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10 March 2016

## MEMORANDUM

TO Sonia Baker | Greater Wellington Regional Council (GWRC)  
FROM Alex James | EOS Ecology

### **Assessment of revised Cameron aquatic and riparian ecology reports prepared for GWRC's flood protection operations and maintenance activities in the Hutt, Wainuiomata, Otaki, and Waikanae River consent applications**

EOS Job No: GRE01-14074

Dear Sonia,

Please find below my reassessment of the revised aquatic and riparian ecology reports prepared by David Cameron of MWH to support GWRC Flood Protection resource consent applications for operations and maintenance activities in the Hutt, Wainuiomata, Otaki, and Waikanae Rivers (Cameron, 2015 a, b, c, d). My original reviews also covered the ecological components of the actual consent application documents prepared by Tonkin & Taylor Ltd and the proposed Code of Practice and Environmental Monitoring Plan. This second review only covers the four revised Cameron reports, thus does not involve revisiting the consent application or Code of Practice. Therefore this second review does not revisit any previous comments regarding consistency of information provided between the Tonkin & Taylor consent application documents and the Cameron ecology reports. My reassessment is based primarily on revisiting the "Further Information" sections of my original reviews and reference to Flood Protection's s92 further information request table and s92 Hutt River and Wainuiomata response letter to GWRC Environmental Regulation dated 20 November 2015.

## 1 HUTT RIVER

### 1.1 FURTHER INFORMATION ASSESSMENT

This section assesses whether the further "information required to complete AEE" from the original Hutt River review (James, 2015a) has been provided. The text from the original review is in *italics*.

*The description of the existing environment needs to provide an effective comparison of the ecology of the area covered by the consent application (the "impact" section) with the upstream catchment outside the influence of flood protection activities (the "reference" section).*

- » Invertebrate and fish data is now provided for the application area and sites upstream of the application area. The author states application area – upstream "reference" area comparisons with respect to flood protection effects would be confounded by other factors so have not attempted this in any detail. Please refer to my general comments around this in Section 5.1, which is applicable to all rivers.

*Better coverage of the invertebrate and fish fauna of tributary waterways covered by the application, and the potential effects of flood protection activities on these. This needs to include inanga spawning in the Opahu Stream.*

- » Additional invertebrate and fish information from tributaries has been provided. The potential effects of flood protection activities on tributary waterways have been adequately covered.

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*A description of the flora and fauna of the Hutt River estuary. GWRC have had surveys undertaken recently (see Robertson & Stevens, 2012).*

- » A good description of estuary ecology has now been provided.

*The description of the Hutt River benthic macroinvertebrate community needs to be expanded to better describe the typical community of the area covered by the application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring. The long-term data of the NRWQN should be included.*

- » The macroinvertebrate information now provided is much more informative and gives a sense of the typical community of the application reach (at least from the shallow habitats that were sampled). While no specific description of the community typical of the habitats most likely to be impacted by gravel extraction and bed/beach recontouring is provided it is highly likely this would consist of the *Deleatidium* and chironomidae dominated community that occur at the Manor Park and Boulcott Hutt River sites. No invertebrate data from the NRWQN has been included. In my view this long-term dataset would have been highly useful to show any macroinvertebrate community trends or variability (or lack thereof) in the Hutt River. I would recommend this data be incorporated into the EMP alongside GWRC SOE data to provide some background/context to any future macroinvertebrate sampling undertaken by the EMP. At this stage such analysis could be undertaken once the COP and EMP are operative.

*A more complete description of riparian vegetation in the application area, specifically covering any remnant native vegetation.*

- » The provided updated Hutt River application area maps now show areas of "native vegetation". The proposed EMP includes mapping of riparian vegetation within three years of consent being granted followed by remapping at nine year intervals. I accept that this will be the most appropriate way to determine the current extent and change over time of all riparian vegetation including native patches.

*More detailed information on the fish species that we should be most concerned about such as those that are abundant and spawn in the area covered by the consent application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring.*

- » Additional information is given on the dominant fish species present in the application area, while a new before-after, control-impact study in relation to Hutt River realignment works was undertaken from April to July 2015 (Cameron, 2015e). This new investigation included three fish surveys, which indicated bluegill bully was by far the most dominant taxa in the riffle, and shallow run habitat that was surveyed. The author does acknowledge the limitations around sampling only this habitat. The dominance of bluegill bully is similar to the findings of the earlier Perrie (2013) survey done in relation to gravel extraction. These two studies provide the only evidence as far as I know that bluegill bully is by far the most abundant fish species in the riffles and shallow runs of the application area. It would have been useful for this to be explicitly stated in the report.

Some good information on spawning periods and locations of fish has been provided, but it would be useful to provide more detail on bluegill bully in particular as this species is resident and abundant in habitats most impacted directly by flood protection activities.

*More detailed information on the bird species that we should be most concerned about such as those native or endemic species that roost, feed, nest, or rest in the area covered by the consent application. Additionally, McArthur et al. (2013) notes, "the identity and number of all native birds on or associated with the riverbed were recorded in 1 km sections within each survey area. Although the results are not reported here, this was done to provide the opportunity to allow comparisons of bird abundance to be made between individual 1 km reaches of river, assisting us to identify reaches of river that support relatively high numbers of key species with a higher degree of spatial resolution." Thus GWRC has much higher resolution bird distribution data available than what has been presented in the ecological AEE report and application report.*

- » The section on river birds has been substantially improved and includes information from a new report (McArthur et al., 2015). It now provides adequate coverage of birds.

*Coverage of herpetofauna that could be present in the consent application area.*

- » There is now a section dedicated to herpetofauna that provides adequate coverage for the purposes of the consent application.

## 1.2 OTHER COMMENTS

### 1.2.1 MOWING OF STOKES VALLEY STREAM

- » The s92 response letter from Tracey Berghan provides an explanation of why alternative methods of Stokes Valley Stream mowing are not viable. The use of a conventional tractor and flat mower or cutting the grass using a scrub bar is impractical from a hazard/health and safety perspective, which is understandable. Planting of the lower batters with vegetation that does not require mowing is also not favoured for erosion/channel stability and flood capacity reasons. This implies the watercourse is managed only for drainage purposes with no consideration of ecology, aesthetics, natural character, or recreation. While planting of batters with sufficient vegetation that a mower driving along the streambed was no longer required may have flood capacity issues, a long term goal (the fourth alternative in the s92 response letter) should be to redesign the whole channel and riparian area to provide for both flood capacity as well as a range of other values such as a naturalised stream channel; planting of low riparian vegetation; recreational usage by creating a riparian walkway; and removal of any fish passage barriers. Providing for such values can be achieved with the right design interventions that are sensitive to both flooding and ecology. This is considered by Flood Protection to be outside the scope of the current resource consent application and would likely trigger a review of the Hutt River Floodplain Management Plan and potential changes to GWRC's 10 year plan. Such improvements would have multiple benefits and would go some way to mitigating the habitat degradation suffered by Stokes Valley Stream for flood protection purposes and should include input from local councils and other arms of GWRC. Shouldn't such integrated improvements to waterways, particularly urban waterways, be a long-term goal of the Flood Protection? As the current activity is permitted by the current Regional Freshwater Plan for the Wellington Region and the COP restricts it to only Stokes Valley Stream and Porirua Stream and the use of rubber-tired machines, then I would consider all that can be done currently is being done. Improvement of the waterway corridor that would allow this maintenance activity to no longer be required would require considerable political and public pressure and perhaps will be on the radar of the local Whaitua when this is established.

### 1.2.2 WATER QUALITY

- » It would have been informative to examine the 20+ years of NRWQN information on water quality and macroinvertebrates to provide a good general background on how these have been tracking over that time. I would recommend analysis of this data be undertaken to provide some background/context to any monitoring data collected by the EMP. At this stage such analysis could be undertaken once the COP and EMP are operative.

### 1.2.3 RECREATIONAL AND COMMERCIAL FISHERY

- » The only information regarding recreational fishing in the application area is about trout. It is likely other recreational fisheries exist in the application area including whitebait, eel and estuarine fish such as yellow eye mullet and flounder. Additionally, there should be some information included on any commercial fisheries operating in the application area. For those species under the quota management system (e.g., eels) there should be catch data available. Such information would be useful to determine if commercial fishing is potentially having impacts on the abundance of such species. I would suggest the future analysis of fish data as part of the EMP include coverage of commercial and recreational fishing data from the application area.

## 2 OTAKI RIVER

### 2.1 FURTHER INFORMATION ASSESSMENT

This section assesses whether the further "information required to complete AEE" from the original Otaki River review (James, 2015b) has been provided. The text from the original review is in *italics*.

*More effective maps should be provided, in particular, the NZFFD records maps (and all maps for that matter) should clearly indicate the sections of rivers and tributaries covered by the consent application, the application report should include a map of ecological survey site locations, and a map showing existing flood protection features (i.e., willow plantings, native plantings, groynes, rock lining, debris fences,*

*etc.]) would be highly useful.*

- » An improved set of maps has been provided.

*Given the consent application involves activities in the estuary and CMA, a more thorough description (that is based on actual data or cited information) of the Otaki River estuary and the potential effects of flood protection activities is required.*

- » There is now a better description of the Otaki River estuary, although there is no coverage of estuary invertebrates. Presumably this is due to a lack of information and if so, this should be stated. Additionally, is the 1992 Boffa Miskell information regarding the plant species present and extent of salt marsh in the northern lagoon still valid 20+ years later (certainly such communities may be affected by sedimentation and tidal inundation)? Some comment from the author on this is warranted.

*The description of the existing environment needs to provide an effective comparison of the ecology of the area covered by the consent application (the "impact" section) with the upstream catchment outside the influence of flood protection activities (the "reference" section).*

- » The author states application area – upstream "reference" area comparisons with respect to flood protection effects would be confounded by other factors so have not attempted this in any detail. Please refer to my general comments around this in Section 5.1, which is applicable to all rivers.

*Better coverage of the invertebrate and fish fauna of tributary waterways in the area covered by the application compared to tributaries outside of the area.*

- » Adequate information on invertebrates and fish of tributary waterways has now been provided, although no comparison to tributaries outside the area has been made. Please see my comments around such comparisons in Section 5.1. Also no comment is made on whether freshwater mussels/kakahi are may be present in tributary waterways.

*The description of the Otaki River benthic macroinvertebrate community needs to be expanded to better describe the typical community of the area covered by the application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring.*

- » The macroinvertebrate information now provided is much more informative and gives a sense of the typical community of the application reach (at least from the shallow habitats that were sampled). While no specific description of the community typical of the habitats most likely to be impacted by gravel extraction and bed/beach recontouring is provided it is highly likely this would consist of the *Deleatidium* dominated community that occur at the two GWRC SOE sites.

*More detailed information on the fish species that we should be most concerned about such as those that are abundant and spawn in the area covered by the consent application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring. For the lower Otaki River section covered by the consent application there is very little fish information, which may make this difficult to do until the initial baseline surveys outlined in the EMP are undertaken.*

- » The available fish information is now examined in more detail. The author acknowledges there is minimal fish community information from the application area and recommends this is rectified by regular EMP monitoring. I agree that at this stage it is appropriate for additional fish information to be collected by the EMP once the consent is granted.
- » The original AEE implied drift dive trout surveys have been undertaken in the Otaki River, while the updated maps in the current version (Cameron, 2015b) indicate some drift dive reaches. Given the Otaki River is considered a regionally important trout fishing destination by Fish & Game I would have thought this information would be useful to present in the AEE. Some comment on why this was excluded is warranted.

*A more complete description of riparian vegetation in the application area, specifically covering any remnant native vegetation or significant areas of native plantings.*

- » The provided updated Otaki River application area maps now show areas of "native vegetation". The proposed EMP includes mapping of riparian vegetation within three years of consent being granted followed by remapping at nine year intervals. I accept that this will be the most appropriate way to determine the current extent and change over time of all riparian vegetation

including native patches.

*More detailed information on the bird species that we should be most concerned about such as those native or endemic species that roost, feed, nest, or rest in the area covered by the consent application. The nesting of pied stilt, banded dotterel, and black-fronted dotterel are covered, but there are likely other species that utilise riverbed and river mouth/estuary habitat.*

- » The section on river birds has been substantially improved and includes information from a new report (McArthur *et al.*, 2015). It now provides adequate coverage of birds.

*Coverage of herpetofauna that could be present in the consent application area.*

- » There is now a section dedicated to herpetofauna that provides adequate coverage for the purposes of the consent application.

## 2.2 OTHER COMMENTS

### 2.2.1 AQUATIC PLANTS

- » Some useful information on macrophytes in tributaries is now included. In some tributaries included in the application area the unwanted organism *Myriophyllum aquaticum* (Parrot's feather) is present. This species is included in the regional pest management strategy of several regions (not Wellington). The endemic *Myriophyllum triphyllum* is also present in the same watercourses. As mentioned in my earlier review (James, 2015b) it would be useful for the COP to include guidance on protecting substantial patches of native macrophytes while implementing measure such that invasive species are not spread.

### 2.2.2 RECREATIONAL AND COMMERCIAL FISHERY

- » Some brief information on trout, whitebait, and estuarine fish recreational fishing is provided. It is possible that some commercial fisheries operate in the application area (e.g., eeling in tributary streams). For those species under the quota management system (e.g., eels) there should be catch data available. Such information would be useful to determine if commercial fishing is potentially having impacts on the abundance of such species. I would suggest the future analysis of fish data as part of the EMP include some coverage of commercial and recreational fishing data from the application area.

## 3 WAIKANAĒ RIVER

### 3.1 FURTHER INFORMATION ASSESSMENT

This section assesses whether the further "information required to complete AEE" from the original Waikanae River review (James, 2015c) has been provided. The text from the original review is in *italics*.

*More effective maps should be provided, in particular, the NZFFD records maps (and all maps for that matter) should clearly indicate the sections of rivers and tributaries covered by the consent application, the application report should include a map of ecological survey site locations, and a map showing existing flood protection features (i.e., willow plantings, native plantings, groynes, rock lining, debris fences, etc.) would be highly useful.*

- » An improved set of maps has been provided.

*Given the consent application involves activities in the estuary and CMA, as well as a major gravel extraction exercise in the lower river that will more than likely result in sediment deposition in the estuary, a more thorough description of the Waikanae River estuary and the potential effects of flood protection activities in this environment is required.*

- » There is now a better description of the Waikanae River estuary. However, is the 1992 Boffa Miskell information regarding the plant species present still valid 20+ years later (certainly such communities may be affected by sedimentation and tidal inundation)? It is also unclear if any of the regionally rare or endangered plant species occur in the application area. Some comment from the author on this is warranted.
- » I would expect some additional estuary information would be collected as part of the site-specific EMP that would be required

under the proposed COP for the major gravel extraction operation planned for the lower Waikanae River.

*The description of the existing environment needs to provide an effective comparison of the ecology of the area covered by the consent application (the "impact" section) with the upstream catchment outside the influence of flood protection activities (the "reference" section).*

- » The author states "it is not possible to draw conclusions about the effects of flood protection activities on macroinvertebrate communities at RSoE sites because of these underlying differences in macroinvertebrate habitat". It is true there are major habitat and land use differences between the two Waikanae RSoE sites, however please refer to my general comments around this in Section 5.1, which is applicable to all rivers.

*The description of the Waikanae River benthic macroinvertebrate community needs to be expanded to better describe the typical community of the area covered by the application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring.*

- » The macroinvertebrate information now provided is more informative and gives a sense of the typical community of the application reach (at least from the shallow habitats that were sampled). While no specific description of the community typical of the habitats most likely to be impacted by gravel extraction and bed/beach recontouring is provided it is highly likely this would consist of the *Deleatidium* dominated community that occurs at the GWRC SOE site within the application area. This may however, not be the case for the lower Waikanae River where a major gravel extraction programme is planned in the tidally-influenced part of the river. I would expect the macroinvertebrate community of this part of the river to be described as part of the site-specific EMP that the scale of this work would require under the proposed COP.

*More detailed information on the fish species and their abundance, and which species we should be most concerned about such as those that are abundant and spawn in the area covered by the consent application, especially in habitats that are impacted by gravel extraction and bed/beach recontouring.*

- » The available fish information is now examined in more detail. There is however no information specific to the lower part of the river where a major gravel extraction programme is planned. I anticipate additional fish information will be collected from that project area as part of the site-specific EMP that the scale of this work would require under the proposed COP.

*A more complete description of riparian vegetation in the application area, specifically covering any remnant native vegetation or significant areas of native plantings.*

- » The provided updated Waikanae River application area maps now show areas of "native vegetation". The proposed EMP includes mapping of riparian vegetation within three years of consent being granted followed by remapping at nine year intervals. I accept that this will be the most appropriate way to determine the current extent and change over time of all riparian vegetation, including native patches.

*More detailed information on the bird species that we should be most concerned about such as those native or endemic species that roost, feed, nest, or rest in the area covered by the consent application. Riverbed nesting birds have been covered, but there are likely other species that utilise riverbed and river mouth/estuary habitat. Additionally, estuary birds are not well covered given the apparent importance of the Waikanae Estuary to shorebirds.*

- » The section on river birds has been substantially improved and includes information from a new report (McArthur *et al.*, 2015). It now provides adequate coverage of birds including detailing the Waikanae Estuary "bird site of value".

*Coverage of herpetofauna that could be present in the consent application area.*

- » There is now a section dedicated to herpetofauna that provides adequate coverage for the purposes of the consent application.

## 3.2 OTHER COMMENTS

### 3.2.1 RECREATIONAL AND COMMERCIAL FISHERY

- » Some information on trout and whitebait recreational fishing is provided. It is possible that some commercial fisheries operate in the application area (e.g., eeling). For those species under the quota management system (e.g., eels) there should be catch data available. Such information would be useful to determine if commercial fishing is potentially having impacts on the abundance of such species. I would suggest the future analysis of fish data as part of the EMP include some coverage of commercial and recreational fishing data from the application area.

## 4 WAINUIOMATA RIVER

### 4.1 FURTHER INFORMATION ASSESSMENT

This section assesses whether the further “information required to complete AEE” from the original Wainuiomata River review (James, 2015d) has been provided. The text from the original review are in *italics*.

*More effective maps should be provided, in particular, the NZFFD records maps (and all maps for that matter) should clearly indicate the sections of river covered by the consent application, the application report should include a map of ecological survey site locations, and a map showing existing flood protection features (i.e., willow plantings, native plantings, rock lining, etc.) would be highly useful.*

- » The NZFFD maps now indicate the river section covered by the application and maps are provided showing the design channel. However, unlike for the Hutt, Otaki, and Waikanae River ecological reports, there are no maps detailing existing flood protection features. While this is not crucial, it would be highly useful to determine visually the extent of flood protection activities in the application area.

*The description of the existing environment needs to provide an effective comparison of the ecology of the area covered by the consent application (the “impact” section) with the upstream catchment outside the influence of flood protection activities (the “reference” section).*

- » The author states “it is not possible to draw conclusions about the effects of flood protection activities on macroinvertebrate communities based on these monitoring results because the river reach managed by flood protection lies within the urban area where macroinvertebrate habitat quality is already reduced by land use activities”. It is true there are major habitat and land use differences between the application area and upstream Wainuiomata RSoE site, however please refer to my general comments around this in Section 5.1, which is applicable to all rivers.

*The description of the Wainuiomata River benthic macroinvertebrate community needs to be expanded to better describe the typical community of the area covered by the application, especially in habitats that are impacted by bed recontouring and potential gravel extraction.*

- » The macroinvertebrate information now provided is more informative and includes new data from within the application area, giving a sense of the typical community of the application reach (at least from the shallow habitats that were sampled). While no specific description of the community typical of the habitats most likely to be impacted by gravel extraction and bed/beach recontouring is provided, it is likely this would consist of the *Aoteapsyche*- and *Potamopyrgus*-dominated community that occurs at the other sites sampled within the application area.

*More detailed information on the fish species that we should be most concerned about such as those that are abundant and spawn in the area covered by the consent application, especially in habitats that are impacted by bed recontouring and potential gravel extraction.*

- » The available fish information is now examined in more detail.

*A description of riparian vegetation in the application area, specifically covering any remnant native vegetation or significant areas of native plantings.*

- » The updated Wainuiomata River ecology report is missing detailed maps showing areas of native vegetation (among many other features) that were included with the Hutt, Otaki, and Waikanae reports. Though not crucial, these would have been useful.
- » The proposed EMP includes mapping of riparian vegetation within three years of consent being granted followed by remapping at nine year intervals. I accept that this will be the most appropriate way to determine the current extent and change over time of all riparian vegetation including native patches.

*A description of the bird species that we should be most concerned about such as those native or endemic species that roost, feed, nest, or rest in the area covered by the consent application.*

- » The section on river birds now includes comment on the application area.

*Coverage of herpetofauna that could be present in the consent application area.*

- » There is now a section dedicated to herpetofauna that provides adequate coverage for the purposes of the consent application.

## 4.2 OTHER COMMENTS

### 4.2.1 RECREATIONAL AND COMMERCIAL FISHERY

- » Some information on trout and whitebait recreational fishing is provided. It is possible that some commercial fisheries operate in the application area (e.g., eeling). For those species under the quota management system (e.g., eels) there should be catch data available. Such information would be useful to determine if commercial fishing is potentially having impacts on the abundance of such species. I would suggest the future analysis of fish data as part of the EMP include some coverage of commercial and recreational fishing data from the application area.

## 5 OTHER COMMENTS

### 5.1 COMPARISON OF APPLICATION AREA WITH REFERENCE AREAS

Flood Protection is correct in their assertion that a direct comparison of the application areas with reference areas would not be particularly informative with respect to flood protection effects as there are many confounding factors (e.g., land use). However, comparison of fish and invertebrate communities that incorporate components around stability/variability of said communities over time would allow for useful application area–reference area comparisons (e.g., species turnover, metric variability over time (MCI, EPT, etc.), and change in community structure over time using statistical techniques such as non-metric multidimensional scaling (NMS)). What is of interest is the natural variation in fish and invertebrate communities observed at reference sites and whether sites within the application area show lesser, similar, or greater variation. Less or similar variation in the application area sites compared to reference sites would imply any impacts of flood protection activities are relatively minor or undetectable, where greater variability in the application area could be indicative of flood protection activity impacts. For the Hutt River and Waikanae River at least, invertebrate data going back several years was available from sites inside and upstream of the application area, thus such comparisons are possible. While knowing if invertebrate community structure in the application area has been less stable than those further upstream would be very useful information to include in the AEE, at this stage I would recommend the EMP incorporate such data analysis to give background and context to future EMP monitoring results.

While targeted, activity-based studies can be informative, the overall health of river in the entire application area is the most important thing in the long term. Measurement of this could include setting monitoring sites inside and outside the application area for determining trends over time, along with a set number of ever moving random sites to more effectively measure “health” (whatever that is deemed to be for the river of interest). Monitoring under such a scheme could include geomorphology (as measured by the Natural Character Index), macroinvertebrates, and fish.

## 5.2 THE USE OF WILLOWS

The s92 response letter from Tracey Berghan includes a section on “Options for integration of native trees with willows for bank edge protection” that sets out the advantages of using willow for bank protection and how native species are currently being integrated within the area managed by GWRC Flood Protection (FP). I agree there are no native plant species that provide the flood protection services of willows and that willows are a ‘softer’ alternative to rock and other hard-engineering bank erosion control. While it is inevitable willows will be a major part of GWRC FP’s large river management for the foreseeable future, there is surely a place for concerted research into optimising the extent and width of willow monocultures and larger scale, long-term testing of natives and willow-native mixes for flood protection purposes. Just because willows have been used from the earliest days of European settlement of New Zealand for riverbank erosion protection this doesn’t mean there are not viable alternatives that are yet to be developed. I do acknowledge that such conversations are outside the scope of the current consent applications, however as GWRC FP is showing great innovation with the COP/EMP adaptive management concept, it would be disappointing if they also did not think beyond using willow monocultures for front line flood defence.

## 5.3 DEPOSITED FINE SEDIMENT

The original reviews (James, 2015a, b) indicated the targeted activity studies had not measured deposited fine sediment in depositional environments (e.g., pools, backwaters) or indicated how long deposited sediments resulting from flood protection activities may remain in situ. Despite another targeted activity study occurring since that review (Cameron, 2015e) this has still not been rectified. I would strongly suggest the next targeted activity studies undertaken by GWRC Flood Protection measure deposited sediment in depositional environments rather than just in riffles and shallow runs. To gain an understanding of how long deposited fine sediments may stay in situ a relatively simple examination of flow records to determine the return period of freshes that would be expected to mobilise the fines in pools and backwaters and of larger events that would cause reworking of the river gravels is required. Such information is really required to determine the relative potential effects of flood protection activities causing the mobilisation and subsequent settling of fine sediments during relatively low flow periods. In my opinion this is something that should be included in at least the application report and is a desktop exercise using existing flow data, but could be added to the EMP programme and done later.

## 5.4 GRAVEL BAR AND BEACH FLORA AND FAUNA

The GWRC Flood Protection s92 further information request table states, “This is dynamic and constantly changing, therefore not viable to map. Provide generalised description can be provided (*sic*)”. It is true this is a dynamic environment and this is one of features that could mean it has a novel flora and fauna that can exist in such environments. The flora and fauna of such environments (with the exception of birds) is not well covered in any of the revised AEEs, although my original reviews (James, 2015a, b, c, d) did note this information could be obtained later via the EMP (provided the EMP provides provision for such data collection). All that is required is an idea of what species utilise these environments, and if there are any endemic/native species present. This would potentially allow patches where endemic/native plants are present to be identified prior to activities such as beach ripping and scalping, so that they can be avoided wherever possible.

## 5.5 EVENT MONITORING

From reading the updated Cameron reports, I note the thresholds for initiating event monitoring have changed since my last review. Minor-scale works are now regarded as those affecting less than 175 m lineal length of wetted riverbed (previously 150 m), moderate-scale works are those affecting between 175 m and 800 m (previously 150 m to 500 m), and large-scale works those affecting greater than 800 m (previously 500 m). While revisiting any updated COP document is outside the scope of this review it would be useful to know what these thresholds are based on. I also further reiterate comments made in my earlier review of the COP (see below):

- » I am not convinced the level of event monitoring required being tied to disturbance of some length of riverbed and/or days of in-river works is the best way. This ignores the ecological values of the habitats being disturbed and opens the programme up to abuse or mismanagement – i.e., scheduling works to disturb only 790 m of river any one time so as to avoid additional monitoring requirements.
- » This method does not account for the varying sizes of rivers managed by GWRC Flood Protection whereby, for example, a 175 m long bed recontour in a large river such as the Otaki may not have as big an effect as it would on a smaller river such as the Wainuiomata.

- » I would suggest an alternative scheme based on first considering the ecological value of the habitat to be disturbed in the context of that particular river catchment, and secondly on the area (rather than length) of wetted riverbed to be disturbed is developed.

## 6 CONCLUSION

Overall the updated aquatic and riparian ecology reports (Cameron, 2015a, b, c, d) included most of the additional information that was requested. The only concerns I have relate to:

- » The use of 20+-year-old data estuary vegetation information for Otaki River and Waikanae River. Some comment on the use of such old data from such dynamic environments is warranted, as is an indication of whether the vegetation survey work proposed under the EMP will extend to estuarine areas.
- » A lack on any information on commercial fisheries operating in the application areas (e.g., eeling) that may negatively impact fish populations.
- » No adequate comparison of available data between sites inside (impact) and outside (reference) the application areas.

In my opinion, at this stage of the process it is appropriate that where data that is lacking (e.g., detailed riparian vegetation cover, fish from Otaki River application area) or where further investigation/data analysis is required (statistical comparison of sites inside/outside the application areas), that it can be collected/undertaken under the COP/EMP after the consent is granted; *provided* the item is included in the EMP.

## REFERENCES

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