Eastern Bays Shared Path: Freshwater Fish Passage Requirements

EOS Ecology Report No. HUT01-18016-01 | March 2019

SCIENCE + ENGAGEMENT

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Prepared for Hutt City Council

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EXECUTIVE SUMMARY

Hutt City Council (HCC) is seeking to create a wider cycle/pedestrian path along part of Marine Drive in the Eastern Bays of Wellington. This project includes upgrading seawalls to ensure resilience to storm surges and future sea level rise. Through the project area numerous stormwater and piped stream outlets discharge to the intertidal zone. Several of these have relatively high quality open stream channels upstream that are known to, or are highly likely to have, freshwater fish present. EOS Ecology was commissioned by HCC to undertake an assessment of fish passage requirements in the project area to aid the resource consent application.

Fourteen pipe outlets of that were of potential importance to fish passage were visited on 7 March 2018 and where possible the upstream freshwater habitats were visited and photographed. Based on the site visit and a desktop assessment of GIS data and grey literature, the presence of fish in each catchment was assigned as "confirmed" (fish known to be present), "possible" (quite likely to have fish but no actual data to confirm), or "unlikely" (unlikely to have fish). Five pipe outlets were confirmed to have fish upstream, six pipe outlets possibly have fish upstream, and three were deemed unlikely to have fish upstream.

Of the 14 outlets, three are seaward of the toe of the proposed seawall and so will not require any extension. In general there will be no significant alteration to the remaining 11 pipe outlets other than an extension to the existing pipe end. However there is the potential for the seawall design and outlet level relative to the existing beach level to have potential adverse effects on fish passage if they become perched.

A number of avoidance and mitigation measures are proposed, including:

- In the absence of detailed catchment investigations take a conservative approach and require all 14 visited outlets to require fish passage.
- Ensure the three outlets that are currently elevated above the existing beach level do not become perched with an overhang.
- Modest pipe extensions at those outlets that are currently at beach level (11 of 14 assessed) should not result in any alteration to fish passage provided erosional and depositional processes around those outlets remain the same.
- For those outlets that are important for fish and little penguin passage seek a joint solution.
- Outlet-specific proposals are provided for seven outlets. This includes consideration of fish passage improvement for three sites with elevated outlets, one site with a currently buried outlet with louvers attached, and two sites where duckbill outlet valves have been previously proposed and consented that will impede fish passage.
- A freshwater ecologist with fish passage experience will need to be involved in the detailed design of the outlets.
- Avoid blockage of outlets by beach nourishment gravels through not installing gravels within 20 m of certain outlets, and monitoring these outlets during peak migration periods of banded kokopu.

Overall, with the implementation of the proposed avoidance and mitigation measures, the project will not have any adverse effects on the passage of migratory freshwater fish.

1 INTRODUCTION

As part of the Hutt City Council (HCC) transport strategy the HCC is seeking to improve safety for pedestrians and cyclists along part of Marine Drive in the Eastern Bays of Wellington by creating a wider cycle/pedestrian path and replacing a number of seawalls to provide fit-for-purpose structures that are resilient to storm surges and future sea level rise. The project will provide a safe connection for residents in the Eastern Bays to workplaces, schools, shops and public transport facilities in the rest of Hutt City. It will also connect to the planned Wainuiomata Hill and Beltway Shared Paths and, in the future, through to Wellington City by joining up and connecting to planned new facilities by both the New Zealand Transport Agency and Wellington City Council.

Along the length of the project area (approximately 4.4 km between Sorrento Bay and Windy Point/Eastbourne, Figure 1), 69% of the existing road-harbour interface is proposed to be changed to allow for a 2.5–3.5 m width shared path and upgraded seawall. The proposed seawall types have been selected based on a multi-criteria assessment (MCA) by a range of technical experts encompassing intertidal ecology, avifauna ecology, terrestrial ecology, coastal processes, landscape and visual, civil design, planning and consenting, and engagement. More detail on seawall types and general construction methodology is provided in the Eastern Bays Shared Path Design Features Report (Stantec, 2018). Beach nourishment has been proposed to mitigate the loss of beach area and is detailed in Tonkin & Taylor (2019).

Through the project area numerous stormwater and piped stream outlets discharge to the intertidal zone. Some of these have natural open stream channels upstream that are known or likely to have native fish present. Many of New Zealand's endemic and native freshwater fish are diadromous, which means they migrate between freshwater and the ocean at some stage in their lifecycles. The most likely freshwater fish species to be found in the Eastern Bays streams is banded kokopu (*Galaxias fasciatus*), which have the ability to live in very small streams and navigate long sections of piped stream to find suitable habitat. They have been previously found in three of the streams that discharge to the harbour through the project area. There is also the possibility other diadromous species; in particular eels (*Anguilla* spp.) and koaro (*Galaxias brevipinnis*) could be present in some of the larger streams.

Because this project includes alterations to pipe outlets and potential beach nourishment, which have the potential to affect fish passage, HCC commissioned EOS Ecology to undertake an assessment of fish passage requirements in the project area to aid in the resource consent application.

2 METHODS

Prior to visiting pipe outlets in the project area, a desktop exercise was undertaken to identify pipe outlets that were most likely to have freshwater habitat upstream where freshwater fish may be present. This involved using aerial photographs, topographic maps, the New Zealand Freshwater Fish Database (NZFFD), prior information collected on outlets (GHD, 2018; Fred Overmars penguin access data), the River Environment Classifications (REC), HCC GIS layers (stormwater pipes, stormwater outlets, hydrology), and "Schedule F1b – inanga spawning habitat" in GWRC's Proposed Natural Resources Plan (PRNP) to determine those outlets that appeared to be at the bottom of catchments of sufficient size to have permanent freshwater habitats upstream. These data sources provided various outlet and catchment information:

» Aerial photographs and topographic maps were used to determine the relative size of catchment

upstream of each outlet, with the larger catchments more likely to have freshwater habitat for fish. Additionally some of the larger Eastern Bays streams (but not all) are shown on topographic maps.

» The New Zealand Freshwater Fish Database (NZFFD) is a publically accessible national repository for freshwater fish data collected by various organisations and individuals over several decades. It provides site-based information on the fish communities where streams have been surveyed, and can be used to indicate which species have been recorded in a catchment in the past (and which are likely to be present now).

» GHD (2018) details several stormwater outlets in Petone and the Eastern Bays where duckbill valve devices are to be installed at selected sites to prevent pipe blockage by beach gravels. As part of their detailed design report they include catchment assessments for some of the outlets of interest for fish passage. The GWRC officer's report for the associated consent application was also viewed and gave some insight into previous investigations of fish passage in the Eastern Bays.

» Fred Overmars (Sustainability Solutions) has assessed outlets in the project area for little penguin access requirements and identified nine culverts that are currently accessible or used as habitat by little penguins, or are possibly accessible (Overmars, 2018). These culverts also happen to generally be the larger diameter ones, which implies a larger upstream catchment and a higher likelihood of freshwater fish habitat being present. They are referred to in later tables as "Overmars' Site".

» The River Environment Classification (REC) maps rivers that have a similar character across New Zealand's landscape and includes New Zealand's entire river network. It was used to provide clues as to where streams in the Eastern Bays may be located. However, the basis of REC is a synthetic river network derived from a hydrologically correct digital elevation model (DEM) which was built at a 30 m-pixel size by NIWA using 20 m contour data from the NZMS260 map series (Snelder *et al.,* 2004). The DEM was hydrologically corrected using the NZMS260 map river lines as a guide. The NZMS260 map series (superseded in 2009 by NZTopo50) was produced at a 1:50,000 scale and did not include many small headwater streams. Given all the outlets of interest in this project have small catchments, REC coverage was poor and not particularly useful.

» HCC provided GIS layers of stormwater pipes, stormwater inlets, stormwater outlets, and waterways (hydrology). The stormwater outlets layer was used to accurately locate outlets. The stormwater pipe layer in conjunction with the hydrology layer and aerial imagery were used to determine if outlets were likely to have open freshwater habitats upstream. In practice the HCC hydrology layer coverage was patchy and incomplete, with it being only useful for some outlets/catchments.

» A check of "Schedule F1b – inanga spawning habitat" in GWRCs PNRP showed none of the streams that discharge in the project area are listed as inanga spawning locations.

To distinguish among the various outlets/catchments we have used the HCC "Asset ID" from their stormwater outlets GIS layer and the chainage (in metres) measured on the project plans (Revision J). Streams have also been given surrogate names generally based on nearby roads. Where streams had already been informally named (i.e., by Fred Overmars, Sustainability Solutions) we have used these names for consistency.

Fourteen pipe outlets were visited on 7 March 2018 and where access was possible the upstream freshwater habitats were visited and photographed (Figure 1). The Esri ArcGIS Collector application (http://doc.arcgis.com/en/collector/) on an iPhone 5S with a high-resolution aerial photo base map and various GIS layers loaded was used to accurately and safely locate outlets and upstream freshwater habitats. Expert knowledge of small Wellington streams was used to determine if these habitats would

likely provide habitat for native fish (namely banded kokopu which are capable of living in very small streams). No fish sampling was undertaken, however where access allowed and appropriate habitat was present (i.e., pools) the streams were carefully searched by eye for fish. Based on the desktop assessment and site visit the presence of fish in each catchment was assigned as "confirmed" (confirmed fish presence either based on existing information or observing fish during the site visit), "possible" (catchment quite likely to have fish but no actual data/sightings to confirm), and "unlikely" (catchment is unlikely to have fish).

Figure 1 Pipe outlets (14) within the Eastern Bays Shared Pathway project area that were investigated for fish passage on 7 March 2018 by EOS Ecology.

3 OUTLET FISH PASSAGE ASSESSMENT

3.1 Sorrento Bay

3.1.1 Howard Road Stream

One outlet that possibly has fish upstream was found in Sorrento Bay (Table 1, Figure 2, Figure 3). Howard Road Stream is very small and shallow and does not appear on topographic maps, the REC, or the HCC waterways (hydrology) GIS layer. It drains a steep, narrow catchment before being piped beneath Marine Drive and discharging to the intertidal zone over exposed bedrock. Given its location above bedrock, this outlet does not appear to be regularly blocked by beach gravels. A possible fish sighting was made during the site visit (the only other animal it could have been was a freshwater crayfish/koura). A double curve concrete seawall is proposed at this location.

Table 1 Details of the Sorrento Bay outlet opposite 123 Marine Drive. Proposed seawall design is from Revision J plans and may be subject to change.

Stream/Outlet Asset ID (pipe diameter)	Approx. chainage (m)	Outlet location	Likelihood of fish upstream	Public access	Proposed seawall design
Howard Road Stream Outlet Asset ID: 670075R01102 (375 mm)	1016	Opposite 123 Marine Drive	POSSIBLE. Possible fish sighting on 7 March 2018	Public walkway to Howard Rd along stream	Double curve concrete

Howard Road Stream seawall outlet

Howard Road Stream flowing over intertidal bedrock

Howard Road Stream channel directly upstream of Marine Drive

Howard Road Stream channel along public walkway

Figure 2 Photos of Howard Road Stream in Sorrento Bay taken on 7 March 2018 by EOS Ecology.

Figure 3 Pipe outlets within Sorrento Bay and Lowry Bay assessed for fish passage on 7 March 2018 by EOS Ecology.

3.2 Lowry Bay

3.2.1 Wilmore Way Stream

The Wilmore Way Stream outlet discharges to the intertidal zone with an approximately 45 cm vertical drop (at low tide) over the edge of the existing seawall to a pebble beach below (Figure 3, Table 2, Figure 4,). Banded kokopu whitebait could climb this small drop, which will only be evident at low tide. The elevated position of this pipe means it is rarely, if ever, blocked by intertidal gravels. The natural open stream upstream is too small to appear on topographic maps, the REC, or the HCC hydrology GIS layer and drains a short, steep forested catchment. It has limited fish habitat available with some shallow pools observed interspersed by sections of very shallow surface flow (1–2 cm water depth). It is possible fish are present. It is probable this stream has sections of intermittent surface flow during dry periods. A double/triple curve concrete seawall is proposed at this location.

Table 2 Details of the Lowry Bay outlets investigated on 7 March 2018 by EOS Ecology. Proposed seawall design is from Revision J plans and may be subject to change.

Stream/Outlet Asset ID (pipe diameter)	Approx. chainage (m)	Outlet location	Likelihood of fish upstream	Public access	Proposed seawall design
Wilmore Way Stream Outlet Asset ID: 670071R01102 (300 mm)	1245	Opposite Wilmore Way	POSSIBLE. Small, steep stream with some permanent reaches	Up Wilmore Way or from public walkways in upper catchment	Double/triple curve concrete
Lowry Bay North Stream/ Overmars' Site 01 (triple 600 mm)	1300	Opposite boundary fence of 212 Marine Dr	CONFIRMED. NZFFD banded kokopu record.	Extensive access along public walkways	Double curve concrete
Whiorau Grove Stream Outlet Asset ID: 670060R01074 and 670061R01074 (paired triple 475 mm pipes with separate louvered outlets)	1540 & 1550	On either side of Lowry Bay bus stop opposite Cheviot Rd	POSSIBLE. Open sections in urban area and forested gullies further upstream	On private property in urban area. Bush bashing required further upstream.	Chainage 1540: Double curve concrete Chainage 1550: Single curve concrete
30 Cheviot Road Stream Outlet Asset ID: 670057R01074 (450 mm) Also Outlet 44 in GHD (2018)	1552	Next to beach access steps at Lowry Bay bus stop	POSSIBLE. Source unclear upstream of Cheviot Road. Potentially linked to Whiorau Grove Stream?	Open channel visible upstream of Cheviot Road.	Single curve concrete
Lowry Bay South Stream/Overmars' Site 02 Outlet Asset ID: 670065R01102 (750 mm) Also Outlet 45 in GHD (2018)	1590	Opposite 231 Marine Drive	CONFIRMED. Taylor & Kelly (2001) banded kokopu observation	Private accessway directly upstream of Marine Drive. Bush bashing required further upstream.	Single curve concrete
Gill Road Stream Outlet Asset ID: 670042R01102 (600 m)	1784	Opposite Gill Road	POSSIBLE. Forested gully upstream of urban area	Bush bashing required for access.	Double curve concrete

* Outlets referred to in Overmars (2018)

Outlet of Wilmore Way Stream

Wilmore Way Stream

Outlet of Lowry Bay North Stream

Lowry Bay North Stream at Cheviot Rd end

Figure 4 Photos of outlets of Wilmore Way Stream and Lowry Bay North Stream assessed for fish passage on 7 March 2018 by EOS Ecology.

3.2.2 Lowry Bay North Stream

The Lowry Bay North Stream outlet consists of triple 600 mm pipes discharging to a cobble beach and appears to be at least partially blocked by beach substrate much of the time (Figure 3, Table 2, Figure 4). At the time of the site visit surface flow could be seen coming through the central pipe only. Lowry Bay North Stream has a relatively large upstream catchment from which banded kokopu have been confirmed (2002 NZFFD record). This stream is large enough to appear on topographic maps and the REC, and the lower section through the urban area is shown on the HCC hydrology GIS layer. A double/triple curve concrete seawall is proposed at this location.

3.2.3 Whiorau Grove Stream

Whiorau Grove Stream discharges to the Lowry Bay beach via two louvered outlets located on either side of the Lowry Bay bus stop (Figure 3, Table 2, Figure 5). Based on HCC hydrology and stormwater pipe GIS layers this stream originates from the forested gully at the end of Whiorau Grove. The stream is too small to appear on topographic maps or the REC, with the HCC hydrology GIS layer only showing some open channel sections through the urban area. While it was not possible to visit this stream upstream of the urban area (no easy public access), based on the size of the channel at Whiorau Grove and Cheviot Street as well as the size of the catchment upstream of the urban area it is highly like this stream has adequate habitat for at least banded kokopu. At the time of the site visit the current louvered outlets appeared completely blocked by beach sediments with the outlet at chainage 1540 m appearing to be flowing through the gravel while a surface flow was evident at the 1550 m chainage outlet (Figure 5). A double curved seawall is proposed at the chainage 1540 m outlet while a single curve concrete wall is to be built at the chainage 1550 m outlet, although this outlet appears to be seaward of the toe of the proposed seawall and hence will not require an extension.

3.2.4 30 Cheviot Road Stream

The 30 Cheviot Road Stream outlet discharges to the Lowry Bay beach immediately adjacent to the Whiorau Grove Stream outlet at chainage 1550 m. There is a granted resource consent for the installation of a slip-on duckbill outlet attachment as part of a trial into the ability of these devices to prevent beach material blocking outlet pipes (see GHD, 2018). To gain such a consent it was concluded this outlet was not connected to any upstream open freshwater habitats, however my investigation based on HCC GIS and visiting an open channel at Cheviot Road that appears connected to this outlet would indicate there is indeed open freshwater habitat upstream of this outlet (Figure 3, Table 2, Figure 5). It is unclear on where the short channel indicated on the HCC hydrology GIS layer originates - based on topography it is potentially linked to the Whiorau Grove Stream catchment that discharges to the same location by the Lowry Bay bus stop. I would recommend a duckbill outlet be not installed on this outlet until the source of this flow and extent of open channel upstream is determined. A single curve concrete seawall is proposed at this location, although this outlet appears to be seaward of the toe of the proposed seawall and hence will not require an extension.


Whiorau Grove Stream louvered outlet at chainage 1540


Whiorau Grove Stream at Whiorau Grove


Whiorau Grove Stream louvered outlet at chainage 1550


Whiorau Grove Stream at Cheviot Road


30 Cheviot Road Stream outlet


30 Cheviot Road Stream upstream of Cheviot Road culvert

Figure 5 Photos of outlets of Whiorau Grove Stream and 30 Cheviot Road Stream assessed for fish passage on 7 March 2018 by EOS Ecology.

3.2.5 Lowry Bay South Stream

At the time of the site visit the beach outlet of Lowry Bay South Stream (Figure 3, Table 2, Figure 6) was covered in beach gravels through which water was flowing and forming a surface pool. Photos of the same outlet in GHD (2018) show it to be partially open with surface flow. Hence it is likely the opening of this pipe varies over time depending on beach sediment levels. This outlet has been granted resource consent for the installation of a slip-on duckbill outlet attachment to prevent beach material blocking outlet pipes (see GHD, 2018). To gain such a consent it was concluded this outlet was not connected to any upstream open freshwater habitats, however my investigation based on HCC GIS and visiting the open channel in the vicinity directly upstream of Marine Drive clearly show this outlet has open freshwater habitat upstream (Figure 3, Table 2, Figure 6). Taylor & Kelly (2001) report observing a school of approximately 10 banded

kokopu in the pool upstream of the Marine Drive culvert, including large adults, hence at least one species of fish is confirmed in this catchment. Based on the fact that fish are known to be present in this stream I recommend a duckbill device be not installed on this outlet. A single curve concrete seawall is proposed at this location.

3.2.6 Gill Road Stream

The Gill Road Stream outlet pipe at the beach was fully open at the time of the site visit and had flowing surface water (Figure 3, Table 2, Figure 6). The forested catchment upstream of the urban area was not easily accessible hence it is unknown if it has suitable freshwater fish habitat. Based on the other small catchments observed (e.g., Wilmore Way Stream) it is certainly possible fish habitat is present upstream. A double curve concrete seawall is proposed for this location.

Lowry Bay South Stream beach outlet

Lowry Bay South Stream upstream of Marine Drive

Gill Road Stream beach outlet

Gill Road Stream forested catchment

Figure 6 Photos of Lowry Bay South Stream and Gill Road Stream assessed for fish passage on 7 March 2018 by EOS Ecology.

3.3 York Bay

3.3.1 York Bay North Stream

York Bay North Stream had a fully open pipe outlet at the time of the site visit with an open channel directly upstream of Marine Drive and a forested catchment upstream of the urban area (Table 3, Figure 7, Figure 8). At the time of the visit during low tide flow from the pipe had caused minor scour of beach gravels leading to a slightly perched outlet (approximately 10 cm). Banded kokopu are confirmed to be present upstream (2003 NZFFD record). This stream is large enough to appear on topographic maps, the REC, and the lower section through the urban area is shown on the HCC hydrology GIS layer. However topographic maps and the REC appear to have a single stream outlet in York Bay, whereas in reality there are two permanently flowing streams discharging to the bay (see Section 3.3.2 below on York Bay South Stream). A triple curve concrete seawall is proposed at this location.

3.3.2 York Bay South Stream

York Bay South Stream had an open pipe outlet with a cobble-pebble substrate filling the bottom of the pipe at the time of the site visit. Upstream of Marine Drive is an open channel where two small schools of juvenile galaxiid fish (most likely young banded kokopu) were observed during the site visit (Table 3, Figure 7, Figure 8). Upstream of the urban area the stream has a forested catchment. This stream is large enough to appear on topographic maps, the REC, and fragments of the lower section through the urban area are shown on the HCC hydrology GIS layer. However topographic maps and the REC appear to have a single stream outlet in York Bay, whereas in reality there are two permanently flowing streams discharging to the bay (see Section 3.3.1 above on York Bay North Stream). The current level of the pipe (and beach), which has resulted in the culvert base being filled in natural gravels, provides ideal conditions for fish passage. A double curve concrete seawall is proposed at this location.

Table 3 Details of the York Bay outlets investigated on 7 March 2018 by EOS Ecology. Proposed seawall design is from Revision J plans and may be subject to change.

Stream/Outlet Asset ID (pipe diameter)	Approx. chainage (m)	Outlet Location	Likelihood of fish upstream	Public access	Proposed seawall design
York Bay North Stream Overmars' Site 03* /Outlet Asset ID: 670031R01102 (600 mm)	2375	Opposite 301 Marine Drive	CONFIRMED. NZFFD banded kokopu record.	Publically accessible in urban area. Bush bashing required upstream of urban area.	Triple curve concrete
York Bay South Stream Overmars' Site 04* /Outlet Asset ID: 670028R01102 (600 mm)	2450	Opposite Taungata Road	CONFIRMED. Juvenile galaxiids observed on 7 March 2018.	Publically accessible in urban area. Bush bashing required upstream of urban area.	Double curve concrete

* Outlets referred to in Overmars (2018)

York Bay North Stream beach outlet

York Bay North Stream upstream of Marine Drive

York Bay South Stream beach outlet

York Bay South Stream upstream of Marine Drive

Figure 7 Photos of York Bay streams assessed for fish passage on 7 March 2018 by EOS Ecology.

Figure 8 Pipe outlets within York Bay and Mahina Bay assessed for fish passage on 7 March 2018 by EOS Ecology.

3.4 Mahina Bay

3.4.1 421 Marine Drive Stream

The beach outlet pipe of 421 Marine Drive Stream was almost completely filled with gravel with no surface flow evident at the time of the site visit (Figure 8, Table 4, Figure 9). Upstream of the Marine Drive culvert the stream flows through another culvert under a parking area, which has a perched outlet. The upstream catchment consists of a relatively short, steep forested gully and the observed open channel had a very small volume of water present. This stream is too small to appear on topographic maps or the REC, however two short sections are shown on the HCC hydrology GIS layer. It is unlikely this stream has freshwater fish present, although further investigation of upstream freshwater habitats and a fish survey would be required to confirm this. A double curve concrete seawall is proposed at this location.

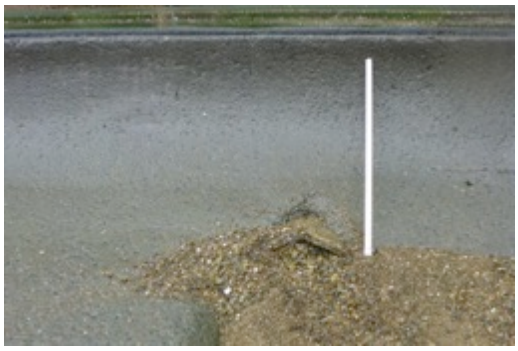
3.4.2 Mahina Bay Stream

The outlet of Mahina Bay Stream was completely obscured by sediment at the time of the site visit with the flow of the small stream observed upstream of Marine Drive apparently flowing through the beach gravels (Figure 8, Table 4, Figure 9). This stream is too small to appear on topographic maps and is not shown on the HCC hydrology GIS layer but is depicted in the REC. A fish (likely a banded kokopu) was observed in a pool upstream of Marine Drive during the site visit indicating that the outlet must be open enough to provide fish passage at times. A double curve concrete seawall is proposed at this location.

Table 4 Details of the Mahina Bay outlets investigated on 7 March 2018 by EOS Ecology. Proposed seawall design is from Revision J plans and may be subject to change.

Stream/Outlet Asset ID (pipe diameter)	Approx. chainage (m)	Outlet Location	Likelihood of fish upstream	Upstream access	Proposed seawall design
421 Marine Drive Stream Outlet Asset ID: 670138R01102 (525 mm)	3095	Opposite 421 Marine Drive	UNLIKELY	Up private driveway. Bush bashing required upstream of urban area.	Double curve concrete
Mahina Bay Stream Overmars' Site 05* /Outlet Asset ID: 670009R01102 (600 mm)	3280	Opposite Mahina Road	CONFIRMED. Fish observed on 7 March 2018.	Publically accessible in urban area. Bush bashing required upstream of urban area.	Double curve concrete

* Outlet referred to in Overmars (2018)



421 Marine Drive Stream beach outlet

421 Marine Drive Stream open channel

Mahina Bay Stream beach outlet (buried)

Mahina Bay Stream upstream of Marine Drive

Figure 9 Photos of Mahina Bay streams assessed for fish passage on 7 March 2018 by EOS Ecology.

3.5 Sunshine Bay and Windy Point

3.5.1 Sunshine Bay Stream

Sunshine Bay Stream had a fully open outlet set in the existing seawall well above the current beach level (Table 5, Figure 10, Figure 11). The natural open stream upstream does not appear on topographic maps, the REC, or the HCC hydrology GIS layer. The upstream catchment could not be assessed during the site visit; hence the state of the freshwater habitat there not known. However, given the short, steep catchment it is unlikely to have suitable fish habitat upstream although further investigation of upstream freshwater habitats and a fish survey would be required to confirm this. A double curve concrete seawall is proposed at this location.

3.5.2 Waerenga Road Stream

Waerenga Road Stream discharges to the southern end of Days Bay (near Windy Point) with the pipe almost completely blocked by beach sediments at the time of the site visit (Table 5, Figure 10, Figure 11). The natural open stream upstream does not appear on topographic maps, the REC, or the HCC hydrology GIS layer. The upstream catchment could not be assessed during the site visit; hence the form of the open channel is not known. However, given the short, steep catchment that is unlikely to have suitable fish habitat upstream although further investigation of upstream freshwater habitats and a fish survey would be required to confirm this. A double curve concrete seawall is proposed at this location although this outlet appears to be seaward of the toe of the proposed seawall and hence will not require an extension.

Table 5 **Details of the Sunshine Bay and Windy Point outlets investigated on 7 March 2018 by EOS Ecology. Proposed seawall design is from Revision J plans and may be subject to change.**

Stream/Outlet Asset ID (pipe diameter)	Approx. chainage (m)	Outlet Location	Likelihood of fish upstream	Upstream access	Proposed seawall design
Sunshine Bay Stream Outlet Asset ID: 670126R01102 (375 mm)	3784	Opposite 507 Marine Drive	UNLIKELY	Bush bashing required	Double curve concrete
Waerenga Road Stream Outlet Asset ID: 67097R01102 (300 mm)	5011	Opposite Waerenga Road	UNLIKELY	Bush bashing required	Double curve concrete

Sunshine Bay Stream beach outlet

Waerenga Road Stream catchment (top) and beach outlet (bottom)

Figure 10 **Photos of Sunshine Bay and Windy Point streams assessed for fish passage on 7 March 2018 by EOS Ecology.**

Figure 11 Pipe outlets at Sunshine Bay and Windy Point assessed for fish passage on 7 March 2018 by EOS Ecology.

4 ASSESSMENT OF ENVIRONMENTAL EFFECTS

4.1 Proposed Outlet Pipe Alterations

Based on the assessment of the outfalls and upstream channels/catchments, there are 14 outfalls where fish passage considerations are required. All are within the proposed curved seawall treatment. Three of the outlets where the curved treatment is proposed are seaward of the toe of the proposed seawall hence will not require any extension. A further three outlets were elevated above the existing beach level, with two of these being above the MWHS (mean high water spring) mark.

The Design Features Report (Stantec, 2018) states the following: "There are a large number of culverts under the existing carriageway which will need to be extended by some degree to accommodate the increased width of the new path. The required extensions will simply comprise lengthening the culvert using standard couplers connecting onto new plastic pipes that will be tied into the wall to be flush with seawall."

It is further stated in Stantec (2018), "The treatment of culverts and stormwater outfalls in seawalls will be addressed in the detailed design stage to incorporate the required features." To this end, proposals made here to avoid or mitigate any negative effects can be addressed, as necessary, during the detailed design stage.

4.2 Beach Nourishment

Beach nourishment has been proposed as mitigation for the loss of beach area as a result of seawall construction for sections of beach at Point Howard, Lowry Bay, and York Bay. This involves the addition of sand and gravels of a similar composition and size distribution to discrete sections of beach. The proposed nourishment areas and methodologies are detailed in Tonkin & Taylor (2019).

4.3 Potential Effects

Generally there will be no significant alteration to pipe outlets other than an extension to the existing pipe end. The seawall design and the level of the outlet relative to the existing beach level have the potential to have adverse effects on fish passage as does beach nourishment where sediments are added near existing stream outlet pipes.

4.3.1 Pipe Extensions

Extensions to outlet pipes for the curved concrete seawall design will be in the order of up to a few metres. For those pipes that discharge at the current beach level and will require extension (9 of the 14 assessed; Table 7) there will be little change to the current state in terms of fish passage as the outlets will function in a similar fashion to the existing outlets; being at a similar height up the shore with no great alteration to the beach substrate size around their outlets. For some of these outlets their level relative to beach substrate means they are periodically blocked/buried in beach sediments, and it is likely this will continue to be the case following pipe extension.

Theoretically pipe extensions could make the upstream migration of fish more difficult as they have to traverse longer pipes. In reality the fish species known to be present or likely to be present in the affected Eastern Bays streams, banded kokopu, have extreme abilities to traverse instream barriers including

sections of piped stream. They are able to reach remnant open stream habitat in catchments that have mostly been piped through many kilometres of pipe (e.g., Puketea Stream in the Wellington Botanic Gardens). They are also known to live within piped sections of streams where there is suitable habitat (authors personal observation).

With pipes, water velocity is one of the major potential fish passage barriers. The observed outlets in the project were all relatively low gradient with small flows at the time of the site visit, meaning that with exception of larger high flow events, outlet pipes are unlikely to create velocity barriers for banded kokopu. Additionally, many pipes will be partially or fully inundated during high tides so there will be regular periods of extremely low velocities or flow reversal to further aid the upstream movement of fish. Hence the magnitude of pipe extension proposed for the Eastern Bays Shared Path are unlikely to result in any significant changes to the current fish passage situation.

4.3.2 Elevated Outlets

Three outlets of potential fish passage importance have outlets that are elevated above beach level (Table 7). There is the potential for these extended outlets to be perched, if for example, they discharge to the upper curves of a double or triple curved concrete seawall. Site-specific guidance for these culverts is provided in Section 5.2.

4.3.3 Beach Nourishment

The addition of supplementary beach sediment has the potential to block the piped outlets of streams and it is likely alongshore transport will result in movement both to the south and north of the nourishment locations (Tonkin & Taylor, 2019). This has the potential to have negative outcomes for fish passage, particular for banded kokopu, which are known from some of the affected catchments and require access to the ocean to complete their lifecycle. Blockages could occur directly at the time of beach nourishment sediment addition or over a longer period as this sediment is redistributed by natural processes. Details of stream outlets potentially impacted by the proposed beach nourishment are shown in Table 6.

Table 6 Details of streams potentially affected by proposed beach nourishment. For those streams with outlets near the nourishment footprint the approximate distance from the nourishment extent is shown in parentheses.

Beach nourishment section	Stream outlets within nourishment footprint	Stream outlets near nourishment footprint	Fish upstream
Point Howard	None	None	Not applicable
Lowry Bay	Gill Road Stream	Lowry Bay South Stream (~10 m) Whiorau Grove Stream (~45 m) 30 Cheviot Road Stream (~60 m)	Gill Road Stream - possible Lowry Bay South Stream - confirmed
York Bay	None	York Bay South Stream (~10 m)	York Bay South Stream - confirmed

From a fish passage perspective there are no issues with the Point Howard site as this is not near any stream outlets. However the Lowry Bay beach nourishment site includes the outlet of Gill Road Stream that may have migratory fish upstream and the northern limit of nourishment is very close (~10 m) to the outlet of Lowry Bay South Stream, which is known to have banded kokopu in the catchment. Further to the north is the twin Whiorau Grove Stream outlet and the 30 Cheviot Road Stream outlet (Table 6). In York Bay the proposed nourishment section does not include any stream outlets, but York Bay South Stream, which is known to have migratory fish present, has its outlet just to the north of the northern end of the nourishment section (Table 6).

Fish migration occurs during certain periods every year, which is species and life stage dependent. For the affected streams, banded kokopu is the species known or most likely to be present; hence it is sensible to ensure the outlets potentially affected by beach nourishment are open during the key periods for this species. Banded kokopu larvae move downstream from freshwater to the ocean between March and September with a June-July peak (Ministry for Primary Industries, 2015). The juveniles (whitebait) make there way upstream from the ocean to freshwater between August and December with a September-October peak (Ministry for Primary Industries, 2015). Some of the potentially affected outlets are already full or partially buried at times with the current sediment supply and erosion-deposition dynamics. For example the louvered Whiorau Grove Stream outlets (Figure 5) and Lowry Bay South Stream outlet (Figure 6) where completely buried at the time of the 7 March 2018 site visit. It is unknown if and for how long these culverts are ever fully or partially open under current conditions.

5 PROPOSED AVOIDANCE AND MITIGATION

5.1 General Proposals

» In the absence of more detailed catchment investigations (habitat assessment and fish surveys) it is sensible to take a conservative approach and require all the visited outlets (including those designated “unlikely”) to require fish passage.

» For the three fish passage outlets that are currently elevated above the existing beach level (Howard Road Stream, Wilmore Way Stream, and Sunshine Bay Stream; Table 7) it will be important to ensure the extended outlets do not become perched with an overhang. The fish species present or likely to be present in the affected streams have exceptional climbing abilities to negotiate instream barriers, however they cannot get beyond perched outlets with an overhang. Solutions will be site-specific as it will depend on the relative level of the outlet and seawall design at each location, but may include constructing a short concrete ramp or use of mussel spat rope. A freshwater ecologist with fish passage experience will need to be involved in the detailed design of these outlets. Coverage of these specific elevated outlets is included in Section 5.2 below.

» The majority (11 of the 14 assessed; Table 7) of fish passage outlets are at beach level and a modest extension of the same diameter and gradient should not alter this. Provided conditions (e.g., beach sediment erosion and depositional dynamics) around these beach level outlets remain the same as they are now there should be no alteration in their fish passage status as a result of construction of the Eastern Bays Shared Pathway. The exception are four outlets that currently have or are proposed to have structures installed, which are detailed in Section 5.2 below.

» Where pipe outlets have both fish and little penguin values there is the potential to create a solution (e.g., ramp) that provides for both fish and penguin passage.

» Avoid and minimise the potential to block stream outlets during beach nourishment by:

  » Avoiding initial placement of sediment from within 20 m of existing outlets (Tonkin & Taylor, 2019);

  » Monitoring of stream outlets indicated in Table 6 during construction and afterwards and where necessary, clearance of gravels and sand to maintain opening especially during periods of peak banded kokopu migrations.

Table 7 Details of the pipe outlets/catchments assessed for fish passage by EOS Ecology.

Stream	Approx. chainage (m)	Fish upstream	Outlet level relative to beach	Proposed seawall type	Recommendation
Howard Road Stream	1016	Possible	Elevated	Double curve concrete	See Section 5.2.1. Ensure extended outlet is not perched. Potential ramp or mussel spat rope requirement.
Wilmore Way Stream	1245	Possible	Elevated	Double/triple curve concrete	See Section 5.2.2. Ensure extended outlet is not perched. Potential ramp or mussel spat rope requirement.
Lowry Bay North Stream/ Overmars' Site 01	1300	Confirmed	Beach level (partially buried)	Double curve concrete	No specific recommendation.
Whiorau Grove Stream	1540 & 1550	Possible	Beach level (both buried)	Chainage 1540: Double curve concrete Chainage 1550*: Single curve concrete	See Section 5.2.3. Ensure any new outlet involving louver devices allows for fish passage.
30 Cheviot Road Stream* Also Outlet 44 in GHD (2018)	1552	Possible	Beach level (partially buried)	Single curve concrete	See Section 5.2.4. Review consented duckbill valve installation. Thorough catchment investigation including fish survey.
Lowry Bay South Stream/Overmars' Site 02 Also Outlet 45 in GHD (2018)	1590	Confirmed	Beach level (buried)	Single curve concrete	See Section 5.2.5. Review consented duckbill valve installation.
Gill Road Stream	1784	Possible	Beach level	Double curve concrete	No specific recommendation.
York Bay North Stream /Overmars' Site 03	2375	Confirmed	Beach level	Triple curve concrete	No specific recommendation.
York Bay South Stream /Overmars' Site 04	2450	Confirmed	Beach level (partially buried)	Double curve concrete	No specific recommendation.
421 Marine Drive Stream	3095	Unlikely	Beach level (buried)	Double curve concrete	No specific recommendation.
Mahina Bay Stream /Overmars' Site 05	3280	Confirmed	Beach level (buried)	Double curve concrete	No specific recommendation.
Sunshine Bay Stream	3784	Unlikely	Elevated	Double curve concrete	See Section 5.2.6. Ensure extended outlet is not perched at low tide. Potential ramp or mussel spat rope requirement.
Waerenga Road Stream*	5011	Unlikely	Beach level (buried)	Double curve concrete	No specific recommendation.

* Outlets that appear to be seaward of the toe of the proposed seawall, hence will probably not require pipe extensions

5.2 Outlet-Specific Proposals

5.2.1 Howard Road Stream

Howard Road Stream has an elevated outlet that discharges over bedrock/rocky shore and then on to a beach at times of low flow (Figure 2). This outlet is well above high tide level and according to the plans (Revision J) any extension would be minor and still have the outlet above high tide level. Hence it does not get regularly inundated by ocean water. The current situation at this outlet allows for good upstream fish passage by banded kokopu at all tidal levels. A double curve concrete seawall is proposed at this location and has the potential to impede fish passage over much of the tidal range if this outlet were to discharge to the upper level of such a wall. If this were to occur then a minor alteration to the seawall at this point (e.g., installation of a short ramp through/within the seawall structure down to the bedrock rocky shore) and/or installation of mussel spat rope may be required to maintain fish passage during all tide levels.

5.2.2 Wilmore Way Stream

Wilmore Way Stream has an elevated outlet with a small vertical drop (approx. 45 cm) to a pebble beach when the tide is low (Figure 4). This outlet appears to be just above the high tide level. The current situation at this outlet allows for adequate upstream fish passage by banded kokopu at all tidal levels (they will be able to climb the small vertical drop if necessary). A double/triple curve seawall is proposed at this location, which has the potential to impede fish passage over much of the tidal range if this outlet were to discharge to the upper level (or second level if a triple curve) of such a wall. If this were to occur then a minor alteration to the seawall at this point (e.g., installation of a short ramp through/within the seawall structure) and/or installation of mussel spat rope may be required to maintain fish passage during all tide levels.

5.2.3 Whiorau Grove Stream

Whiorau Grove Stream has twin outlets with existing louvers attached, which were almost entirely buried at the time of the site visit (Figure 5). It is possible these louvers would limit fish passage at times when the outlets are more exposed, although it was impossible to determine this due to them being buried. At this stage it is unknown what will happen to the current louvers should these outlets be extended (i.e., reattached, discarded, or replaced). Whatever the case a freshwater ecologist with knowledge of fish passage will need to be involved in the detailed design of these outlets to ensure fish passage requirements are met.

5.2.4 30 Cheviot Road Stream

A duckbill outlet valve to limit blockage by beach gravels is proposed (and consented) for 30 Cheviot Road Stream as outlined in GHD (2018) where it is referred to as “Outlet 44”. Such an outlet will likely impede fish passage and there would appear to be open freshwater habitats upstream of this outlet that could support fish. While potentially out of scope of this report, it is strongly recommended this decision is reviewed and a thorough catchment investigation (including fish survey) is undertaken before any such outlet device installation is allowed. With respect to seawall construction, this outlet is on the seaward

side of the toe of the proposed wall hence will likely not require any extension or alteration, however if such extension/alteration is necessary then this is unlikely to be an issue for continued fish passage.

5.2.5 Lowry Bay South Stream

A duckbill outlet valve to limit blockage by beach gravels is proposed (and consented) for 30 Cheviot Road Stream as outlined in GHD (2018) where it is referred to as "Outlet 45". Such an outlet will likely impede fish passage in a catchment where fish are confirmed to be present upstream. While potentially out of scope of this report, it is strongly recommended a duckbill outlet valve is not installed on this outlet. Provided this duckbill outlet is not installed, any extension of this pipe is unlikely to be an issue for continued fish passage.

5.2.6 Sunshine Bay Stream

Sunshine Bay Stream has an elevated outlet with two vertical drops down to a rocky beach at low tide (Figure 10). The outlet in currently above the high tide level and is likely to remain so after extension according to the plans (Revision J). The current situation at this outlet allows for adequate upstream fish passage by banded kokopu at all tidal levels (they will be able to climb the vertical drops if necessary). A double curve concrete seawall is proposed at this location. A double curve seawall at this location has the potential to impede fish passage over much of the tidal range if this outlet were to discharge to the upper level of such a wall, due to the overhang in the curved seawall. If this were to occur then a minor alteration to the seawall at this point (e.g., installation of a short ramp through/within the seawall structure down to the bedrock rocky shore) and/or installation of mussel spat rope may be required to maintain fish passage.

5.3 Other Recommendations

- While outside the scope of this project (and not necessary to determine the potential effects of the project) it would be worthwhile to:
  - Correct the poor spatial knowledge of the Eastern Bays streams through ground truthing and catchment investigations to expand HCC's waterways (hydrology) GIS layer;
  - Undertake fish surveys in the catchments identified in this report to determine the distribution and diversity of freshwater fish in Eastern Bays streams.

6 ACKNOWLEDGEMENTS

Thank you to HCC and Fred Overmars for providing GIS information. Thanks to Kirsty Brennan (EOS Ecology) for producing the site maps and Shelley McMurtrie (EOS Ecology) for peer review.

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