HAWKE'S BAY
REGIONAL COUNCIL

Our Ref: CL170122E, LU170121E, LU170123E, CL170124E, LU170125E and CL170126E

11 January 2018

Hawke's Bay Regional Council
C/- David Ray at Mitchell Daysh Ltd
PO Box 1307, Hamilton 3240
Email: david.ray@mitchelldaysh.co.nz
cc: Gary Clode Email: gary.clode@hbrc.govt.nz

Dear Sir

REQUEST FOR FURTHER INFORMATION

We have reviewed your resource consent applications and assessment of environmental effects (AEE) for gravel extraction from the Ngaruroro, Tukituki and Tutaekuri Rivers. More information is needed so that we can better understand your proposal and its potential effects. In accordance with Section 92 of the Resource Management Act (1991) (RMA) we request the following information. N.B. This request for further information should be read in conjunction with the appended technical reviews.

1. Timing & Amenity

AEE's: *"As there are areas which can be used for public amenity of various forms (swimming, walking, boating, angling), the gravel extraction operation can result in the temporary reduction in amenity of the area. Because gravel extraction activities are generally intrusive to passive recreation the extraction areas are largely avoided during these times."*

As explained above, extraction areas will be largely avoided to reduce effects on passive recreation but the exact location of the areas and timing of such avoidance is not clear. We understand that the proposed activities will generally occur during daylight hours and that the current annual consents given to gravel extractors specify working hours however this is not clear in the application. We note proposed condition 4 *"the consent holder shall notify the Council five working days prior to any new extraction operation commencing within the area specified by the resource consent".* We also note the public access points and restrictions in Section 6.2 of the *'Environmental Code of Practice For River Control and Waterway Works'.*

a) **Please confirm** the general timing for the proposed activities. Would the activities occur during weekends and public holidays**?** i.e. note the standard construction work hours: 7am to 7pm Monday to Friday, 8am to 4pm Saturday and no work Sunday and public holidays. Would the proposed activities occur during the summer school holidays (mid-December to late-January/early February)**?** We assume it would and we note the restrictions during nesting seasons.

b) Given the above, **could you proffer** a condition that further mitigates and manages effects on amenity and recreation by way of general controls on timing and proximity to public access points**?**

In regard to the questions above, although the restricted discretionary rule is largely confined to controlling dust, it would seem prudent to consider timing and minimising adverse effects on recreation and amenity i.e. due to the sheer presence and operation of heavy vehicles. Given the notification process (condition 4), and the fact that the timing and location may well be known well before the *“five working days prior”,* we believe that the activity should be able to be pro-actively managed with respect to timing.

2. Tukituki River

   a) Given that the upper and middle Tukituki River are the only sources to re-stock the lower Tukituki River with gravels, how is the balance to be struck between gravel removal in the upper/middle sections and replenishment to the lower sections**?**

   b) How will the applicant manage the gravel resource and extractors in years with few or no floods**?**

   c) How will the applicant manage the cumulative impacts of multiple operators at various locations along the river**?** There is also the problem of lack of access to some of the aggrading sections, which could result in impacts from localised over-extraction in a section that is otherwise balanced or aggrading. How best to deal with local discontinuities in the downstream balance of aggradation and degradation**?**

   d) The applicant has not provided any rationale for setting the river extraction rates other than local mean river bed level should be maintained, in relation to some local design datum. This does not take any direct account of the actual gravel fluxes reaching the coast, time lag effects, and cumulative impacts from multiple operations. Please provide details on these matters.

   e) The criteria for siting extraction locations presented in Section 3.2 requires some further contextualisation. It is not clear how gravel extraction “aids transport of sediment through the river system” – presumably this refers to artificial manipulation of channel depths or river course alignment**?**

   f) We note in Section 4.2 (page 34) that the applicant intends to *“continue to investigate and utilise where appropriate new modelling and LIDAR techniques to improve volume estimates”.* Can the applicant proffer a consent condition that commits to modelling and use of LIDAR**?**

3. Ngaruroro River

   a) Please detail the modelling assumptions for the rates of upstream gravel supply and transfer from lateral sources (tributaries, mass wasting, bank failure, etc.) that support the model formulation.

   b) While model results indicate that the extraction from the Ngaruroro River has little impact on bedload transport rates, a key question is: what are the impacts on reach sediment storage and active alluvial width, and thus habitat and the longer-term trajectory of the river**?**

   c) The ‘extraction’ reaches (sections 36-51) for 2015 in Figure 15 (p.28) show a gravel volume deficit at 13 of 16 sections, raising the question: why do extraction works continue here**?** This seems to violate conditions for sustainability set out in point 2 of the application (Part A), and in paragraph 3 above the figure.

   d) Forecast demand continues at 250,000-300,000 m^3·yr-1 (Section 3.3, Figure 11), so where is the ‘red line’ for ceasing operations**?**

e) Evidently there is a substantial supply in the upstream sections, but how long will a deficit be allowed (i.e. before reductions in extraction allowances are made)**?**

4. Tutaekuri River

Evidently modelling is still underway for the Tutaekuri River this should provide an instructive case study for understanding the limits of gravel extraction for these systems, as well as the anticipated recovery times following over-extraction in the larger river systems.

a) Can the applicant proffer a consent condition that commits to modelling the response times for replenishment of gravel stores, based on this case study**?** With suitable scaling to account for flows and sediment storage, this should provide some criteria for allowing a recovery phase, following over-extraction in other rivers.

5. General River / Fluvial Matters

a) The proposal would be greatly strengthened with a presentation of the modelled results (including validation of historic river trajectories) for all rivers under consideration, and therefore some objective and transparent criteria for managing consent conditions. Results should be presented as a suite of outcomes, reflecting uncertainty in the input parameters and governing conditions. Despite the many uncertainties and approximations involved, a mass balance model should emerge that can be used to generate more robust determination of extraction thresholds. A plot showing mean bed elevation trends and gravel transport rates over time (past 50 years, and going forward 25 years) should provide a good demonstration of how well we understand these systems, and will provide a strong basis for managing this resource.

b) The key component of the 'proposed activity' is the extraction of gravel material. The rationale (Part A; Form 9) for the volume to be extracted is dependent upon (a) calculation and comparison of mean bed levels and reach volumes with bed level design grade lines; (b) comparison of the mean bed levels and reach volumes with bed level design grade lines; and (c) based on (a) and (b), an assessment of the sustainable extraction for the current year.

   Mean bed level has a 'design grade line' for comparison, but it is not clear how volumes are used in the decision-making process. Mean bed level changes may not reflect lateral adjustments and changes to reach sediment stores. Cross-sections must be considered and analysed as a longitudinal pattern to determine any trends of system accumulation or deficit. Haschenburger and Cowie (2009), for instance, show the swings from positive to negative volumetric balance within different survey epochs in the Ngaruroro River (their Figure 7), emphasising the variation in capacities for storage and transfer within these reaches and possible bedrock controls. This may also reflect the role of tributaries and major sediment source areas.

   Changes in channel storage are not fully reflected in mean bed level measurements. This '1-dimensional' view of channel behaviour does not account for important changes in active lateral width, channel/floodplain configuration, and planform morphology, which could be signalling local sediment surplus or deficits without accompanying vertical changes. Some further criteria for evaluating reach condition should be included in the Annual Gravel Status Assessments.

Please provide:

1. A more robust prediction system of sustainable extractable gravel volumes across the full width and length of the channel instead of just mean bed levels – e.g. can the applicant have a more robust prediction system of volumes instead of mean bed levels**?**
2. An electronic copy of: *Stevens, M., Larsen, B., (2015): Gravel Management Plan - Gravel Demand Forecast (Issue 5), March 2015.*
3. An electronic copy of: *Stevens, M., Larsen, B., (2015): Gravel Management Plan Gravel Resource Inventory (Issue 3).*

c) With a cross-section database that dates to the 1940s, it should be feasible for the applicant to demonstrate the typical range of reach storage volume variability and, crucially, the rates of change in both natural or managed regimes. Reaches that could be susceptible to rapid change can then be identified – some reaches are bound to be more resilient to disturbance than others, based on storage characteristics (e.g., Lisle and Church, 2002). By presenting this information, it can be made clear what sensible thresholds could be proposed as an acceptable quantum of change within a given interval before extraction operations cease. These data would also provide some idea of recourse for ceasing extraction operations before bed degradation sets in (recalling the precautionary motive). In the current application, the reader is provided no insights into the potential magnitude or characteristic timescales of storage changes.

Longitudinal bed level (ideally storage volume) trends should be considered in more detail. Longitudinal trends may signal a translating wave of surplus or deficit, and may show a cumulative response developing from multiple extraction sites. By the time mean bed level drops below design levels in the 3-yearly surveys, it may be too late to intervene and prevent erosional response. A historic summary would be helpful, to show the range of natural, as well as extraction-induced variability, and to demonstrate how realistic decision-making thresholds could be developed.

As part of the presentation of model results in (a), a plot of historic bed levels and volume changes from 1960s to present should be provided. A few cumulative plots (volume vs. time, summing the net volume change year-to-year) from representative survey reaches will show the running surplus or deficit, and should demonstrate the sustainability of this resource under the managed supply regime. **Please provide** plots/graphs.

d) While HBRC’s statutory flood hazard management responsibilities provide an important mandate for gravel extraction, the reviewers felt that the sections on flood protection (Section 2.2) lacked much detail on particular areas that were subject to aggradation-induced exacerbation of flood risk, relative to gravel surplus or deficit. There is mention of hydrodynamic models (Section 2.2; p. 8, 2.3.1; p.9), but the results from these studies do not appear to be brought to bear in this application. **Please provide** figures showing longitudinal trends in river bed build-up relative to infrastructure and residences at risk, with accompanying annotations of the maps in Appendix A.

e) **Please clarify** which volumes of which fractions typically apply to contractor consents, and whether consented volumes pertain to *gross or net* extraction. For instance, if 75% of material is finer than the desired fractions, four times the volume of raw material must be excavated, and considerably more fine-grained, mobile material is left behind.

f) The description of proposed activity states that they would like to extract the gravel more efficiently (Section 3.1; p.21), although there is no qualification of this. **Please clarify** this point.

g) The application provides little consideration of alternative mitigation measures for dealing with the principal problems: flood risk and land protection. We suggest there is scope for broadly considering other alternatives to solving the aggradation problem, including the creation of 'room to move' for the river (e.g. Biron et al., 2014; Buffin-Bélanger et al., 2015). By widening the river corridor at sites of notable aggradation, there is increased conveyance for flood flows, and the river has room to erode and modify the accumulated deposits. This point in the river's long profile is, after all, the former site of unconfined fans and braid plains, which dealt with aggradation by frequent switching and reworking of the deposit. This also creates more braided riverbed habitat, which is mentioned as being uncommon and important (Sec 2.6). Some further investigation into the feasibility of this would seem warranted. This is one example – and there are likely good reasons for not accepting this model - but a considered review of alternative river management strategies would strengthen the justification for the proposed gravel extraction regime. **Please provide** an alternatives assessment for the proposal.

h) Linked to question 4 (a) and (c) above, we believe the proposal could be significantly strengthened with a more quantitative framework, and a completion of the analyses that are said to be in progress (Part B, Section 4.2 of the application). While the historic and forecast extraction volumes are quite precise, the reviewers could find no estimates for rates of natural gravel supply and transfer. In order to declare the management scheme to be a sustainable venture, it must be made clear what proportion of this resource is being captured, what margin of safety is required in order to maintain equilibrium, and in the case of over-extraction, what the pathway and timeline to recovery will be. The Ngaruroro River modelling looks like a promising step towards this. **Please provide** further details on these matters.

6. General Coastal Matters

a) Section 4.7 of the applications does not provide a strong treatment of the question of coastal sediment budget; however, Appendix H at least provides some further context. Numbers are offered in 4.7, showing a deficit of material transferred across the coastal tract at the mouth of the Tukituki River, with little commentary. It is difficult to resolve the different numbers in Section 4.7 and Appendix H, as only a few of the quantities would seem to agree. The earliest reference we could find for numbers in Appendix H is Tonkin and Taylor (2005). The Komar (2015) text is cited extensively, but it does not appear in any references, nor does it appear to be accessible from the HBRC website. **Please provide** 'up to date' numbers and the Komar (2015) report and highlight the research provenance of the original estimates.

b) Coastal hazard issues are a major concern in Hawke's Bay. The Clifton to Tangoio Coastal Hazards Strategy 2120 (2016) maps out the critical importance of managing the regional coastal sediment supply. The Coastal Hazards and Climate Change (2017) further emphasizes regional exposure to coastal risks. While the New Zealand Coastal Policy Statement (2010) is deemed irrelevant in Section 5.2.2, we feel that it would be well to invoke Policy 3 from this document:

Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse.

Gravel yield from the lower Tukituki River is assessed at 28,000 m^3·yr-1, though extractions from this lower part of the river have averaged roughly 50,000 m^{3}·yr-1 since 2000. **Please provide** a **more detailed study** in order to justify continued removals from this portion of the Tukituki River, given the timescales for recovery of gravel stores. The study must include, as a minimum, indication of uncertainty and natural variability in estimated transport rates (both fluvial and coastal), and an assessment of the threshold transport rates in the Tukituki River required to maintain gravel nourishment of the coastal sedimentary system.

c) Related questions that arises is what is the effect on beach protection from coastal swells and tsunami arising from the reduction of gravel supplies to the coast from the Tukituki River**?** Given that a reduction in gravel supply from the Tukituki River will render the coast more susceptible to erosion, what mitigation measures should be considered to protect the coast from storm swells, tsunami and rising sea levels**?**

7. Climate Change

We note that the application states 'a 5% reduction in flow, as expected with future climate change, causes a 6-10% reduction in gravel supply into the extraction reaches'. Climate and river hydrology, including the potential effects of climate change, require further consideration. Hydrologic and in-channel hydraulic drivers are principal concerns for forecasting sediment supply. Thus, **please provide** assessment of variation and changing trends warranted for any long-term endeavour (e.g. 10-year extraction consent or 25-year management horizon) along with further consideration of climate change effects. Linking the historic presentation of bed-level and volume trends in 5(c) to prevailing climatic conditions should be effective in elucidating this relationship.

8. Ecology

a) P22 S3.6.2 of the AEE: How has the value of '1m' buffer distance between gravel extraction area and active channel been determined**?** It seems quite close for a highly porous river bed material. Does the applicant have observations that this has prevented muddy water in the extraction pits from seeping through and into the flowing river**? Please provide** some evidence (e.g. anecdotal and/or photos) that a buffer of 1m is enough to prevent an increase in suspended sediment downstream of the gravel activity.

b) How would gravel extractor sub-contractors be held accountable for any deviation they make away from the approved practice / consent conditions by the <u>applicant/consent holder</u> (i.e. not the regulator)**?**

c) We note the Environmental Code of Practice and the Ecological Management and Enhancement Plans provide commentary on a range of enhancement initiatives. In particular Section 5.7 of the code discusses the potential for artificial pool creation:

"The maintenance of permanent deep pools in rivers is important for providing habitat for fisheries, particularly as refugia during low flows. Pools and riffles naturally migrate over time within a river system. However, there is potential for some river work activities, such as beach raking and edge retreat, to contribute to or exacerbate the natural instability of pool and riffle systems. Consequently, the creation of artificial deep pools can be highly beneficial. These can also have the added advantage of being able to be used as swimming holes by the public and as water supply sources by the Rural Fire Control authorities."

The Tutaekuri and Ngaruroro River Ecological Management and Enhancement Plans recommend further studies on the effects of gravel extraction and raking and investigating the artificial creation of pools for ecological habitat enhancement.

The allowance for there to be some "ecological enhancement" gravel extraction, which may include extraction from the wetted channel, as part of this consent, could be of benefit. The purpose would be for deeper pools to be dug out of the rivers to provide better habitat for salmonids if the river systems appear to be losing their deeper pools. Or, for gravel pits to be dug deeper than they would normally be such that when they are reconnected they form a deeper pool. This addition could be considered part of an offset mitigation for the river management activity overall, if the applicant would consider incorporating this as part of the proposal as a consent condition that specifies general triggers for when pool creation (and studies) will be undertaken and monitored**?**

Next Steps

You must respond in writing to this request, before 5 February 2018 and do one of the following:

a) Provide the information.
b) Tell us that you agree to provide the information, but propose an alternative reasonable date (suggest a date).
c) Tell us that you refuse to provide the information.

Please use the attached form to respond to this information request. If you prefer you can email your response to sven.exeter@mottmac.com. I have put processing of your application on hold until we receive your response. Please contact me on 0273037354 if you have any questions.

Yours faithfully

SPExeter

SVEN EXETER – CONSULTANT; FOR
EXTERNAL RELATIONS GROUP
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To: Sven Exeter

Hawke's Bay Regional Council
Private Bag 6006
Napier
C/- sven.exeter@mottmac.com

In response to the Council's request for further information dated 11 January 2018 and relating to the gravel extraction applications:

Please tick your response.

☐ the information requested is attached

☐ I'm unable to provide the information by 5 February 2018, but could send it to you by

____

☐ I refuse to provide the information.

Signature of applicant or authorised agent: ____

Name: ____ Date: ________________

Please print full name of person who signed above.

Review: Application for resource consent, Tukituki River, Hawke's Bay

Dr. Jon Tunnicliffe (Lecturer in River Science)
Prof. Paul Kench (Head of School, Professor of Coastal Geomorphology)
School of Environment
The University of Auckland

Scope:

Hawke's Bay Regional Council (Regional Assets section) is applying for a new resource consent to extract gravel (defined as gravel and associated sand, silt, and other riverbed sediments) from the Tukituki, Waipawa, Ngaruroro, Tutaekuri and Esk river beds, comprising the active river channel and berms, for the purposes of maintaining the design channel capacity and the alleviation of flood and erosion risk in the region. The consent process is in accordance with RMA procedures and timelines, as well as additional consultation with stakeholders. This review considers the terms for 25-year consents for the Tukituki, Ngaruroro and Tutaekuri rivers, including mitigation measures for potential impacts to riverine ecology (flora and fauna), and regional sediment budget.

Executive Summary:

The reviewers have found the overall concept of shifting the gravel extraction consent process over to HBRC to be a reasonable initiative. This will reduce the administrative burden, allow for a centralised and pro-active management of the resource, and will facilitate a more collaborative and consultative process among iwi and stakeholders. The applicant has provided a good and reasonably comprehensive assessment of local site impacts (particularly ecological elements) and strategies for impact minimisation and mitigation. The aims of this gravel extraction initiative are shown to be consistent across multiple Regional and National mandates for resource management, and are shown to be compatible with the approach taken in other regional councils.

The reviewers have concluded, however, that the rationale for setting the rate of extraction is not sufficiently explained or quantified in order to show how the multiple competing interests (e.g. gravel extractors, "one-off construction projects", or unspecified "environmental benefits") will be weighed against system erosion, degradation and maintenance of floodplain stores, in this 25-year management regime. This sets up some obvious difficulties in maintaining transparency and accountability for river management. There is no clear elaboration of a sediment budget, no expression of uncertainty in current or future trajectory of the river system, and little demonstration of an overarching precautionary approach to long-term asset management. Furthermore, there is no consideration of alternative management strategies that might achieve similar ends for flood control and erosion management.

The reviewers suggest that a compact summary of the current state of knowledge of mean bed level and reach volumes relative to extraction and natural variations in sediment supply would help to demonstrate how effectively the resource could be managed, and sensible thresholds that could be set, given the constraints of a 3-year monitoring window. Detailed forecasts of gravel demand are presented, but no scenarios are considered for shifts in hydroclimatic regime, with consequent shifts in sediment supply. Numerous sediment studies are cited in the assessment, but results do not seem to be effectively employed in informing the decision-making rationale. Some further information on flood risks specifically related to channel conveyance would strengthen the application as well.

Contents

1. General Comments:

The three applications under consideration (Tukituki, Ngaruroro and Tuaekuri rivers) each provide an overview of measures for environmental protection and mitigation from various effects arising from gravel extraction. This includes carefully managing the manner of extraction, the location along the river, seasonal timing, broad consultation with stakeholders, and mindfulness of cultural impacts (tangata whenua). Impacts on water quality (notably turbidity), habitat (nesting birds, fish passage), public amenities (swimming, angling) and infrastructure (bridges, water takes) are also discussed. The applicant has taken efforts to consult broadly with other river managers who are dealing with similar pressures to manage gravel resources effectively and sustainably. This compilation of best practices is used to underpin the proposed strategy for the gravel management scheme.

The applicant points out that the flood management and extraction regime has been managed in much the same way since the 1960s. The 1991 RMA introduced some environmental considerations into gravel extraction works, giving rise to the process of resource consenting for excavating or disturbing a river bed. Historic information on rates of extraction show some variation in volumetric rates of removal over time, with a spike in 1990 and 1991, related to construction of the Napier Expressway. Peak extraction from the three rivers reached almost 1.4M m^3 of gravel in 1991. Post mid-90s, totals from the three rivers under consideration are in the order of 400,000 $m^3 \cdot yr^{-1}$, with roughly 70% of the that volume coming from the Ngaruroro, 24% from the Tukituki and 6% from the Tutaekuri rivers.

1.1 Tukituki River

It is repeatedly emphasised that the Lower Tukituki is sensitive to degradation, and should have “minimal extraction for some time” (2.3.1 and 3.3). It is pointed out that the river is undergoing net aggradation (4.2; p.34) in the middle and upper catchment, though this tends to be localised. Target extraction areas for the lower river are included in Figure 11 (p.23). The amount of gravel removed from the river has tapered off since 2004, evidently in response the coastal erosion issue (3.3). However, no clear thresholds for protection are set, nor is any systematic course of action proposed for managing this problem.

There are difficulties in incentivising extractors to work in the upper and middle aggrading reaches, because of the lengthy trucking distances. Despite this, HBRC would like to provide “longer term certainty” to contractors working here (p.2) and intends to provide “multi-year authorisations” to extract gravel (3.1) with suggestions of programs running up to 10 years (Secs. 3.9; App G: 5.4). Given that the upper and middle Tukituki are the only sources to re-stock the lower Tukituki, how is this balance to be struck? What to do about years with few or no floods? How to handle the cumulative impacts of multiple operators at various locations along the river?

From a coastal perspective, extraction from the river (particularly the lower reaches) must imply there has been reduced sediment delivery to the coast, which presents difficulties in the context of ongoing coastal hazard mitigation work taking place in the region. In particular, the Tukituki River meets the coast at one of the erosion hotspots in the region. Previous studies have concluded that there is a prevailing northerly littoral drift, and hence river supplies should not be a major input at Haumoana. However, depletion of alongshore sources are likely to place further demand on southern gravel volumes and exacerbate erosion. The proposal is rather vague on these potential coastal consequences (3.3), and whether the new operating regime proposed will impact the coastal system.

The applicant has not provided any rationale for setting the river extraction rates other than local mean river bed level should be maintained, in relation to some local design datum. This does not take any direct account of the actual gravel fluxes reaching the coast, time lag effects, and cumulative impacts from multiple operations. Also, the criteria for siting extraction locations presented in 3.2 could use some further contextualisation. It is not clear how gravel extraction “aids transport of sediment through the river system” – presumably this refers to artificial manipulation of channel depths or river course alignment? A few important knowledge gaps seem to emerge in this list of criteria. There is also the problem of lack of access to some of the aggrading sections, which could result in discontinuities in the downstream balance of aggradation and degradation.

1.2 Ngaruroro River

The Ngaruroro River provides most of the gravel volumes for construction and infrastructure works in the region. The river is steeper than the Tukituki, and the substrate is relatively coarse in the middle to upper reaches of the system. Tectonic uplift in the 1931 Hawke’s Bay earthquake abruptly lifted the river base-level, resulting in trapping of gravels before the river reaches the coast. Much like the Tukituki, there is a natural tendency for the river to aggrade in the middle reaches, owing to the confinement of the river course. Through processes of selective transport and gravel attrition, the river has a marked fining gradient and it is mainly sand and silts that reach the coast (Cowie and Brierley, 2009; Appendix H).

A scoping report by Tonkin and Taylor in 2010 (and subsequent work to 2016), modelling by NIWA (Measures, 2012), and a gravel resource inventory by Stevens and Larsen (2015) are cited as the basis for information requirements in this document, but there are few specific findings incorporated into the design of a threshold for sustainable extraction (2.3.2; p.11, 4.2; p.32). Section 4.2 of the Tukituki and Tutaekuri reports are exceptionally vague in this regard, and Appendix H provides only a cursory overview of some favourable model results.

Section 4.2 of the Ngaruroro provides much better detail, although the applicant should lay out the fundamental assumptions (n.b. rates of gravel supply and transfer from lateral sources) that support the model formulation. While model results indicate that the extraction from the Ngaruroro has little impact on bedload transport *rates*, a key question is: what are the impacts on reach sediment *storage and active alluvial width*, and thus habitat and the longer-term trajectory of the river? Reach storage provides a buffer against change, and thus dictates response and recovery times for any surplus or deficit of bedload material at a given reach.

The 'extraction' reaches (sections 36-51) for 2015 in Figure 15 (p.28) show a gravel volume deficit at 13 of 16 sections, raising the question: why do extraction works continue here? This seems to violate conditions for sustainability set out in point 2 of the application (Part A), and in paragraph 3 above the figure. Forecast demand continues at 250-300,000 $m^3{\cdot}yr^{-1}$ (Section 3.3, Figure 11), so where is the 'red line' for ceasing operations? Evidently there is a substantial supply in the upstream sections, but how long will a deficit be permitted?

The proposal would be greatly strengthened with a presentation of the modelled results for all rivers under consideration, and therefore some objective and transparent criteria for managing consent conditions. Results should be presented as a suite of outcomes, reflecting uncertainty in the input parameters and governing conditions. Despite the many uncertainties and approximations involved, a mass balance model should emerge that can be used to generate more robust determination of extraction thresholds.

1.3 Tutaekuri River

The Tutaekuri River setting is largely similar to that of the Ngaruroro; gravel transport ceases some 3-4 km from the coast, and thus it supplies mainly sand and silt to the Huamoana littoral cell. The catchment area is less than half that of the Ngaruroro, and thus flows and bedload yield are proportionately less. The river was subjected to over-extraction in 1991, leading to rapid entrenchment around bridges and destabilisation of stop banks between Taradale and Puketapu Bridge. This has resulted in a substantial reduction in gravel removal since then, with an average rate of about 15,000 $m^3{\cdot}yr^{-1}$ since the mid-1990s. Evidently modelling is still underway for the Tutaekuri; this should provide an instructive case study for understanding the limits of gravel extraction for these systems, as well as the anticipated recovery times following over-extraction in the larger river systems.

2. Part A: Application for Resource Consent

The key component of the 'proposed activity' is the extraction of gravel material. The rationale (Part A; Form 9) for the volume to be extracted is dependent upon (a) calculation and comparison of mean bed levels and reach volumes with bed level design grade lines; (b) comparison of the mean bed levels and reach volumes with bed level design grade lines; and (c) based on (a) and (b), an assessment of the sustainable extraction for the current year.

Mean bed level has a 'design grade line' for comparison, but it is not clear how volumes are used in the decision-making process. Mean bed level changes may not reflect lateral adjustments and changes to reach sediment stores. Cross-sections must be considered and analysed as a longitudinal pattern to determine any trends of system accumulation or deficit. Haschenburger and Cowie (2009), for instance, show the swings from positive to negative volumetric balance within different survey epochs in the Ngaruroro (their Figure 7), emphasising the variation in capacities for storage and transfer within these reaches and possible bedrock controls. This may also reflect the role of tributaries and major sediment source areas.

Upstream of a given reach, any developing aggradation or degradation trend might be expected to impact downstream reaches within the 3-year monitoring horizon. A deficit trend down-river or at the coast can propagate upstream, e.g. via knickpoint migration. Alternatively, an anomalous change at one cross-section with no concomitant changes upstream or downstream could indicate a transitory divergence that is not part of the larger system trajectory. Ideally, this evaluation of longitudinal trends should be one component of a broader effort to estimate the river sediment budget on a regular basis. There is little other recourse for understanding the system trajectory.

With a cross-section database that dates to the 1940s, it should be feasible for the applicant to demonstrate the typical range of reach storage volume variability and, crucially, the *rates* of change in both natural or managed regimes. Reaches that could be susceptible to rapid change can then be identified – some reaches are bound to be more resilient to disturbance than others, based on storage characteristics (e.g., Lisle and Church, 2002). By presenting this information, it can be made clear what sensible thresholds could be proposed as an acceptable quantum of change before extraction operations cease. These data would also provide some idea of recourse for ceasing extraction operations *before* bed degradation sets in (recalling the precautionary motive). In the current application, the reader is provided no insights into the potential magnitude or characteristic timescales of storage changes.

3. Part B: Assessment of Effects on the Environment

3.1 Management Plan

The overall concept of shifting the gravel extraction consent process over to HBRC would seem to be a reasonable initiative. This will reduce the administrative burden, allow for a centralised and pro-active management of the resource, and will facilitate a more collaborative and consultative process among iwi and stakeholders. The applicants have provided a good and reasonably comprehensive assessment of local site impacts (particularly ecological elements) and strategies for impact minimisation and mitigation. The economics of the scheme would appear to offer the best value for managing flood risk via gravel extraction. The aims of this gravel extraction initiative are shown to be consistent across multiple Regional and National mandates for resource management.

The suggestion of multi-year authorisations could use some further explanation, such as the potential time horizon and the conditions for granting these. It should be made clearer how this is consistent with broader management vision over the course of the 25-year plan.

3.2 Flood Protection

While HBRC's statutory flood hazard management responsibilities provide an important mandate for gravel extraction, the reviewers felt that the sections on flood protection (2.2) lacked much detail on particular areas that were subject to aggradation-induced exacerbation of flood risk, relative to gravel surplus or deficit. There is mention of hydrodynamic models (2.2; p. 8, 2.3.1; p.9), but the results from these studies do not appear to be brought to bear in this application. Some figures showing longitudinal trends in river bed build-up relative to infrastructure at residences at risk, with accompanying annotations of the maps in Appendix A, would help in this respect.

3.2 Monitoring

The gravel surveys are slated to occur every 3 years (Form 9, Pt 2; every 6 years for berm surveys and grain-size sampling), however the Gravel Advice Committee reassess annually (Form 9, Sec A, Point 2c). Presumably between survey years the committee will consider contractor's Annual Gravel Status Reports, as per Condition 23 of the Consent Conditions (Appendix B). It would be sensible to have annual surveys carried out some distance upstream and downstream of impacted reaches, to assess the achieved removal volumes, as well as any local impacts. There is passing mention of LiDAR or photogrammetry to improve monitoring, but no commitments to move in this direction (Section 4.2) – cross-sections are thought to be the most pragmatic tool for the job. A 3-year review is mentioned in Section 4.2 – it is not clear how this relates to the annual review (Who are the participants? What is the scope [ecology, substrate quality, water quality, coastal impacts]? What criteria, beyond bed levels and reach volumes, will be tested?).

While cross-sections have been effective as a monitoring tool for many decades, it should be emphasised that these give only a partial picture of sediment flux over time. Compensating erosion and deposition between cross section surveys (even surveyed within a few days), quickly leads to negative bias in the estimates of net volume change between surveys (Lane et al., 1994; Ashmore and Church, 1998; Lindsay and Ashmore, 2002; Brasington et al., 2003). Bedload transport estimates derived from such cross sections are therefore necessarily a minimum – material may transfer through without effecting any net change on morphology. This is particularly true for surveys taken every three years.

It could also be noted that changes in reach morphology (e.g. meandering, braided) are likely to be indicative of changes in sediment supply, and should constitute part of the monitoring feedback. The lower Waitaki River, for example, has been starved of sediment owing to hydropower infrastructure upstream, but bed levels have remained more or less constant. Signs of gravel deficit in this case manifest through narrowing of the braidplain, accompanied by a reduction in braiding activity and a tendency for flows to congregate in one or two principal braids (Hicks et al., 2009).

3.3 Effects on Coastal Sediment Supply

Section 4.7 of the applications does not provide a strong treatment of the question of coastal sediment budget; however, Appendix H at least provides some further context. Numbers are offered in 4.7, showing a deficit of material transferred across the coastal tract at the mouth of the Tukituki, with little commentary. It is difficult to resolve the different numbers in Section 4.7 and Appendix H, as only a few of the quantities would seem to agree. The earliest reference we could find for numbers in Appendix H is Tonkin and Taylor (2005). The Komar (2015) text is cited extensively, but it does not appear in any references, nor does it not appear to be accessible from the HBRC website.

The numbers, with a few exceptions, are provided as a simple balance sheet, with little indication of the pathways and routing, and more importantly, uncertainty or model output range. This is not acceptable for a 25-year management plan that is dealing with climate variation and changes in sediment supply arising from numerous factors. Yield rates from gravel abrasion, for instance, are notoriously difficult to characterize, even in studies from broader international literature, and could be expected to vary widely depending on the supplied sediment mixture, storm climate, beach configuration. Yet, this is somehow quantified to a precision of 100 m^3 in Appendix H. Yield from the lower Tukituki is assessed at 28,000 $m^3 \cdot yr^{-1}$, though extractions from this lower part of the river have averaged roughly 50,000 $m^3 \cdot yr^{-1}$ since 2000. There would appear to be a strong imperative for more detailed study in order to justify continued removals from this portion of the river, given the timescales for recovery of gravel stores.

These issues may be considered a minor in the broader framing of flood and erosion control for the catchment, but coastal hazard issues are a major concern in Hawke's Bay. The Clifton to Tangoio Coastal Hazards Strategy 2120 (2016) maps out the critical importance of managing the regional coastal sediment supply. The Coastal Hazards and Climate Change (2017) further emphasizes regional exposure to coastal risks. While the New Zealand Coastal Policy Statement (2010) is deemed irrelevant in Section 5.2.2, we feel that it would be well to invoke Policy 3 from this document:

*Adopt a **precautionary approach** towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse.*

3.4 Substrate Size Fractions

The report does not explicitly consider the relative proportion of grain size fractions, which may be extracted for various purposes. The dynamics of bed structure, entrainment and suspension of materials depend critically upon the fractions present on the bed and in the subsurface distribution. In our experience, extractors tend to preferentially target coarse grain size fractions (e.g. >45mm), resulting in significantly more sidecast materials, and more gross removal in order to obtain the consented volumes of quality aggregate. The Ngaruroro application (3.3) states clearly that demand for silt and sand is low.

It should be made clear which volumes of which fractions typically apply to contractor consents, and whether consented volumes pertain to *gross* or *net* extraction. For instance, if 75% of material is finer than the desired fractions, four times the volume of raw material must be excavated, and considerably more fine-grained, mobile material is left behind. The description of proposed activity states that they would like to extract the gravel *more efficiently* (3.1; p.21), although there is no qualification of this. The point should be clarified further.

3.5 Gravel Raking

Section 4.1.3 discusses the management of exotic vegetation on the channel, which is managed by gravel raking. This has no bearing on gravel extraction, and could be removed.

It is pointed out in Section 7 that gravel raking tends to enhance the mobility of material, for which there is growing evidence (cf. Warmen, 2014; Reeve, 2016), but there is no mention of the fact that the mobilised fractions would tend to be finer, overall, and the process is preferentially winnowing fine bed material and leaving coarser fractions behind. A lowering of the effective bank strength could result in wider, shallower flows that may not be as effective in transporting the imposed sediment load.

4. Consideration of alternative measures

The application provides little consideration of alternative mitigation measures for dealing with the principal problems: flood risk and land protection. We suggest there is scope for broadly considering other alternatives to solving the aggradation problem, including the creation of 'room to move' for the river (e.g. Biron et al., 2014; Buffin-Bélanger et al., 2015). By widening the river corridor at sites of notable aggradation, there is increased conveyance for flood flows, and the river has room to erode and modify the accumulated deposits. This point in the river's long profile is, after all, the former site of unconfined fans and braid plains, which dealt with aggradation by frequent switching and reworking of the deposit. This also creates more braided riverbed habitat, which is mentioned as being uncommon and important (Sec 2.6). Some further investigation into the feasibility of this would seem warranted.

This is one example – and there are likely good reasons for not accepting this model - but a considered review of alternative river management strategies would strengthen the justification for the proposed gravel extraction regime.

5. Conclusions

The three applications provide a reasonably comprehensive picture of key considerations for managing gravel extraction within their respective catchments, or more specifically the channelised river bed, ensuring that any potential effects are adequately avoided, remedied, or mitigated. The documentation provided as appendices provides some background on river ecology, potential impacts, economic drivers, and summary of current best practices within the New Zealand context.

A few important issues stand out:

(1) Climate and river hydrology, including the potential effects of climate change, are notably absent. Hydrologic and in-channel hydraulic drivers are principal concerns for forecasting sediment supply, and thus some assessment of variation and changing trends is warranted for any long-term endeavour, e.g. 10-year extraction consent or 25-year management horizon.

(2) Longitudinal bed level (ideally storage volume) trends should be considered in more detail. Longitudinal trends may signal a translating wave of surplus or deficit, and may show a cumulative response developing from multiple extraction sites. By the time mean bed level drops below design levels in the 3-yearly surveys, it may be too late to intervene and prevent

erosional response. A historic summary would be helpful, to show the range of natural, as well as extraction-induced variability, and to demonstrate how realistic decision-making thresholds could be developed.

(3) Changes in channel storage are not fully reflected in mean bed level measurements. This '1-dimensional' view of channel behaviour does not account for important changes in active lateral width, channel/floodplain configuration, and planform morphology, which could be signalling local sediment surplus or deficits without accompanying vertical changes. Some further criteria for evaluating reach condition should be included in the Annual Gravel Status Assessments

(4) Finally, we believe the proposal could be significantly strengthened with a more quantitative framework, and a completion of the analyses that are said to be in progress (Part B, 4.2). While the historic and forecast extraction volumes are quite precise, the reviewers could find *no estimates for rates of natural gravel supply and transfer*. In order to declare the management scheme to be a sustainable venture, it must be made clear what proportion of this resource is being captured, what margin of safety is required in order to maintain equilibrium, and in the case of over-extraction, what the pathway and timeline to recovery will be. The Ngaruroro modelling looks like a promising step towards this.

At present, the proposal is lacking rigour in important decision-making criteria, takes little consideration of long-term (25-year) management goals, and it leaves open many questions of accountability and transparency on the part of the consent granter (HBRC). A sustainable gravel management plan must be suitably evidence-based, in order to manage river and coastal systems with potentially complex modes of adjustment and long timescales of recovery. With the systematic presentation of the sediment budget for the river (including variability and uncertainty), and for coastal transfers, a much stronger case for sustainable extraction rates could be made. Without understanding the system and its linkages it is very difficult to explore and understand what impacts there may or may not be.

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MEMO

To:	Malcolm Miller
From:	Andy Hicks
Date:	4 December 2017
Subject:	**GRAVEL EXTRACTION CONSENT**
File Ref:	LU170123E etc
Cc:	

Hi Malcolm,

Thank you for providing the consent application and supporting information or the Council's proposed gravel extraction strategy.

I am supportive of the intent of the application, and note that the supporting information appears very thorough and provides enough material to enable meaningful discussions during the notification process.

I do not have any major concerns for this application, but I think there may be opportunity to improve on some things which I detail in notes below.

But to summarise, my main comments would be:

1. Provide some evidence (anecdotal and photos would be fine for me) that a buffer of 1m is enough to prevent an increase in suspended sediment downstream of the gravel activity
2. Explore how subcontractors will be held accountable for any deviation they make away from approved practice
3. Consider expanding the consented activity to include some flexibly around habitat enhancements (as approved on a case by case basis by by F+G, Science Manager etc.)

It is worth noting that overall I consider Council's river management activities to be beneficial to river ecology (albeit more with regards to gravel raking rather than this gravel extraction). My main concern relates to their being some distance between council and subcontractors, whereby policy does not always appear to be adhered to. I am also sure there will be some opportunities we could make better use of with some flexibility in the consent, so that the overall river management continues to become better at maximising ecological values.

Cheers,
Andy

Minor points below:
Page 21 3.4d: reference to 100m, 200m and 50m (with advice from expert) as minimum distances seems a bit inconsistent and could create uncertainty for what the minimum distance should be.

Page 22. 3.5: Not sure it is appropriate for a consent, but there will be a very large number of contractors operating under HBRC's consent and the chance of operators acting inappropriately may be high. I have seen dubious activities whilst at council without having to look too hard. And I think it is these inappropriate activities, which are not in compliance with the rules, that has given 'river management' a bad name amongst anglers, forest and bird etc. It is one thing to have excellent conditions, but if these are not adhered to it undermines the legitimacy of the management. One suggestion to help with this is that I think a log of complaints received, against which contractors, should be kept and the approach taken to solve any issues outlined, such that the management of subcontractor behaviour is very transparent and discoverable should council wish to review how well the process is being handled. This can also be made available to public enquiries.

P22 3.6.2: How has the value of '1m' buffer distance between gravel extraction area and active channel been determined? It seems quite close for a highly porous river bed material. Do we have observations that this has prevented muddy water in the extraction pits from seeping through and into the flowing river?

Proposed Conditions: Point 4: "The consent holder shall notify council five working days prior to any new extraction": suggest adding more stakeholders to this notification, or perhaps maintain a website with activities underway and those proposed. E.g. fish and game, forest and bird, science manager.

P32: Comment that Cawthron supports the 1m buffer: I note that Cawthron stated "in practice a one-metre buffer may not allow much tolerance between gravel works and the wetted channel". I would not extend this to say Cawthron supports the 1m buffer, but rather reinforces my question above of whether 1m is enough (and it may be – it would just be good to provide evidence to show 1m is enough – e.g. present photos of operations showing no sediment plume emerging despite only having a 1m buffer – Figure 14 looks like more than 1m to me).

Proposed discussion point: allow for there to be some "ecological enhancement" gravel extraction, which may include extraction from the wetted channel, as part of this consent. The purpose would be for deeper pools to be dug out of the rivers to provide better habitat for salmonids if the river systems appear to be losing their deeper pools. Or, for gravel pits to be dug deeper than they would normally be such that when they are reconnected they form a deeper pool. I think it could be incorporated into this consent, with a proviso that any activity is approved by Fish and Game, the Science Manager and perhaps the Department of Conservation. This would allow us to experiment with habitat enhancements while machinery is in the area where gravel extraction is occurring, as well as undergo experiments looking at rate of pool infilling. This addition could be considered part of an offset mitigation for the river management activity overall (although it is not clear whether river management is responsible for pools being filled in – hence the need for some experimentation – but there is certainly blame being aimed at Council so it would be good to be proactive in this area – and habitat enhancement would be useful regardless of what is causing the issue).