RiverLink

Notices of Requirement for Designations and Applications for Resource Consent

Volume Four: Supporting Technical Reports

Technical Report #2

Stormwater

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 # 2
STORMWATER AND OPERATIONAL WATER QUALITY ASSESSMENT

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1. INTRODUCTION

1. My name is Allen Ingles. I am a Technical Director - Water at GHD, and I am the author of this report.

1.1 Qualifications and experience

2. I have over 35 years' experience in flood protection, land drainage, and stormwater engineering in both the public and private sectors in New Zealand and the United Kingdom. I hold a New Zealand Certificate in Engineering (civil), am an Incorporated Engineer with the Institution of Civil Engineers (ICE), United Kingdom and an Associate Member of the ICE (AMICE).
3. I have been involved in the preparation of numerous RMA applications and the presentation of expert evidence for stormwater and three waters aspects of development projects including commercial/industrial developments, residential /subdivision developments, transport projects and local authority developments. Recent projects included three waters and flooding evidence to support the designation for the Memorial park and Peter Johnstone park in Mosgiel and expert evidence supporting the consenting of stormwater management and treatment for the Warkworth/Matakana Link Road interchange along with providing expert witness support at the subsequent Environment Court mediation.

1.2 Code of Conduct

4. 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.

1.3 Purpose and scope of assessment

5. My assessment:
   i. considers the relevant matters set out in the GWRC Proposed Natural Resources Plan (PNRP) and operative regional plans;
   ii. describes the existing stormwater system within the Project Area, including volumes, flows, network capacity and water quality, and catchment characteristics;
   iii. describes the assessment methodology for Project stormwater effects, and the targeted level of service for stormwater flood effects, conveyance and treatment;
   iv. identifies operational stormwater management issues and opportunities for the Project;
   v. identifies and assesses changes to stormwater management systems as a result of the Project and effects on volumes, flows, network and quality, and catchment characteristics, and consequential effects on fish passage, including opportunities for improvement (in conjunction with Project designers, ecologists, landscape leads); and
   vi. identifies mitigation measures for construction and operation, and measures to restore fish passage wherever reasonably practicable.

1.4 Assumptions and Exclusions in this Assessment

6. The following assumptions have been adopted for my stormwater assessment:

   i. design and assessment of highway stormwater flows and stormwater management have been carried out in accordance with the Waka Kotahi – NZ Transport Agency stormwater design guidelines[1];

   ii. design and assessment of stormwater flows and stormwater management for urban and commercial areas has been undertaken in accordance with the Wellington Water Limited (WWL) Regional Standards for Water Services[2].

   iii. design for the KiwiRail corridor unless indicated otherwise has been carried out in accordance with WWL Regional Standards for Water Services.

7. The scope of work is limited to assessing culverts and stormwater infrastructure affected by the Project works, I have not undertaken a wider catchment assessment to assess flooding issues.

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

   i. Appendix A – Stormwater Design Detail.

2. EXECUTIVE SUMMARY

2.1 Scope

9. This report covers the stormwater management for the various Project elements including:

   i. describing the existing stormwater regime for the Project area;

   ii. describing the proposed stormwater management and upgrade design for the various elements to achieve the required level of service including consideration of climate change;

   iii. providing an assessment of stormwater volumes and stormwater discharge quality and the approaches adopted to avoid or mitigate adverse impacts; and

   iv. consideration of ecological impacts resulting from the stormwater works.

2.2 Existing environment

10. The Project area consists of a combination of undeveloped bush clad slopes and highly developed urban areas, with green areas along the river corridor.

11. Stormwater from the Project area discharges to the Te Awa Kairangi/Hutt River. Discharges for the site are achieved via gravity for the Project area except for the residential commercial area at the bottom end of the site on the western side of the river which is assisted via pumping.

12. It is noted that a number of areas have historical flooding issues when flood levels in the Te Awa Kairangi/Hutt River are at a high level.

13. No treatment of stormwater discharges within the catchment currently occurs.

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[1] NZTA Waka Kotahi: Stormwater Treatment Standard for State Highway Infrastructure, May 2010
[2] https://www.wellingtonwater.co.nz/assets/Uploads/Regional-Standard-for-Water-Services-May-2019.pdf

2.3 Proposed stormwater design

14. Design of the stormwater management for the various elements of the Project works has been undertaken to:

    i. achieve the design level of service for the various Project areas including consideration of climate change;

    ii. upgrade infrastructure under the new stopbank to provide a similar 100 year design life;

    iii. Meet GWRC Flood Protection criteria for pipes through stopbanks and security of drainage during flood events.

    iv. provide treatment of runoff from upgrade works and to existing discharges where this can practically be achieved; and

    v. avoid or mitigate ecological impacts associated with loss of habitat or obstruction of fish passage.

2.4 Assessments of stormwater discharges

15. The stormwater design has included assessment of stormwater volumes and quality, and identification of mitigation measures that can be adopted to avoid or minimise adverse effects or improve current stormwater management where there is an opportunity to do so.

16. The volumetric assessment shows that the overall changes in peak discharge volumes for the various sections of the Project are relatively small, and the Riverlink Project will be hydraulically neutral or there will be a net reduction in flows when all areas of the Project are considered together.

17. The assessment of stormwater quality indicates that the proposed stormwater design for the Riverlink Project, with the inclusion of treatment of discharges from the highway upgrade, the railway station development, the new bridge and areas of road narrowing and carpark upgrade, will result in a reduction in the contaminant load discharged to the Te Awa Kairangi/Hutt River. This will result in improvements in water quality in the receiving environment particularly during and immediately following rainfall events.

2.5 Effects on the receiving environment

18. My assessment of effects shows that:

    i. although no attenuation of flows is being provided, localised flow increases will be minor;

    ii. overall, there will be a reduction in stormwater flows; and

    iii. the effect on adjacent land and the receiving environment, including the Te Awa Kairangi/Hutt River, will be negligible.

19. At present there is no identified treatment of any stormwater discharges to the Te Awa Kairangi/Hutt River. The proposed stormwater design for the Riverlink Project includes treatment of discharges from the area of the highway upgrade, the railway station development, the new bridge and areas of road narrowing and carpark upgrade. The addition of proposed treatment will result in a reduction in the contaminant load discharged to the Te Awa Kairangi/Hutt River. This will result in improvements in water quality in the receiving environment, particularly during and immediately following rainfall events.

20. The freshwater ecology assessment by Mr Dean Miller and Mr Patrick Lees (Technical Assessment #6) has identified that the Project will result in the loss of a small area of habitat on Harbour View Stream as a result of the interchange alignment design which requires culvert extension. The grade and sizes of the pipe provided will not allow fish passage. There are existing barriers to fish passage in the section immediately upstream that are not being modified or replaced and as a result it is not practical to provide fish passage in the altered section as there would be no benefit. An offset for the loss of stream habitat in this location is proposed, with details for the offset to be pursuant to a condition of consent as set out in Appendix A of the AEE, in Volume 2 of the application.

21. Provision of fish passage through the Tirohanga Stream replacement culvert (Outlet 38) has been proposed. This will improve ecological outcomes for this stream. Automated flap gates are recommended such that fish passage in other pipes is not precluded should fish passage become possible in future.

22. The assessment by Mr Miller and Mr Lees indicates that, with respect to provision of fish passage and subject to an appropriate offset being provided for the loss of stream habitat in Harbour View Stream, the Project will result in a positive overall outcome within the immediate Te Awa Kairangi catchment.

3. PROJECT DESCRIPTION AND SCOPE

23. 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 the assessment of freshwater ecology impacts/effects.

24. The Project is the design, construction and operation of various elements that make up 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 / Te Awa Kairangi/Hutt River 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 SH 2/Harbour View Road / Melling Link and SH 2 / Tirohanga Road with a new grade separated interchange;

    iv. construction of a new road bridge across the Te Awa Kairangi/Hutt River with a direct connection 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; and

    ix. associated works including construction and installation of culverts, stormwater management systems, signage, lighting, landscape and street furniture, pedestrian/cycle connections and landscaping within the Project area.

25. This report covers the stormwater management for the various Project elements including:

    i. definition of the existing stormwater regime for the Project area;

    ii. proposed stormwater management and preliminary design for the various elements to achieve the required level of service, including consideration of climate change and protection of stopbank integrity;

    iii. assessment of stormwater volumes and stormwater discharge quality, and the approaches adopted to avoid or mitigate adverse impacts; and

    iv. consideration of ecological impacts resulting from the stormwater works.

26. This report covers an assessment of the effects on the receiving environment resulting from the stormwater management proposed for the operational phase of the Project works (post-construction). The effects of construction water management are addressed in the Assessment of Construction Water Quality and Erosion and Sediment Control by Mr Ed Breese (Technical Assessment # 3).

4. EXISTING ENVIRONMENT

27. The Project area includes a corridor either side of the Te Awa Kairangi/Hutt River between Ewen Bridge and Kennedy Good Bridge (approximately 3.6 km). Land use with the Project area either side of the Te Awa Kairangi/Hutt River floodway consists of State Highway (SH 2), rail lines and urban roads to the west and east of the river. See Figure 1 below.

28. The Project area includes the Te Awa Kairangi/Hutt River, and as part of the Project Greater Wellington Regional Council (GWRC) is undertaking an upgrade of the Te Awa Kairangi/Hutt River corridor to improve the flood flow capacity of the river in this reach.

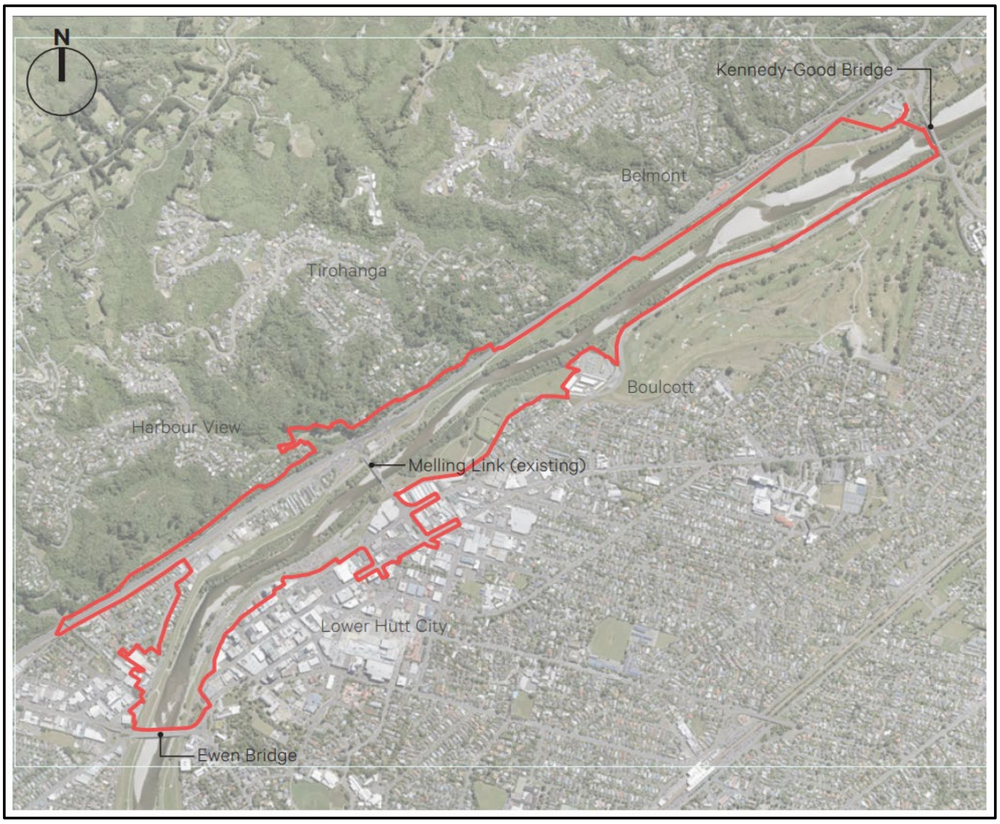

Figure 1 Project area

29. The Project catchment areas which feed into the existing stormwater networks can be divided into the western (true right bank) and eastern (true left bank) catchments of Te Awa Kairangi / Te Awa Kairangi/Hutt River (See Figure 2).

4.1.1 Area to the west of the Te Awa Kairangi/Hutt River

30. Drainage from the hills to the west of SH 2 is via a number of streams running down to culverts which transport flows under the highway, rail corridor and urban area to discharge to the Te Awa Kairangi/Hutt River. These culverts vary in size up to 1800 mm in diameter and are gravity lines, with flows surcharging (flows backing up to pressurise the pipe) to allow discharge to the Te Awa Kairangi/Hutt River during periods of high flows within the river. The catchments are generally bush covered with small areas of residential development on the ridgelines.
31. The right bank catchment between the hills and the river consists of highway (SH 2) and rail corridor adjacent to urban and commercial areas. The catchment is a mixture of green space and impervious surfaces. Stormwater flows from these areas discharge to the Te Awa Kairangi/Hutt River either via gravity systems, where levels permit this, or via pumped systems.

4.1.2 Area to the east of the Te Awa Kairangi/Hutt River

32. The left bank catchment (the east side of the Te Awa Kairangi/Hutt River) is a mixture of urban and commercial areas. The catchment is characterised by flat gradients and predominantly impervious coverage. The total left bank catchment is approximately 63 ha. Stormwater discharges to the Te Awa Kairangi/Hutt River currently via gravity lines.

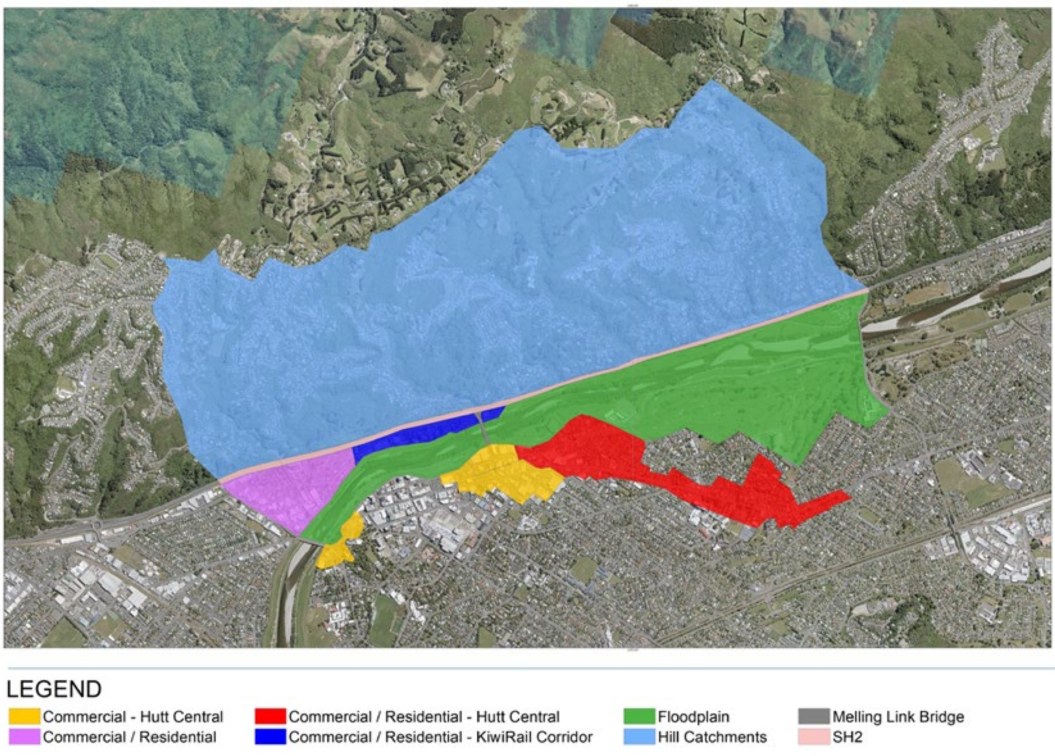

Figure 2 Catchment areas

4.2 Stormwater Catchments West of the Te Awa Kairangi/Hutt River

4.2.1 Hill Catchments

33. The hill catchments to the west of the Te Awa Kairangi/Hutt River are shown in light blue in Figure 2 above. These catchments are generally steep with established native bush cover. Housing development is limited to the top of ridgelines. The geology of the area is greywacke and soil cover will be relatively shallow with limited infiltration capacity.

34. The catchments are generally long and thin in shape. They are typically 30 -100 ha in area and between 600-2000 m in length (The total area of hill catchment above the Project area is 527 ha). Based on these dimensions the catchments will have a relatively short time of concentration (time for runoff to travel from the top of the catchment to the bottom). I estimate this to be between 0.5 hours to 1 hour. The exception to this is Speedy's Stream, at the top end of the Project area which has a catchment area of 11.7 km^2 and a length in the order of 3 km. Based upon these dimensions I estimate the Speedy's Stream catchment time of concentration will be in the order of 2-3 hours.

35. The hill catchments have limited development and established vegetative cover. Although they are relatively steep, the vegetative cover will reinforce soils and reduce erosion associated with rainfall impact and overland flow so that sediment loads will be low except for extreme events.

36. Contaminant loads associated with urban development include hydrocarbons and metals associated with vehicle movements, zinc associated with the roofs of buildings and potential waste associated with damaged wastewater infrastructure. However, as development in the hill catchments is generally limited to the top of ridgelines and roads crossing the catchments, I expect that the contaminant loads in stormwater from these areas will be small.

4.2.2 Residential / Commercial and KiwiRail areas

37. The catchment shown in dark blue, in Figure 2 above, consists of an area of approximately 7.2 ha. The 7.2 ha includes land between SH 2 and the Te Awa Kairangi/Hutt River, and extends 700 m downstream of the existing Melling Bridge and the carpark immediately upstream of the bridge. The area comprises of a mixture of commercial and residential properties along with the rail corridor.

38. Drainage is via a number of culverts, ranging in size from 300 – 825 mm in diameter, discharging to the Te Awa Kairangi/Hutt River via gravity. The outlets to the river generally include passive flap gates to prevent backflow during extreme flood events in the river.

39. Soils in the area are alluvial silts, sands and gravels which would allow infiltration of stormwater into ground. However, the catchment is highly developed with impermeable surfacing over more than 60% of the catchment area. As a result, I expect that the majority of rainfall will discharge as surface runoff via the reticulation system.

40. Stormwater quality will be impacted by development within the area. The stormwater from this catchment is expected to contain contaminant loads typical of urban commercial development.

4.2.3 SH 2 catchment

41. The SH 2 catchment area is shown in pink in Figure 2 above. This catchment encompasses the four-lane highway that runs between Wellington and the Hutt Valley along with the associated footpath and hard shoulder. It includes a paved area of approximately 9 ha within the Project area. Due to the predominant impervious paved surfaces of the catchment, I have estimated that approximately 90% of all rainfall will discharge as surface flow.

42. The highway has daily traffic volumes of approximately 40,000 vehicles. As a consequence, the contaminant loads of heavy metals and hydrocarbons associated with vehicle activity will be relatively high in stormwater from this catchment. Stormwater generally discharges to the adjacent Te Awa Kairangi/Hutt River via a road specific reticulated system or to the local area stormwater network. The discharges occur via trapped sumps. I expect that the traps will capture minor quantities of grit and debris, but they will not prevent discharges of heavy metals and hydrocarbons. No further treatment of the stormwater is currently provided before discharge to the river.

4.2.4 Commercial / residential area (Marsden Street)

43. The southern Melling catchment is shown in purple in Figure 2 above. This catchment consists of approximately 11.4 ha, that includes land between SH 2 and the Te Awa Kairangi/Hutt River and extending from the bottom end of the Project area to the residential / commercial & KiwiRail area referred to above. The area consists of a mixture of commercial and residential properties along with the rail corridor.

44. Soils in the area are alluvial silts, sands and gravels and would allow infiltration to ground. However, the catchment is highly developed with impermeable surfacing covering more than 60% of the catchment area. As a result, I expect that the majority of rainfall will discharge as surface runoff via the reticulation system.

45. Stormwater quality will be impacted by development within the area, and I expect the stormwater to contain contaminant loads typical of urban commercial development.

4.3 Stormwater catchments east of the Te Awa Kairangi/Hutt River

4.3.1 Commercial / residential area

46. The catchments on the left bank of the river, shown in red and yellow in Figure 2 above, encompass parts of the Hutt Central commercial area and extend up High Street past the Hospital to include the residential areas of Boulcott. These suburbs also have stormwater networks that drain into an open channel that discharges downstream of the catchment area. The total area of the existing urban area discharging to the river within the Project area is 62.1 ha. Most of the catchment comprises the area north of Hutt Central from Queens Drive to the northern parts of Boulcott. However, there is also a small area of commercial development near Ewen Bridge (4.6 ha).

47. The rest of Hutt Central (outside of the shaded project areas shown in Fig 2) drains to the Opahu Stream which receives runoff from as far north as Boulcott near the existing stopbank. This catchment drains most of the city commercial area and discharges to the Te Awa Kairangi/Hutt River downstream of the Project area near the Ava Rail Bridge.

48. Drainage for the project areas is via several pipes ranging in size from 600 – 900 mm in diameter discharging to the Te Awa Kairangi/Hutt River via gravity. The outlets to the river generally include flap gates to prevent back flow during extreme events in the river. The flap gates are located on the river side of the stopbank and are generally located in concrete structures back from the outlet to prevent tampering by the public, siltation or blockage issues. Penstocks are included on the pipelines on the land side of the stopbank to provide backup protection in the event of leakage or failure of the flap gate.

49. Soils in the area are alluvial silts, sands and gravels and would allow infiltration to ground. However, the catchment is highly developed with impermeable surfacing over more than 60% of the catchment area. As such I expect that the majority of rainfall will discharge as surface runoff via the reticulation system.

50. Stormwater quality will be impacted by development within the area, and I expect the stormwater to contain contaminant loads typical of urban commercial development.

51. There is previous history of flooding in southern Queens Drive and Market Grove near the outlet at High Street and Queens Drive, on High Street, Kings Crescent, Raroa Road and Pretoria Street. There is also previous history of flooding in the Melling Road area.

4.4 Melling Link Bridge catchment

52. The Melling Link Bridge catchment is shown in dark grey in Figure 2 above. Stormwater flows from the Melling Link Bridge discharge to the Te Awa Kairangi/Hutt River. The catchment has an area of approximately 0.3 ha. The entire surface area of the bridge is impervious and as a result I expect that there will be close to 100% runoff of all rainfall.

53. The footpaths along either side have no drainage collection system. Runoff flows to the river edge of the path where it discharges directly to the River. Stormwater from the roadway across the bridge discharges to channels along both sides of the road before flowing to stormwater collection sumps either side of the bridge and into the local network, discharging to the river.

54. Stormwater discharges will be impacted by the significant traffic load and will contain concentrations of heavy metals and hydrocarbons similar to, or approaching those of, the adjacent highway.

4.5 Floodplain catchment

55. The floodplain catchment consists of the area inside the stopbanks and is shown in green in Figure 2 above. The area is predominantly grassed with tree cover along the river margins. The floodplain within the Project area also includes gravelled paths, a carparking area on the left bank downstream of Melling Link Bridge and a substation and storage facility on the left bank upstream of the bridge.

56. The area is relatively flat and is made-up of alluvial sands and silts. Rainfall will generally infiltrate to ground except during higher intensity events where soil infiltration will be difficult and when the Te Awa Kairangi/Hutt River is in flood out of its banks (flow out of the main channel but still within the stopbanks).

57. Stormwater discharges from this area will be high quality with contaminants generally limited to low levels of suspended solids during higher intensity events.

4.6 Existing drainage

4.6.1 Hill drainage

58. Drainage from the Hill catchments is via gravity systems out to the Te Awa Kairangi/Hutt River. The existing open channels are culverted from the upstream side of the highway out to the river. Larger scale flood events in the Te Awa Kairangi/Hutt River impact flows from the Hill catchments, requiring some surcharging of the culverts to maintain manageable flows.

4.6.2 Residential / commercial (North Melling) and KiwiRail corridor

59. Drainage from this area is via a series of culverts that discharge via gravity. The culverts currently run under the stopbank system to an outlet channel formed in the flood berm. Outlet structures for a number of the culverts include flap gates to prevent backflow from the river during flood events. However, it is likely that this would only occur during extreme events. Surface drainage to the river would not be possible when river levels are very high and the flap gates are resulting in localised surface flooding.

4.6.3 State highway drainage

60. Drainage of the highway within the Project area is via a kerb and channel system conveying flow to sumps that discharge out to the river. The highway is currently above adjacent flood levels in the river, allowing gravity discharge at all times.

4.6.4 Commercial / residential area (Marsden Street)

61. The southern part of Melling (the area approximately bounded by Marsden Street, SH2 and Railway Avenue) currently drains to the corner of Marsden Street and Bridge Street north of Ewen Bridge. Flow discharges through a 525 mm diameter pipeline under the existing embankment into the Te Awa Kairangi/Hutt River upstream of Ewen Bridge. The discharge is assisted by a pump on the city side of the stopbank. The pump operates when the existing stormwater outlet cannot convey the flows; flows are pumped from the city side pump station through a separate pressure pipeline. The existing pump station has a penstock manhole with a flap gate on the gravity pipeline.

4.6.5 Stormwater catchments east of the Te Awa Kairangi/Hutt River

62. Drainage from this area is via a series of pipelines that discharge via gravity to the river. The culverts currently run under the stopbank system to an outlet in the flood berm. Outlet structures for a number of the pipes include flap gates and penstocks, some of which are automated, to prevent backflow during flood events. However, it is likely that this would only occur during extreme events. Surface drainage may be inhibited in these situations resulting in localised ponding.

4.7 Stormwater treatment

63. Stormwater runoff within the Project area discharges directly to the Te Awa Kairangi/Hutt River. The majority of the stormwater network was installed more than 40 years ago, and no treatment of runoff occurs prior to discharge.

64. Runoff from the developed areas is generally via kerb and channel systems discharging to sump systems which will allow capture of grit and some hydrocarbons if they contain trapped outed However, these generally provide little or no significant capture of suspended solids, metals and hydrocarbons which will be present in runoff.

4.8 Receiving environment

65. All stormwater from the Project area is discharged to the Te Awa Kairangi/Hutt River either via gravity or by lift pumps during periods of high flow in the river that prevent gravity discharge or when penstocks are closed to prevent backflow.

66. The Te Awa Kairangi/Hutt River is a large river with a catchment area of over 600 km^2. While the headwaters are located in the Akatarawa and Tararua Ranges, and a large part of the catchment is native bush or forested (approximately 400 km^2), the lower reaches run through Upper Hutt and Hutt City.

67. The urban catchments in the Hutt Valley discharge stormwater to the Te Awa Kairangi/Hutt River and runoff from SH 2, which runs alongside the river for some distance, also flows to the river and discharges to it. In addition, the major tributaries of the river also drain urban areas. As a result, I expect that the water quality within the river will be impacted during rainfall events, with elevated concentrations of suspended sediments, metals and hydrocarbons although this will vary significantly depending on the rainfall event and the flow within the river.

68. The Te Awa Kairangi/Hutt River has high recreational value with extensive walkways and cycle paths and the river is also known for its established trout population and associated value for recreational fishing.

5. STORMWATER MANAGEMENT REQUIREMENTS

5.1 Planning requirements for stormwater management

5.1.1 PNRP requirements

69. The PNRP sets policy expectations for stormwater applications requiring minimisation of effects on water quality as far as reasonably practicable. This includes providing a framework for applicants to follow which includes avoiding the production of contaminants, reducing the amount of contaminants, minimising volume discharges and promoting use of land and treatment devices over discharges directly to water[3].

70. In addition the PNRP encourages applicants to take a source control and treatment train approach to new activities, encourages water sensitive design, and seeks progressive improvement of existing road and other public infrastructure during upgrade and maintenance activities[4].

71. In relation to stormwater from State Highways, the PNRP seeks to minimise adverse effects by identifying priorities for improvement and methods and timeframes for this improvement, protecting sites with significant values, implementing good management practice and progressively improving discharge quality over time[5].

72. From a stormwater volume perspective, to not increase the risk to human health or development as a result of flooding, the PNRP seeks to retain hydraulic neutrality[6] . Hydraulic neutrality relates to ensuring development is not generating an increase in flows or including attenuation systems that reduce increased flows, such that pre-development

[3] Policy P67 of the PNRP, currently under appeal.
[4] Policy P73 of the PNRP, currently under appeal.
[5] Policy P78 of the PNRP, currently under appeal
[6] Policy P79 of the PNRP

flows are not greater than post-development flows so that there is no increase in flood or inundation risk

5.2 Global consents

73. It is understood that there is no existing consent for stormwater discharges for the section of SH 2 within the Project area. A consent for discharges of operational stormwater will be sought for the areas of development which cover SH 2 and the Melling Intersection works as part of the consenting for the Riverlink Project.

74. Existing discharges to and from Hutt City Council's stormwater network are authorised via a global stormwater consent managed by Wellington Water on their behalf. GWRC, as regulator, has advised that due to the modified/new development proposed as part of RiverLink, the global consent cannot be relied upon to manage stormwater discharges from the Project. It is understood that a discharge permit is therefore being sought for operational stormwater discharges from new and modified impermeable surfaces.

5.3 Waka Kotahi SH 2 stormwater design

5.3.1 Design criteria

75. The stormwater design for SH 2 and the Melling Intersection is in accordance with criteria set out in P46 NZ Transport Agency State Highway Stormwater Specification. In particular, this requires that stormwater design for State Highways:

    i. considers climate change and allows for climate change impacts forecast out to 100 years;

    ii. meets the required levels of service for protection of the highway from flooding; and

    iii. meets the requirements set out in Waka Kotahi's Stormwater Treatment Standard for State Highway Infrastructure, May 2010.

5.4 Hutt City stormwater design criteria

76. Stormwater design will be in accordance with the Wellington Water - Regional Standard for Water Services.

77. Where stormwater pipes or culverts pass through flood protection assets (i.e. stopbanks), design will be in accordance with GWRC's standards for stopbank design and river protection.

78. Treatment will be considered and designed in accordance with Wellington Water's Water Sensitive Urban Design Guidelines and the Regional Standard for Water Services

6. STORMWATER METHODOLOGY AND DESIGN

6.1 Stormwater design methodology

79. The stormwater design has focussed on providing the design level of service for the various areas of the Project while avoiding or mitigating adverse effects of increased flows, contaminant loads in discharges to the Te Awa Kairangi/Hutt River and habitat loss.

80. A key issue with the stormwater management from the developed catchments is the spatial constraints for stormwater network upgrades and inclusion of treatment systems where no treatment is currently provided.

81. The highway realignment, combined with the stopbank reconstruction, mean there is little availability of space for treatment systems such as raingardens / wetlands to treat design flows from the interchange area.

82. Stormwater runoff from the Project area currently discharges to the Te Awa Kairangi/Hutt River. Extreme event flood flows or large flood events coinciding with high tides result in river levels that restrict or prevent gravity discharge to the river requiring pumping to achieve the required level of service. This is particularly the case in the downstream section of the Project area.

83. Future climate change will result in more frequent operation of the pump stations, the need for upgrading of the pump stations to cater for increased flows, and the potential need for construction of new pump stations in locations where pumping is not currently required.

84. While not ideal because of maintenance requirements, treatment of runoff from the Melling Bridge and areas of the highway will need to be provided in the floodplain as spatial constraints mean there is no practical alternative.

85. Retrofitting treatment systems within the existing stormwater network serving the urban and commercial catchments is unlikely to be practical. However, where renewed roading or streetscape improvements provide an opportunity to do so the design has endeavoured to incorporate treatment. This will include:

    i. installation of Gross Pollutant Traps (GPTs) within the stormwater network (e.g. traps in catchpits) to capture solids typically greater than five millimetres;

    ii. and/or installation of package raingarden systems with a relatively small footprint, which can be incorporated within proposed landscape works.

86. Design has sought to daylight existing stormwater pipe outlets or provide more natural stormwater management where possible. However, opportunities are very limited due to the highly developed nature of the majority of the Project area and the constraints imposed by needing to discharge flows through the stopbank system to the Te Awa Kairangi/Hutt River.

6.2 Stormwater design

6.2.1 Highway culverts

87. SH 2 is being upgraded over a length of approximately 1.7 km in the vicinity of the Melling Link Bridge, although 0.4 km will be limited to resealing / pavement improvement. This upgrade work is to facilitate the construction of a grade separated interchange and a new bridge across Te Awa Kairangi/Hutt River. The works will encompass:

    i. changes to the vertical alignment of SH 2;

    ii. construction of a new bridge crossing over the Te Awa Kairangi/Hutt River and removal of the existing bridge;

    iii. construction of off / on ramps to the interchange/bridge crossing from the highway; and

    iv. changes to local roads on both sides of the new interchange (Tirohanga Road/Harbour View Rd and Queens Drive/High St.

88. Stormwater modifications and culvert upgrades will be provided for the 1.3 km length of highway where there is significant work to the roading network occurring. Where work is limited to surface improvements, no modification to the existing stormwater system is proposed.

89. Three cross culverts which convey stream flow require replacement / construction across the highway and out to the Te Awa Kairangi/Hutt River. These are described below and shown in Figure 3.

    i. The Jubilee Park cross culvert (Outlet 31): this takes flow from the Jubilee Park catchment and the two small catchments immediately to the east. The flow from the three catchments combines into one culvert that crosses under the highway and out to the river. Te Awa Kairangi/Hutt River Outlet 31 currently connects to a pipe system which runs parallel to SH 2 that takes the flow from all three streams from the Western Hills and will be retained. The replacement Outlet 31 will connect to this existing network.

    ii. The Harbour View cross culvert (Outlet 36b): this culvert conveys flows from the catchment above Harbour View Road out to the Te Awa Kairangi/Hutt River.

    iii. Tirohanga Stream Culvert (Outlet 38): this culvert is approximately 150 m east of the existing Melling Link Bridge. It conveys stream flows under the highway and the adjacent carpark directly to the Te Awa Kairangi/Hutt River.

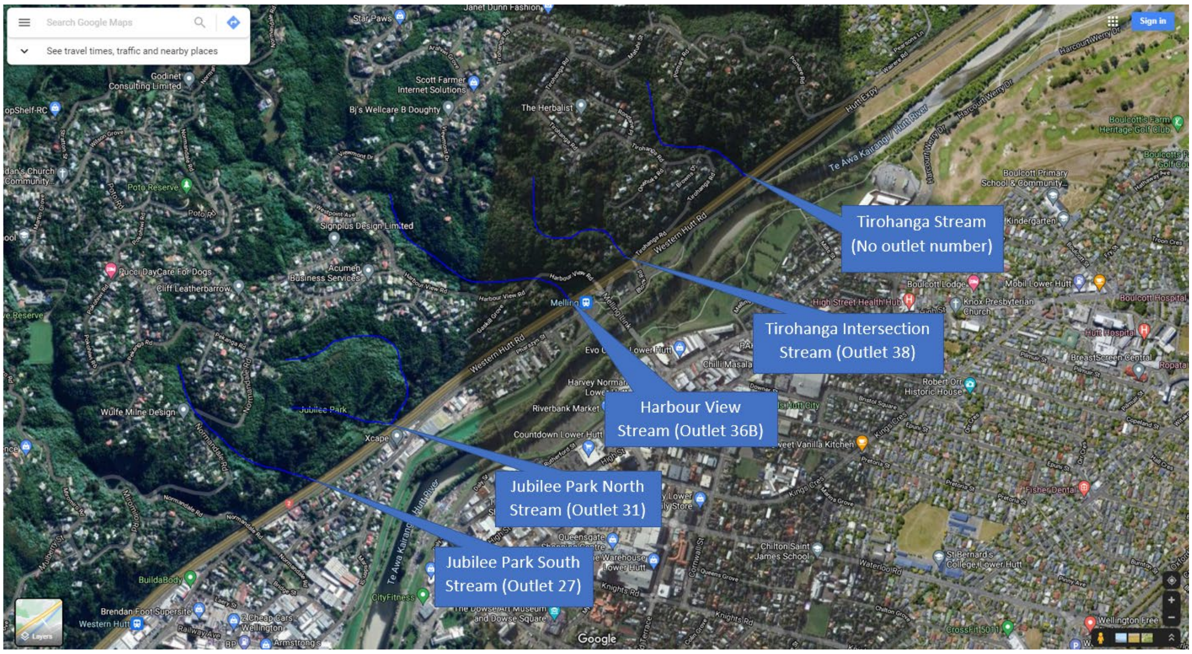

Figure 3 Culvert outlets (image source: Google Earth accessed 26 June 2021

90. The cross culverts have been designed for increased rainfall intensities associated with climate change out to the year 2120, which results in an increase in rainfall depths of 30% over the existing situation.

91. All of the above culverts have been individually sized and considered for fish passage requirements alongside Project ecologist Mr Lees.

6.3 SH2 and interchange road drainage

92. Stormwater from the modified section of SH 2, the interchange and the associated on / off ramps will discharge via a kerb and channel system, trapped sumps and a pipe network to Outlets 37c and 33, located 50 m upstream and 390 m downstream of the existing Melling Link Bridge (as shown in Figure 3 above). These culverts will be replaced with new larger diameter culverts, to accommodate the increased flows associated with climate change and to provide the required 100 year design life for the highway and the new stopbank structure.

6.4 New rail station and carpark

93. The revised development for the new rail station consists of:

    i. a new train station building located approximately 500 m to the west of the existing Melling Station;

    ii. removal of approximately 500 m of track; and

    iii. development of a new carpark area.

94. Stormwater from the carpark area will discharge via the upgraded culvert immediately adjacent (Outlet 33). Stormwater from the southern area around the new train station location will discharge via Outlet 29 combining with Outlet 31 before running though the stopbank to the Te Awa Kairangi/Hutt River. Outlet 29 will take flow from the highway and the railway station and some flow from a small area of Pharazyn Street. Flow through Outlet 29 will be conveyed through a proprietary treatment device and then connect to Outlet 31 before it goes through the bank, reducing the need for a separate culvert outlet.

95. Because this area is very low lying, where Outlet 29 connects into Outlet 31 further backflow prevention is provided which includes the pumpstation to allow continued service of stormwater drainage in that area when flows in the Hutt River are high. The existing Outlet 30 is abandoned with flow through this small diameter pipe amalgamated into the revised stormwater system (into Outlet 31 via Outlet 29).

6.5 New Melling bridge

96. Stormwater from the new Melling Link Bridge will be collected in a kerb and channel system and conveyed east where it will be collected and conveyed to a treatment swale, between the carpark area and the river, prior to discharge to the river prior to discharge to the river.

6.6 Hutt City stormwater design

97. The Riverlink Project results in only minor variations to existing Hutt City stormwater catchments, associated with the construction of the new stopbank.

98. The existing major outlets to the Te Awa Kairangi/Hutt River are proposed to be upsized to increase capacity for future climate change and to provide 100 year design life under the new stopbank. Some of the downstream invert levels will require lifting but in general, the upgrade will allow retention of the flat grades, provide futureproofing for increased impervious areas, and improve network capacity. Outlets will be modified with daylighting of the section across the flood berm that are currently culverted and the development of new naturalised channels.

99. The existing Marsden Street pump station will be replaced at a new location nearby and four new pump stations are proposed to mitigate historic flooding issues and the impacts of future climate change on stormwater flows and river levels. The pump stations are located at outlets 23, 24, 35, and 40. See Figure 4 for locations.

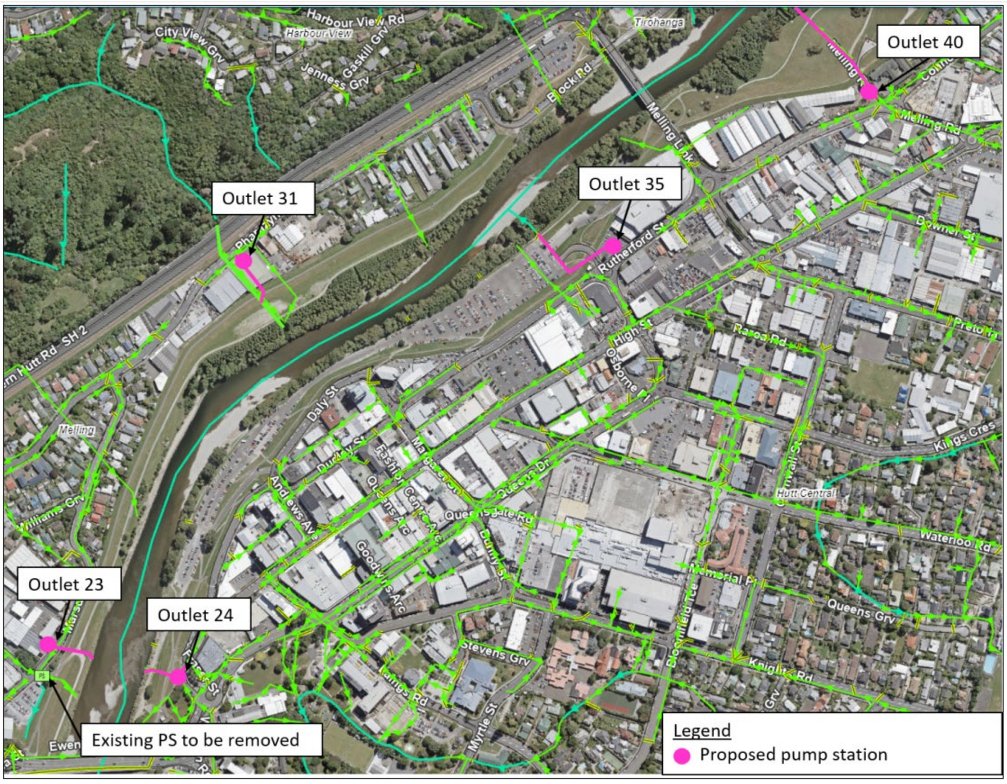

Figure 4 Location of Pump Stations

100. Penstocks will be provided on pipes or culverts through the stopbank, in accordance with GWRC requirements to prevent backflow in the event of leakage or issues with the flap gates. These will be automated systems to minimise concerns around fish passage.

101. The new carpark within the floodway will fall towards the river. Runoff will be collected in a treatment swale for treatment of flows prior to discharge to the Te Awa Kairangi/Hutt River.

102. All redundant services through or under the stopbank will be removed.

6.7 River corridor

103. The Te Awa Kairangi/Hutt River corridor will generally be increased in width along the reach between the existing Melling Link Bridge and the downstream end of the Project area at Ewen Bridge. The new stopbank alignment on the right (western) bank will be set back between 0 – 30 m from the existing stopbank, while on the left (eastern) bank the new embankment generally follows the line of the existing bank or extends out into the existing floodway slightly.

104. The new stopbank alignment will result in a reduction in the area of carparking in the floodplain. This will reduce the impervious area and vehicle related contaminant load in runoff from this area.

105. New and reconfigured hardstand areas including pedestrian and cycle paths and areas for recreation amenity activities will also be constructed on the crest of the stopbanks and within the floodplain. This may result in a slight increase in the impervious area in the river corridor but any impact on contaminant loads and runoff volume will be minimal.

7. ASSESSMENT METHODOLOGY PROJECT AND STORMWATER DESIGN

106. My assessment of effects has been undertaken by considering the volumetric, quality and environmental impacts of the Project on stormwater. In each of these subject areas I have assessed the changes between pre and post development, including the effect of the design features that have been incorporated into the Project. A more detailed description of the stormwater design is provided in **Appendix A** Stormwater Design Detail.

7.1 Stormwater discharge volumes

107. Stormwater discharges for the various catchments have been assessed for the pre development (current) flows and the post development flows with climate change. Flows have been assessed for 10 year event flow (typical service level without surcharging; also referred to as 10% Annual Return Interval (ARI)) and 100 year event flows (extreme event service level; 1 % ARI).

108. Flows for the smaller developed catchments and highway catchments have been assessed using the Rational Method[7]. The Rational Method is not appropriate for larger catchments and flows for the larger undeveloped hill catchments have been obtained using the NIWA Stream Explorer programme which uses the Regional Method[8].

109. The criteria for assessment of climate change impacts for Waka Kotahi and Hutt City Council differ. Where outlets service culverts that cross under sections of SH 2 that are being upgraded, a climate change allowance of 30% has been adopted. Climate change flows for outlets under the new stopbank servicing other areas for the site have an allowance of 20% in accordance with the Regional Standard for Water Services *(*Wellington Water May 2019*)*.

110. Our design process for stormwater has also considered extreme events that exceed the design criteria, to assess where the resulting overland flow would occur (secondary flow paths). We have undertaken this design process to ensure that the design does not result in an increase in flood risk for adjacent/downstream property as a result of the stormwater works.

7.2 Stormwater quality

7.2.1 State Highway runoff

111. The revised layout for SH 2 and the Melling interchange, along with the increased flood channel width for the Te Awa Kairangi/Hutt River, result in significant spatial constraints for stormwater treatment. These constraints combine with grade issues and generally prevent the use of treatment devices for the Project that would otherwise be adopted. The common treatment systems used for highway stormwater include ponds, artificial wetlands and roadside treatment swales.

[7] The Rational Method is a simple flow assessment method for smaller catchments based on catchment area, perviousness of the catchment and rainfall intensity, based on time for runoff to get to the discharge point.
[8] The Regional Method is a flow assessment method developed by NIWA which uses catchment area and an assessed relationship with a network of reliable flow measurement sites

112. The proposed treatment systems for the SH 2 stormwater discharges are as follows:

i. Stormwater discharges from the interchange area and the riverside off ramp will discharge to a raingarden facility located at the eastern end of the railway carpark before discharging to Outlet 33.

ii. Discharges to Outlet 37c will discharge to a treatment swale running alongside the path / cycleway within the floodway for a length of approximately 70 m before discharging to the river. The swale will be designed in accordance with Waka Kotahi design guidelines and will be vegetated with low maintenance low growing native grasses.

iii. Stormwater discharges from the 500 m of roadway west of the interchange will discharge to Outlet 29 via proprietary treatment devices located within the footpath / landscaped area adjacent to the new rail station drop off area. The devices will be sized to capture and treat the runoff from rainfall intensities of up to 10 mm / hr with flows in excess of this being bypassed to the culvert. It is expected that the treatment of flows up to this intensity will allow treatment in the order of 95% of all rainfall events.

113. The selection of these systems has been based initially on availability of space and grade requirements and then on performance and maintainability.

114. The treatment swale system provides a relatively low maintenance effective treatment system. The swale is in the floodway and will be inundated during larger flood events in the river when flows are out of bank. However, this is not expected to be the case during typical rainfall events. While swales within the floodway can silt up as floodwaters recede, alignment of the swale parallel with the river maintains flow within the swale channel reducing siltation and deposition of contaminants. The swale will require periodic excavation and re-establishment of the vegetative cover, this is expected to be required every 5-10 years.

115. Assessment of flood inundation frequency indicates that the treatment swale on the left (east) bank servicing the carpark and bridge discharges will be inundated on a 2 yearly basis. The treatment swale on the right (west) bank servicing highway runoff will be inundated on an annual basis for the current proposed alignment but may be able to be relocated closer to the base of the stopbank reducing the frequency to 2 yearly. Velocities in the treatment swale would be less than 1 m/s for the 2 year return events and 1.3-1.5 m/s for more extreme events with increased depth of inundation. These velocities combined with the protection provided by the vegetative cover will prevent scour and remobilisation of captured contaminants during flood events

116. If properly designed, constructed and maintained, the raingardens are able to provide a relatively high level of treatment. The Auckland Council contaminant load model[9] indicates sediment, metal and hydrocarbon removal of 70-80%. They can be incorporated as part of the landscape design and require limited short-term maintenance. The raingarden system allows easy inspection to assess if maintenance is required or if there are any issues with operation.

117. The use of proprietary systems is not generally a preferred approach as they require regular inspection and maintenance / contaminant removal to maintain performance with associated costs. However, if well maintained they do offer a relatively high level of treatment (sediment removal of 75%, metals 40-65%, hydrocarbons 80%), and have significantly reduced spatial requirements compared to other treatment options. Proprietary

[9] Auckland Council CLM Version 2.0 March 2010

devices are the only practical solution available for the 480 m length of SH 2 adjacent to the new railway station.

7.3 KiwiRail corridor, new station and carpark runoff

118. Stormwater from the new railway station carpark will be treated via a series of tree-pit raingardens along the carpark prior to discharging via the upgraded culvert immediately adjacent (Outfall 33).

119. The existing section of rail corridor where the rails are removed will be landscaped allowing infiltration to ground. Surface runoff that does occur will discharge via the existing piped network to the adjacent culverts, Outlets 33 and Outlet 29.

120. Operational stormwater from the rail line will discharge to ground (infiltration), as per KiwiRail's existing practice.

121. Stormwater discharges from the new railway station building and immediate area will discharge via Outlet 29. Flows will combine with flows from the carpark and be treated before discharging to the culvert.

7.4 Melling Link Bridge

122. Stormwater from the new Melling Link Bridge will be collected in a kerb and channel system and conveyed east where it will be collected and conveyed to a treatment swale in the floodway prior to discharge to the river via a piped system to a treatment swale along the river berm within the flood channel, similar to that proposed for the highway discharge at Outlet 37c. The treatment swale will be incorporated within the landscaping proposed for the area between the carparking paved area in the floodway and the channel of the River (new River Bank Carpark).

123. The treatment swale will provide a high level of treatment of runoff before discharging to the river, except when flood flows in the Te Awa Kairangi/Hutt River are out of bank when the system will in effect be a direct discharge. During the infrequent periods when out of bank flows occur, the flood flows within the Te Awa Kairangi/Hutt River will have high suspended solids concentrations. Concentrations will be in excess of those present in runoff and any effect on the receiving environment will be negligible.

8. ASSESSMENT OF STORMWATER EFFECTS

8.1 Stormwater volumes

124. The results of my assessment for catchment flows are summarised in Table 1 and Table 2 below.

8.2 Hill catchments

125. The hill catchments west of SH 2 remain unchanged as part of the Project and there is no increase in flow as a result of the Project works.

8.2.1 SH2 and interchange

126. The construction of the grade separated interchange for SH 2 will result in an increase in paved area, with an associated increase in surface runoff of approximately 50%.

127. The highway/interchange development will result in an increase in impervious area in the order of 2 ha. This will result in an increase in discharges from the highway. Consideration has been given to options for attenuation of flow to maintain hydraulic neutrality. However, spatial and topographical constraints prevent this being practically achievable beyond the small level of attenuation that will be achieved within the raingarden facility provided. The increase in flows would be minor and therefore the effect on flood levels in the Te Awa Kairangi/Hutt River would be minor, and there is no additional risk to properties downstream.

8.2.2 KiwiRail corridor, new rail station and carpark runoff

128. The future KiwiRail corridor, new station area and adjacent commercial area will have a similar development intensity to the existing area. However, the new stopbank alignment will result in a net reduction in the catchment area resulting in a reduction in stormwater flows to the Te Awa Kairangi/Hutt River via Outlet 29, in the order of 65%.

8.2.3 Hutt Valley zone

129. The peak flow rates for each outlet are provided in Table 1 and Table 2 below. The Table 2 values include the future allowance for additional catchment area being diverted to pump stations for Outlets 23, 24 and 35. Futureproofing of outlet sizing and pump station structure considers these increased flows. However, diversion of these flows and providing the associated increase in pump capacity is not included in this Project. Excluding future catchment diversion that might occur, I have assessed that any change in flows due to the Project is negligible.

8.2.4 Melling Link Bridge

130. No attenuation of stormwater has been considered for the new bridge as the bridge will effectively intercept rainfall that would otherwise fall directly to surface water (the River).

Table 1 Hill Catchment highway flow rates for a 10% AEP

Catchment	Peak flow rate current (L/s)	Peak flow rate post construction (L/s)	Peak flow rate post construction with CC allowance to 2120 (L/s)
West Bank – Waka Kotahi SH2, KiwiRail and hill catchments			
Outfall 29	361	505	660
Outfall 31 (Jubilee Park Culvert)	509	509	660
Outlet 33 KiwiRail	777	601	790
Outlet 36b (Harbour view Culvert	3,300	3,300	4,290
Outlet 37c	261	262	340
Outlet 38 Tirohanga Stream	1,560	1,560	2,030

Catchment	Peak flow rate current (L/s)	Peak flow rate post construction (L/s)	Peak flow rate post construction with CC allowance to 2120 (L/s)
West Bank – Hutt City catchments			
Outfall 23	1,487	1,309	1,563
Outfall 23 plus future Pumpstation flows	N/A	1,961	2,342
Outfall 27	3,928	3,928	4,737
East Bank			
Outfall 24	756	718	857
Outfall 24 Plus future PS flows	N/A	2,086	2,491
Outfall 35	2,058	2,058	2,495
Outfall 35 Plus future PS flows	N/A	2,836	3,411
Outfall 37	542	549	657
Outfall 40	4,534	4,584	5,485

Table 2 Flow rates for a 1% AEP

Catchment	Peak flow rate current (L/s)	Peak flow rate post construction (L/s)	Peak flow rate post Construction with CC allowance to 2120 (L/s)
West Bank – Waka Kotahi SH2, KiwiRail and hill catchments			
Outfall 29	575	804	1,045
Outfall 31 (Jubilee Park Culvert)	775	775	1,010
Outlet 33 KiwiRail	1,236	960	1,240
Outlet 36b (Harbour view Culvert	5,050	*NC*	6,570
Outlet 37c	415	417	540
Outlet 38 Tirohanga Stream	2,390	*No Change*	3,110
West Bank – Hutt City catchments			
Outfall 23	2,355	2,072	2,490
Outfall 23 Plus future PS flows	N/A	3,105	3,731
Outfall 27	6,123	6,123	7,394

Catchment	Peak flow rate current (L/s)	Peak flow rate post construction (L/s)	Peak flow rate post Construction with CC allowance to 2120 (L/s)
East Bank			
Outfall 24	1,197	1,136	1,365
Outfall 24 Plus future PS flows	N/A	3,302	3,968
Outfall 35	3,280	3,306	3,967
Outfall 35 Plus future Pumpstation flows	N/A	4,521	5,425
Outfall 37	852	862	1,039
Outfall 40	*7,125*	7,204	8,677

8.2.5 Volumetric effect

131. The overall change in peak discharge volumes for the various sections of the Project area are relatively small. The Riverlink Project will be hydraulically neutral, or there will be a net reduction in flows, when all areas of the Project are considered together.

132. Design of the stormwater system has considered inclusion of attenuation. However, the highly developed nature of the catchment and associated spatial constraints preclude the inclusion of attenuation, and given the very small change in flows, any effect on flood levels in the Te Awa Kairangi/Hutt River will be indiscernible and have no adverse effect on flood risk downstream.

133. It is also noted that the time of concentration of flows for the catchments within the Project area is short (0.5- 1.0hr except for Speedy's Stream which is slightly longer at 2-3 hours) when compared with that of the Te Awa Kairangi/Hutt River (approximately 26 hrs). Therefore, coincidence of peak flows from the catchment with flows in the Te Awa Kairangi/Hutt River is extremely unlikely further reducing the frequency of the impact of any variation in flows associated with the Project.

134. Based on the above considerations, I have assessed that any volumetric effects on the Te Awa Kairangi/Hutt River and flood levels will be negligible.

8.2.6 Secondary flow paths

135. The design that has been developed for the Project utilises existing discharge points and rationalises the number of pipelines through the new stopbank system where practicable. Relocation of a culvert alignment is only proposed in one location, (Outlet 36b) in the vicinity of the new Melling Link Bridge, where the existing culvert alignment is within the bridge abutment. All outlets through the new stopbank are being replaced to provide a 100 year design life and the sizing of the outlets has included allowance for climate change in accordance with relevant design standards.

136. The drainage networks are not being altered over the majority of the Project area, with change generally limited to the SH 2 area in the vicinity of the Melling Link Bridge and the adjacent area. This includes the new train station, the new station carpark and commercial and residential areas.

137. Secondary flows within the Project area will be via overland flowpaths towards the Te Awa Kairangi/Hutt River to outlets through the stopbank or to pump stations discharging to the Te Awa Kairangi/Hutt River. When levels in the river prevent discharge, or the capacity of the pump stations are exceeded, ponding will occur in the lower lying areas outside the stopbank. Secondary flowpaths post development will remain substantially unchanged from the existing flowpaths, except for the fact that outlets and pump stations will have been sized to accommodate 100 year event flows with allowance for climate change.

138. I have assessed that the effects of the Project on secondary flow paths will be positive. In my opinion, the Project will result in an increase in the levels of service from the current condition and a reduced incidence of secondary flows and depths of ponding.

8.3 Quality assessment

139. Stormwater discharges from the Project area can be classified into three areas as shown in Figure 4:

  i. undeveloped/limited development including the bush clad hill catchments and the landscaped areas within the floodway;

  ii. commercial / residential areas including the new station and carparking areas; and

  iii. State Highway 2 including the new Interchange and the new Melling Link Bridge.

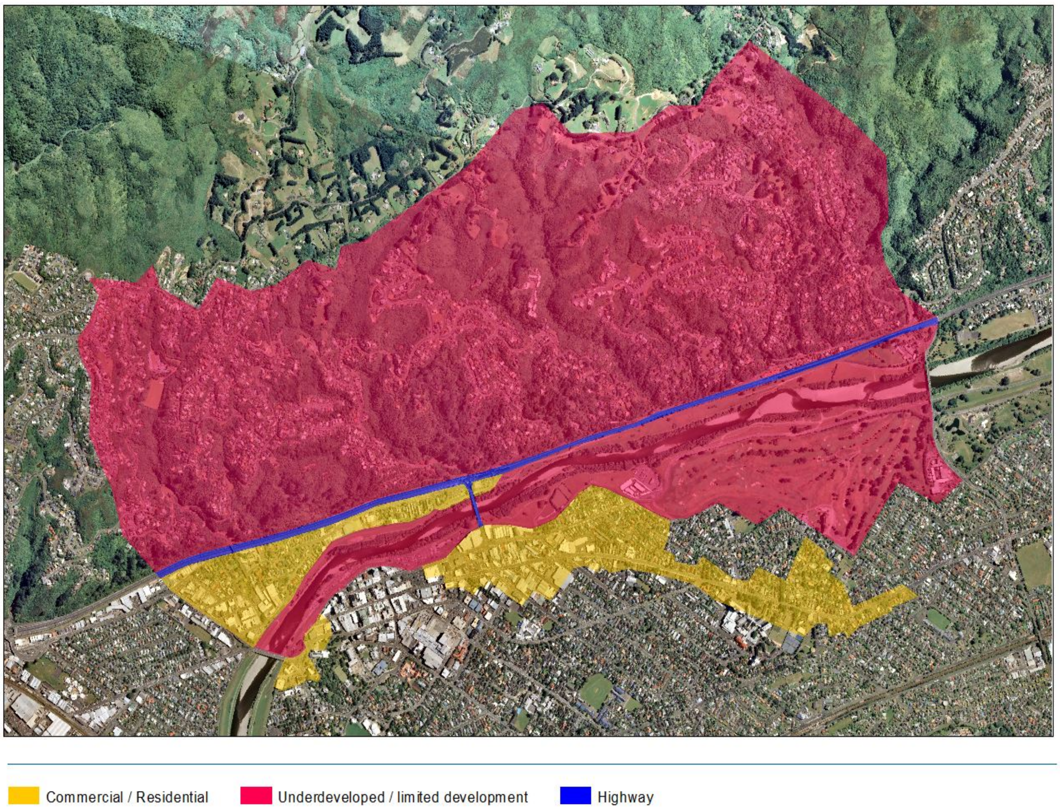

Figure 4 Catchment classifications

140. I have assessed the effects of the Project on stormwater quality for these three areas below.

8.4 Undeveloped/limited development Areas

141. Stormwater discharges from areas west of SH 2 are substantially unaffected by development. Contaminants in stormwater discharges pre-Project will generally be limited to low levels of naturally occurring nutrients and suspended solids although suspended solid concentrations will increase during larger rainfall events.

142. In my opinion, the Project will not affect these areas and there will be no change in stormwater quality.

8.5 Commercial / Residential areas

143. These areas consist of a mixture of buildings and structures, paved surfaces including roads and carparking and small areas of landscaping. Typical contaminants anticipated in runoff from these areas include suspended solids, metals and hydrocarbons associated with vehicle activity and metals associated with roofing.

144. Contaminant loads and concentrations in stormwater are related to site usage, traffic volumes and the age and type of buildings. These will vary across the Project area.

145. Residential and quieter commercial areas have low traffic volumes and contaminant loads will be relatively low, with sediment loads and hydrocarbon loads in the order of 10 kg/100 m of road /year and 20 g/100 m of road /year respectively. For more developed areas and thoroughfares, the loads are expected to be in the order of 35 kg/100 m of road /year and 280 g/100 m of road /year respectively.

146. Contaminant loads in roof discharges are typically associated with metals associated with metal roof cladding, although there are sediment loads associated with windborne material. Metal loads in runoff vary significantly depending on the nature of the roofing materials. Unpainted galvanised steel roofing can generate zinc loads up to 2 kg /1000 m^2 /year, however these are typically associated with older structures. Painting of these roofs reduces the zinc load by an order of magnitude and use of modern materials such as Coloursteel reduces zinc load by two orders of magnitude.

147. Spatial restrictions within the developed area and very flat grades prevent retrofitting of new treatment facilities within the current stormwater network. However, the Project will not result in any significant alteration of activity in the residential / commercial area that will impact stormwater contaminant loads with the exception of the following:

    i. there will be a reduction in area of the commercial residential area on the west bank associated with the train station and stopbank relocation;

    ii. there will be a reduction in railway carparking area when compared to the current Melling Station facility, and the discharge from the car parking area at the new rail station will be treated prior to discharge which will result in a reduction in load;[10] and

    iii. the design includes the potential pedestrianisation (or one laning) and treatment of runoff of a section of Margaret Street.

148. I note (i) to (iii) above will result in a reduction in contaminant loads in discharges to the Te Awa Kairangi/Hutt River.

149. I have not undertaken a catchment wide assessment of pre and post contaminants loadings. Rather, I have assessed the reduction in contaminant loads in discharges to the Te Awa Kairangi/Hutt River as a result of the above changes using the Auckland Council Contaminant Load Model (CLM). The results are shown in Table 3 below.

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[10] Runoff from the current Melling Station car park is untreated.

Table 3 Annual contaminant load reduction

Area	Suspended solids (kg/y)	Zinc (g/y)	Copper (g/y)	Total petroleum hydrocarbons (g/y)
Commercial residential area	-1177	-5812	-619	-2647
Reduction of carparking and treatment	-350	-365	-122	-2787
Pedestrianisation and treatment	-20	-23	-1	-172

8.6 State Highway 2

150. Within the Project area, as noted in the Transport Assessment of Mr Duncan Tindall (Technical Assessment #9), SH 2 carries traffic volumes in the order of 40,000 traffic movements per day and Melling Link Bridge carries traffic volumes in the order of 20,000 per day. These large traffic volumes result in significant contaminant loads in runoff which is currently untreated before discharge to the Te Awa Kairangi/Hutt River.

151. The construction of the Melling Interchange will include upgrading of the highway over a length of approximately 1.7 km although 0.4 km of this length is minor resurfacing. The design of the stormwater management for the 1.3 km section of highway and the new Melling Link Bridge will include treatment of stormwater discharges in accordance with Waka Kotahi Stormwater Treatment Standard for State Highway Infrastructure where this can practically be achieved.

152. The design for the Project includes treatment of the highway and interchange discharges, to be achieved via treatment swales and raingardens, with proprietary devices also being used where spatial constraints prevent the use of alternatives. Treatment of the bridge discharge will be via a treatment swale in the floodway.

153. I assessed the change due to the Project using the CLM. My assessment shows that although the impervious surfacing for both the highway and the bridge increases, the treatment of the discharges will result in a significant reduction in the contaminant load discharged to the Te Awa Kairangi/Hutt River.

154. The results of the CLM model assessment are shown in Table 4 below.

Table 4 Annual stormwater contaminant load and percentage reduction

Area	Suspended Solids kg/y	Zinc g/y	Copper g/y	Total Petroleum Hydrocarbons g/y
SH2 and Interchange	1446 *(67%)*	9344 *(21%)*	2596 *(35%)*	70703 *(21%)*
Melling Bridge	165 *(67%)*	1065 *(21%)*	296 *(34%)*	8064*(20%)*

(50%) the value in brackets is the % reduction in contaminant load from the current situation.

8.7 Overall effects of the Project on stormwater quality

155. The information set out above demonstrates that although spatial and topographical constraints prevent retrofitting treatment devices in the developed areas of the site, there will be a reduction in the contaminant load being discharged to the Te Awa Kairangi/Hutt River due to:

156. reductions in developed catchment areas as a result of the stopbank realignment;

157. reduction in carpark areas;

158. inclusion of treatment of runoff from the newly developed carparks; and

159. treatment of discharges from the upgraded section of highway and the new bridge.

160. I expect the reduced contaminant loads to result in a net improvement in water quality downstream of the Project area, during, and immediately following, rainfall events. However, given the level of dilution that will occur within the Te Awa Kairangi/Hutt River, improvement will be very minor, if measurable.

8.8 Habitat loss and fish passage: Harbour View Stream

161. The relocation of the Melling Link Bridge, and the associated relocation of the existing culvert under Harbour View Road, will result in the loss of a 25 m section of natural waterway between the highway and the Harbour View Road.

162. This section of waterway cannot be retained as part of the new works as it is the location of the new Melling Link Bridge abutment and slip way for the new interchange. The waterway cannot be reinstated within the immediate vicinity, due to the topographical and spatial constraints.

163. In addition, the replacement culvert will be unable to provide fish passage as the pipe is required to connect to an upstream pipe that is very steep and goes up through the embankment under Harbour View Road. This upstream pipe is not being replaced and therefore any flows in the replacement (new) pipe will be extremely high velocity preventing fish passage. The upstream outlet is also in a small pond at the base of a water fall which also likely inhibits upstream passage. The required grade and size of the replacement pipe will not allow fish passage and given existing barriers in the section immediately upstream that are not being modified or replaced will not allow passage, it is not practical to provide fish passage as there would be no ecological benefit in doing so.

164. The Freshwater Ecology Assessment (Technical Report #6) identifies that an offset will be required to address the loss of this waterway, which will be secured via a condition of consent, as set out in Appendix A of the AEE, in Volume 2 of the application.

8.9 Fish passage: Tirohanga Stream and elsewhere

165. The Freshwater Ecology Assessment for the Project (Technical Assessment #6) has identified native fish and biodiversity within Tirohanga Stream (Outlet 38) and design for the replacement stream culvert has therefore considered provision for fish passage. Preliminary design for the culvert has been based on complying with the permitted activity criteria of the PNRP, NIWA Fish Passage Guidelines and the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES FW). The proposed culvert structure is an 1800 mm diameter RCRRJ pipe with the invert embedded 450 mm to allow the establishment of a natural bed within the structure. It is noted that this will be an improvement in regard to fish passage compared to the existing situation on this stream as the existing culvert is perched.

166. Surcharging of the pipe during extreme event flood levels within the Te Awa Kairangi/Hutt River will still allow a gravity discharge from the upstream catchment avoiding the requirement for flap gates/backflow prevention devices which can impede fish passage.

167. The Freshwater Ecology Assessment has determined there are no other waterbodies where culverts are being replaced that require consideration of fish passage due to existing infrastructure or natural barriers that prevent fish passage present, irrespective of the Project design.

168. Despite this, the design has sought to include provision for automated flap gates/backflow protection structures to ensure that fish passage is not precluded should fish passage become possible in future.

8.10 Alternatives considered for treatment

169. Other alternatives for stormwater treatment within the floodway include wetlands or raingardens.

170. While it may be possible to construct raingardens and/or wetland treatment systems in the floodway, these structures involve the formation of basins on the river berms that will be inundated on a regular basis (approx. two yearly interval). When inundated the basins will slow flood flows promoting the settlement of sediment in the systems which will fill / blind the basins rendering them ineffective as treatment devices. In addition, large scale remedial/replanting works and an establishment period will be required before the devices will be suitable for treatment again. As wetland treatment systems typically take around two years for vegetation establishment, they are likely to require replanting before or soon after establishment. Given the frequency and expense of remedial work these systems are not considered appropriate in the floodway.

8.11 Proprietary devices

171. While use of proprietary devices may have to be adopted in some locations, they require a high level of maintenance, with associated cost, to maintain treatment performance and are generally not a preferred option.

172. Proprietary devices typically require a head of approximately 0.5 m for operation and therefore retrofitting within systems within the urban and commercial catchment areas is not likely to be practical due to the limited fall available.

173. Proprietary systems are typically located close to the source of the contaminants (e.g. carpark or road) to limit the volumes requiring treatment. They are not typically placed at or near the outlet of larger catchments (the area generally being modified within this Project) due the large flow volumes that would require treatment.

8.12 Summary

174. In my opinion, the use of treatment swales and proprietary devices are the best practicable option (BPO). This is because spatial and topographical constraints (very flat grades) rule out any suitable alternatives. In relation to water sensitive urban design, this is particularly difficult to achieve in a highly developed catchment that has limited grades and discharges to a river that can have flood levels well above the surrounding ground level. In this regard, serviceability and functionality has informed the stormwater design. However, I have endeavoured to provide treatment wherever this can practically be achieved.

9. RECOMMENDATIONS

175. I recommend that stormwater design for changes to local roads, the new train station and hardstand areas in the floodplain be carried out in accordance with the requirements of the WWL Water Sensitive Urban Design Guidelines and Regional Standards for Water Services; and that design for the SH 2 upgrades and new Melling Intersection be in accordance with the Waka Kotahi Stormwater Treatment Standard for State Highway Infrastructure where this can practically be achieved

176. I recommend that as part of detailed design further consideration be given to the design of stormwater pipes and culverts and potential rationalisation or amalgamation of infrastructure where it extends through newly constructed sections of stopbank to minimise the number of culverts under the stopbank.

177. I recommend that all culverts, or sections of culverts, that are being replaced be designed to allow for future flow increases associated with climate change and include backflow prevention from the Hutt River in accordance with GWRC Flood Protection requirements.

178. I recommend that consideration is given to the use of automated or non-passive flap gates where culverts are conveying flows from upstream waterways such that fish passage is not precluded should it become possible in future. Notwithstanding my recommendation, I understand the Project Partners have proposed to install non-passive flap gates wherever new or altered flap gates are needed within a natural waterway or connected area, in order to avoid the need for a non-complying activity consent under Regulation 74 of the Resource Management (National Environmental Standards for Freshwater) Regulations 2020.

179. I recommend that the design for the upgrade of the culvert conveying Tirohanga Stream (Outlet 38) include provision for fish passage.

180. I recommend that a comprehensive Stormwater Management Plan is developed for the Project area for the construction phase and long-term operation of the Project. The plan is to include, but not be limited to, the following:

- Documentation of the stormwater treatment systems and control systems within the project including location plan, role of the facility and inspection and maintenance requirements and who will be responsible for maintenance;
- Health and safety considerations for undertaking maintenance and environmental considerations for maintenance works including erosion and sediment control and disposal requirements; and
- Record sheets for documentation of inspections and remedial and maintenance works undertaken.

181. I also recommend that an Erosion and Sediment Control Plan (as well as a suite of Site Specific Erosion and Sediment Control Plans) be prepared and implemented. These management plans are addressed in detail in the Construction Water Quality Technical Assessment #3 (with drafts appended to that assessment).

10. CONCLUSIONS

182. The Riverlink Project will include significant upgrades to the existing stormwater infrastructure in order to service the SH 2 and Melling Interchange upgrades, provide an appropriate design life of pipes through the new stopbanks and make provision for future climate change impacts.

183. The scope of the stormwater upgrade, and the significant spatial and topographical constraints, limit the opportunity for large scale treatment and attenuation of flows. However, the design has addressed treatment and flow management and endeavoured to capture opportunities for inclusion of improvements where opportunities arise, such as road narrowing or closure.

184. My assessment of effects shows that although no attenuation of flows is being provided, localised flow increases will be minor and overall there will be a reduction in flows. As such, I have assessed that the effect of the Project on adjacent land and the receiving waters of the Te Awa Kairangi/Hutt River will be negligible.

185. In the existing environment we have not identified any treatment of stormwater discharges to the Te Awa Kairangi/Hutt River. The proposed stormwater design for the Riverlink Project includes treatment of discharges from the area of the highway upgrade, the new station development, the new Melling Link Bridge, some areas of road narrowing and the Hutt City carpark (within the floodway). The treatment will result in a reduction in the contaminant load discharged to the Te Awa Kairangi/Hutt River. This will result in improvements in water quality in the receiving environment, particularly during and immediately following rainfall events.

186. The stormwater effects on freshwater ecology have been assessed by Mr Miller and Mr Lees, who has assessed that the Project will result in the loss of a small area of natural stream habitat. An offset for this loss is proposed, with details for the offset to be pursuant to a condition of consent, as set out in Appendix A to the AEE, in Volume 2. This effect will need to be offset.

187. The design also provides for improved fish passage through the Tirohanga Stream culvert and will not preclude fish passage through other outlets downstream of Melling. The Freshwater Ecology Assessment describes the Project will improve the overall ecological outcomes for the Te Awa Kairangi/Hutt River catchment.

188. Based on my assessment I consider that the stormwater management proposed will overall have a negligible adverse effect, if not a net beneficial effect on the receiving environment.

23 July 2021

Mr Allen Ingles

Appendix A - Stormwater Design Detail

1. The stormwater design for the Riverlink project consists of various elements including:
   i. Highway Drainage, road and cross drainage;
   ii. Urban Drainage, residential and commercial;
   iii. Bridge Drainage for the new Melling Link Bridge; and
   iv. the details of the various elements are set out below.

10.1 SH2

2. SH2 is being upgraded over a length of approximately 1.7 km in the vicinity of the Melling Link Bridge, although 0.4 km will be limited to resealing / pavement improvement which will not alter stormwater management from the current regime. This upgrade work is to facilitate the construction of a grade separated interchange and a new bridge across Te Awa Kairangi/Hutt River The works will encompass:
   i. changes to the vertical alignment of SH2;
   ii. construction of a new bridge crossing over the Te Awa Kairangi/Hutt River and removal of the existing bridge; and
   iii. construction of off / on ramps to the interchange/bridge crossing from the highway.
   iv. changes to local roads (Tirohanga Road, Harbour View Road) and Queens Dr/High St on city side?
3. Stormwater modifications and upgrades are limited to the area where there is significant work to the roading occurring. Where work is limited to surface improvements, no modification to the existing stormwater system is proposed.

10.2 Cross culverts

4. Three cross culverts require replacement / construction across the highway and out to the Te Awa Kairangi/Hutt River. These are described below and shown in Figure 1.
   i. The Jubilee Cross culvert (Outlet 31): This takes flow from the Jubilee Park catchment and the two small catchments immediately to the east. The flow from the three catchments combines into one culvert that crosses under the highway and out to the river.
   ii. The Harbour View Cross Culvert (Outlet 36B): This culvert conveys flows from the catchment above Harbour View Road out to the Te Awa Kairangi/Hutt River.
   iii. Tirohanga Stream Culvert (Outlet 38): This culvert is approximately 150 m east of the existing Melling Link Bridge. It conveys stream flows under the highway and the adjacent carpark directly to the Te Awa Kairangi/Hutt River.

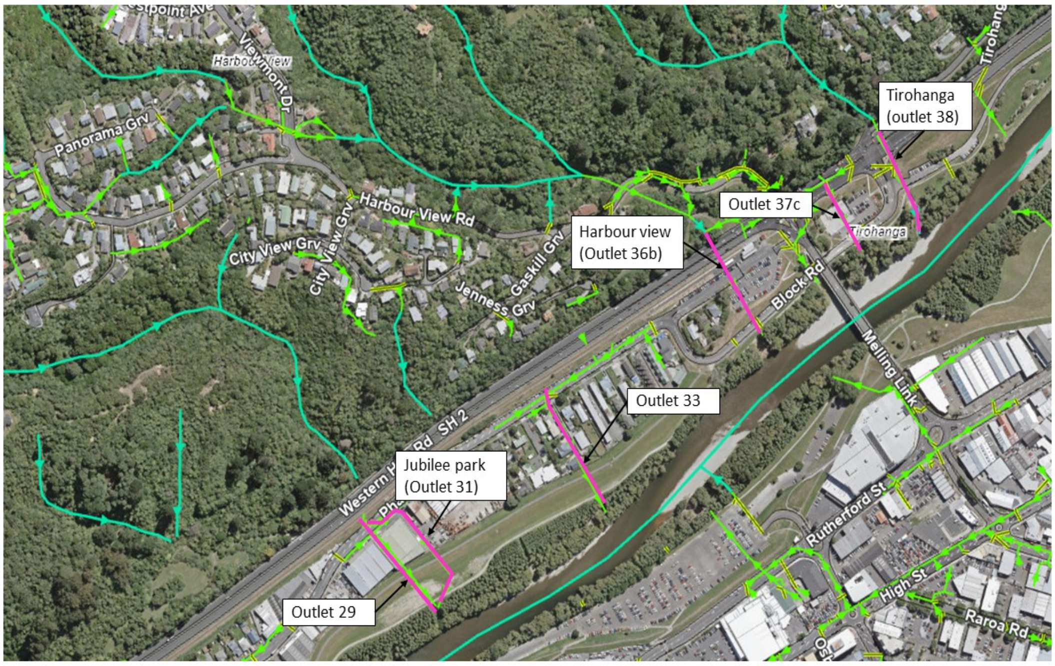

Figure 1 Culvert outlets

5. The cross culverts have been designed for increased rainfall intensities associated with climate change to the year 2120 which results in an increase in rainfall depths of 30% over existing.

6. No allowance has been made for increased flows associated with future development as:

7. the landform does not readily allow further development beyond that which already exists; and

8. the current PNRP rules require that if any further development is to occur this would need to be hydraulically neutral.

9. Preliminary design of the culverts has assumed that peak flows from the catchment will coincide with peak flows in the Te Awa Kairangi/Hutt River. This is a very conservative approach as the critical duration events for the hill catchment will be short, less than 1 hour (except for Speedy's Stream which is 2-3 hours), and the Te Awa Kairangi/Hutt River has a critical duration in the order of 26 hrs. While it is expected that coincidence of peak flows will be considered further in detailed design, in my opinion it is unlikely to result in a significant reduction in pipe diameter.

10.2.1 The Jubilee Park cross culvert (Outlet 31)

10. The Jubilee Park culvert will collect flow from the Jubilee Park Area (8 ha), the catchment 80 m to the East (7 ha) and the small catchment 120 m further east (3 ha). The proposed culvert located at road chainage 300 m is 825 mm diameter, constructed using reinforced concrete rubber ring jointed pipes (RCRRJ) to allow low level surcharging of the line that will occur during larger events in the Te Awa Kairangi/Hutt River.

11. The culvert will discharge to the Te Awa Kairangi/Hutt River via gravity for typical rainfall and river flow regimes. However, the new highway level in this location is lower than the existing road and will be at a similar level or lower than the 50 year flood level in the river. This will require the inclusion of a pump station to discharge stormwater flows during the more extreme flood events in the river to achieve the required level of service for stormwater management.

12. Initial design flows for the pump station will be approximately 2.0 m^3/s with operation being relatively infrequent. However, design of the pump station will need to consider climate change through the life of the asset, and design flows will increase to 2.7 m^3/s. Flood levels in the Te Awa Kairangi/Hutt River will also increase, requiring increased frequency of pump operation. The pump station will be sized to accommodate the increase flows associated with climate change over the 100 year life of the asset. However, pump capacity will initially be limited to accommodate climate change increase over 20 years, the typical design life for flood pumps.

13. The pump station will be designed as an inline system so that only one pipe though the new stopbank structure is required. In addition to the catchment flows from the western side of SH 2 the pump station and culvert will need to accommodate flows from the immediate catchment area which includes the new train station and carparking area.

14. The catchments serviced by the Jubilee Park culvert have not been identified as providing a habitat capable of supporting fish populations and design of the culvert for fish passage has not been considered although it is noted that automated flap gate/backflow protection devices have been proposed so as not preclude fish passage should it become possible in future.

10.2.2 The Harbour View cross culvert (Outlet 36B)

15. The existing culvert consists of a nominal 1800 mm pipe that runs under the highway approximately 100 m downstream of the existing Melling Link Bridge. This alignment coincides with the location of the bridge abutments of the new crossing and the associated foundations improvements and a new alignment is required for the culvert.

16. A new 2100 mm diameter RCRRJ culvert will be constructed on the western side of the new bridge alignment. The culvert will connect into the existing 1350 mm diameter pipeline that crosses under Harbour View Road via a new manhole structure.

17. The inlet for the catchment flows will be on the upstream side of Harbour View Road and surcharging of the pipeline can occur ensuring gravity discharge to the Te Awa Kairangi/Hutt River will be possible even for the future 100 year event flood in the river.

18. The current stream alignment includes a 25 m section of open natural waterway between the highway and the Harbour View Road culvert which has been identified in the Freshwater Ecology Assessment as providing habitat for indigenous biodiversity.

19. This section of waterway cannot be retained as part of the new works and Mr Lees' assessment indicates that removal of the section of stream habitat will require measures to re-establish a similar section of stream habitat to support indigenous biodiversity. Fish passage upstream of the new culvert is not possible due to the length and grade of the culvert under Harbour View Road; design of the new culvert has therefore not considered fish passage.

10.2.3 Tirohanga Stream Culvert

20. The existing Tirohanga Stream discharges via gravity under SH 2 to the Te Awa Kairangi/Hutt River via an existing 1200 mm diameter concrete pipe. This culvert requires replacement to provide a suitable asset design life for the highway development and the new stopbank.

21. The Freshwater Ecology Assessment has identified upstream of the culvert this stream provides habitat for indigenous biodiversity, and in accordance with Waka Kotahi design guidelines and requirements set out in the PNRP, the NES FW and the NIWA Fish Passage Guidelines, the design has considered provision for fish passage. Preliminary

design for the culvert has been based on complying with the permitted activity criteria set out in condition 70(2) of the NES FW. The proposed culvert structure is an 1800 mm diameter RCRRJ pipe with the inverted embedded 450 mm to allow the establishment of a bed within the structure.

22. Surcharging of the pipe during extreme event flood levels within the Te Awa Kairangi/Hutt River will still allow a gravity discharge from the upstream catchment, avoiding the requirement for flap gates /backflow prevention devices which can impede fish passage.

SH2 and interchange road drainage

23. Stormwater from the modified section of SH 2, the interchange and the associated on / off ramps will discharge via a kerb and channel system, trapped sumps and a pipe network to Outlets 37c and 33, located 50 m upstream and 390 m downstream of the existing Melling Link Bridge. These culverts will be replaced with new larger 750 mm diameter culverts, to accommodate the increased flows associated with climate change and to provide the required 100 year design life for the highway and the new stopbank structure.

24. Discharges via both culverts to the Te Awa Kairangi/Hutt River can currently be achieved via gravity and this is expected to include the 100 year event post construction. However increased flood level in the Te Awa Kairangi/Hutt River, associated with climate change, will prevent gravity discharge from Outlet 33 during peak flood levels in the Te Awa Kairangi/Hutt River at some point in the future. For this future scenario it is assumed that overflows would be conveyed to the proposed pump station 240 m to the west (outlet 29) and that this pump station would be upgraded to accommodate these flows at that time.

25. Waka Kotahi design guidelines and the PNRP include requirements for treatment / improvement to stormwater discharge quality. Given the high traffic loads on SH 2 within the Project area, treatment will be important to mitigate and reduce adverse effects on the receiving environment.

26. The revised layout for the highway and interchange, along with the increased flood channel width for the Te Awa Kairangi/Hutt River, result in significant spatial constraints and this, combined with grade issues, prevent the use of treatment devices more commonly used for highway stormwater treatment. The proposed treatment systems for the road discharges are as follows:

    i. Discharges to the Outlet 37c will discharge to a treatment swale running alongside the path / cycleway within the floodway for a length of approximately 70 m before discharging to the river. The swale will be designed in accordance with Waka Kotahi design guidelines and vegetated with low maintenance low growing native grasses.

    ii. Stormwater discharges from the interchange area and the riverside off ramp will discharge to raingarden facility located at the eastern end of the new station carpark before discharging to Outlet 33.

    iii. Stormwater discharges from the 500 m of roadway west of the interchange will discharge to the Outlet 31 via proprietary treatment devices located within the footpath /landscaped area adjacent to the new station drop off area. The devices will be sized to capture and treat the runoff from rainfall intensities of up to 10 mm / hr with flows in excess of this being bypassed to the culvert. It is expected that the treatment of flows up to this intensity will allow treatment in the order of 95% of all rainfall events.

27. The treatment swale system provides a relatively low maintenance effective treatment system. The swale is in the floodway and will be inundated during larger flood events in the river when flows are out of bank, However, this is not expected to be the case during typical rainfall events. While channels within the floodway can silt up as floodwaters recede, alignment of the channel parallel with the river maintains flow within the channel reducing siltation. The swale will require periodic excavation and re-establishment of the vegetative cover, expected to be every 5-10 years.

28. If properly designed, constructed and maintained, the raingardens are able to provide a relatively high level of treatment. They can be incorporated as part of the landscape design and require limited short-term maintenance. The raingarden system allows easy inspection to assess if maintenance is required or if there are any issues with operation.

29. The use of proprietary systems is not generally a preferred approach as they require regular inspection and maintenance / contaminant removal to maintain performance with associated costs. However, if well maintained they do offer a relatively high level of treatment, have significantly reduced spatial requirements and are seen as the only practical solution available for the section of road where they are proposed.

30. The highway/interchange development will result in an increase in impervious area in the order of 2 ha. This will increase result in an increase in peak discharges from the highway. Consideration has been given to options for attenuation of flow to maintain hydraulic neutrality. However, spatial and topographical constraints prevent this being practically achievable beyond the small level of attenuation that will be achieved within the raingarden facility provided. However, when considered with the flow volumes from all areas within the Riverlink project, the project will be hydraulically neutral or there will be a net reduction in flows.

10.3 KiwiRail corridor and new station and carpark stormwater design

31. The revised development for KiwiRail consists of:

    i. a new train station building located approximately 500 m to the west of the existing station;

    ii. removal of approximately 500 m of track; and

    iii. redevelopment of a new carpark area.

32. Stormwater from the carpark area will discharge via the upgraded culvert immediately adjacent (Outfall 33). Runoff from the carpark will flow to a series of tree pit raingardens along the carpark that will treat flows prior to discharging to a pipe network connecting to the culvert.

33. The existing section of rail corridor where the rails are removed will be landscaped allowing infiltration to ground. Surface runoff that does occur will discharge via the piped network to the adjacent culverts.

34. Stormwater discharges from the retained section of rail line will be unchanged and continue to discharge as per the current regime discharging to the local network and the Marsden Street outlet to the Te Awa Kairangi/Hutt River.

35. Stormwater discharges from the new railway station building and immediate area (formerly discharging via Outlet 29) will discharge via Outlet 31. Flows will combine with the treated flows from the carpark before discharging to the culvert. As noted above, stormwater discharges from this area will require pumping during high flows in the Te Awa Kairangi/Hutt River.

36. While there will be no significant change in the intensity of development / %impervious area within this catchment, there will be an overall reduction in catchment area as result of the relocation of the stopbank alignment. Attenuation is not practically achievable and given the catchment reduction not considerate necessary.

10.4 New Melling Bridge

37. Stormwater from the new Melling Link Bridge will be collected in a kerb and channel system and conveyed east via a piped system to a treatment swale along the river berm within the flood channel, similar to that proposed for the highway discharge at Outlet 37c. The treatment swale will be incorporated within the landscaping proposed for the area between the carparking paved area in the floodway and the channel.

38. The treatment swale will provide a high level of treatment of runoff before discharging to the river, except when flood flows in the Te Awa Kairangi/Hutt River are out of bank when the system will in effect be a direct discharge. During the infrequent periods when out of bank flows occur, the river will have high suspended solids concentrations, in excess of those present in runoff, and flow volumes will be high increasing the level of dilution.

39. No attenuation of stormwater has been considered as the bridge will effectively intercept rainfall that would otherwise fall directly on the river channel.

40. The new bridge structure replaces the existing bridge that will be removed on completion of the new structure. The existing bridge has no flow attenuation and treatment of flow. Replacement of this structure with a new bridge, albeit of increased area, will have no discernible impact on volumes discharging to the Te Awa Kairangi/Hutt River and improved discharge quality for all rainfall events except during periods of out of bank flow in the Te Awa Kairangi/Hutt River.

10.5 Hutt City stormwater

10.5.1 Design criteria

41. Stormwater design will be in accordance with the Wellington Water - [Regional Standard for Water Services]

42. Treatment will be considered and designed in accordance with Wellington Water's Water Sensitive Urban Design Guidelines and the Regional Standard for Water Services.

10.5.2 Hydrology

43. Design of stormwater infrastructure for Hutt City uses rainfall values provided from HIRDS V4 at the Hutt City Civic Buildings with an additional 20% allowance for climate change.

10.6 Drainage design

44. The Riverlink project will result in only negligible increases in the area of the Marsden Street catchment and catchments on the east side of the Te Awa Kairangi/Hutt River. The only significant factor affecting the catchment area will be the construction of a new stopbank with the alignment moving several metres toward or away from the river depending on the location. These changes have been included in design.

45. Due to bed modifications in the Te Awa Kairangi/Hutt River, most of the downstream culvert invert levels will require lifting to enable pipes to discharge above the river at bed level. The existing outlets to the Te Awa Kairangi/Hutt River are to be replaced where they extend through the new stopbank to provide a design life comparable with that of the stopbank. As part of this exercise, the culverts will be upsized by at least one diameter or

to box culverts, in order to allow retention of the flat grades, provide futureproofing for intensification of development and provide for climate change. The revised pipe diameter will extend from the outlet back to the upstream manhole (or new pump station) on the city side of the stopbank.

46. Design has sought to minimise the number of culverts and pipes through the stopbank as far as practical, and all pipes and culverts will have automated flap gates and penstocks to provide security against backflow.

47. The pump station at Outlet 23 (Marsden Street) is proposed to be upgraded and there are three new pumping stations proposed in areas with a previous history of flooding. These are at:

    i. the existing Outlet 24 (located at the east end of High Street and Queens Drive);

    ii. the existing Outlet 35 (located in the existing carriageway area in Rutherford Street); and

    iii. The existing Outlet 40 (located in the existing carriageway area in Melling Road).

48. The additional pumping stations will allow stormwater networks to discharge to the Te Awa Kairangi/Hutt River more efficiently during higher flood levels and minimise risk of flooding frequency in the upstream parts of the stormwater networks.

49. The discharge pipes and pump stations also allow for the future incorporation of some of the existing catchment currently draining to other areas (in particular the Opahu Stream. This includes at:

    i. Outlet 23 – Upgrade of pump station at the existing location is to be confirmed depending on finalised road realignments in this area.

    ii. Outlet 24 – Design for the pump station allows for inclusion of runoff from an additional 7.2 ha of the CBD area in the future.

    iii. Outlet 35 – A new pump station is proposed at Rutherford Street. It is expected that surface ponding from the catchment discharging to outlet 37 in high river levels will also enter the proposed pump station along with a small contribution from the commercial area.

    iv. Outlet 40 – A pump station will be sited in Melling Road next to the stopbank.

50. The indicative locations of pump stations will be confirmed / refined at the detailed design stage as land and road areas are confirmed. Pump stations will typically be sited close to the stopbank and design of stopbank will need to consider the deep excavation for the pumpstation. The locations and required excavation are to be determined during detailed design.

51. Non-return valves / flap gates and automated penstocks will be installed on all upgraded stormwater (excludes streams) lines. Flap gates will be located on the river side of the stopbank in concrete chambers to prevent vandalism and blockage from sediment accumulation. The automated penstocks will be located on the city / SH 2 side of the stopbank allowing access for power packs in the event of a power failure. The final location of these structures will be determined during detailed design.

52. The proposed works within this area will not increase impermeable surfacing and road closures and reduction of road width to one lane within the catchment will result in a net reduction in paved area. This will result in reduced traffic loading with an associated reduction in contaminant generation. These road modifications will permit inclusion of localised source treatment of runoff from these areas. This is expected to be achieved using proprietary tree pit raingardens.

53. Construction of the carpark in the floodplain will require capture and treatment of stormwater prior to discharge to the adjacent river. Treatment swales are proposed as the primary treatment device on the floodplain.

54. Overall there is expected to be a net decrease or no change in the area of impermeable surfacing from the Hutt Central area and no volumetric management is proposed. Pipe upgrades and pump stations have been proposed in low lying urban catchments to account for climate change impacts and the higher design flood levels in the Te Awa Kairangi/Hutt River.

55. The addition of new pumping stations will reduce flooding risk in urban catchments with existing or potential climate change induced capacity issues. They will allow stormwater networks to discharge to the Te Awa Kairangi/Hutt River more efficiently during river elevated flood levels and minimise risk of flooding frequency in the upstream parts of the stormwater networks.

10.7 River corridor

56. The Te Awa Kairangi/Hutt River corridor will generally be increased in width along the reach between the existing Melling Link bridge and the downstream end of the project area at Ewen Bridge. The new stopbank alignment on the right (western) bank will be set back between 0 – 30 m from the existing stopbank, while on the left (eastern) bank the new embankment generally follows the line of the existing bank or extends out into the existing floodway slightly. In the area of the CBD the stopbank (toe) on the eastern bank extends into the Hutt CBD / Daly St.

57. The new stopbank alignment will result in a reduction in the area of carparking in the floodplain. This will reduce the impervious area and vehicle related contaminant load in runoff from these areas. The new carpark within the floodway will grade towards the river to the treatment swale prior to discharge to the Te Awa Kairangi/Hutt River.