 m).	Continuous turbidity monitoring will be undertaken in Te Awa Kairangi | Hutt River upstream and downstream of the site, specifically; • Kennedy Good Bridge (upstream); • Melling Bridge (within the works); and • Ewen Bridge (downstream). • Ava Rail Bridge (downstream) In addition, grab samples will be taken at the downstream end of a work site which is more than 500 m upstream of a continuous monitoring location (as measured by the river centreline).
Water quality trigger limits	100 mg/L measured downstream of the zone of reasonable from outlet points.	Turbidity has return to ambient clarity (as defined by upstream reference sites) one hour after works have ceased each day.
Reporting	Grab-sampling results will be submitted to GWRC following rainfall trigger events.	The information will be available on-line.

7.2.1 Management triggers and processes

In accordance with consent requirements set out in Section 2.1, the management trigger limits, set out in Table 7.2 shall apply.

Table 7.2: Management trigger limits

Sampling method	Proactive trigger	Management trigger
Grab-sampling (outside the river channel)	N/A	170 NTU downstream of the zone of reasonable mixing from outlet points.
Grab-sampling (within the river channel)	10% Different from the value at the control one hour after work is completed for the day; and Above a baseline of 15 NTU	15% Different from the value at the control one hour after work is completed for the day; and Above a baseline of 15 NTU
Continuous monitoring	10% Different from the value at the control one hour after work is completed for the day; and Above a baseline of 15 NTU	15% Different from the value at the control one hour after work is completed for the day; and Above a baseline of 15 NTU

Exceedance of the proactive trigger will initiate:

- A site investigation to determine if any improvements to construction methods and/or ESC measures can be made on-site.

Exceedance of the management trigger will initiate a site investigation required to:

- Determine the cause of the exceedance and what changes can be made to onsite management to prevent re-occurrence; and
- Record the date, time and weather condition when the sample was taken, details of the onsite investigations, probable cause of exceedance and actions taken or to be taken to prevent re-occurrence.
- Determine if proposed actions are insufficient for managing effects and if so, activating adaptive management procedures with wider stakeholders as per Condition XX.

Findings of site investigations are to be submitted to the Engineer and GWRC 5 working days after the exceedance being recorded.

7.2.2 Ecological monitoring

The Ecological Monitoring Plan details the monitoring procedures which are require in addition to ESC monitoring requirements. Details on regular monitoring are set out in RiverLink Technical Assessment No. 6 (Freshwater Ecology).

8 Risk and contingency measures

8.1 Contingency measures

Contingency measures for response to extreme events is set out in Table 8.1 below. Refer to Section 8.1.1 for specific flood risk management procedures.

Table 8.1: Contingency measures

Cause	Effect	Contingency action
Earthquake	Riverbank/slope failure	Check failure; determine if slip poses a threat to water quality; remove material from the work zone/river where possible; construct a temporary protective bund to protect the slip from flowing water where possible; carry out remedial works.
	Raised riverbed and water level	Assess magnitude of bed level change; stabilise inundated exposed surfaces; revise construction methodology to account for changes to water level and flood risk.
Human error	Failure of stabilisation methods and slope scour	Determine extent of sediment loss; assess risk to water quality; rapidly stabilise/repair slopes.
	Failure of SRP or sediment pit	Determine extent of loss of sediment, contain lost sediment with silt fences, direct water away from damaged / disturbed repair, or replace treatment pond. If deemed necessary, a suitable form of flocculation may be implemented.
Prolonged drought	Failure of stabilisation methods	Use geofabric, compacted hardfill or coconut matting to stabilise surfaces if vegetation/grass strike has not been achieved after 3 months.
Extreme rainfall event	Scour on worked faces	Redirect water and rapidly stabilise/repair slopes.
	Slope failure	Check failure; determine if slip poses a threat to water quality; remove material from the work zone/river where possible.
	Flood event	Refer to Section 8.1.1
	Overtopping of drains/diversions	Direct water away from overtopping area, repair or replace the drain/diversion.
	Failure of SRP or sediment pit	Determine extent of loss of sediment, contain lost sediment with silt fences, direct water away from damaged / disturbed repair, or replace treatment pond. If deemed necessary, a suitable form of flocculation may be implemented.

8.1.1 Forecasted rainfall event

When the metservice forecast identified a rainfall event, which is defined as rainfall greater than 7 mm/hr and 20 mm/24 hours, is expected in the next 12 hours then typical rainfall measure will be implemented which include but are not limited to:

- Suspension of all earthworks;
- Temporary stabilisation using hardfill, geofabric and mulch;

- Formation of cut off bunds, contour drains to contain/separate dirty and clean water;
- Removal and wash down of plant;
- Surface roughening of slopes to minimise erosion potential; and
- Flocculation of treatment devices.

8.1.2 Incident response

Should a failure of and erosion and sediment control device, spill or discharge with the potential to cause acute effects occur, the follow procedure shall be undertaken:

Immediately notify the Manager of the issue;

Immediately undertake onsite investigations to determine the cause of the issue, and what changes can be made to onsite management to prevent re-occurrence;

Re-establish control measures as soon as practicable where these have failed or have not been implemented in accordance with the ESCP;

Liaise with the Manager to establish whether any additional remediation and/or mitigation is required, and carry out any such action as required by and to the satisfaction of the Manager;

Record the date, time and weather conditions, details of investigations, probable cause of the issue, lessons learnt and actions taken or to be taken to prevent re-occurrence; and

Within 5 working days of the issue being recorded, provide the information required by (v) above to the Manager.

8.2 Flood risk management

Project works which occur within the floodplain of Te Awa Kairangi | Hutt River and may be exposed to flood events. The Project Environmental Manager (refer to Section 4.4 of the ESCP for contact details) shall monitoring weather forecast in anticipation of heavy rainfall which may result in flood flows within the Project designation. Should sufficiently heavy rainfall be forecast, flood management procedures set out in Table 8.2 will be put in place.

Table 8.2: Flood management procedures

Alert level	Event magnitude	Consequence	Response procedure
0	Water level and flow velocity increases unsafe level for works	Health and safety of vehicle operators compromised.	• Remove machinery and material from the flowing channel.
1	Water covers the entire bed (excluding river banks)	Level 0 consequences and: Breach of any protective bund. Increase erosion of erodible slopes. Elevation of naturally occurring suspended solids in the river	• Rapid stabilisation of erodible bank slopes on the standing water side of the bund using uncompacted gravels and cobbles. • Remove machinery and materials from the active river channel.

2	Water elevated up to Bankfull levels	Level 1 consequences and: Bank-full water level inundates partially completed works on both banks. Natural bedload sediment transport expected when flow exceeds 200 m3/s (Williams, 1991).	• Rapid stabilisation of exposed surfaces on both side of the river using pinned geofabric or rock rip rap. • Remove machinery and materials from the floodplain.
3	Water level breaches bank and inundates berms	Level 2 consequences and: Inundation of the floodplain leading to erosion of both stabilised and stabilised surfaces.	• Rapid stabilisation of erodible bank slopes using geofabric and rock rip rap materials immediately available/adjacent to the workface. • Where materials are not immediately available for use at the time of the alert, all staff and vehicles are to evacuate the floodplain. • Follow any Civil Defence instructions.
4	Stopbank design event	Overtopping of the stopbanks. Extreme erosion and risk to health and safety.	• Evacuate the floodplain immediately and head for high ground. • Follow all Civil Defence instructions.

1. Rainfall event and flow magnitudes associated with each alert level are to be determine in detailed design phase.

9 Applicability

This report has been prepared for the exclusive use of Riverlink with respect to the particular brief given to us. We understand and agree that our client will submit this report as part of an application for resource consent and that Greater Wellington Regional Council as the consenting authority will use this report for the purpose of assessing that application and in undertaking its regulatory functions in connection with Resource Consent WGN100XXXX. 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.

Appendix A: River channel definitions

- **Channel definitions: Figures A1 and A2**
- **Channel definitions: Table A1 - Terms**

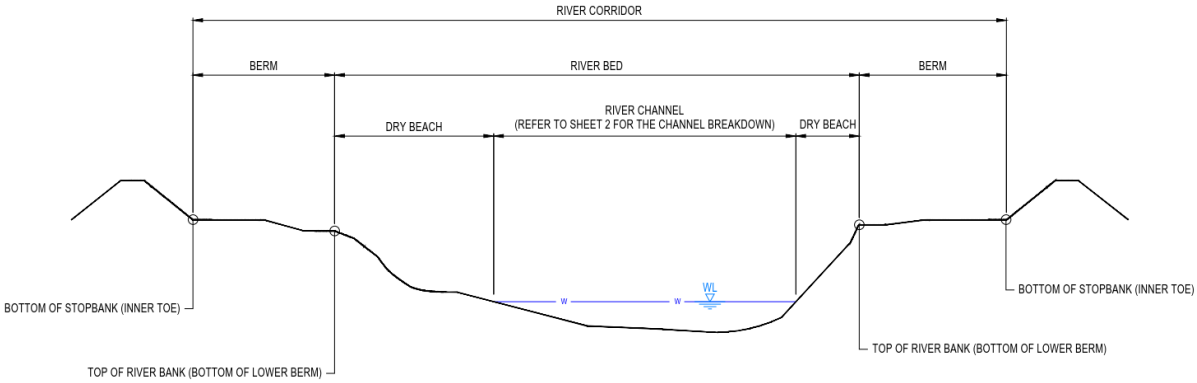

Figure A1: River Corridor Definitions

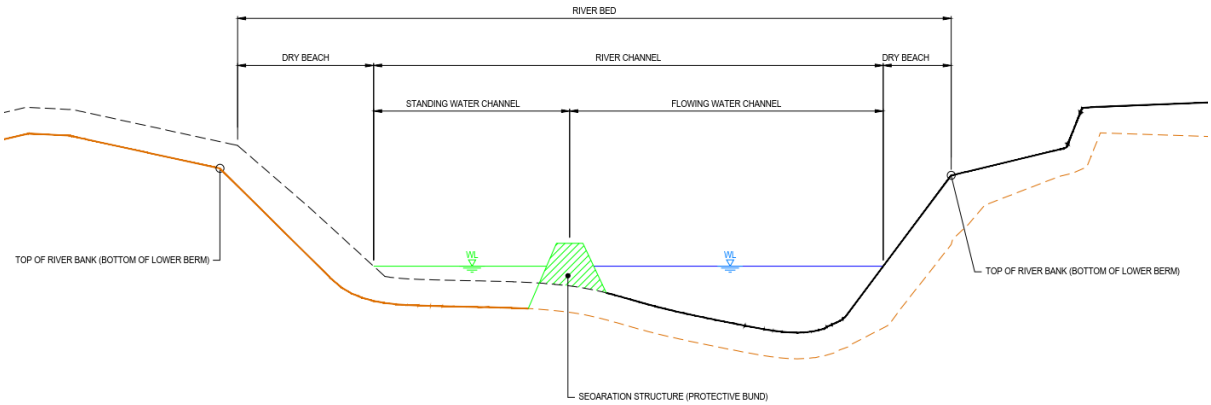

Figure A2: River Bed Definitions

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Table A1: River corridor and bed terms

Term	Definition
River corridor	Area of land between the top of the left and right stopbanks. Broadly this includes (1) the river bed; and (2) the land area between any river bed and the stopbank adjacent to the river bed; and (3) where there is no stopbank adjacent to the river bed.
Berm	The area of land between the river bed and inner toe of the stopbank.
River bed	The space of land which the waters of the river cover at its fullest flow without overtopping its banks.
River channel	Part of the river bed covered by water at any particular time.
Dry beach	Part of the river bed not covered by water at any particular time.
Flowing channel	Part of the river channel where water is flowing in the general path of the river course
Standing water channel	Part of the river channel where water is separated from the flowing channel by a structure (typically a bund or barrier).

Appendix B: Site audit template & Prompts

Template

Riverlink – SSESCP XX- Audit for GWRC Consent WGN100XXX

Date;	
Name of auditor;	
Weather and site conditions;	
Progress of works since the previous inspection;	
Sediment management (including identification of problem areas that are control measures, and any measures put in place to treat these areas);	
Runoff control (check of diversions channels and surface grades);	
Condition of sediment control measures, including silt fences, contour drains, DEBs and SRPs;	
Maintenance required, contractor responsible for the maintenance, and the date this will be completed by;	
General comments	

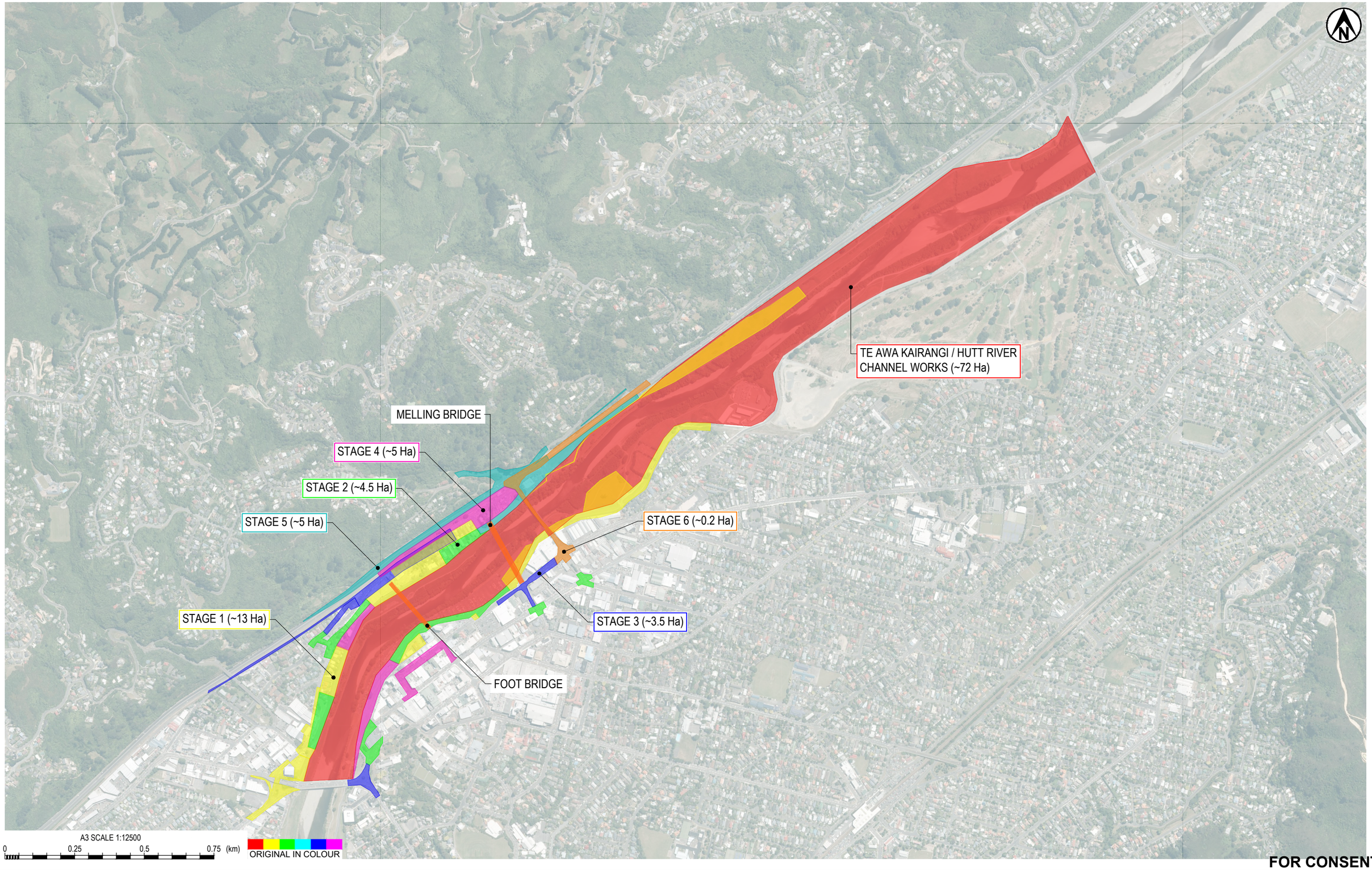
Prompts

Riverlink – SSESCP Riverbank construction – Weekly Audit for GWRC Consent WGN100XXX

Date;	*Date of inspection*
Name;	*Name/initial of inspector*
Weather and site conditions;	*What is it like on site?*
Progress of works since the previous inspection;	
What works are currently underway? *Are there any new areas of work, and what sediment control measures are in place for each new area?* *Are there any areas which have been stabilised?*	
Sediment management (including identification of problem areas that are control measures, and any measures put in place to treat these areas);	
Are there any areas where scouring is occurring? *Have exposed surfaces been track rolled prior to rainfall to minimise sediment generation?* *Have roads and tracks been swept/scraped of loose material that could result in dust or sediment?*	
Runoff control (check of diversions channels and surface grades);	
Have any new diversion channels been constructed? *What is the condition of existing diversion channels? Check they are they adequately collecting and directing runoff, and are not scouring or filled with silt?*	
Condition of sediment control measures, including silt fences, contour drains, DEBs and SRPs;	
What is the current water level in DEBs and SRPs? Are they discharging? *Are the sediment control measures in good condition? Check if any silt needs to be removed, runoff is receiving adequate treatment (measures are appropriate), and any other issues identified.*	
Maintenance required, contractor responsible for the maintenance, and the date this will be completed by;	

What maintenance is required to address any actions required above? *Who will complete each maintenance item, and when will it be completed (today, this week, or by a specific project related date)?*
General comments
How much rainfall has occurred over the last week? *Were the any trigger rainfall events, and were any of the water quality triggers exceeded?* *Are there any significant rainfall events forecast, and what is planned as a response?* *Are there any shutdown periods coming up (Christmas, Easter, etc.), and who is the emergency contact during this period?* *Any other comments?*

Appendix C: Staging plans



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Client: RIVERLINK

Project: TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY

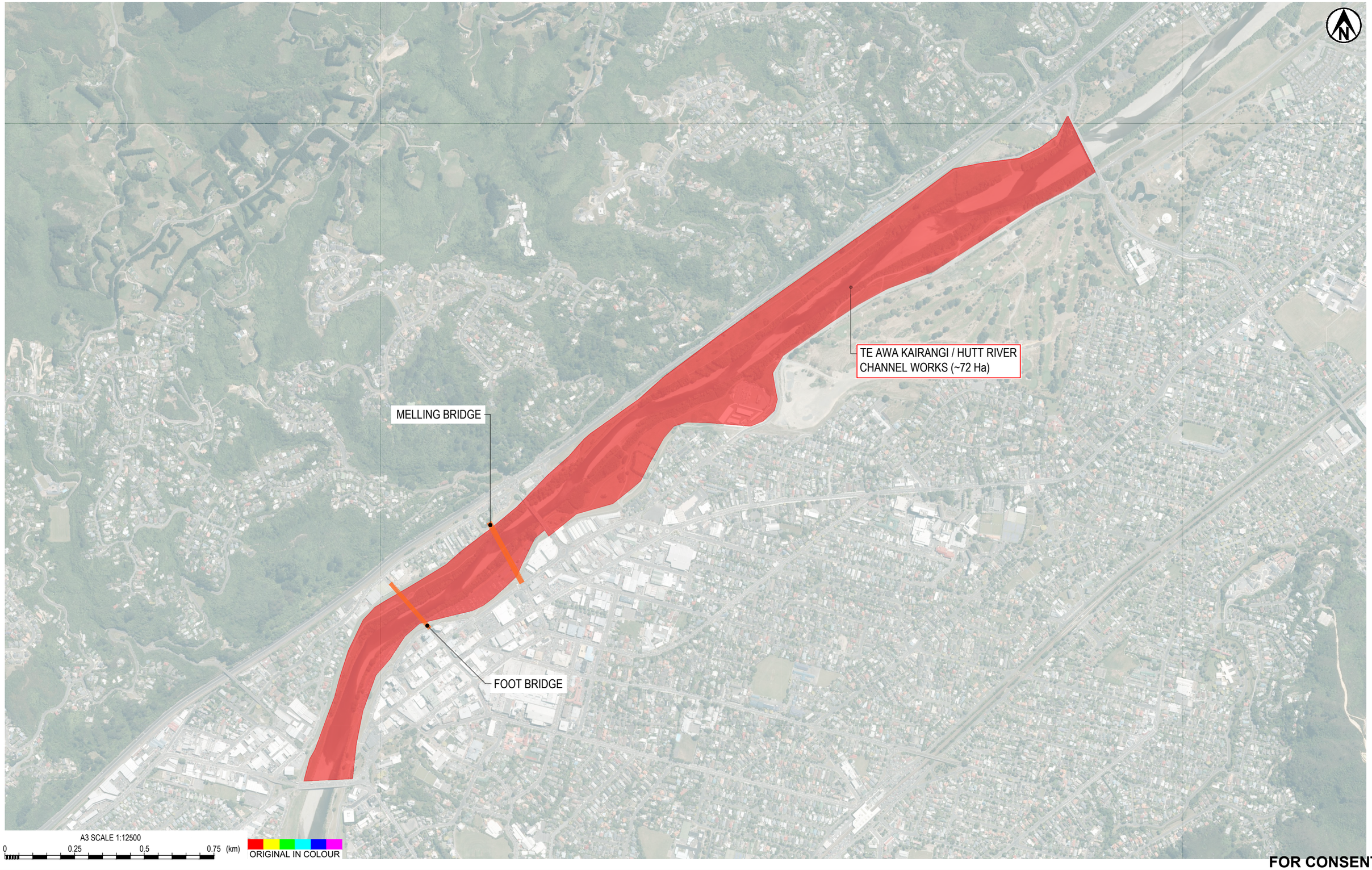
Title: EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (1 OF 8)

Original Size: A3

Drawing No: FIGURE-C1

Rev: A

Plot Date: 28 July 2021 - 2:41 pm Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-C1_C9.dwg



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Project: TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY

Title: EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (2 OF 8)

Original Size: A3

Drawing No: FIGURE-C2

Rev: A

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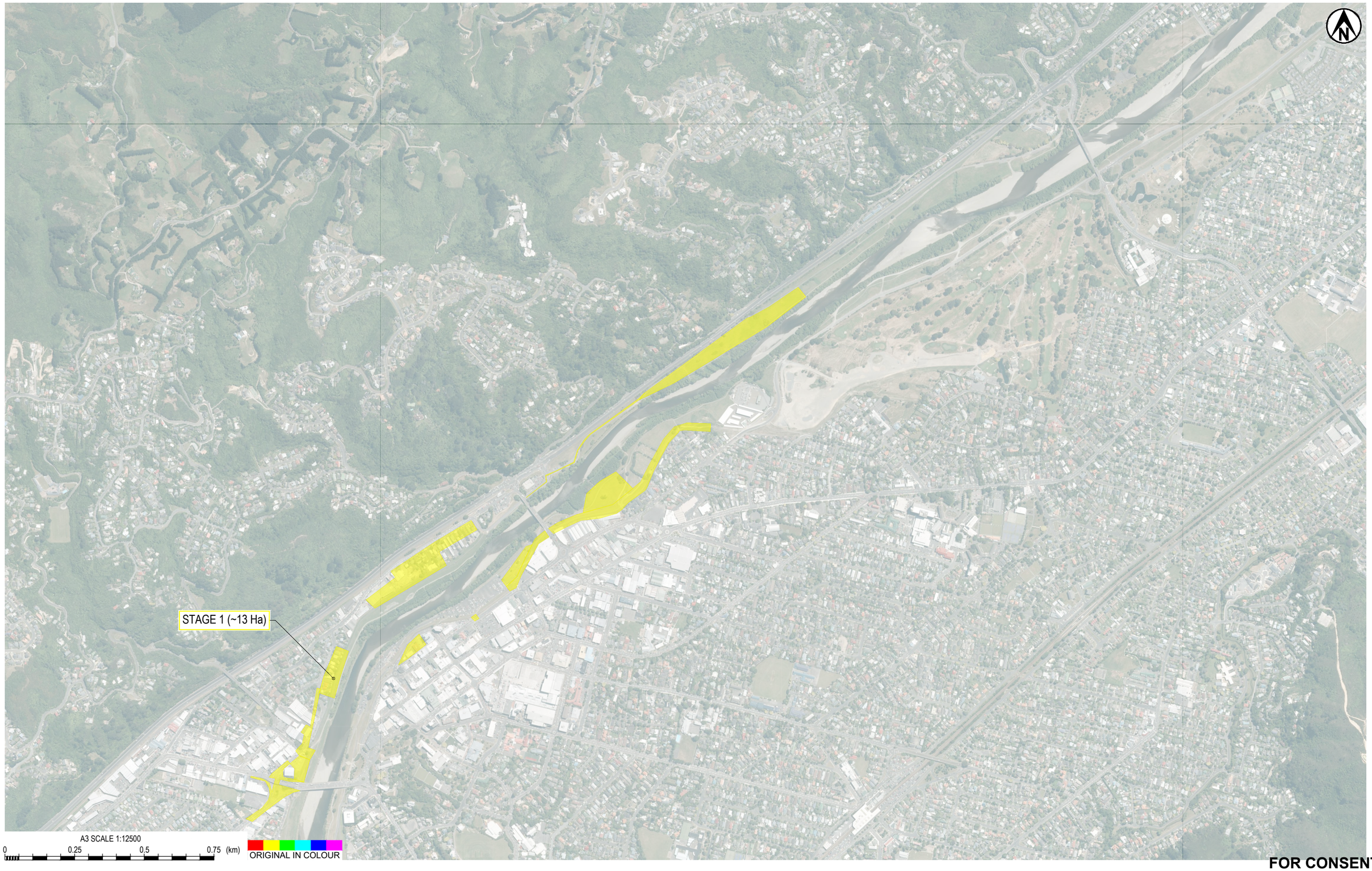

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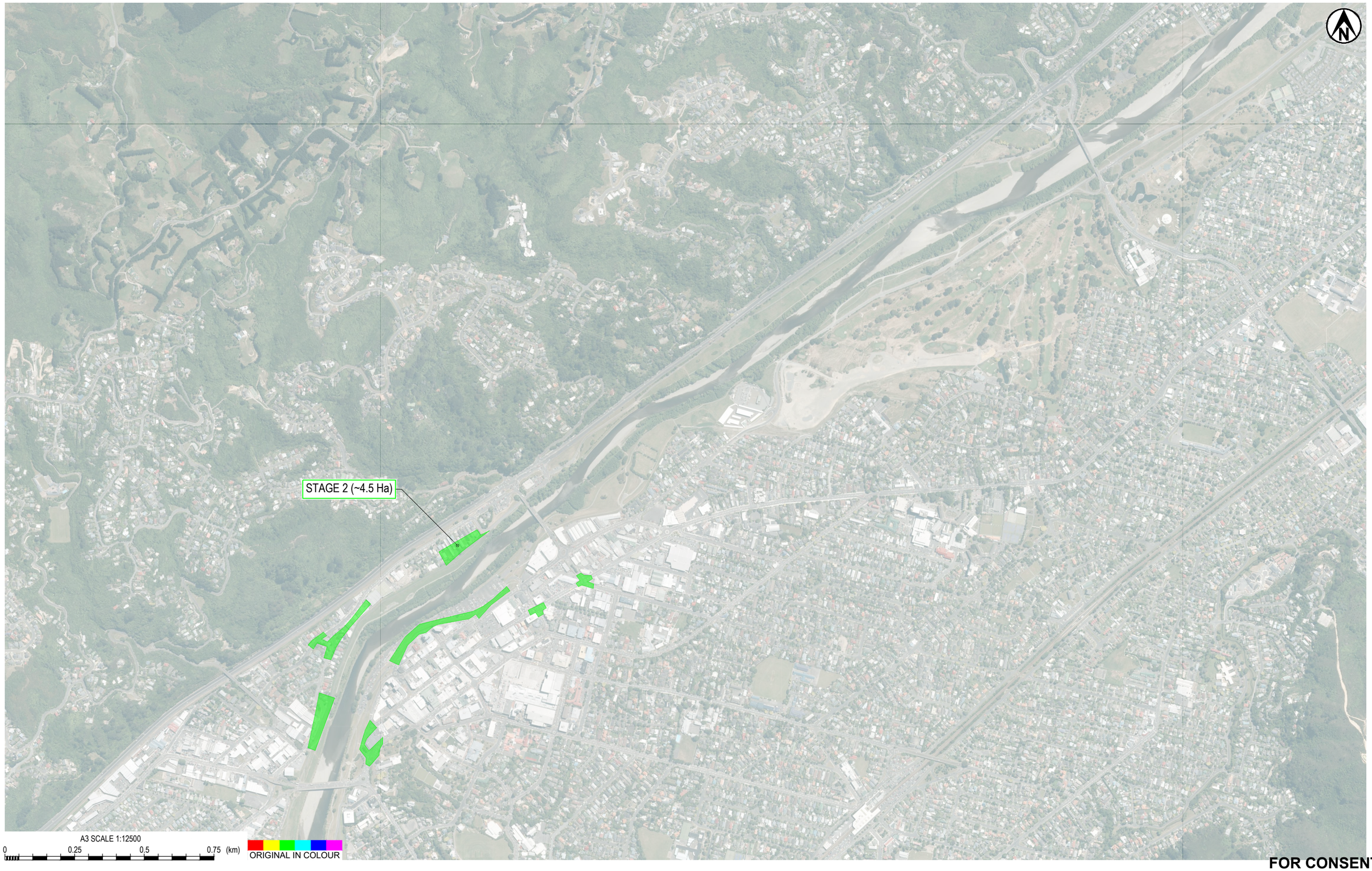
Client: **RIVERLINK**

Project: **TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY**

Title: **EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (3 OF 8)**

Original Size: **A3** Drawing No: **FIGURE-C3** Rev: **A**

Plot Date: 28 July 2021 - 2:41 pm Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-C1_C9.dwg



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Project: TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY

Title: EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (4 OF 8)

Original Size: A3

Drawing No: FIGURE-C4

Rev: A

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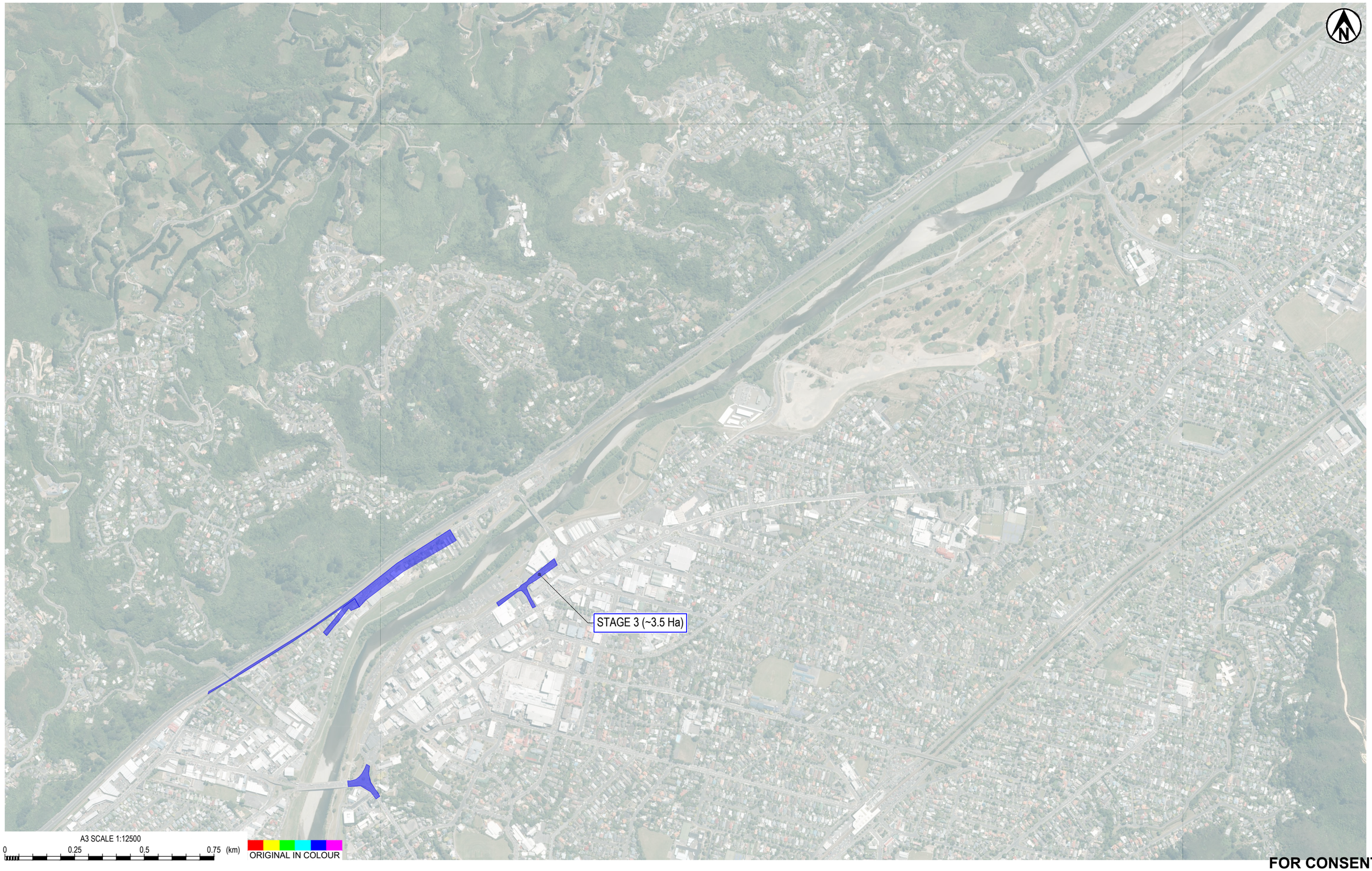

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Client: **RIVERLINK**

Project: **TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY**

Title: **EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (5 OF 8)**

Original Size: **A3** Drawing No: **FIGURE-C5** Rev: **A**

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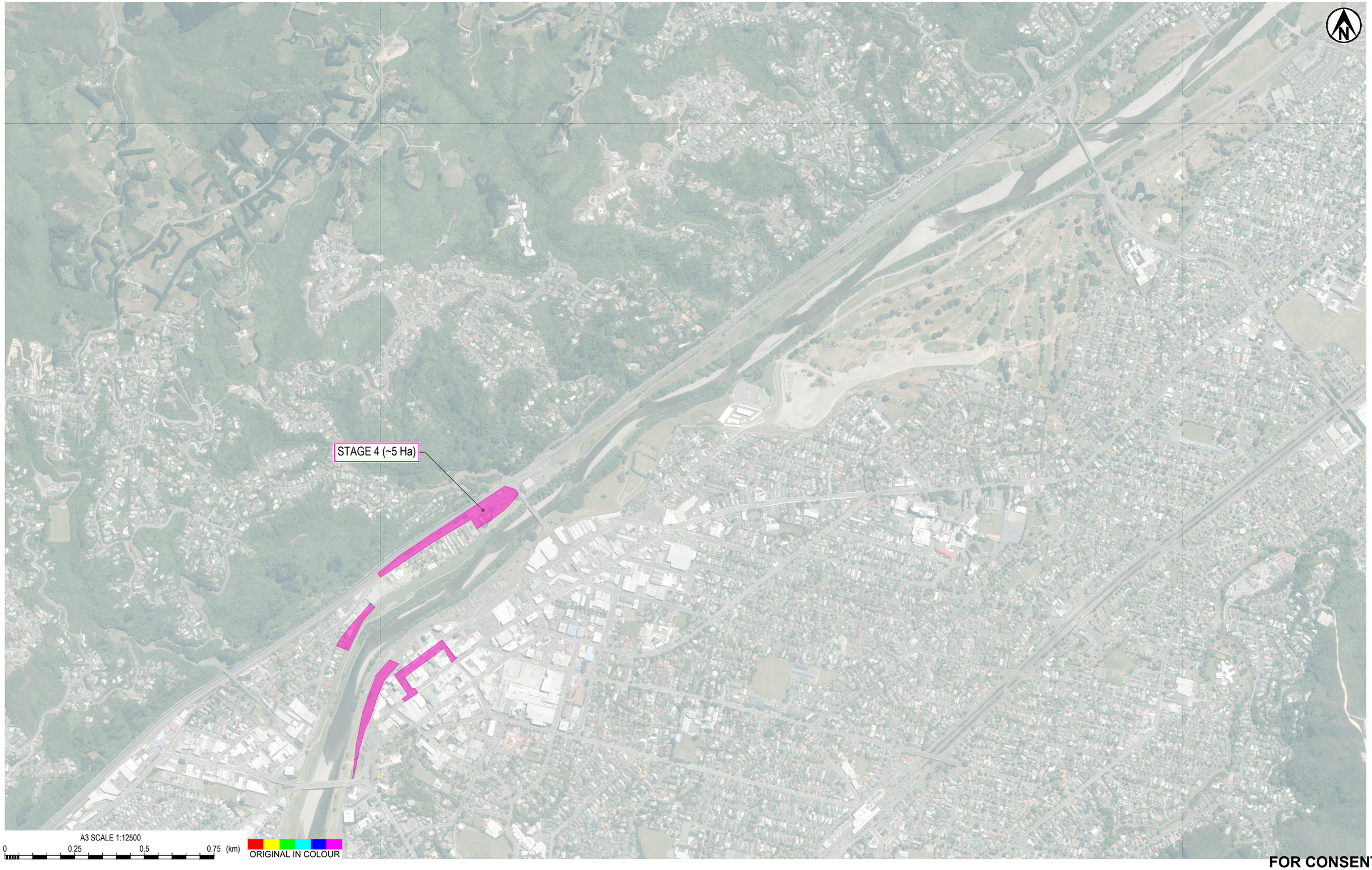

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Approved	EDB		
Date	29/07/21		
Scale	12500	This Drawing must not be used for Construction unless signed as Approved	

Client: RIVERLINK

Project: TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY

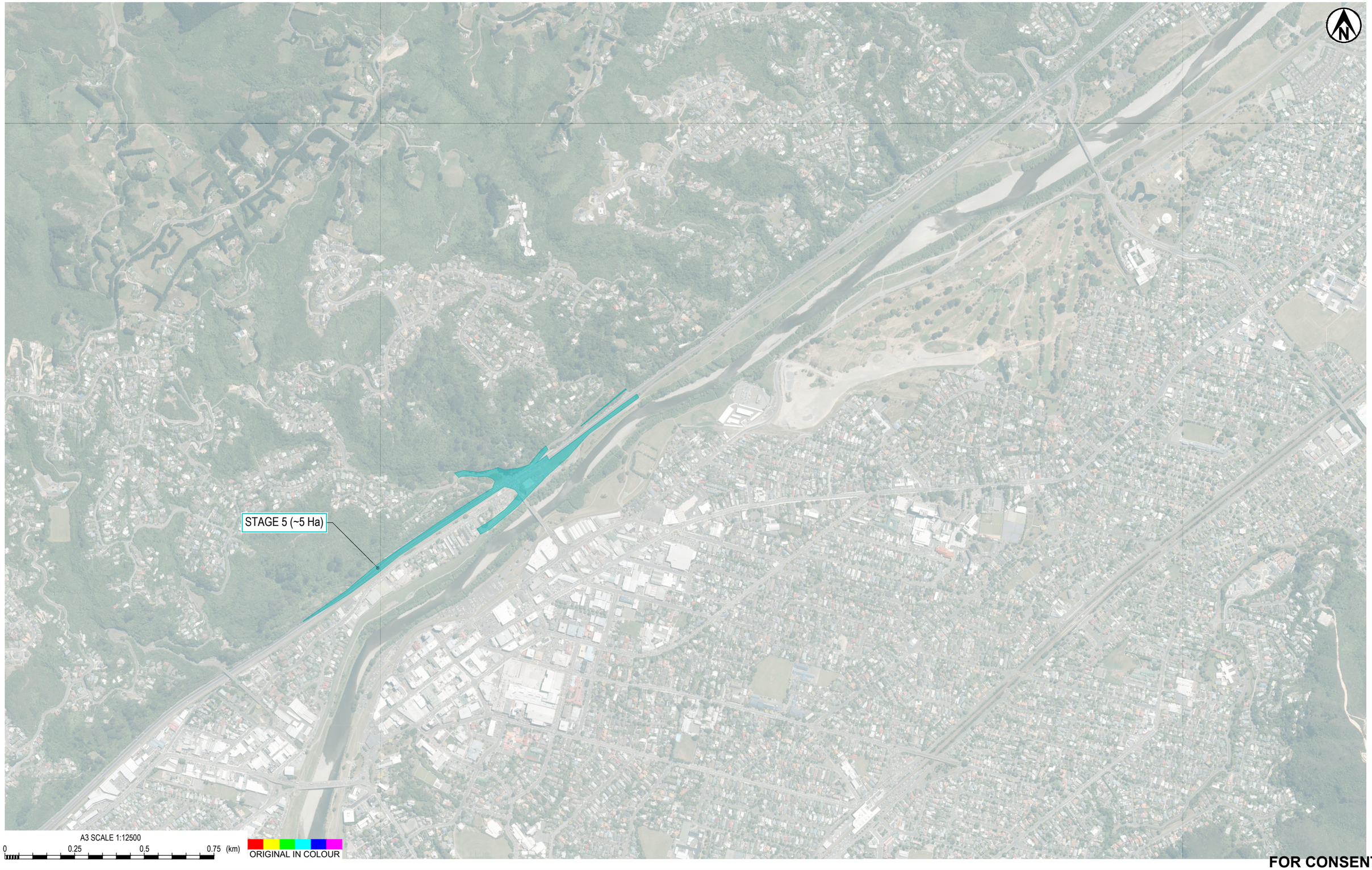
Title: EROSION AND SEDIMENT CONTROL PLAN
STAGING PLANS (6 OF 8)

Original Size: A3

Drawing No: FIGURE-C6

Rev: A

Plot Date: 28 July 2021 - 2:41 pm Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-C1_C9.dwg



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No	Revision	Drawn	Checked	Approved	Date
A	FOR CONSENT	DFL	ALGO	EDB	29/07/21

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RiverLink

Isthmus. Tonkin+Taylor GHD Holmes

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Client: RIVERLINK

Project: TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY

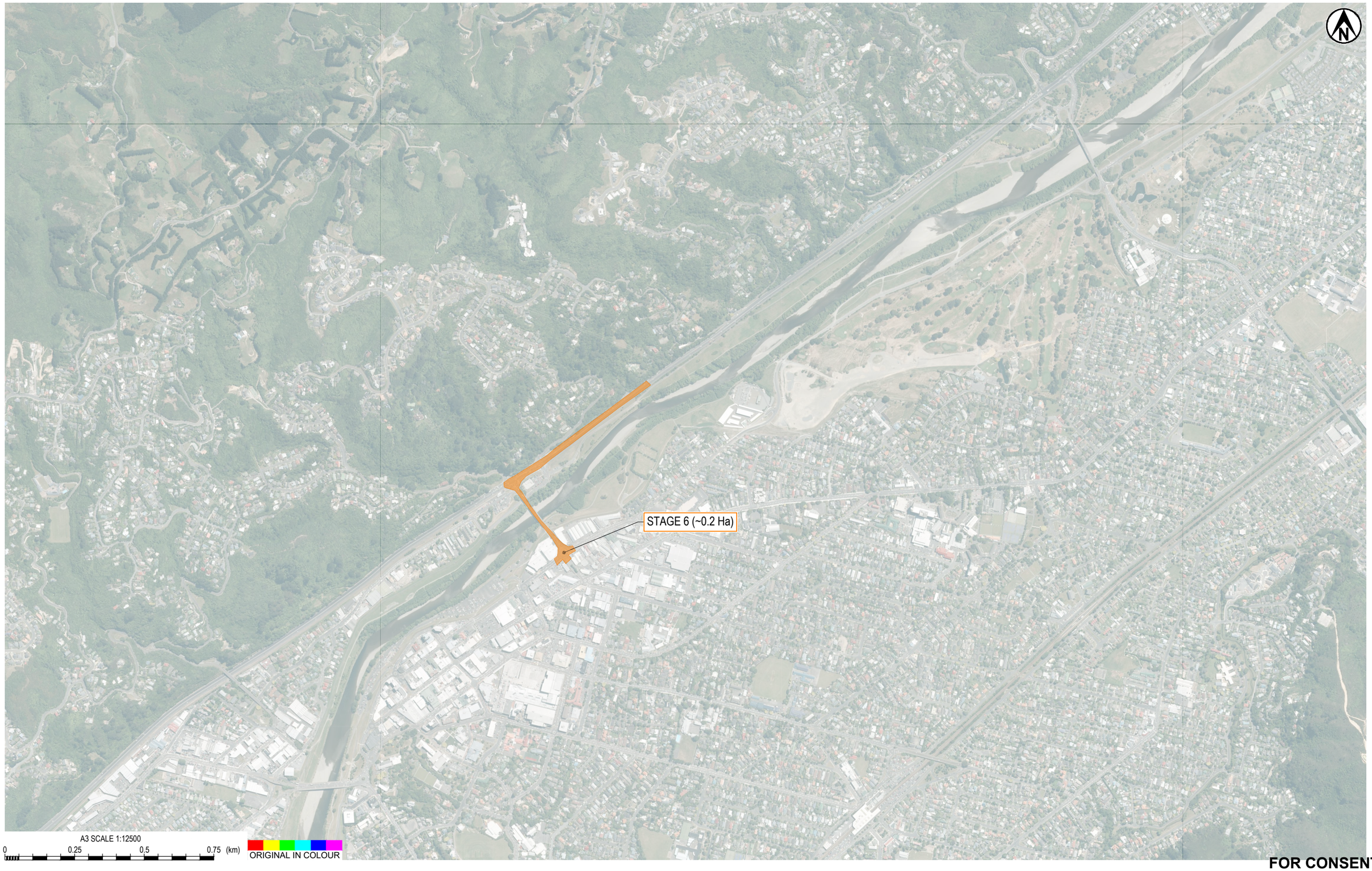
Title: EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (7 OF 8)

Original Size: A3

Drawing No: FIGURE-C7

Rev: A

Plot Date: 28 July 2021 - 2:41 pm Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-C1_C9.dwg



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No	Revision	Drawn	Checked	Approved	Date
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Client: **RIVERLINK**

Project: **TECHNICAL ASSESSMENT No. 4 - CONSTRUCTION WATER QUALITY**

Title: **EROSION AND SEDIMENT CONTROL PLAN STAGING PLANS (8 OF 8)**

Original Size: **A3** Drawing No: **FIGURE-C8** Rev: **A**

Plot Date: 28 July 2021 - 2:41 pm Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-C1_C9.dwg

Appendix D: Vegetation removal plan

- **Refer to Drawing No. A16-4381-G012 and A16-4381-G013 in the AEE drawing set**

Appendix E: SSESCP Example – Riverbank works

Appendix F: Chemical Treatment Management Plan

DRAFT

Appendix B – example Site Specific Erosion and Sediment Control Plan – River Works Reach A

RiverLink Pre-Implementation Planning/Design Services

DRAFT

Site Specific Erosion and Sediment Control Plan -Reach A Construction

29 July 2021

Revision	Status	Prepared by	Reviewed by	Approved by	Date
0	Draft	Alistair Gordon	Ed Breese	Ed Breese	20/01/2021
0	Draft	Alistair Gordon	Ed Breese	Chris Bauld	29/04/2021
A	For Consent	Alistair Gordon	Ed Breese	Ed Breese	29/07/21

The Site Specific Erosion and Sediment Control Plan is a living document and will be updated as the project progresses to account for changing construction environment and in response to monitoring information.

Note first draft prior to consultation with Iwi and Project Ecologist.

DRAFT

Contents

1 Introduction

This Site-Specific Erosion and Sediment Control Plan (SSESCP) has been prepared on behalf of Riverlink in support of the RiverLink Project in Lower Hutt. It describes the erosion and sediment control practise for a specific construction activity for the Riverlink Project.

The RiverLink project will involve in-river and land-based works resulting in disturbance along the Te Awa Kairangi | Hutt River. The Project wants to minimise the impact on downstream water quality as much as practical during the works, and to ensure compliance with the Greater Wellington Regional Council (GWRC) Regional Plan, Consent and industry guidance.

The SSESCP is a living field document that has been developed in consultation with suitably qualified staff (i.e. construction supervisors and engineers), Iwi, project ecologists, and Contractors.

2 Legislative requirements

Activities undertaken under this SSESCP are to be compliant with Conditions set out in Resource Consent WGNXXXX. Table 2.1 outlines where this SSESCP address conditions.

Table 2.1: SSESCP compliance with Conditions of WGNXXXX

Condition reference	Consent requirement	Section(s) of this SSESCP which address conditions/comments
Item 114 (i)	Detailed description of the specific site activities and construction methodology	Section 5
(ii)	Identification of potential for erosion and sediment generation	Section 5
(iii)	Proposed methods of avoiding, minimising and treating sediment	Section 6
(iv)	Outline of sequencing of works and related ESC measures	Section 6
(v)	Drawings to an appropriate scale	Appendix A
(vi)	Specifications for ESC measures and design calculations	Section 6 and Appendix B
(vii)	Site management	Section 9
(viii)	Monitoring, trigger levels, and reporting	Section 8
(ix)	Contingency measures, including response measures in heavy rainfall	Section 7
(x)	Decommissioning methodology for erosion and sediment control measures;	Section 9.8
(xi)	Procedures for re-instating ESC measures at the end of each working day; and	Section 9.8
(xii)	Roles and responsibilities	Section 9.2

3 SSESCP administration

The SSESCP is a controlled plan and shall be updated to account for the changing construction environment and is to be certified by GWRC and Hutt City Council (HCC) as part of the control procedures described in the ESCP. Refer to Section 4 of the ESCP for control and certification procedures.

The document will be reviewed annually and updated if required. The document may be updated in response to site inspection or audits or in response to incidents or to reflect improvements in erosion and sediment control or the annual review of monitoring data. The amended documents will be submitted to GWRC and HCC for certification.

4 Scope

4.1 Proposed works

This SSESCP covers the Project activity for riverbank construction along a segment of Te Awa Kairangi | Hutt River referred to by this plan as Reach A. Reach A is one of eight reaches which makes up the progressive staging of Project works within the River Corridor. The extent of Reach A and types of bank edge protection (rock rip rap banks and vegetated banks) are shown on Figures 100 and 101, attached in Appendix A. Riverbank works includes the river edge interface and earthworks on the berms. Typical details for riverbank types will be developed at detailed design stage and included as an update to this SSESCP.

Riverbank works are be undertaken concurrently to various other Project activities which interact with the works addressed by this SSESCP. As such, this SSESCP is to be read in conjunction with separate SSESCPs for riverbank construction of Reaches B-H, stopbank construction, stormwater construction, river widening and reprofiling, bridge construction and landscaping.

4.2 Receiving environment

Te Awa Kairangi | Hutt River is the receiving environment for any stormwater discharges associated with the Project activity covered by the scope of this SSESCP. Refer to Section 2.3 of the ESCP for a description of the Project location in relation to the receiving environment.

5 Activity description

The works are located within the River Corridor of Te Awa Kairangi / Hutt River and will involve works both within the river bed, channel and on both berms. Key activities, which have the potential to generate erosion and sediment discharges, include:

- Enabling works;
- Removal of existing riverbank structures;
- Earthworks to form riverbanks in the 'dry' (On berms and on dry beaches);
- Earthworks to form riverbanks in standing water (standing water channel separated from flowing water by a protective bund);
- Earthworks to form riverbanks in flowing water (unprotected from the flowing course of the river); and
- Rapid stabilisation of erodible surfaces exposed by works.

5.1 Staged approach

To minimise the unstabilised area during construction, riverbank works will follow a staged exposure and rapid stabilisation approach. Condition XX sets the maximum length of a disturbed reach within the river channel to 500 m. The nature of riverbank construction works makes working within the river channel unavoidable in a number of locations. As such, the staging of riverbank works has been developed with the following considerations in mind:

- Conducting works in a downstream to upstream direction;

- Conducting river channel works simultaneously with other channel works in the immediate vicinity to minimise time spent working in the wet; and
- Conducting dry works in conjunction to channel works where possible to minimise the unstabilised area both in the dry (berm and dry beaches) and in the wet (river channel).

5.2 Works in the 'dry'

Any riverbank works which can be undertaken outside of the river channel are considered to be in the dry and are not subject to the disturbed reach restrictions set by Condition XX. However, to minimise the disturbed area at any one time, 'dry' riverbank works will typically be undertaken in conjunction with riverbank works in the wetted channel as part of the staged disturbance and rapid stabilisation approach.

5.3 Works in the 'wet'

Riverbank construction requires some work within the wetted channel either within the flowing channel or in the standing water channel behind a protective bund. Condition XX sets a maximum disturbed reach of the wetted river channel to 500 m. To minimise the duration of wetted works, riverbank works will typically be undertaken in conjunction with river reprofiling and widening works. Refer to the SSESCP for river reprofiling and widening for detail of a staging description.

5.4 Activity details

The type of works, earthworks extent and durations for riverbank works in Reach A are summarised in Table 5.1 below to provide an example for how SSESCPs will break down works within each Reach.

Table 5.1: Riverbank details

Activity	Length	Earthworks volume (m^3/s)	Duration	% dry	% flowing	%standing
West (true right bank)	**460**	**18,000**	25 - 40 working days	N/A	N/A	N/A
Rock rip rap removal and replacement	300	11,800	20 -30 working days	60%	30%	10%
Vegetation management	160	6,200	~5 – 10 days working days	85%	0%	15%
East (true left bank)	**425**	**6,600**	~10 - 20 working days	N/A	N/A	N/A
Rock rip rap	N/A	N/A	N/A	N/A	N/A	N/A
Vegetation management	425	6,600	~10 – 25 working days	90%	10%	0%

Note: Length, earthworks volumes, duration and % breakdown are estimates based on information from Design Freeze #2 and are to updated following detailed design.

6 Erosion and sediment control methodology

6.1 Specific control measures

The construction of riverbanks will follow a sequenced procedure, moving from downstream to upstream. Where a length of riverbank is exposed during earthworks, it will be rapidly restabilised prior to commencing work on subsequent lengths. Construction of rock rip rap banks is more intensive will be constructed in lengths of approximately 20-50 m. Construction of vegetated banks

is less intensive will constructed in lengths between 100-200 m. Specific construction sequences and erosion control measures are set out in Table 6.1 below. Refer to Figures 100-104 for staging plans and cross sections, attached in Appendix A.

Table 6.1: Construction sequences and specific control measures

Work sequence		ESC measure	Comments
Activity 1: Enabling works			
A	Transport construction material to workface location	• Stabilisation of haul roads. • Controlled vehicle movements and crossing locations.	• Hauls road located outside of the river channel. • Lateral river crossing at specified locations. Refer to Figure 101, Appendix A. • Vehicles to move in flowing water a maximum speed set by in-river vehicle trials.
B	Formation of access into the flowing channel (if required).	• Use of appropriate material. • Controlled access points.	• Riverbed material to be used to construct access ramps. • Entry points to the active channel at specified locations. Refer to Figure 101, Appendix A.
C	Formation of protective bund (where applicable).	• Separate flowing and standing water. • Use of appropriate material.	• Protective bund to be constructed as per Section 6.2 in indicative locations on Figure 101, Appendix A. • Bund to be formed from riverbed material and replaced if high flow events wash out the bund.
Activity 2: Rock rip rap riverbanks (refer Figures 102 and 103)			
A	A1: Strip vegetation and topsoil in dry. A2: Earthworks of existing riverbank down to water level.	• Work in the dry. • Minimise footprint and duration of unstabilised areas.	• Machinery position on the dry above the banks. Material is to be pulled away from the wetted channel. • Stockpile topsoil material on upper berm. • **Footprint/duration restriction:** – Maximum 50 m length where the toe of the excavation will be in flowing water. – Maximum length equal to protective bund length where the excavation toe is in standing water.
B	B1: Remove existing rock in standing or flowing water. B2: Earthworks to toe level of rock rip rap wall in standing or flowing water.	• Earthworks behind protective bund; or • Minimise footprint and duration of unstabilised are exposed to flowing water. • Cut material directly onto berms or load out trucks.	• **Footprint/duration restriction:** – Maximum 50 m length where the toe of the excavation will be in flowing water. – Maximum length equal to protective bund length where the excavation toe is in standing water.

			• Protective bund to be constructed as per Section 6.2 in indicative locations on Figure 101, Appendix A. • Unstabilised surfaces exposed to flowing water less than 12 hours per day.
C	C1: Roll out and pin geofabric. Lay bedding layer from toe to top of bank level. C2: Rapidly place rock up to the flowing or standing water level. C3: Backfill excavation to river bed design level.	• Rapid stabilisation using appropriate cover types/materials • Minimise footprint and duration of unstabilised are exposed to flowing water.	• Bedding layer to be clean gravels. Rock rip rap armour to stabilised bank slope. • River bed backfill to use material sourced from riverbed excavations in previous sequences to reinstate bed level with armouring cover similar to pre-construction. • **Footprint/duration restriction:** – Maximum 50 m length in flowing water. – Maximum length equal to protective bund length. – Unstabilised surfaces exposed to flowing water less than 12 hours per day.
D	D1: Placement of rock rip rap to bank design level in the dry D2: Placement and compaction of hardfill on lower berm surface. D3: Topsoil, adhesive hydroseed and final berm planting	• Work in the dry. • Rapid stabilisation. • Minimise footprint and duration of unstabilised areas.	• Machinery on dry banks. • 150 mm thick compacted hardfill provide rapid stabilisation. Topsoil (or growth medium), hydroseeding and berm planting provide long term stabilisation. • **Footprint/duration restriction:** – Maximum 50 m length in flowing water. – Maximum length equal to protective bund length.
Activity 3: Vegetated riverbanks			
A	A1: Strip vegetation and topsoil in dry. A2: Earthworks of existing riverbank down to water level.	• Works in dry.	• Machinery position on the dry above the banks and is to pull material away from the wetted channel. • If silts or clays are exposed as part of these works and are susceptible to erosion in fresh events they will be removed, or the surface protected.
B	B1: Topsoil, coconut matting, grass seeding and/or final bank edge planting. D2: Placement and compaction of hardfill on lower berm surface.	• Works in dry. • Rapid stabilisation.	• Machinery on dry banks. • Coconut matting to provide stabilisation on bank edges while planting establishes. • 150 mm thick compacted hardfill provide rapid stabilisation. Topsoil, hydroseeding and berm planting provide long term stabilisation.

	D3: Topsoil, adhesive hydroseed and final berm planting.		

6.2 Protective bunds

The proposed locations of protective bunds are shown indicatively on staging plans (refer Figure 101, Appendix A) and design cross sections attached in Appendix A. Bunds are to be formed from in-situ bed material and must meet the following minimum requirements:

- Height of minimum 1 m above the existing 7-day MALF; and
- Top width of minimum 1 m.

Protective bunds require specific design to be provided as an update to this SSESCP prior to construction should the proposed bunds exceed the following:

- Length greater than 250 m; and
- Expected lifespan greater than two month.

6.3 Works in contaminated sites

The Project Primary Site Investigations and Technical Assessment for Contaminated Land indicate the no contaminated land sites are present within the work zones of riverbanks. No specific erosion and sediment controls for contaminated land are required.

Completion of detailed contaminated land site investigations is required to confirm no contamination is present prior to commencing works. This SSESCP will be updated accordingly.

7 Risk and contingency measures

Refer to Section 8 of the ESCP for an overview of risk and contingency measures.

8 Monitoring

The activities in this SSESCP will be monitored in accordance with the Monitoring Programme as per Resource Consent Conditions and Section 7 of the ESCP.

A feed-back loop of monitoring results will input to improvement procedures including: adapting erosion and sediment controls, educating site staff and improving management practises in response to monitoring outcomes. Table 8.1 sets out a register for improvement actions associated with riverbank works.

Table 8.1: Improvement actions register

I.D.	Description	Consequence	Opportunity to deploy for other activities
XX	XX	XX	XX
XX	XX	XX	XX
XX	XX	XX	XX

9 Site management

9.1 Stabilisation

The ESCP sets out the definition of a stabilised area. All riverbank surfaces, including berms, will be stabilised upon completion either immediately with compacted hardfill or with permanent cover determined by landscaping design. Sequencing of works for both rock rip rap and vegetated riverbanks provides rapid and progressive stabilisation of riverbanks and minimises the footprint and for which duration slopes are unstabilised. Refer to typical stabilisation steps on Figures 102-104, Appendix A.

The application of different methods of stabilisation is set out in Table 6.1.

9.2 Roles & Responsibilities

Role and responsibilities are set out in Section 4.4 Of the ESCP.

9.3 Training

Training requirements are set out in Section 4.5 of the ESCP.

9.4 Maintenance

No sediment treatment structures and/or devices and subsequent maintenance requirements are proposed as part of this SSESCP.

Inspection of vegetation/grass strike for stabilisation of lower and upper berms is to be monitored required as part of the audits. Should the Project's Environmental Manager determine grass strike rate unsatisfactory maintenance actions, which can be deployed prior to drought contingency requirements in Section 7, include:

- Re-spreading of additional topsoil and grass seed; and
- Irrigation on low strike areas.

9.5 Chemical treatment

No chemical treatment is proposed as an ESC measure in this SSESCP. Procedures in the Chemical Management Plan do not apply for this activity.

9.6 Seasonal restrictions

Seasonal restriction for Te Awa Kairangi / Hutt River which apply to works part of this SSESWCP include:

- No works in the flowing channel between the between 1 September – 1 December as specified in RiverLink Technical Assessment #6 – Freshwater Ecology; and
- Restrictions set out in Table 9.1, which require specific management procedures to allow for work to proceed.

Table 9.1 sets out the details of season-specific management procedures required by the activity constraints calendar set by GWRC's Code of Best Practise for River Management Activities (2019). Refer to Appendix C for the full activity calendar for Te Awa Kairangi / Hutt River.

Table 9.1: Seasonal restriction procedures

Activity	Location	Permitted work periods	Conditional work period	Specific management during restricted season

Berm earthworks and planting	Berms	All year	N/A	N/A
Riverbank edges	Flowing water	02 Jan – 31 Jul	01 Aug – 01 Jan and flow < 1.2 m^3/s	Refer to activity constraints calendar attached in Appendix C and Site Specific Effects Management in Appendix D as required.
	Dry beaches	02 Mar – 31 Jul	01 Aug – 01 Mar	Refer to activity constraints calendar attached in Appendix C and Site Specific Effects Management in Appendix D as required.
	River bed	All year	2 consecutive days of every 7 days	Avoid works.
All works	All locations	02 Mar – 01 Dec	01 Dec- 01 Mar	Avoid works on weekends and public holidays where possible

9.7 Certification of ESC structures

This SSESCP does not specify any use of structures which require as-built certification.

9.8 Decommissioning

Decommissioning of protective bunds is to be undertaken once works which occur behind bunds is complete. Material from protective bunds shall be formed from naturally occurring riverbed material and will be reintegrated into the final river bed profile or remove as part of river bed reprofiling and widening works.

This SSESCP does not specify any other ESC structures which require decommissioning.

10 Applicability

This report has been prepared for the exclusive use of Riverlink with respect to the particular brief given to us. We understand and agree that our client will submit this report as part of an application for resource consent and that Greater Wellington Regional Council as the consenting authority will use this report for the purpose of assessing that application and in undertaking its regulatory functions in connection with Resource Consent WGN100XXXX. 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.

Appendix A: Drawings

- **Figure 100: Reach A Riverbank Staging Plan (1 of 2)**
- **Figure 101: Reach A Riverbank Staging Plan (2 of 2)**
- **Figure 102: Typical Staging Cross Section (1 of 3)**
- **Figure 103: Typical Staging Cross Section (2 of 3)**
- **Figure 104: Typical Staging Cross Section (3 of 3)**
- **Annotated Design Cross Sections: A16-4381-SB400 – SB404**
- **Typical rock rip rap bank detail: Design to be completed at detailed design**
- **Typical vegetation detail: Design to be completed at detail design**

LEGEND

- PROPOSED STOPBANK CENTRELINE
- PROPOSED TOP OF BANK
- PROPOSED BOTTOM OF BANK
- PROPOSED STRUCTURAL RETAINING WALL
- GWRC RIVER CROSS SECTION ALIGNMENTS
- PROPOSED DESIGN CHANNEL
- PROPOSED ROCK RIPRAP
- ACTIVE CHANNEL
- PROPOSED LOWER BERM
- PROPOSED BATTER
- PROPOSED UPPER BERM
- GRAVEL BEACHES
- LOW FLOW MEANDER LINE
- REACH BOUNDARY
- EDGE OF EXISTING CHANNEL

NOTES:

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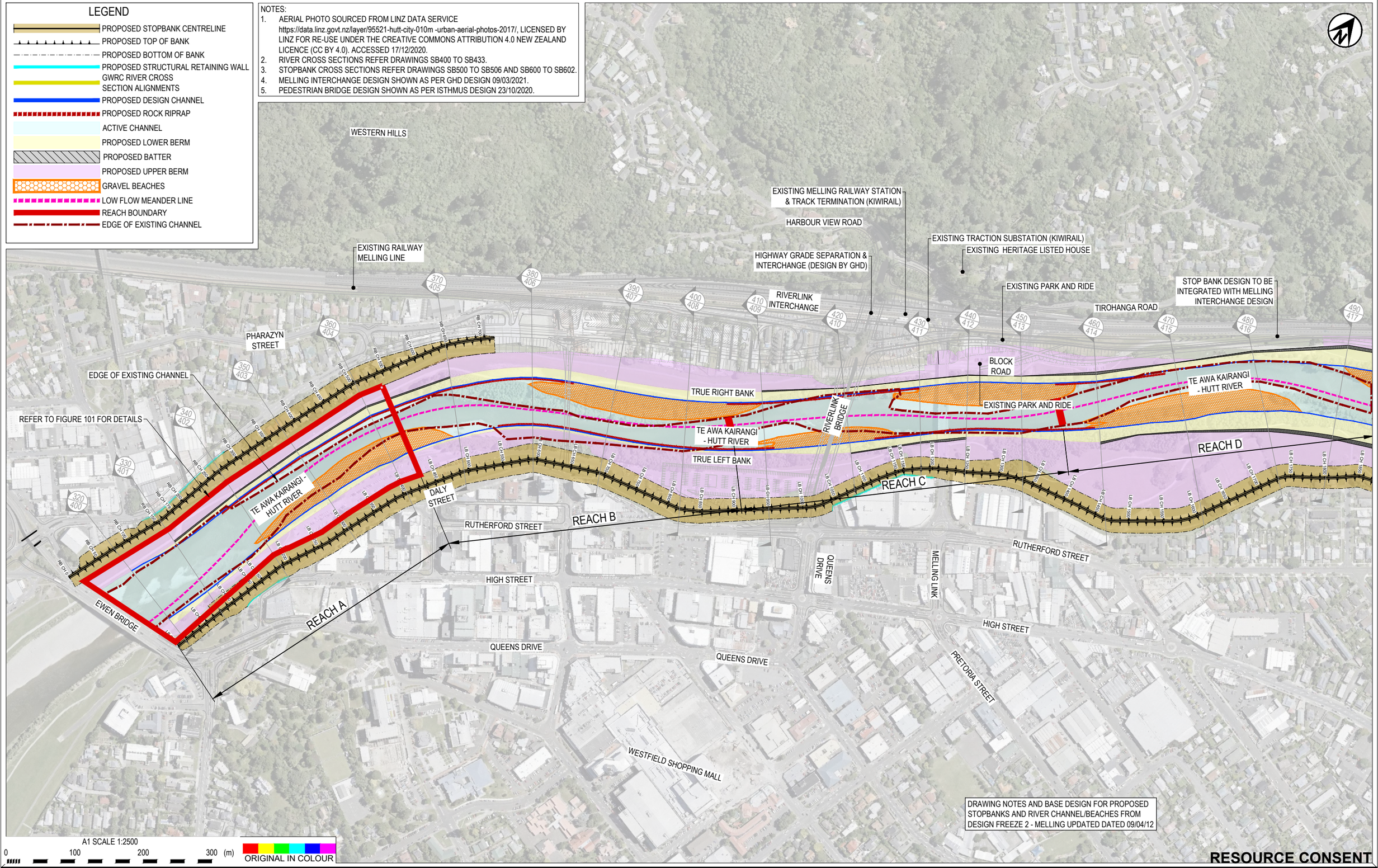
2. RIVER CROSS SECTIONS REFER DRAWINGS SB400 TO SB433.
3. STOPBANK CROSS SECTIONS REFER DRAWINGS SB500 TO SB506 AND SB600 TO SB602.
4. MELLING INTERCHANGE DESIGN SHOWN AS PER GHD DESIGN 09/03/2021.
5. PEDESTRIAN BRIDGE DESIGN SHOWN AS PER ISTHMUS DESIGN 23/10/2020.



DRAWING NOTES AND BASE DESIGN FOR PROPOSED STOPBANKS AND RIVER CHANNEL/BEACHES FROM DESIGN FREEZE 2 - MELLING UPDATED DATED 09/04/12

RESOURCE CONSENT

No	Revision	Drawn	Checked	Approved	Date
A	RESOURCE CONSENT	LIWA	ALGO	EDB	04/29/2021

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RiverLink Isthmus. Tonkin+Taylor GHD Holmes

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Approved	E. BREESE		
Date	04/29/2021		
Scale	1:2500	This Drawing must not be used for Construction unless signed as Approved	

Client: **RIVERLINK**
Project: **RIVERLINK**
Title: **CONSTRUCTION WATER QUALITY ASSESSMENT REACH A RIVERBANK STAGING PLAN (SHEET 1 OF 2)**

Original Size: **A1** Drawing No: **FIGURE 100** Rev: **A**

Plot Date: 28 July 2021 - 11:50 am Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-F100.dwg

LEGEND

- PROPOSED STOPBANK CENTRELINE
- PROPOSED TOP OF BANK
- PROPOSED BOTTOM OF BANK
- PROPOSED STRUCTURAL RETAINING WALL
- GWRC RIVER CROSS SECTION ALIGNMENTS
- PROPOSED DESIGN CHANNEL
- PROPOSED ROCK RIPRAP
- ACTIVE CHANNEL
- PROPOSED LOWER BERM
- PROPOSED BATTER
- PROPOSED UPPER BERM
- GRAVEL BEACHES
- LOW FLOW MEANDER LINE
- REACH BOUNDARY
- EDGE OF EXISTING CHANNEL
- PROPOSED BUND

NOTES:

1. AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE https://data.linz.govt.nz/layer/95521-hutt-city-010m -urban-aerial-photos-2017/, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 17/12/2020.
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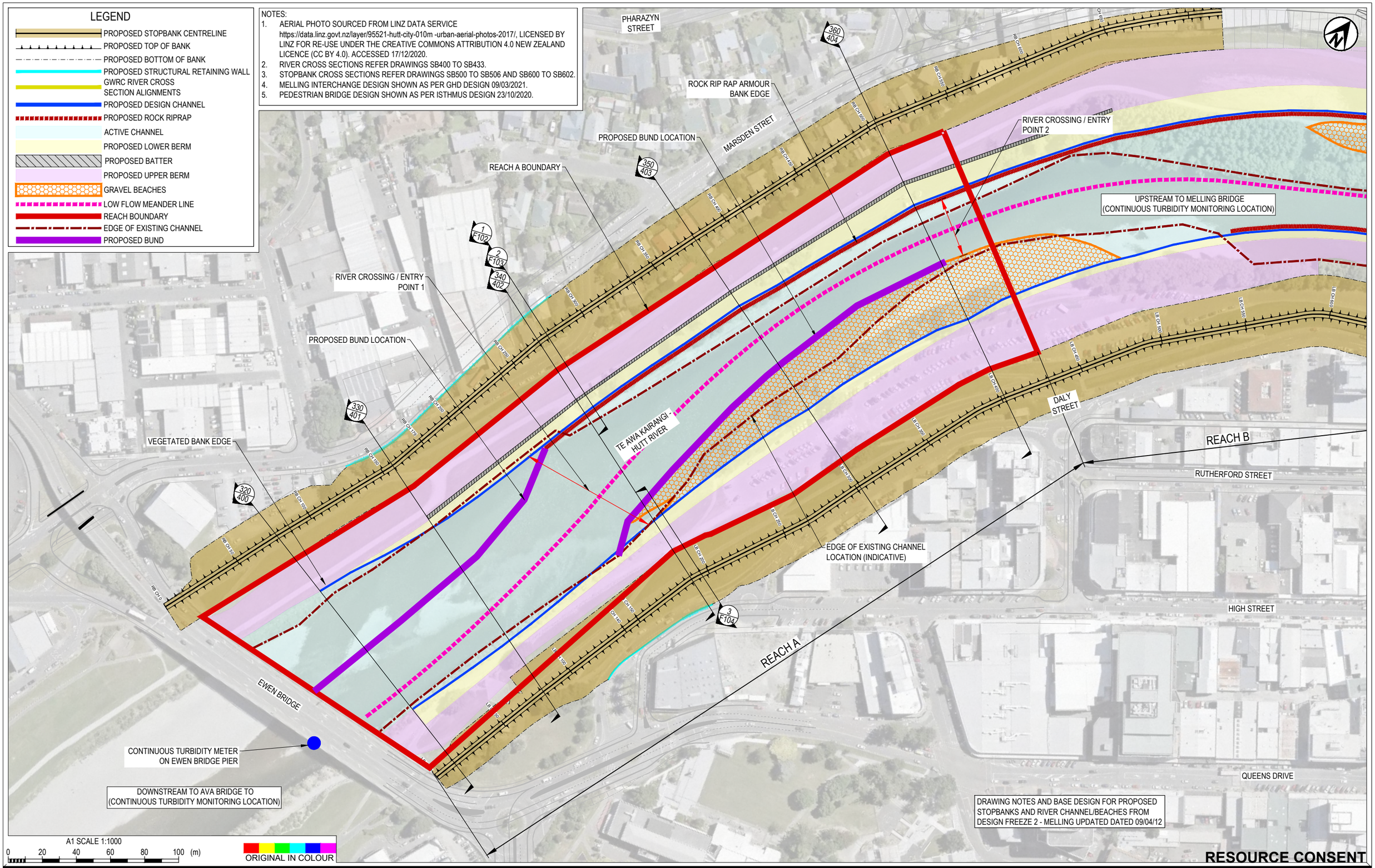

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A	RESOURCE CONSENT		LIWA	ALGO	EDB	04/29/2021

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Approved	E. BREESE		
Date	04/29/2021		
Scale	1:1000	This Drawing must not be used for Construction unless signed as Approved	

Client: **RIVERLINK**

Project: **RIVERLINK**

Title: **CONSTRUCTION WATER QUALITY ASSESSMENT REACH A RIVERBANK STAGING PLAN (SHEET 2 OF 2)**

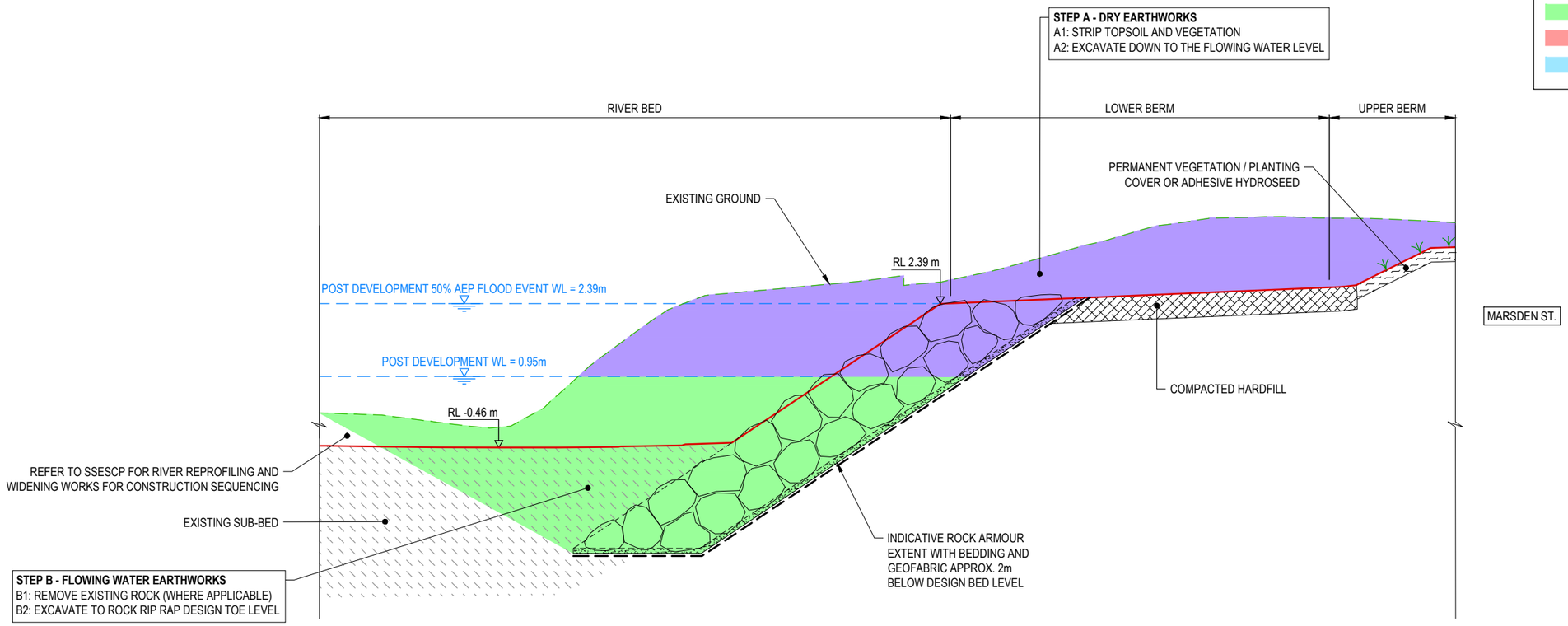
Original Size: **A1** Drawing No: **FIGURE 101** Rev: **A**

Plot Date: 28 July 2021 - 11:51 am Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-F101.dwg

NOTES:
1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) WELLINGTON VERTICAL DATUM 1953.
3. DIMENSIONS SHOWN HAVE BEEN PULLED DIRECTLY FROM THE DIMENSIONS IN THE DESIGN CAD FILE. THESE SHOW WHAT WE HAVE DESIGNED TO AND MAY NOT LINE UP WITH THE DISTINCT POINTS ON THE SECTIONS DESIGN FILE, SUPPLIED BY GWRC 14.01.2021.
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.

LEGEND
- EXISTING GROUND COMBINED SURVEY DEM2014 - LIDAR2019
- RIVERBED DESIGN PROFILE
- WATER LEVEL
- GEOFABRIC
- TOPSOIL
- COMPACTED HARDFILL
- ROCK ARMOUR BEDDING
- EXISTING SUB-BED

CONSTRUCTION SEQUENCE STEPS:
- A: DRY EARTHWORKS
- B: FLOWING WATER EARTHWORKS
- C: FLOWING WATER STABILISATION WORKS
- D: DRY STABILISATION WORKS



SECTION 1 F101 BANK EXCAVATION (RIGHT) CROSS SECTION
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A3 SCALE 1:100
0 1 2 3 4 5 (m)
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RESOURCE CONSENT

No	Revision	Drawn	Checked	Approved	Date
A	RESOURCE CONSENT ISSUE	LIWA	ALGO	EDB	04/29/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn	LIWA	Designer	ALGO
Drafting Check	TRJ	Design Check	EDB
Approved	E. BREESE		
Date	04/29/2021		
Scale	1:100	This Drawing must not be used for Construction unless signed as Approved	

Client: RIVERLINK
Project: RIVERLINK
Title: CONSTRUCTION WATER QUALITY ASSESSMENT TYPICAL BANK EXCAVATION (RIGHT)

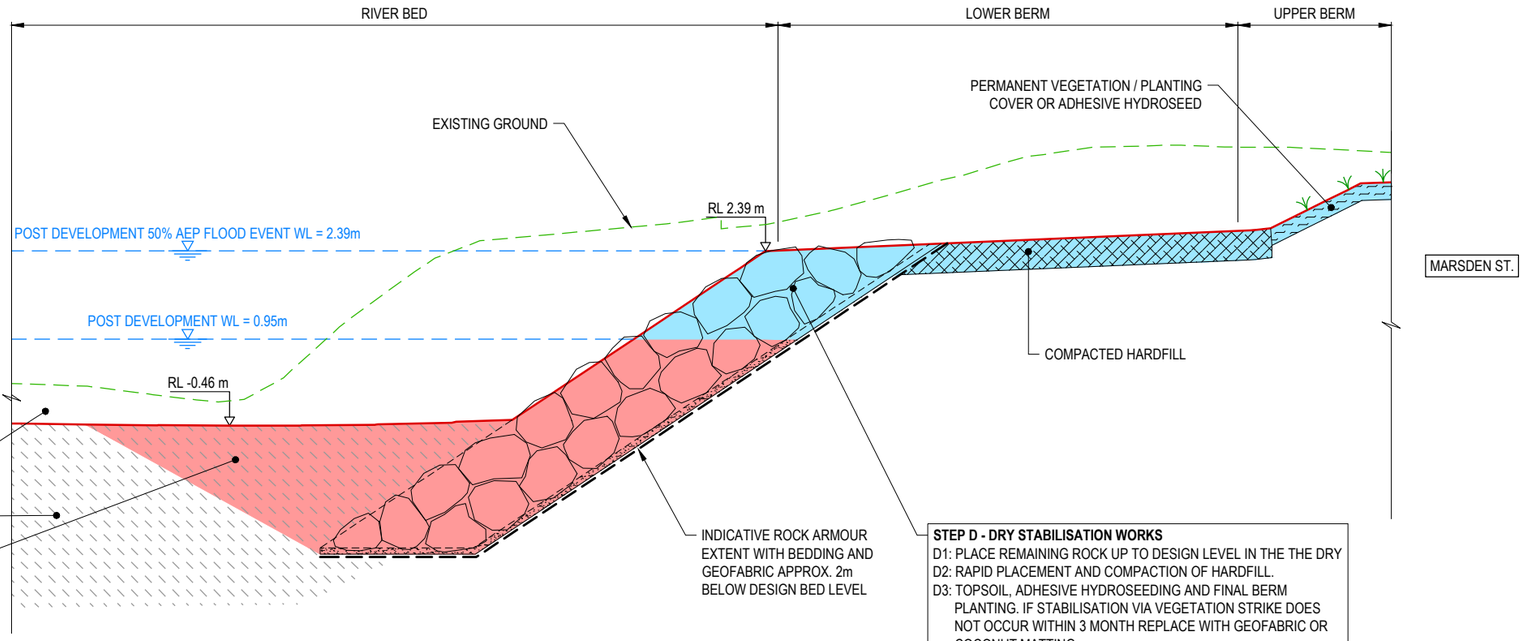
Original Size: A3 Drawing No: FIGURE 102 Rev: A

Plot Date: 28 July 2021 - 11:42 am Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-F102_104.dwg

NOTES:
1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) WELLINGTON VERTICAL DATUM 1953.
3. DIMENSIONS SHOWN HAVE BEEN PULLED DIRECTLY FROM THE DIMENSIONS IN THE DESIGN CAD FILE. THESE SHOW WHAT WE HAVE DESIGNED TO AND MAY NOT LINE UP WITH THE DISTINCT POINTS ON THE SECTIONS DESIGN FILE, SUPPLIED BY GWRC 14.01.2021.
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.

LEGEND
- EXISTING GROUND COMBINED SURVEY DEM2014 - LIDAR2019
- RIVERBED DESIGN PROFILE
- WATER LEVEL
- GEOFABRIC
- TOP SOIL
- COMPACTED HARDFILL
- ROCK ARMOUR BEDDING
- EXISTING SUB-BED

CONSTRUCTION SEQUENCE STEPS:
- A: DRY EARTHWORKS
- B: FLOWING WATER EARTHWORKS
- C: FLOWING WATER STABILISATION WORKS
- D: DRY STABILISATION WORKS



STEP C - FLOWING WATER STABILISATION WORKS
C1: ROLL OUT AND PIN GEOFABRIC. PLACE BEDDING LAYER ON TOP.
C2: RAPIDLY PLACE ROCK UP TO THE FLOWING WATER LEVEL
C3: BACKFILL EXCAVATION TO DESIGN RIVERBED LEVEL USING APPROPRIATE MATERIAL.

STEP D - DRY STABILISATION WORKS
D1: PLACE REMAINING ROCK UP TO DESIGN LEVEL IN THE THE DRY
D2: RAPID PLACEMENT AND COMPACTION OF HARDFILL.
D3: TOPSOIL, ADHESIVE HYDROSEEDING AND FINAL BERM PLANTING. IF STABILISATION VIA VEGETATION STRIKE DOES NOT OCCUR WITHIN 3 MONTH REPLACE WITH GEOFABRIC OR COCONUT MATTING.

SECTION 2 / F101 — BANK STABILISATION (RIGHT) CROSS SECTION
SCALE 1: 100

A3 SCALE 1:100
0 1 2 3 4 5 (m)
ORIGINAL IN COLOUR

RESOURCE CONSENT

No	Revision	Drawn	Checked	Approved	Date
A	RESOURCE CONSENT ISSUE	LIWA	ALGO	EDB	04/29/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink
Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn	LIWA	Designer	ALGO
Drafting Check	TRJ	Design Check	EDB
Approved	E. BREESE		
Date	04/29/2021		
Scale	1:100	This Drawing must not be used for Construction unless signed as Approved	

Client: RIVERLINK
Project: RIVERLINK
Title: CONSTRUCTION WATER QUALITY ASSESSMENT TYPICAL BANK STABILISATION (RIGHT)

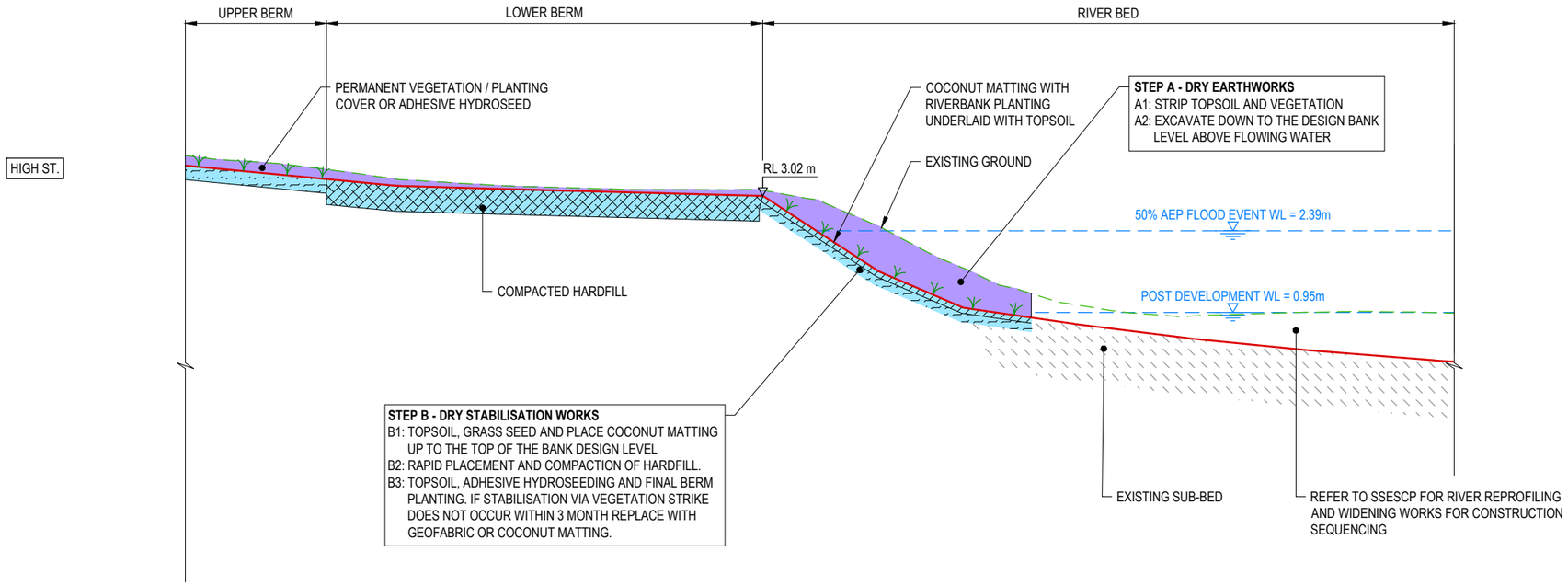
Original Size: A3
Drawing No: FIGURE 103
Rev: A

Plot Date: 28 July 2021 - 11:42 am Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-F102_104.dwg

NOTES:
1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) WELLINGTON VERTICAL DATUM 1953.
3. DIMENSIONS SHOWN HAVE BEEN PULLED DIRECTLY FROM THE DIMENSIONS IN THE DESIGN CAD FILE. THESE SHOW WHAT WE HAVE DESIGNED TO AND MAY NOT LINE UP WITH THE DISTINCT POINTS ON THE SECTIONS DESIGN FILE, SUPPLIED BY GWRC 14.01.2021.
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.

LEGEND
- EXISTING GROUND COMBINED SURVEY DEM2014 - LIDAR2019
- RIVERBED DESIGN PROFILE
- WATER LEVEL
- TOP SOIL
- COMPACTED HARDFILL
- COCONUT MATTING
- EXISTING SUB-BED

CONSTRUCTION SEQUENCE STEPS:
- A: DRY EARTHWORKS
- B: DRY STABILISATION WORKS



SECTION 3 F101 BANK EXCAVATION / STABILISATION (LEFT) CROSS SECTION
SCALE 1: 100

A3 SCALE 1:100
0 1 2 3 4 5 (m)
ORIGINAL IN COLOUR

RESOURCE CONSENT

No	Revision	Drawn	Checked	Approved	Date
A	RESOURCE CONSENT ISSUE	LIWA	ALGO	EDB	04/29/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink
Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn	LIWA	Designer	ALGO
Drafting Check	TRJ	Design Check	EDB
Approved	E. BREESE		
Date	04/29/2021		
Scale	1:100	This Drawing must not be used for Construction unless signed as Approved	

Client: RIVERLINK
Project: RIVERLINK
Title: CONSTRUCTION WATER QUALITY ASSESSMENT TYPICAL BANK EXCAVATION/STABILISATION (LEFT)

Original Size: A3 Drawing No: **FIGURE 104** Rev: A

Plot Date: 28 July 2021 - 11:42 am Plotted By: Daniel Foley-Logan Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\FIG\1009095.0000-F102_104.dwg

ANNOTATION FOR CONSENT

Technical Assessment No. 4 - Construction Water Quality Assessment:
Annotation of River Cross Section 320, Drawing no. A16-4381-SB400, Rev D.

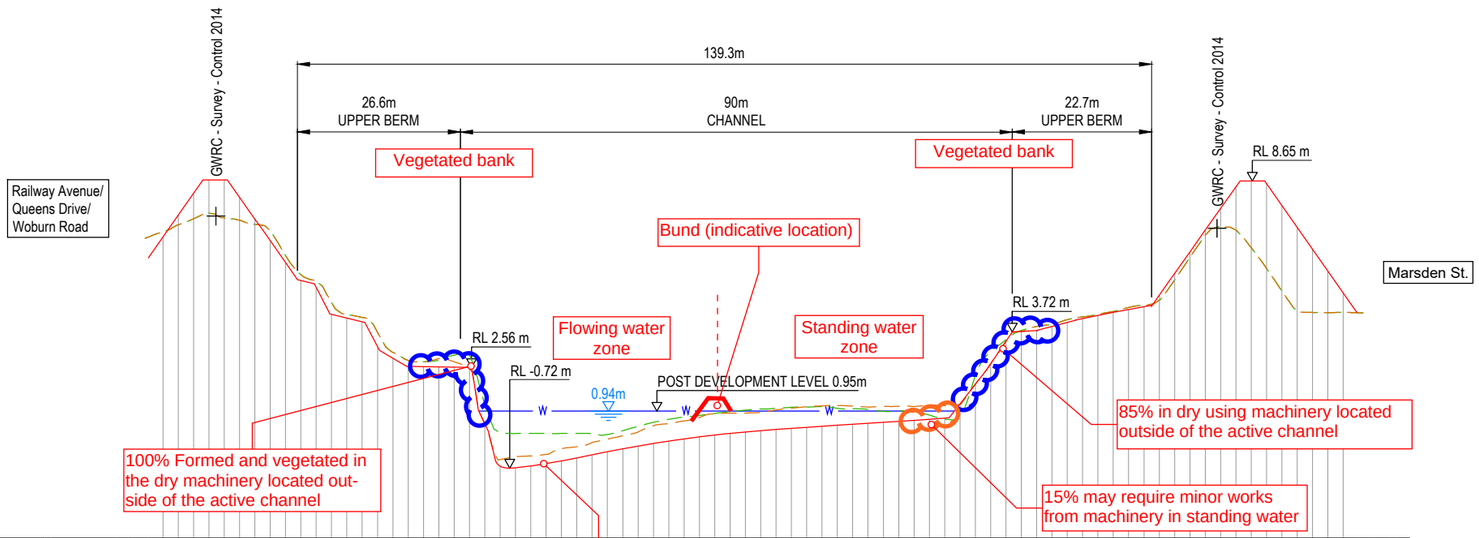
Example Site Specific Erosion and Sediment Control Plan -Riverbank Construction for Reach A Appendix A, Figure 105 - Riverbank works for Cross Section 320

Dated: 29/04/21 By: A.Gordon Checked: E. Breese Approved: E. Breese

LEGEND

- PROPOSED STOPBANK AND RIVERWORKS DESIGN
- EXISTING GROUND (2019 LIDAR)
- PROPOSED MELLING INTERCHANGE DESIGN
- EXISTING GROUND (2014 LIDAR)

NOTES:
1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) WELLINGTON VERTICAL DATUM 1953.
3. DIMENSIONS SHOWN HAVE BEEN PULLED DIRECTLY FROM THE DIMENSIONS IN THE DESIGN CAD FILE. THESE SHOW WHAT WE HAVE DESIGNED TO AND MAY NOT LINE UP WITH THE DISTINCT POINTS ON THE SECTIONS DESIGN FILE, SUPPLIED BY GWRC 14.01.2021.
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.



Datum RL -3.0

OFFSET	MELLING INTERCHANGE LEVEL(m)	DESIGN STOPBANK RIVERBED LEVEL(m)	COMBINED SURVEY DEM2014-LIDAR2019(m)
0.00			
2.50			
5.00			
7.50			
10.00		6.81	6.81
12.50		7.53	6.97
15.00		8.24	7.22
17.50		8.68	7.41
20.00		8.68	7.60
22.50		8.12	7.44
25.00		7.40	7.37
27.50		6.70	7.23
30.00		5.98	7.02
32.50		5.40	6.21
35.00		5.17	5.59
37.50		4.30	5.40
40.00		4.18	4.68
42.50		4.06	4.29
45.00		3.24	4.20
47.50		2.87	3.71
50.00		2.60	3.06
52.50		2.59	2.79
55.00		2.58	2.75
57.50		2.57	2.86
60.00		2.56	2.75
62.50		0.73	2.55
65.00		-0.65	0.73
67.50		-0.71	-0.44
70.00		-0.65	-0.35
72.50		-0.57	-0.32
75.00		-0.48	-0.27
77.50		-0.39	-0.09
80.00		-0.28	-0.02
82.50		-0.19	0.11
85.00		-0.09	0.22
87.50		0.00	0.33
90.00		0.08	0.46
92.50		0.16	0.66
95.00		0.23	0.73
97.50		0.30	0.82
100.00		0.36	0.93
102.50		0.41	1.06
105.00		0.46	1.08
107.50		0.50	1.08
110.00		0.54	1.10
112.50		0.58	1.18
115.00		0.61	1.24
117.50		0.65	1.28
120.00		0.68	1.31
122.50		0.71	1.32
125.00		0.74	1.30
127.50		0.77	1.27
130.00		0.80	1.30
132.50		0.84	1.30
135.00		0.87	1.29
137.50		0.91	1.34
140.00		1.38	1.32
142.50		2.02	1.36
145.00		2.69	2.02
147.50		3.42	2.69
150.00		3.74	3.42
152.50		3.77	3.73
155.00		3.90	3.90
157.50		4.04	3.97
160.00		4.16	4.12
162.50		4.26	4.21
165.00		4.36	4.30
167.50		4.45	4.39
170.00		4.54	4.52
172.50		4.92	4.60
175.00		5.63	4.76
177.50		6.33	5.42
180.00		7.04	6.15
182.50		7.75	6.87
185.00		8.46	7.15
187.50		8.65	7.05
190.00		8.56	6.47
192.50		7.85	5.79
195.00		7.13	5.06
197.50		6.42	4.43
200.00		5.71	4.36
202.50		5.00	4.35
205.00			4.36
207.50			4.35
207.73			

SECTION 320/140 RIVER CROSS SECTION

SCALE 1: 1000 H
1: 200 V

A3 SCALE 1:1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DESIGN FREEZE 2 - MELLING UPDATE

No	Revision	Drawn	Checked	Approved	Date
A	DESIGN FREEZE 1	DSW	LOHA		44160
B	DESIGN FREEZE 2 - DRAFT	DSW	LOHA		44267
C	DESIGN FREEZE 2 - AMENDED	RHTA	LOHA		03/26/2021
D	DESIGN FREEZE 2 - MELLING UPDATE	RHTA	LOHA		04/09/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn DSW | Designer TXH
Drafting Check RBS | Design Check LOHA
Approved NOT FOR CONSTRUCTION
Date 03/12/2021
Scale 1:1000
This Drawing must not be used for Construction unless signed as Approved

Client RIVERLINK
Project RIVERLINK
Title RIVER CROSS SECTIONS SECTION 320

Original Size A3 Drawing No: A16-4381-SB400 Rev: D

Plot Date: 9 April 2021 - 10:48 am Plotted By: Rohini Tatiparthi Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\DWG\A16-4381-SB400_433.dwg

ANNOTATION FOR CONSENT

Technical Assessment No. 4 - Construction Water Quality Assessment: Annotation of River Cross Section 330, Drawing no. A16-4381-SB401, Rev D.

Example Site Specific Erosion and Sediment Control Plan -Riverbank Construction for Reach A Appendix A, Figure 106 - Riverbank works for Cross Section 330

Dated: 29/04/21 By: A.Gordon Checked: E. Breese Approved: E. Breese

LEGEND

- PROPOSED STOPBANK AND RIVERWORKS DESIGN
- EXISTING GROUND (2019 LIDAR)
- PROPOSED MELLING INTERCHANGE DESIGN
- EXISTING GROUND (2014 LIDAR)

NOTES:

1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
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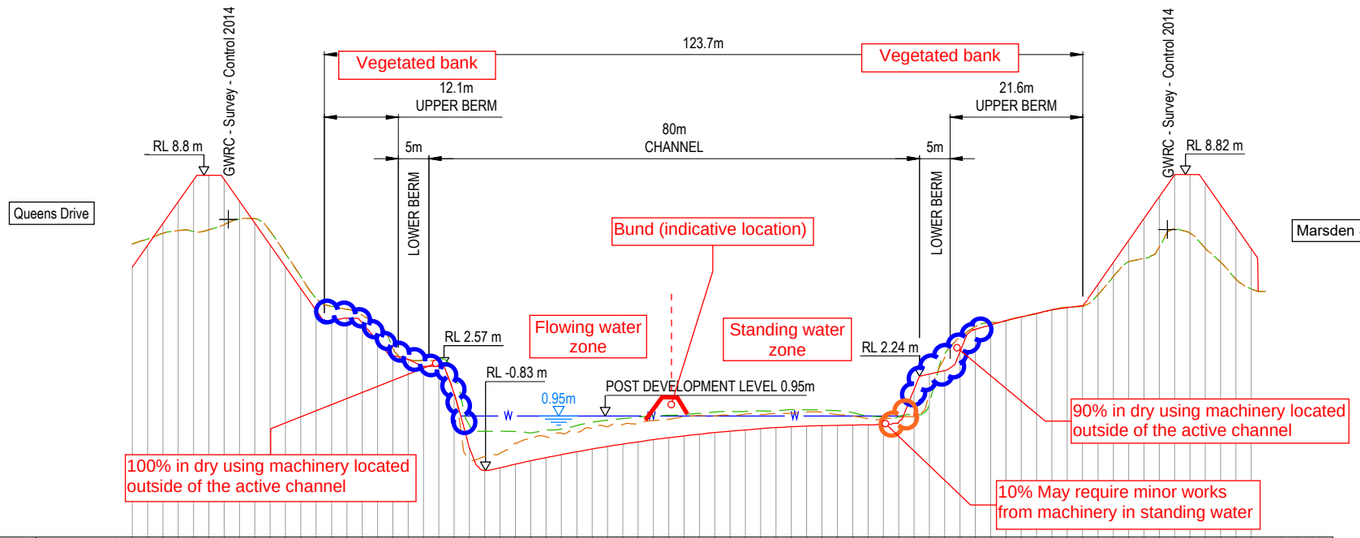
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.



Datum RL -3.0

MELLING INTERCHANGE LEVEL(m)	
DESIGN STOPBANK RIVERBED LEVEL(m)	5.80 6.51 7.22 7.93 8.65 8.80 8.67 7.95 7.24 6.53 5.82 5.11 4.39 4.06 4.14 3.99 3.39 2.92 2.80 2.56 2.57 1.67 -0.10 -0.83 -0.74 -0.62 -0.51 -0.41 -0.31 -0.22 -0.13 -0.04 0.03 0.11 0.18 0.24 0.30 0.36 0.41 0.45 0.50 0.54 0.57 0.60 0.62 0.63 0.65 0.65 0.66 0.67 0.75 1.80 2.32 2.43 3.05 3.78 3.92 4.06 4.18 4.30 4.41 4.48 4.55 5.24 5.96 6.67 7.38 8.10 8.81 8.82 8.55 7.83 7.12 6.41
COMBINED SURVEY DEM2014-LIDAR2019(m)	6.55 6.71 6.91 6.99 6.97 7.02 7.19 7.37 7.38 6.97 6.25 5.49 4.78 4.52 4.43 4.23 4.02 3.17 2.79 2.75 2.75 1.71 -0.47 -0.36 -0.26 0.07 0.17 0.27 0.39 0.41 0.54 0.60 0.67 0.70 0.80 0.84 0.92 0.97 0.95 0.97 1.01 1.00 1.03 1.04 1.08 1.07 1.00 0.95 0.87 0.85 0.90 0.92 1.70 2.96 3.54 3.86 3.99 4.05 4.18 4.29 4.41 4.50 4.53 4.90 5.49 5.98 6.09 6.47 7.07 6.91 6.42 5.97 5.41 5.09
OFFSET	0.00 2.50 5.00 7.50 10.00 12.50 15.00 17.50 20.00 22.50 25.00 27.50 30.00 32.50 35.00 37.50 40.00 42.50 45.00 47.50 50.00 52.50 55.00 57.50 60.00 62.50 65.00 67.50 70.00 72.50 75.00 77.50 80.00 82.50 85.00 87.50 90.00 92.50 95.00 97.50 100.00 102.50 105.00 107.50 110.00 112.50 115.00 117.50 120.00 122.50 125.00 127.50 130.00 132.50 135.00 137.50 140.00 142.50 145.00 147.50 150.00 152.50 155.00 157.50 160.00 162.50 165.00 167.50 170.00 172.50 175.00 177.50 180.00 182.50 185.00 187.50 190.00 192.50 195.00 197.50 197.65

SECTION 330/140 RIVER CROSS SECTION

SCALE 1: 1000 H
1: 200 V

A3 SCALE 1:1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DESIGN FREEZE 2 - MELLING UPDATE

No	Revision	Drawn	Checked	Approved	Date
A	DESIGN FREEZE 1	DSW	LOHA		44160
B	DESIGN FREEZE 2 - DRAFT	DSW	LOHA		44267
C	DESIGN FREEZE 2 - AMENDED	RHTA	LOHA		03/26/2021
D	DESIGN FREEZE 2 - MELLING UPDATE	RHTA	LOHA		04/09/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn DSW | Designer TXH
Drafting Check RBS | Design Check LOHA
Approved NOT FOR CONSTRUCTION
Date 03/12/2021
Scale 1:1000 | This Drawing must not be used for Construction unless signed as Approved

Client RIVERLINK
Project RIVERLINK
Title RIVER CROSS SECTIONS SECTION 330

Original Size A3 | Drawing No: A16-4381-SB401 | Rev: D

Plot Date: 9 April 2021 - 10:48 am Plotted By: Rohini Tatiparthi Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\DWG\A16-4381-SB400_433.dwg

ANNOTATION FOR CONSENT

Technical Assessment No. 4 - Construction Water Quality Assessment: Annotation of River Cross Section 340, Drawing no. A16-4381-SB402, Rev D.

Example Site Specific Erosion and Sediment Control Plan -Riverbank Construction for Reach A Appendix A, Figure 107 - Riverbank works for Cross Section 340

Dated: 29/04/21 By: A.Gordon Checked: E. Breese Approved: E. Breese

LEGEND

- PROPOSED STOPBANK AND RIVERWORKS DESIGN
- EXISTING GROUND (2019 LIDAR)
- PROPOSED MELLING INTERCHANGE DESIGN
- EXISTING GROUND (2014 LIDAR)

NOTES:

1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) WELLINGTON VERTICAL DATUM 1953.
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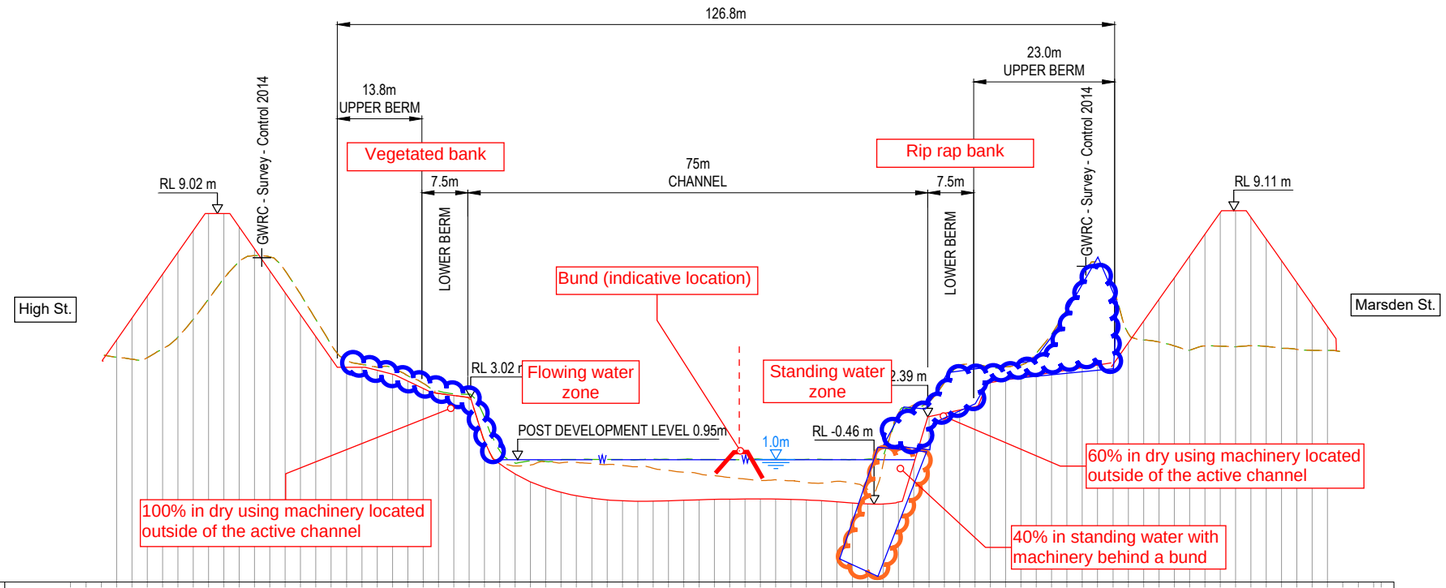
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.



Datum RL -3.0

OFFSET	MELLING INTERCHANGE LEVEL(m)	DESIGN STOPBANK RIVERBED LEVEL(m)	COMBINED SURVEY DEM2014-LIDAR2019(m)
0.00			
2.50			
5.00			
7.50		4.89	4.33
10.00		5.61	4.27
12.50		6.32	4.32
15.00		7.03	4.60
17.50		7.75	4.98
20.00		8.46	5.57
22.50		9.02	6.23
25.00		9.02	6.90
27.50		8.58	7.44
30.00		7.86	7.65
32.50		7.15	7.60
35.00		6.44	7.16
37.50		5.72	6.38
40.00		5.01	5.56
42.50		4.29	4.74
45.00		4.00	4.22
47.50		4.00	4.10
50.00		4.00	4.01
52.50		3.91	3.99
55.00		3.78	3.73
57.50		3.55	3.49
60.00		3.31	3.15
62.50		3.16	3.09
65.00		3.09	2.98
67.50		3.02	1.60
70.00		1.59	0.92
72.50		0.86	0.79
75.00		0.53	0.82
77.50		0.27	0.93
80.00		0.08	0.89
82.50		-0.07	0.90
85.00		-0.18	0.87
87.50		-0.26	0.83
90.00		-0.32	0.81
92.50		-0.35	0.76
95.00		-0.36	0.71
97.50		-0.36	0.64
100.00		-0.35	0.58
102.50		-0.33	0.53
105.00		-0.32	0.47
107.50		-0.30	0.41
110.00		-0.29	0.36
112.50		-0.29	0.32
115.00		-0.29	0.34
117.50		-0.30	0.30
120.00		-0.32	0.24
122.50		-0.35	0.23
125.00		-0.38	0.29
127.50		-0.42	0.23
130.00		-0.45	0.03
132.50		-0.45	0.84
135.00		-0.39	2.51
137.50		0.86	2.77
140.00		2.40	2.87
142.50		2.50	3.51
145.00		2.61	4.07
147.50		2.71	4.09
150.00		3.51	4.00
152.50		3.59	4.02
155.00		3.67	4.07
157.50		3.75	4.47
160.00		3.83	5.09
162.50		3.92	5.92
165.00		4.00	7.00
167.50		4.08	7.45
170.00		4.09	6.71
172.50		4.80	5.11
175.00		5.51	4.90
177.50		6.22	4.83
180.00		6.92	4.70
182.50		7.63	4.56
185.00		8.34	4.70
187.50		9.05	4.70
190.00		9.11	4.68
192.50		8.90	4.71
195.00		8.19	4.69
197.50		7.47	4.63
200.00		6.76	4.59
202.50		6.05	4.56
205.00		5.34	4.56
207.50			
210.00			
212.50			
213.36			

SECTION 340/140 RIVER CROSS SECTION

SCALE 1: 1000 H
1: 200 V

A3 SCALE 1:1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DESIGN FREEZE 2 - MELLING UPDATE

No	Revision	Drawn	Checked	Approved	Date
A	DESIGN FREEZE 1	DSW	LOHA		44160
B	DESIGN FREEZE 2 - DRAFT	DSW	LOHA		44267
C	DESIGN FREEZE 2 - AMENDED	RHTA	LOHA		03/26/2021
D	DESIGN FREEZE 2 - MELLING UPDATE	RHTA	LOHA		04/09/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

Plot Date: 9 April 2021 - 10:48 am Plotted By: Rohini Tatiparthi Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\DWG\A16-4381-SB400_433.dwg

RiverLink Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn DSW Designer TXH
Drafting Check RBS Design Check LOHA
Approved NOT FOR CONSTRUCTION
Date 03/12/2021
Scale 1:1000 This Drawing must not be used for Construction unless signed as Approved

Client RIVERLINK
Project RIVERLINK
Title RIVER CROSS SECTIONS SECTION 340

Original Size A3 Drawing No: A16-4381-SB402 Rev: D

ANNOTATION FOR CONSENT

Technical Assessment No. 4 - Construction Water Quality Assessment: Annotation of River Cross Section 350, Drawing no. A16-4381-SB403, Rev D.

Example Site Specific Erosion and Sediment Control Plan -Riverbank Construction for Reach A Appendix A, Figure 108 - Riverbank works for Cross Section 350

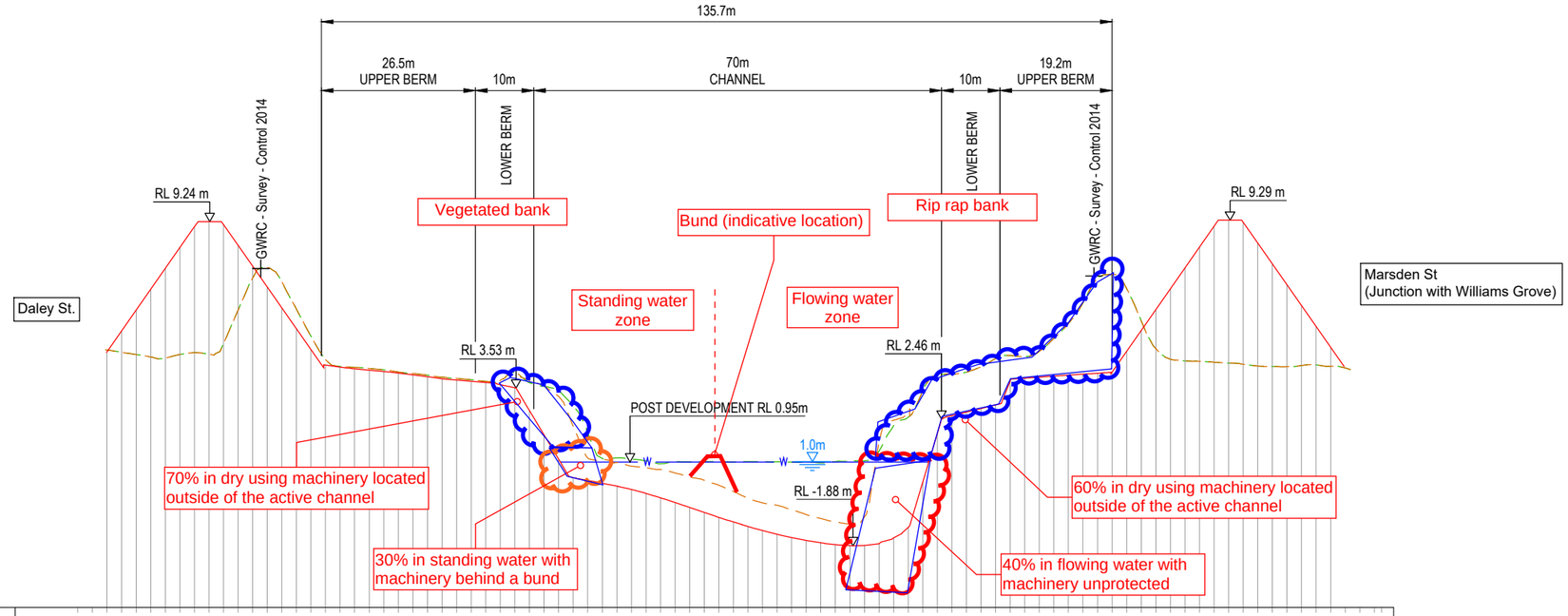
Dated: 29/04/21 By: A.Gordon Checked: E. Breese Approved: E. Breese

LEGEND

- PROPOSED STOPBANK AND RIVERWORKS DESIGN
- EXISTING GROUND (2019 LIDAR)
- PROPOSED MELLING INTERCHANGE DESIGN
- EXISTING GROUND (2014 LIDAR)

NOTES:

1. DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) WELLINGTON VERTICAL DATUM 1953.
3. DIMENSIONS SHOWN HAVE BEEN PULLED DIRECTLY FROM THE DIMENSIONS IN THE DESIGN CAD FILE. THESE SHOW WHAT WE HAVE DESIGNED TO AND MAY NOT LINE UP WITH THE DISTINCT POINTS ON THE SECTIONS DESIGN FILE, SUPPLIED BY GWRC 14.01.2021.
4. 7 DAY MALF WATER LEVEL STANDS FOR 7 DAY MEAN ANNUAL LOW FLOW WATER LEVEL.
5. 2019 LIDAR SOMETIMES PICKED UP WATER LEVEL AND NOT RIVERBED LEVEL. WHERE THIS HAS HAPPENED THE 2014 DESIGN RIVER BED LEVEL WAS USED AS EXISTING RIVER BED LEVEL.



Datum RL -4.0

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SECTION 350/140 RIVER CROSS SECTION

SCALE 1: 1000 H
1: 200 V

A3 SCALE 1:1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DESIGN FREEZE 2 - MELLING UPDATE

No	Revision	Drawn	Checked	Approved	Date
A	DESIGN FREEZE 1	DSW	LOHA		44160
B	DESIGN FREEZE 2 - DRAFT	DSW	LOHA		44267
C	DESIGN FREEZE 2 - AMENDED	RHTA	LOHA		03/26/2021
D	DESIGN FREEZE 2 - MELLING UPDATE	RHTA	LOHA		04/09/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn DSW | Designer TXH
Drafting Check RBS | Design Check LOHA
Approved NOT FOR CONSTRUCTION
Date 03/12/2021
Scale 1:1000
This Drawing must not be used for Construction unless signed as Approved

Client RIVERLINK
Project RIVERLINK
Title RIVER CROSS SECTIONS SECTION 350

Original Size A3 Drawing No: A16-4381-SB403 Rev: D

Plot Date: 9 April 2021 - 10:48 am Plotted By: Rohini Tatiparthi Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\DWG\A16-4381-SB400_433.dwg

ANNOTATION FOR CONSENT

Technical Assessment No. 4 - Construction Water Quality Assessment:
Annotation of River Cross Section 360, Drawing no. A16-4381-SB404, Rev D.

Example Site Specific Erosion and Sediment Control Plan -Riverbank Construction for Reach A Appendix A, Figure 109 - Riverbank works for Cross Section 360

Dated: 29/04/21 By: A.Gordon Checked: E. Breese Approved: E. Breese

LEGEND

- PROPOSED STOPBANK AND RIVERWORKS DESIGN
- EXISTING GROUND (2019 LIDAR)
- PROPOSED MELLING INTERCHANGE DESIGN
- EXISTING GROUND (2014 LIDAR)

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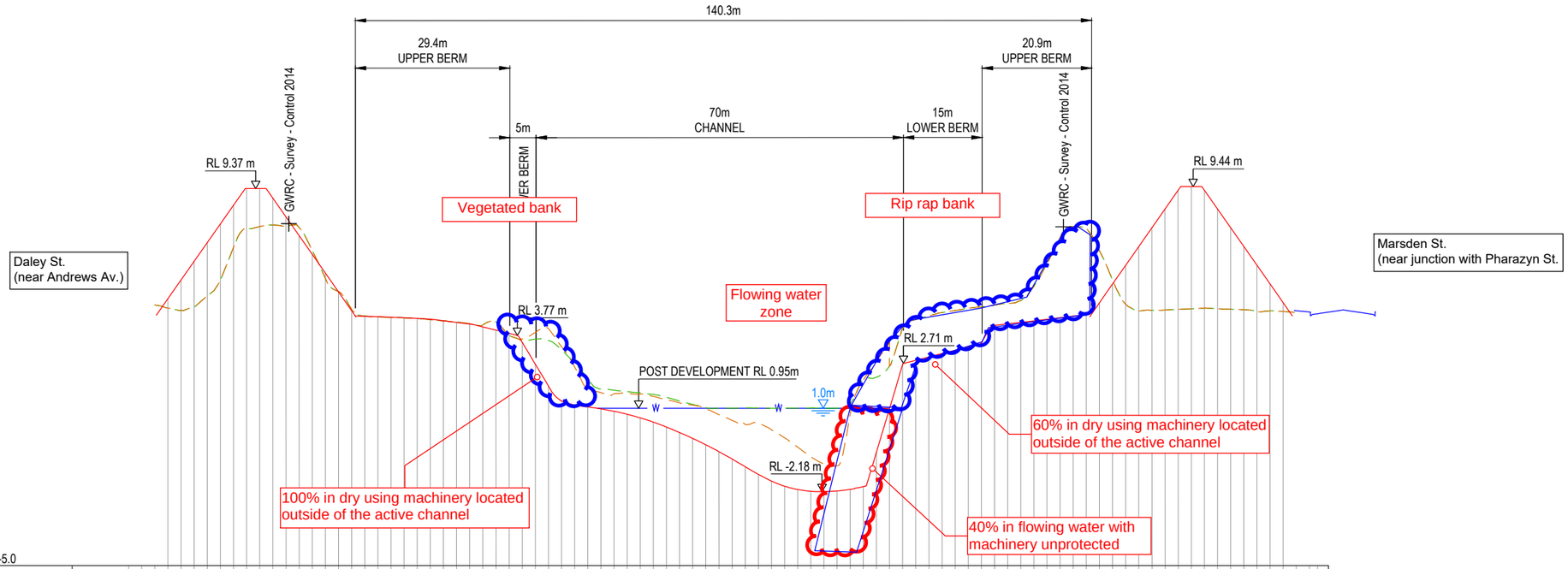

Datum RL -5.0

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COMBINED SURVEY DEM2014-LIDAR2019(m)	4.93, 4.81, 4.73, 4.87, 5.28, 5.87, 7.12, 7.83, 7.92, 7.98, 7.93, 7.88, 7.01, 5.94, 5.45, 4.77, 4.51, 4.48, 4.46, 4.44, 4.42, 4.37, 4.33, 4.28, 4.22, 4.17, 4.28, 3.79, 3.64, 3.89, 4.04, 3.35, 2.57, 1.69, 1.59, 1.55, 1.56, 1.54, 1.44, 1.33, 1.20, 1.11, 0.98, 0.75, 0.53, 0.39, 0.45, 0.18, -0.13, -0.49, -0.85, -1.13, -1.19, 0.77, 2.07, 2.80, 3.49, 4.05, 4.38, 4.51, 4.64, 4.72, 4.81, 4.87, 4.93, 4.99, 5.10, 5.63, 6.50, 7.50, 7.91, 7.85, 7.00, 5.89, 4.96, 4.70, 4.72, 4.74, 4.76, 4.79, 4.81, 4.78, 4.76, 4.75, 4.68, 4.71, 4.68
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SECTION 360/140 RIVER CROSS SECTION

SCALE 1: 1000 H
1: 200 V

A3 SCALE 1:1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

DESIGN FREEZE 2 - MELLING UPDATE

No	Revision	Drawn	Checked	Approved	Date
A	DESIGN FREEZE 1	DSW	LOHA		44160
B	DESIGN FREEZE 2 - DRAFT	DSW	LOHA		44267
C	DESIGN FREEZE 2 - AMENDED	RHTA	LOHA		03/26/2021
D	DESIGN FREEZE 2 - MELLING UPDATE	RHTA	LOHA		04/09/2021

Note: * indicates signatures on original issue of drawing or last revision of drawing

RiverLink Isthmus. Tonkin+Taylor GHD Holmes

DO NOT SCALE

Drawn DSW Designer TXH
Drafting Check RBS Design Check LOHA
Approved NOT FOR CONSTRUCTION
Date 03/12/2021
Scale 1:1000
This Drawing must not be used for Construction unless signed as Approved

Client RIVERLINK
Project RIVERLINK
Title RIVER CROSS SECTIONS SECTION 360

Original Size A3 Drawing No: A16-4381-SB404 Rev: D

Plot Date: 9 April 2021 - 10:48 am Plotted By: Rohini Tatiparthi Cad File No: C:\12dSynergy\data\ALBTCAD\Riverlink_438\CAD\DWG\A16-4381-SB400_433.dwg

Appendix B: Design calculations

No specific design calculation is required for this SSESCP.

Appendix C: Activity constraints calendar

General Activity Constraints Calendar – Te Awa Kairangi/Hutt River (including parts of the Akatarawa River, Stokes Valley, Speedy's and Te Mome Streams)

Value to be protected	Affected areas	Summer			Autumn			Winter			Spring		
		Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Inanga spawning (refer section 10.3.10)	Tidally inundated riparian vegetation on: • Te Awa Kairangi/Hutt River between XS100 and XS210.	*Follow general good practice and requirements for site specific effects management as per Appendix 2.*	Key sensitivity period – banks only 1 January to 28 February Preferably avoid disturbance of vegetation on bank edges at these times, or if unavoidable, follow requirements for site specific effects management as per Appendix 2.		Key sensitivity period - bed and banks 1 March to 31 May Preferably avoid disturbance of vegetation on bed or bank edges at these times, or if unavoidable, follow requirements for site specific effects management as per Appendix 2.			*Follow general good practice and requirements for site specific effects management as per Appendix 2.*		*Follow general good practice and requirements for site specific effects management as per Appendix 2.* Whitebait fishing season – 15 August to 30 November			
Trout spawning (refer section 10.3.10)	Actively flowing channel of: • Akatarawa River	*Follow general good practice*					Key sensitivity period 1 May to 31 October Preferably avoid disturbance of the bed at these times, or if unavoidable, follow requirements for site specific effects management as per Appendix 2.						*Follow general good practice*
Peak native fish migration (refer section 10.3.10)	Actively flowing channel	→	*Follow general good practice*							Key sensitivity period 1 August to 31 December → Avoid the mechanical clearance of silt and weed from low gradient waterways. Limit activities that disturb the wetted channel at these times to no more than 30 hours of in river works or 150 hours per 10 km reach. If these activities are unavoidable, follow requirements for site specific effects management as per Appendix 2.		
Instream ecology at times of low flow (refer section 10.3.10)	Actively flowing channel	As far as is practicable avoid work in the actively flowing channel during periods when the river flow recedes below the minimum flow specified in GWRC's Natural Resources Plan, or if unavoidable, follow requirements for site specific effects management as per Appendix 2.											
River bird nesting (refer section 10.3.10)	Dry beaches of Te Awa Kairangi/Hutt River between: • XS310 and XS2270; and • XS2731 and XS2900.	→			*Follow general good practice*					Key sensitivity period (nesting) 1 August to 28 February → Preferably avoid work on dry gravel beaches at these times, but if urgent works are required, works should be preceded by a survey carried out by a suitably qualified ecologist to identify the presence of banded dotterel, pied stilt and black-fronted dotterel nests or chicks. If nests or chicks are found during pre-works surveys, exclusion zones should be maintained at 100m from nests and 50m from chicks during activities causing continuous disturbance to habitat (e.g. beach contouring or gravel extraction). Vehicles must not be operated within 25m of any nests and chicks and the birds and nests should not be disturbed.		
Lizards and geckos (refer section 10.3.10)	River terrace manuka or kanuka scrub Native grassland Scree or boulder fields	If more than 100 m² of habitat type noted is to be disturbed, or if lizards and/or geckos are known or likely to be present at the site, a suitably qualified herpetologist MUST undertake a prior works survey to check for the presence of lizards and geckos within the affected site. IF any lizard or gecko species is identified in the survey, works must not proceed until Wildlife Act 1953 permits have been issued to distrub wildlife and a detailed plan is in place to avoid or mitigate any adverse effects of the works. (NB: it is a legal requirement to obtain a wildlife permit from the Department of Conservation before lizards and/or geckos are disturbed.)											
Safe machine operation (refer sections 10.3.4, 10.3.6 and 10.3.9)	Actively flowing channel and berms	→ For safety, activities in the actively flowing channel should avoid periods of high flow whenever possible. For control of turbidity in runoff, operation of machinery on berms should avoid times when ground conditions are extremely wet, whenever practicable.						Activities in actively flowing channel and on berms should be programmed outside this period whenever possible, for both safety reasons and control of sediment in runoff.			→		
Peak instream recreational use (refer section 10.3.12)	Active bed and berms	Key sensitivity period 1 December to 28 February Avoid activities in the flowing channel and on berms on Saturdays, Sundays or public holidays at these times.			*Follow general good practice*								
Significant mana whenua values (Refer section 10.3.13)	River corridor	Operational Management Plans must identify significant mana whenua values and sites to be taken into account in work planning and method selection for each management reach.											

Appendix D: Site specific management plan requirements.

DRAFT

Site Specific Effects Management

Many river management activities have the potential for some short-term adverse impacts, but the significance of this needs to be considered in the context of the naturally dynamic river environment (where form and habitat are constantly changing and re-forming). The significance of effects also depends on factors such as the scale of disturbance, the values of a particular site, their sensitivity, and the time for recovery to pre-disturbance levels.

If a proposed activity or set of activities have the potential to generate significant adverse effects on the river environment at a specific site or within a specific reach, the activities may need to be conducted in accordance with a more detailed, Site Specific Effects Management Plan (SSEMP), in addition to the good management practices in section 10 of the Code.

The following activities, or activities within the following locations, will require an SSEMP to be prepared prior to any works, as set out in the conditions of the consent.

- Construction of grade control structures: the construction of grade control structures will require an SSEMP, regardless of the time of year, or projected level of disturbance.
- Wet gravel extraction: all wet gravel extraction will require an SSEMP, regardless of the time of year, or projected level of disturbance.
- Mechanical clearance of bottom rooted plant community in low gradient streams: will require an SSEMP. This includes activities that disturb the bottom of the steam but excludes the use of weed boats.
- Waikanae Estuary Scientific Reserve: all river management activities proposed to be undertaken within the Reserve will require an SSEMP.
- Clearance of riparian vegetation with high ecological values: the clearance of 100m^2 or more of high value riparian vegetation identified in the Operative Natural Resources Plan, GWRC's Key Native Ecosystems and Wetland Programmes, or by flood protection surveys as having significant indigenous biodiversity values will require an SSEMP.
- Additional activities identified in an OMP

For other activities, the method set out below outlines the process for determining when an SSEMP and site specific effects management is necessary, and if required, what it should include. This process should be read in conjunction with the relevant consent conditions.

Process for determining when site specific effects management is required

The five step process below combines:

- the potential risk for adverse effect;
- the scale of the proposed work; and
- the sensitivity of the site,

to determine whether site specific effects management is required to undertake an activity.

Step 1 – Identify activities with high potential for adverse impact

Activities classified as having a high potential for adverse impact are those where it is recognised that recovery of river habitat that is altered by those activities may take months

or possibly years (or possibly not at all). These include activities that cause extensive mechanical disturbance of the wetted riverbed, as listed in Table 1.

Table 1: High potential impact activities

High potential impact activities (wet channel)
· bed recontouring · channel diversion cuts · ripping in the wet channel · construction and repair of impermeable structures

Step 2 – Assign a magnitude to the proposed disturbance

For activities identified in Step 1, Table 2 assigns a magnitude to the proposed disturbance, based on the length of riverbed affected and/or the amount of time involved.

Table 2: Scale of activity disturbance

Amount of proposed disturbance	Magnitude
· > 800m wetted riverbed length; and/or · > 80 hours in river works or >150 hours per 10 km reach.	**Large**
· 175m - 800m wetted riverbed length; and/or · 30 - 80 hours in river works or no more than 150 hours per 10 km reach.	**Moderate**
· < 175m wetted riverbed length; and/or · no more than 30 hours in river works or 150 hours per 10 km reach.	**Small**

Step 3 – Define sensitivity of habitat

Important habitats in terms of river ecology are defined as:

- inanga spawning habitat on the banks only from 1 January to 28 February (i.e. in the months prior to inanga spawning season) and on the banks and beds from 1 March to 31 May (i.e. during inanga spawning season);
- trout spawning habitat from 1 May to 31 October (i.e. during trout spawning season);
- native fish migration routes, particularly between 1 August and 31 December; and
- instream ecology in the actively flowing channel at times when river flows recedes below the minimum flows identified in the Operative Natural Resources Plan.

Table 3 assigns a relative sensitivity to disturbance ranking to these habitats.

The locations of these habitats in each river system are found in the 'affected area' columns in Appendix 7.

Table 3: Habitat sensitivity

Habitat type	Sensitivity
· inanga spawning habitat on the banks only from 1 January to 28 February · inanga spawning habitat on the banks and bed from 1 March to 31 May · trout spawning habitat from 1 May to 31 October · actively flowing channels during minimum flows	**Most**
· inanga spawning habitat from 1 June to 31 December · wetted channel utilised by migrating fish from 1 August to 31 December	**Intermediate**
· other instream habitats	**Least**

Step 4 – Determine risk of adverse impact

Table 4 can be used to determine the level of risk of adverse impact (high, medium or low) arising from river management activities at a specific site, based on a combination of the magnitude of disturbance proposed (determined from Table 2) and from the relative sensitivity of the work site (determined from Table 3).

Table 4: Risk of adverse impact of high potential impact activities

		Habitat sensitivity (from Table 3)		
Magnitude of disturbance (from Table 2)		**Most** · inanga spawning habitat on the banks only from 1 January to 28 February · inanga spawning habitat on the banks and bed from 1 March to 31 May · trout spawning habitat from 1 May to 31 October · actively flowing channels during minimum flows	**Intermediate** · inanga spawning habitat from 1 June to 31 December · the wetted channel utilised by migrating fish from 1 August to 31 December	**Least** · other instream habitats
	Large · > 800m wetted riverbed length; and/or · > 80 hours in river works or >150 hours per 10 km reach.	***High***	***High***	***High***
	Moderate · 175m - 800m wetted riverbed length; and/or · 30 - 80 hours of in-river works or no more than 150 hours per 10 km reach.	***High***	***Medium***	***Low***
	Small · < 175m wetted riverbed length; and/or · no more than 30 hours in-river works or 150 hours per 10 km reach.	***High***	***Low***	***Low***

Step 5 – Determine response based on risk of adverse impact

Table 5 below summarises the appropriate management responses applying according to the determined risk of adverse impact in Table 4.

Table 5: Required management responses based on risk of adverse impact

	Risk of adverse impact (from Table 4)		
	High	**Medium**	**Low**

Management Response	· A site specific before/after habitat assessment must be undertaken at each work site by the operations supervisor using the template at **Appendix 5**; · Preparation of a SSEMP; and · Works to follow all good management practices at section 10 of the Code (unless otherwise prescribed in the SSEMP).	· Works to follow all the good management practices at section 10 of the Code; and · A site specific before/after habitat assessment must be undertaken at each work site by the operations supervisor using the template at **Appendix 5**.	· No specific site management over and above the need for works to follow all the good management practices at section 10 of the Code.

Scope of SSEMPs

Each SSEMP must cover the following matters:

- describe the works proposed, including methodology and timing, noting that any changes must be discussed with all parties involved in the SSEMP preparation
- describe the necessity of the work (noting that necessity will usually be addressed at the Annual Work Plan stage – the Annual Work Plan must be consistent with the decision making framework at section 6 of the Code)
- include an assessment of the various options considered and reasons why undertaking the proposed activities is preferred
- include an assessment as to why the proposed activities are to be undertaken during the period specified and within that habitat, as applicable, and specific measures to remedy or mitigate effects of the proposed activities
- describe the site specific (event) monitoring that will be undertaken
- set out communication requirements with mana whenua, the Department of Conservation, Wellington Fish and Game Council and stakeholder groups specified in the consent conditions
- describe how the design channel and bed levels will be maintained
- describe how the mana whenua values of any kaitiaki sites have been taken into account
- include reporting requirements and site management responsibilities. It is expected that the various expert reports will inform the SSEMP
- include a suitably qualified expert's opinion of how appropriate steps will be taken to avoid, remedy or mitigate adverse effects.

SSEMPs will be prepared by Flood Protection staff and must include communication with relevant parties (who will be dependent on the particular values identified for the site) and certified by the Manager, Environment Regulation before work can commence. Advice will also be sought from a suitably qualified expert. The scope of site specific (event) monitoring is described at section 3 of the Environmental Monitoring Plan at Appendix 3.

Appendix C – draft Chemical Management Plan

RiverLink Pre-Implementation Planning/Design Services

DRAFT

Chemical Treatment Management Plan

29 July 2021

Revision	Status	Prepared by	Reviewed by	Approved by	Date
0	Draft for client comment	Alistair Gordon	Billy Rodenburg	Chris Bauld	29 April 2021
A	For Consent	Alistair Gordon	Billy Rodenburg	Ed Breese	29 July 2021

The Chemical Treatment Management Plan is a living document and will be updated as the project progresses to account for changing construction environment and in response to monitoring information.

DRAFT

Contents

1 Introduction

This Chemical Treatment Management Plan (CTMP) has been prepared on behalf of RiverLink in support of the RiverLink Project in Lower Hutt. It describes the practise and procedures for the use of chemical flocculant treatment for the RiverLink Project.

The RiverLink project will involve in-river and land-based works resulting in disturbance along the Hutt River | Te Awa Kairangi. The project wants to minimise the impact on downstream water quality as much as practical during the works, and to ensure compliance with the Greater Wellington Regional Council (GWRC) Regional Plan, Consent and industry guidance.

This CMP is part of a suite of documents relating to ESC for the project and should be read in conjunction with these related documents. Refer to the Project Erosion and Sediment Control Plan (PESCP) for a full list of the RiverLink ESC plans and a more detailed description of the site works and extent.

2 Legislative requirements

2.1 Resource Consent WGNXXXX

This CMP has been prepared to meet Resource Consent WGNXXXX Condition XX. Table 2-1 outlines where this CMP meets the require of Condition(s).

Table 2-1: CMP consent condition requirements

Consent condition	Consent requirement	Comment/ where this is addressed
Item 116 (i)	Methods of flocculant chemical to be used and alternatives.	Section 6
(ii)	Details of dosage rate and deployment	Section 7 and 8
(iii)	Chemical spill contingency plan	Section 7
(iv)	Monitoring and reporting programme	Section 8.3 and 8.4

Note: Table to be updated once resource consent granted.

2.2 GWRC requirements

For land disturbing activities in the Wellington Region, the use of flocculants for sediment retention ponds (SRPs) is considered a 'best practice' measure to maximise treatment performance of devices and minimise the amount of sediment discharged into the receiving environment. GWRC's requirements for the use of chemical flocculant are set out in:

- Section F2.0 of the Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Wellington Region (2021); and
- Auckland Regional Council's Technical Publication TP227 The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff: Trials, Methodology and Design, June 2004 (TP227).

Table 2-2 outlines where this CMP addresses the relevant requirements.

Table 2-2: GWRC flocculation requirements

ESC guidelines requirement	Comment/ where this is addressed
Site conditions where flocculation applies	Section 4. Specific application to be specified in SSESCP.
Treatment methods and bench testing including: • Rainfall activated systems, • Batch dosing	Section 6 and 7
Operation and maintenance procedures	Section 8
Management of pH in chemically treated devices	Section 8.3
Storage of chemicals on-site	Section 8.5
Safe handling of chemicals	Section 5
Chemical spill procedures	Section 10
Monitoring and rainfall response procedures	Section 8.4
Decommissioning	Section 8.6

3 CMP administration

The CMP is a controlled plan and shall be updated to account for the changing construction environment and is to be certified by GWRC and Hutt City Council (HCC) as part of the control procedures described in the Erosion and Sediment Control Plan (ESCP). Refer to Section 4 of the ESCP for control and certification procedures.

Refer ESCP Section 4.4 for the project ESC roles and responsibilities.

4 Chemical treatment in Site Specific Erosion and Sediment Control Plans

Where a sediment retention pond (SRP) is proposed as an erosion and sediment control measure in an SSESCP it shall include chemical treatment in accordance with this CMP. Chemical treatment may also be proposed in SSESCPs in response to specific concerns or as raised during ESC audits such as where a DEB is not providing sufficient treatment and cannot be easily enlarged.

Where project activities require the use of flocculation, the SSESCP for that activity shall specify the specific design details (including the flocculation method, location, and layout) of chemical treatment systems.

5 Health and Safety

Health and safety requirements for handling flocculants, including material data sheets and training requirements, are set out in the Project Health and Safety documents (yet to be prepared).

6 Flocculation methods

Flocculation can be deployed in three forms: solids, liquid, and powder. Liquid methods are the preferred form to be used across the Project. Solid and powder are to be used as alternatives where liquid is unsuitable. Each are to be used in the following ways:

6.1 Liquid flocculant

Liquid flocculant can be added to sediment laden runoff entering or stored in a retention treatment device. Liquid forms can be deployed by manual batch dosing to contained water or by rainfall activated systems, which mix flocculant with runoff at the entry point of treatment devices.

Rainfall activated liquid dosing is to be applied at all SRPs with catchment areas greater than 500 m^2. Where container impoundment systems (CISs) are used to contain runoff from contaminated land, the use of liquid flocculant or chemical alternatives will be determined following an assessment of contaminants present, effectiveness of chemical treatment and environmental effects. Details for chemical treatment of runoff from contaminated land will be outlined in SSESCPs.

6.2 Solid flocculant

Solid flocculant is supplied in a brick form contained by a wire cage. Blocks can be placed in at points where flowing runoff generates greatest turbulence so to have high contact between solid flocculant and flowing water. Solid forms are suitable for low to moderate flows and will be deployed as required.

A good example of where a solid flocculant would be applicable is within a channel just upstream of a grit trap or DEB which is not large enough to justify a rainfall activated liquid flocculant dosing system.

6.3 Powdered flocculant

Powdered flocculant can be supplied in geotextile socks filled with a media called floc-socks. Floc-socks are then pinned to the ground or across channels to treat dispersed construction runoff or runoff in a channel respectively.

Where liquid flocculant is not available powdered flocculant can be mixed into aqueous form and used for manual batch doing.

7 Bench testing and optimum dosage rates

Prior to the start of construction, bench testing will be carried out to determine the optimum dosage of flocculant chemical. Requirements of bench testing are as follows:

- Representative soil from within the project designation is to be used in bench testing.
- Poly aluminium chloride (PAC) and at least one alternative chemical is to inform selection of the preferred chemical for the deployment across the Project and an alternative for contingency.
- A range of dose concentrations are to be applied to determine the optimum dose rate.

Results from bench testing will added to this CMP once completed.

7.1 Poly aluminium chloride (PAC)

To be added following bench testing.

7.2 Other flocculants

To be added following bench testing.

8 Flocculation management procedures

8.1 Poly aluminium chloride (PAC)

Poly aluminium chloride (PAC) has been assumed to be the primary flocculant chemical to be used across the Project based on project experience by the team at other sites around the Wellington region. Should alternative chemicals or blends be determined to be effective during bench testing, specific management procedures will be prepared and submitted to GWRC and HCC for approval

before deployment on-site. The following management procedures have been set out for use of PAC but can be consider applicable for alternative flocculant chemicals.

8.1.1 Rainfall activated dosing

The procedures outlined below apply for rainfall activated dosing system. The components of a typical rainfall activated system are shown on Figure 1.

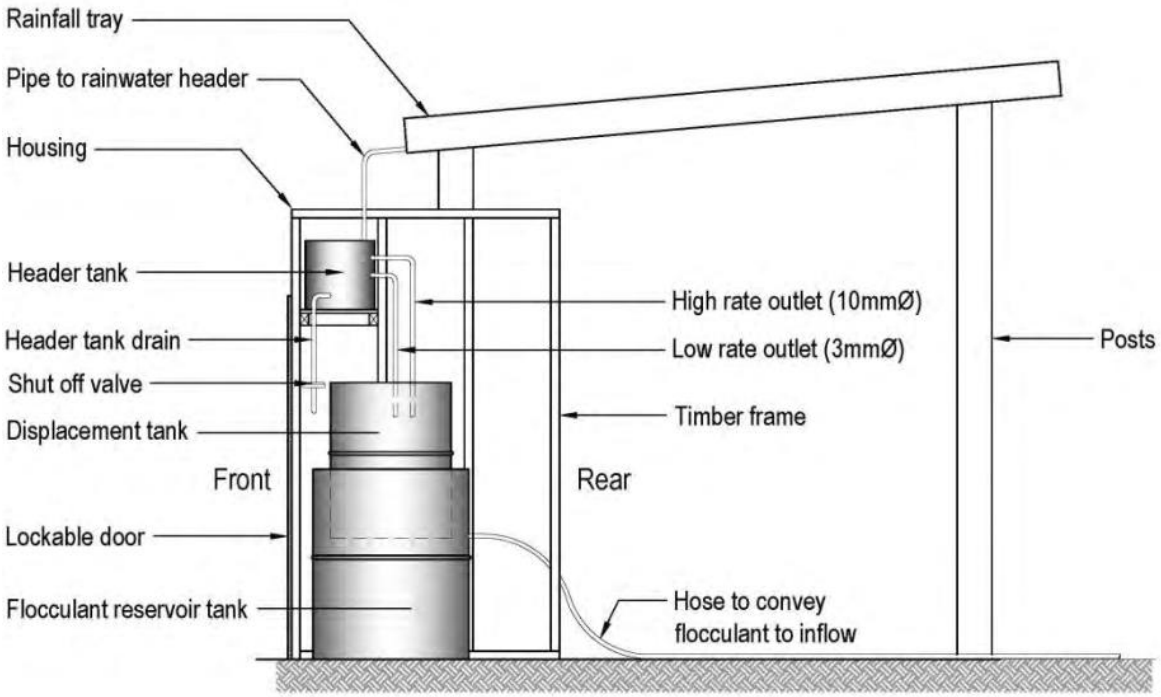

Figure 1. Schematic of a typical rainfall activated system. Source: GWRC ESC Guidelines (2021).

8.1.1.1 Dry weather and prior to forecast rainfall

The header tank is used to avoid dosing during the initial stages of rainfall when site conditions are dry, and no runoff is expected. For an increasing number of antecedent dry days, the header tank is to be adjusted to make the system more sensitive to runoff rates. Volume in the header tank is lowered (using the header tank drain) after:

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

Prior to forecast rainfall, a check of the full operating system is required to ensure appropriate operational effectiveness.

8.1.1.2 Periodic systems checks

Refer Section 8.4 for monitoring frequency. Periodic systems checks should include:

- Check that the rainfall catchment tray is not leaking – especially along the lower edge of the tray. This should be done after rainfall has ceased;
- Check the lower hose with the small tube outlet, from the header tank to the displacement tank, is not blocked; and
- Check the chemical discharge hose is not blocked and flows easily when displacement tank lowered.

8.1.1.3 During rainfall

Check the colour/clarity of water within the treatment pond. Visual indicators of poor performance of the treatment system, or effects of other influences on stormwater quality include:

- If the treated water in the SRP or DEB is consistently very clear or blue it could indicate overdosing, with the possibility of lowered pH. Low pH (i.e., less than 5.5) presents a potential risk to receiving waters as a result of elevated free aluminium concentration in the discharge. If the treated water is consistently clear the pH of the water in the pond shall be tested, and the dosage rate adjusted if required;
- If the treated water in the SRP or DEB is consistently discoloured, it could indicate underdosing. If the treated water is consistently discoloured, the catchment area and soil characteristics will be reviewed, and the design and/or dosing rates will be amended if required.

8.1.1.4 Refilling the chemical reservoir

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

8.1.2 Batch dosing

Batch dosing using PAC will be used as a contingency measure as required at SRPs, DEBs and CISs.

The batch doing of PAC (referred to as PAC dosing) comprises the manual addition of liquid PAC to sediment laden water contained within a pond. The aim of PAC dosing is to further minimise the duration and effects of sediment laden discharges on the receiving environment (if any) in the event that the primary treatment methods are insufficient.

The procedure for batch dosing is set out below:

If live storage is available at time of monitoring:

1. Pond decants will be plugged;
2. PAC will be distributed evenly throughout the main pond;
3. Once dosed with PAC, the water in the SRP will be re-tested. If the TSS and turbidity are below the trigger level, and pH levels acceptable, no further PAC will be applied;
4. The decant plugs will be removed and the pond will be allowed to discharge; and
5. If pH levels are acceptable and the TSS and turbidity are still above the trigger level, the PAC dosing may be repeated.

If live storage is not available at time of monitoring:

1. Up to a quarter of the required PAC volume may be applied near the decants (but not immediately adjacent) to treat the immediate discharge;
2. The remaining volume of PAC will be distributed away from the decants in the main pond;
3. Once dosed with PAC, the SRP outflow will be re-tested. If the TSS and turbidity are below the trigger level and pH levels acceptable, no further PAC will be applied; and
4. If pH levels are acceptable and the TSS and turbidity are still above the trigger level, the PAC dosing may be repeated.

Turbidity and pH are closely monitored throughout this process. The amount of PAC required for batch dosing is calculated on-site once the turbidity level is known. In the event of overdosing and pH levels dropping below 5.5, lime, or a similar product will be on-hand to balance the pH.

8.2 Other flocculants

To be added following bench testing.

8.3 Management triggers

pH in all devices subject to chemical treatment must remain between 5.5 and 8.5 to avoid any adverse toxic effects on the biota of receiving environments. Should the pH at the outlet of a device be measured outside this range, all practical measures shall be undertaken to:

1 Cease the discharge from the device; and

2 Return the pH of the device to be within the acceptable range.

Where a device has discharged for more than 1 hour with a pH outside of the acceptable range after reasonable mixing, an investigation shall be undertaken to determine the probable cause and actions to prevent recurrence of unacceptable pH.

Date, time, and investigation details shall be submitted to GWRC within 5 working days of identifying a breach of the acceptable pH management range.

8.4 Monitoring and reporting

Monitoring requirements, frequency recording location for all chemically treated devices is set out in Table 8-1.

Table 8-1: Monitoring requirements and frequency

Frequency	Requirements	Recording location
Daily	• Inspect water clarity and colour of all devices treated with rainfall activated systems.	Recording sheet stored with rainfall activated system.
As part of regular ESC audits, specifically; • Fortnightly (once per two week period); • In response to rainfall trigger events; • In response to exceedances of continuous water quality monitoring triggers; and • Prior to any extended works shutdown periods (such as the Christmas break). Audits for a SSESCP may be combined, for instance an audit undertaken in response to a rainfall trigger event may also be the fortnightly audit.	• Measure pH, temperature, and turbidity at the outlet of all devices currently discharging and treated with rainfall activated systems. • Inspect integrity of system to ensure operational. • Check the level of flocculant remaining in any rainfall activated dosing systems and refill reservoir as required.	Report monitoring details to GWRC as part of the audit procedures set out in Section 7 of the PESCP.

8.5 Storage of chemicals on-site

Any flocculant should be kept in secure storage, either in a locked shed or container, or in the chemical treatment system shed. This will be secured on the site and located at least 10 m away from any watercourse.

Where flocculant is stored in containers more than 50L in capacity then any storage area shall be bunded to contain any spills in the case of accidental damage or failure of a container.

Empty flocculant drums will be washed out with water. Washwater will be used to aid treatment in SRPs or DEBs in accordance with batch dosing procedures or poured onto dry soil at least 10 m away from any watercourse. Drums can be disposed of to a drum recycling company.

8.6 Decommissioning chemical treatment devices

Decommissioning of any chemically treated system requires the removal of remaining chemicals for appropriate off-site disposal or re-use at another treatment device where practical.

Accumulated sediment in devices should be removed. Re-use of accumulated sediment for fill or other earthworks related tasks shall be in accordance with the earthworks design. This work shall take place under the conditions of the relevant SSESCP for that earthworks area.

In addition to above, a site-specific decommissioning plan shall be prepared for each SRP in accordance with GWRC ESC guidelines.

9 Chemical spill contingency plan

This section is repeated from the GWRC ESC guidelines for reference.

If there is a spill of any flocculant chemical onto the ground it will be immediately contained using earth bunds to prevent it entering water. The spilt chemical will be recovered if possible and placed in polyethylene containers. In the event that spilt chemical cannot be recovered, it will be mixed with a volume of soil equal to at least ten times the volume of spilt chemical. This will effectively neutralise the chemical. The soil with which the chemical has been mixed will be buried a minimum of 0.5 m below the ground surface in a spoil disposal area or taken off site to a landfill.

If there is a spill of larger volumes of flocculant chemicals into a DEB or SRP, discharge from the device to natural water will be stopped and the water will then be tested to determine the level of contamination. Based on the test results the water may require treatment. The potential for large volumes to be spilt is avoided by having only the minimum amount required for each device stored in each tank. Typically, the volume would be less than 100 litres for the flow activated system.

In the highly unlikely event, there is a spill of flocculant chemicals into flowing water:

- GWRC, the Construction Manager and the Environmental Manager will be advised immediately. Refer to Section 4.4 of the ESCP for contact details;
- The volume of the spill should be recorded;
- If possible, the water and spilt chemical should be contained in a bund or pond until all the spilt chemical has been removed from the watercourse or treated; and
- If the chemical cannot be removed from the watercourse or effectively treated any downstream waters users should be identified and advised.

10 Applicability

This report has been prepared for the exclusive use of RiverLink with respect to the particular brief given to us. We understand and agree that our client will submit this report as part of an application for resource consent and that Greater Wellington Regional Council as the consenting authority will use this report for the purpose of assessing that application and in undertaking its regulatory functions in connection with Resource Consent WGN100XXXX. 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.