Review of the response by the applicant in relation to Environment Southlands (ES) request for more information relating to a resource consent application for three new marine farms in Big Glory Bay

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1.0 Background to the application

Zane Smith & Tim Maass-Barrett applied to Environment Southland to establish three marine farms in Big Glory Boy, Stewart Island. Sites 2 and 3 have been previously consented to Tim Maass-Barrett (April 1997), but these sites did not get Fisheries Permits and subsequently lapsed. Site 1 was identified as a potential marine farm site but has not been previously applied for due to the circumstances surrounding sites 2 and 3.

2.0 Job brief

Environment Southland asked Davidson Environmental Limited to review the response to their request for more information sent to the applicant on 5th June 2018. The ES request for more information included a series of comments generated by Davidson Environmental as part of a review of the science aspects of the application.review.

3.0 Scope of the assessment

The assessment by Davidson Environmental is limited to information presented in the Assessment of Environmental Effects (AEE) and the response from John Engel of Bonisch Environmental Limited (response document). For the purposes of the present assessment, the order of subjects follows the same presented in the response document. The response document presents comments related to (A) the ES request for more information and (B) the earlier review by Davidson Environmental Limited.

The aim of this assessment was to provide positive comment on the response and identify any aspects that may require further clarification at the hearing or to ES. Comments in the present assessment are therefore aimed at assisting Council and the Hearings Panel during decision-making.

Comments are restricted to biological aspects. Water column aspects are not discussed within this assessment.

4.0 Review of the response document

4.1 Farm coordinates (Page 1)

Source: Response document

Comments:

The response document outlines a coordinate correction to the original AEE (Map in Appendix 2). In relation to the biological data presented for the application site, there is no doubt that NIWA surveyed the correct application sites (Figure 1). The six stations sampled by NIWA are located within the farm boundaries (apart from the control site).

Opinion: No further clarification required in relation to biological work.

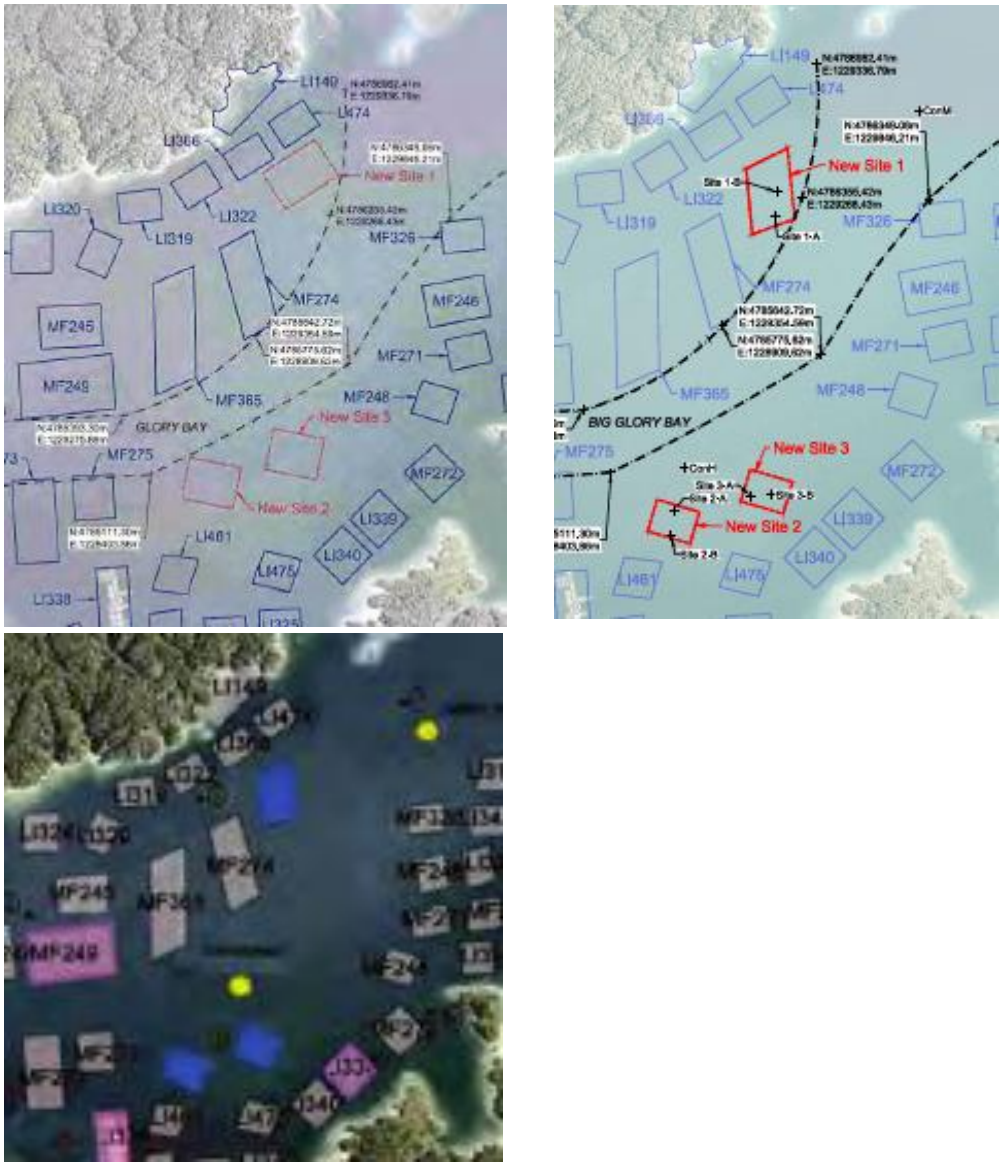

Figure 1. Location of AEE farms (red in top left aerial), corrected locations in response document (red in top right aerial) and NIWA report.

4.2 Description of the activity (Page 2)

ES Number 1: "In order to establish the full nature and extent of the proposed marine farming activities, please confirm the likely density of shellfish to be grown on each proposed marine farming site"

Comments:

The response provides a good outline of the proposed activities occurring at the three sites. This is a combination of spat holding, growing of secondary seed and final seeding (production farming). These activities likely vary from year to year depending on logistical and business constraints. I see no reason to regulate this aspect of the activity unless benthic areas are shown to support important benthic values (i.e. final production farming has the greatest benthic impact of the three activities). If one site or a part of one site was found to support benthic communities considered unsuitable for

production farming, an option would be to undertake only spat holding at that location (i.e. low impact activity).
Opinion: no further clarification required.

4.3 General description of effects (Page 2)

ES Number 2 "Please provide an overview of the general impacts of the shellfish farming, including references and relevant supporting extracts"

Comments:
The response outlines where a general description of effects was produced in the NIWA report and the AEE. These descriptions are based on (A) the literature, and (B) the applications. There is considerable literature on the impacts of mussel farms operating in a variety of environmental regimes. The key question is whether these sites will behave according to the literature of effects and if so is this going to threaten any biological values?
Opinion:
It is likely these sites would conform to the expected impact for sheltered and semi enclosed bays. It is also probable that the applications will exhibit impacts recorded from other mussel farms in the bay.

ES Number 3 "Page 9 of the AEE outlines that monitoring has not detected adverse effects of marine farming that extend significantly beyond the boundaries of each site. Please include a reference from the relevant monitoring reports within BGB, including relevant supporting extracts, and restricting the commentary to shellfish sites"

Comments:
The response document relies heavily on the statement extracted from the 13th Annual monitoring report, "As concluded in the previous surveys, at most farm sites, there is no evidence that the depositional effects from the mussel farming activity have caused significant changes to the epifaunal community apart from an increase in mussel densities."

The monitoring report has not been reviewed as part of the original review or the present review. It is noted, however, that the statement used the words "at most farm sites".

Opinion: The extent of mussel farm impacts away from production droppers is generally accepted in the literature to be approximately <30 m distance. This can mean impacts from shell debris and sediment extend outside the consent. This is not usually regarded as an issue provided there are no biological features of importance in this zone. Little or no data has been presented on the benthic attributes other than the six NIWA sample stations. It is probable that these sites are representative of the whole application sites as depths are consistent. It is suggested that the science provider provide comment

on this aspect to assure decision makers that results are likely to be representative of the wider application sites.

ES Number 4 "Please provide a brief summary of existing shellfish farm monitoring to date in BGB. The summary should take the form of a table outlining what monitoring has been conducted, where the monitoring has been conducted, and the overall finding for each instance of monitoring. This is requested to assist the reader to obtain an overall view of water quality and the benthic environment in BGB"

Comments:
The Table provided in the response document provides a brief summary of monitoring since 1997. This fulfills the request for a "brief summary" of what monitoring activity has occurred. It does not outline "the where" and "an overall finding summary" as requested by ES. It would be useful to the applicant to provide a brief outline of where monitoring has occurred since 1997 and outline a summary of findings. This information would assist with addressing the question of whether farms in the Bay conform to impacts described for mussel farms in the literature.

Note: it is not necessary to outline every instance of monitoring, rather a summary of findings sufficient to establish the impacts of mussel farms in the Bay. It is also noted that bacterial mats are related to salmon farm impacts and need not be included in this summary.

4.4 Biosecurity (Page 6)

Comments: The response document answers the question posed by ES confirming that no materials new to the Bay will be introduced.

4.5 Carrying capacity (Page 6)

Not covered in this review.

4.6 Benthic effects (Page 11)

ES Point 9 "page 13 of the application discusses benthic effects. Please provide an overview of the potential benthic impacts of shellfish farming, including references and relevant supporting extracts"

Comments:
See comments at Number 2 above. Mussel farm impacts are well documented. The key question is how farms in the Bay conform to the literature and whether the applications are expected to also conform. Based on the data provided, it is probable they will conform, however, this can also be commented on by the applicant's science provider.

Points 10, 11 and 12 (Pages 11 and 12):
Source ES letter
Comments:
Zinc and copper data have been collected from other sites in the Bay. The original source of these metals is related to salmon farming activities. Mussel farms are unlikely to result in increased sediment metal concentrations. No data is available on the applications, however, data from recent monitoring of other farms has been provided showing levels are not high (Table on page 12).
Opinion:
The response provides some historical use information in relation to the present sites. It is therefore probable these sites will conform to data from other sites in the bay. Levels will not increase if the applicant farms shellfish.

4.7 Discharges (Page 13)

ES Number 13 "in order to clarify the nature and extent of the proposed activity, please describe the discharge to water outlined on page 3 of the AEE in more detail, including:
(a) a description of the nature, volume, contents and frequency or rate of the proposed discharge;
(b) a description of the procedure for discharge;
(c) a description of the presence of biological matter (for example pseudofaeces, shell fragments and other biological debris); and
(d) a description of the procedure for preventing the discharge of inorganic materials (for example ties, fragments of mussel ropes, baskets, and trays)"

Comments:
The response document describes the standard process of harvesting and the associated discharges. This description outlines the activities and the discharges.
The impacts associated with mussel farms include the impacts from biological material washed back into the environment from which it came. Organic material discharged during harvests has an impact on the environment. The impact forms part of the overall impact on the environment that has been described by several authors (see Keeley *et al*., 2009 for review). It is probable that the harvesting discharge results in the single largest impact event over the crop cycle, however, I am not aware of any study that has attempted to separate the impact of harvesting from other farming activity (e.g. farm floating, float cleaning, backbone cleaning, seeding).

ES Number 14 "with regard to discharges arising from the proposed activities, please provide comment on:
(a) the sensitivity of the receiving environment;
(b) the nature of the contaminants to be discharged, the particular concentration of contaminants needed to achieve the required water quality in the receiving environment and the risks if that concentration of contaminants is exceeded; and

(c) the capacity of the receiving environment to assimilate the contaminants; and:
(d) avoiding significant adverse effects on ecosystems and habitats after reasonable mixing;
(e) using the smallest mixing zone necessary to achieve the required water quality in the receiving environment; and
(f) minimising adverse effects on the life-supporting capacity of water within a mixing zone."

ES asked for comment on six points and stated that information was "required by Policy 23(1) of the NZCPS, and also feeds into our consideration of Section 105 and 107 of the RMA"

The response document addressed the points on pages 15-17.

I consider the following to be key points in the response document:

(a) the sensitivity of the receiving environment;

Response document = "shellfish farming generally is at the low end of the impact scale in regard to effects on water quality and the benthic environment"

Comments:
Mussel farming detectable impacts are usually limited to <30 m distance of the growing structures. Impacts in this area are in the range of ES (environmental score) 3-4, where ES1 is pristine and ES8 is grossly polluted. Salmon farms can reach ES 7 and waters close to human cities are often ES 3-4. The response document is correct when it states shellfish impacts are at the lower end of the impact spectrum. Mussel farms result in some enrichment, small increases in sulphide, redox layer moving closer to surface, mussel shell debris and elevated fine sediment. Some species will decline in abundance, some will increase, and some will remain unchanged. The key issue is therefore to ensure the applications are not placed over an important natural feature that would be adversely impacted (e.g. biogenic reef, dense horse mussel bed, rhodolith bed). If they are placed on habitats and communities that are common and widespread in the area, the impacts are usually regarded by coastal managers as acceptable.

(b) the nature of the contaminants to be discharged, the particular concentration of contaminants needed to achieve the required water quality in the receiving environment and the risks if that concentration of contaminants is exceeded;

Response document = "In regard to suspended solids, the relevant provision is that visual clarity must not be diminished by more than 20% beyond a reasonable mixing zone. As the currents are not strong within the bay, wind is often the main cause of a

plume being formed but, based on experience on existing sites, such plumes are not significant and the suspended material settles within a short time."

Comments:
Organic material is removed from the water at various stages of the crop cycle, the mussels are separated and retained, and the remaining material including a variety of organisms are returned to the water. This usually creates a plume of sediment that originates from accumulated fine sediment on the mussel crop. This sediment has originated from the water column and has been concentrated by mussels during the production of psuedofaeces. All organic material that returns to the water has come from the water. Heavy biological material such as shell, crabs, tubeworms etc fall quickly to the seafloor. Sediment is lighter and can travel hundreds of metres before it reaches the benthos. The detectable impact on the benthos from fine material is generally limited to < 30 m distance.
It could be argued that a reasonable visual mixing zone for the fine sediment should be relatively large based on the organic composition of the material, its source being concentrated from the natural environment and its physical properties (i.e. lightness).

The response document states the applicant will abide by the Industry Code of practice regarding inorganic material (e.g. ties, lashings).

(c) the capacity of the receiving environment to assimilate the contaminants;

Response = "The concentration of stock causes a concentration of faeces and pseudofaeces in one place but not to the extent it creates a toxic environment, either in and around the lines or on the seabed, that will not continue to support marine life."

Comments:
As discussed above, shellfish farms usually have an impact between ES 3-4. This is well below an enriched state where species become dominated with pollution-indicating organisms. Big Glory Bay is sheltered and therefore likely to be at the sensitive end of the spectrum compared to high energy sites where impacts would likely be difficult to detect. Even in low energy mud-dominated environments, mussel farm impacts usually remain below ES 4, suggesting these environments can assimilate the continuation of shellfish farming activities.

(d) avoiding significant adverse effects on ecosystems and habitats after reasonable mixing;

Comments:
This has not been well addressed in the response document. The following comments provide some guidance. Shellfish farms result in a detectable impact within 30 m of growing structures. Although it is detectable, it is not usually regarded by biologists as adverse. Adverse is usually reserved for use in situations where detected impacts are at

a level that leads to serious or intense change. It can also be used when the impact occurs on a "special" habitat or community type that is sensitive, vulnerable or rare. It is suggested that the applicant's scientist confirms that (a) the literature shows shellfish farms in this type of environment do not lead to adverse impacts and (b) "special" or significant habitats or communities are not present under the application sites.

(e) using the smallest mixing zone necessary to achieve the required water quality in the receiving environment;

See comments in (b) above. Note: the mixing zone related to discolouration would likely be based on visual attributes and not impacts on benthic habitats or communities. It is probable that mussel farms act to improve water clarity by filtering sediment from the water in BGB. In this way, they act to improve water quality for most of their lifespan apart from the harvest events.

(f) minimising adverse effects on the life-supporting capacity of water within a mixing zone.

Comments:
This has not been well addressed in the response document. The following comments provide some guidance. In Marlborough, there has been considerable debate about the cumulative effect of mussel farms on food supplies (i.e. seston) for other species. The need for scientific study was recognised as early as 1995 but little work has occurred. In BGB, there are lower numbers of shellfish farms compared to the Marlborough Sounds and there are several salmon farms that produce nitrogen that drives the production of phytoplankton. This question is best answered at an industry level rather than imposing an expectation that each farmer embark on a long-term study. Further reassurance could be obtained from the calculation of CT (clearance time) / RT (retention time) ratio.

4.8 Codes of Practice (Page 17)

Response = "Yes to Aquaculture NZ, Marine Farmers Association for mussels and oysters, and Maritime New Zealand."

Comment: question answered.

4.9 Wildlife and habitats (Page 17)

Response = "There does not appear to be any specific studies carried out in Big Glory Bay so the overview in the Cawthron report is the most rigorous assessment that is

available to the applicants. No formal study or report on this aspect within Big Glory Bay is available.
Some anecdotal information is provided in the response."

Comments:
This aspect of the application has not been specifically dealt with, however, the literature has been cited.
The following comments provide some guidance but are based on general data and not data specific to BGB.
For wildlife (birds and marine mammals), the main issues are (a) exclusion and (b) entanglement. Provided the farmers minimise the escape of inorganic rubbish, this should not be an issue.

Entanglement (marine mammals):
There are two reported incidences of dolphin entanglement and death at a salmon farm in New Zealand, both from the Marlborough Sounds (M. Aviss, MDC). In one, an unidentified dolphin species became trapped while a predator net was being replaced, and in the other case, a Hector's dolphin became trapped under a predator net. Internationally, fatal entanglements of dolphins in predator nets on finfish farms have been reported from Australia (Gibbs and Kemper, 2000; Kemper and Gibbs, 2001; Kemper *et al*., 2003) and Italy (Díaz López and Bernal Shirai, 2007). This may reflect attraction of dolphins to a food source (Kemper and Gibbs, 2001) although such interactions between finfish farms and cetaceans have not been proven (Kemper *et al*., 2003).
There is also one record of a marine mammal becoming trapped or tangled in a mussel farm (i.e. a Bryde's whale) (Wursig and Gailey, 2002). The low incidence of mussel farm entanglements is probably related warps and backbones being under tension thereby reducing the chance of entanglement. This is in stark contrast to lobster pots that have a single line to the surface. This line is usually under little or no tension. Whales migrating up the east coast of the South Island pass hundreds of lobster lines that present a serious entanglement threat. A humpback whale first spotted by DOC staff near Banks Peninsula with a cray pot buoy line tangled around its tail stock and flukes then became entangled in mussel floats when it swam alongside a farm in Tory Channel several days later. This animal was cut free from the cray pot lines by a mussel farmer (Scott Madsen) and was released alive. Wursig and Gailey (2002) stated that entanglements by larger whales in aquaculture facilities are relatively rare events.

Displacement (marine mammals):
For dusky and common dolphins, mussel farms represent an area lost as foraging habitat (Clement and Halliday, 2014). It is unknown if this loss is important to these species. Some species, such as NZ fur seals, may be attracted to mussel farms as hauling out locations (Clement and Halliday, 2014; Davidson and Richards, 2017). Farm structures may also attract bottlenose dolphin, and possibly killer whales, due to these species' curious natures and the associated aggregations of possible prey species under and near

farms. Bottlenose dolphins have been frequently recorded 'sweeping' through mussel farms within the greater Admiralty Bay region (D. Clement, pers. comm).

Entanglement (birds):
Global entanglement of birds in inorganic pollution is significant. Provided the applicants adhere to the mussel industry Code, the risk of entanglement is minimised.

Exclusion (birds):
Many seabirds roost on mussel farm floats while some species feed within farms. In Marlborough, considerable contention exists over the potential exclusion of king shags by mussel farms. This question remains unanswered; however, recent Environment Court decisions have erred on the side of caution. The Stewart Island (Otago) shag and Foveaux shag are closely related but these populations are considerably larger than the king shag and the colonies more widespread.
If it exists, foraging data on these species would be helpful to determine if overlap exists between BGB farms and the foraging habitats of these species. This information may be available from DOC.

Final comment on wildlife:
Based on the literature, species of concern would be exclusion of area to dusky and common dolphin if they relied on BGB for foraging. Similarly, if Stewart Island (Otago shag) and/or Foveaux shags used BGB heavily, some comment on the effect of farms would be useful.

ES Number 17 (Page 19) "page 17 states that no specific habitat areas will be impacted by the proposed sites. Please provide a reference, including supporting extracts, that supports this"

Response = The survey identified those species for which the sites are considered to be their habitat and, for the most part, the species found are representative of what is found in the wider bay. Brachiopods were present and are regarded as sensitive to disturbance but they have also been found under mussel lines. Monitoring in the bay, as is stated in Section 4.4 of the application, has shown that the mussel sites have retained "… a moderately high species richness and diversity". However, changes will occur whereby some species will move out and other opportunist species will move in to make use of conditions that are better suited for them.

Comments:
The NIWA study sampled the biota at the three applications using drop camera (n=4 per site) and grab sampler (2 per site). As depths were relatively consistent at each site, it is assumed their samples are representative of the species and substratum over the wider site. Some species of brachiopods are of scientific interest and are a group known to be impacted by mussel faring activities (Davidson and Richards, 2014). The giant lampshell (*Neothyrus*) was recorded from two of the applications and also CM13-A and CM 13-B (control mouth stations). In their discussion (Page 27), the authors state this species is "common around Stewart Island, especially Paterson Inlet where they are protected in the local marine reserve." The authors also state they can be found under

mussel farms where they can be more abundant than adjacent dredge areas. Davidson and Richards (2014) also recorded giant lampshell under a retired mussel farm in the Marlborough Sounds, however, their abundance under droppers was lower compared to control areas suggesting they were impacted to some degree.
The key issue in this instance is their distribution in Paterson Inlet. NIWA state they are common around the Island and especially so in Paterson Inlet. It is presumed they are suggesting a reduction in their abundance at the present site would therefore represent a small loss.

It is not clear if the abundance recorded at the application sites are above or below densities known from the wider Bay. A comment from NIWA in this regard would be useful.

ES Number 18 (Page 20) "in order to address the effects of the proposal on indigenous biological diversity, please provide an assessment of the adverse effects on the matters listed in Policy 11(a)(i)-(vi) of the New Zealand Coastal Policy Statement 2010 (NCPS), in particular whether these effects are 'avoided' as required by the policy"

Response = "data collected deals with marine invertebrates. Marine mammal aspects rely on accumulated knowledge collected during years of use of BGB by marine farmers.

(i) no indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists have been identified on any of the sites;
(ii) none identified. Bottle nose dolphins are known to visit the area but hectors dolphins have not been reported. Even if they were to visit the area, the risk of mussel farming causing any impact is very low;
(iii) none identified on the sites proposed;
(iv) none identified on the sites proposed;
(v) none identified on the sites proposed;
(vi) no such areas exist within the bay but there is a marine reserve in Paterson Inlet, just outside Big Glory Bay."

Comments:

(i) Do nationally vulnerable Foveaux shag (*L. stewarti*) use BGB for foraging?
(ii) Bottlenose dolphins in Marlborough **do not** appear to be excluded from mussel farming water space. It is probable this applies to BGB.

ES Point 19 (page 21) "in order to address the effects of the proposal on indigenous biological diversity, please provide an assessment of the adverse effects on the matters listed in Policy 11(b)(i)-(vi) of the New Zealand Coastal Policy Statement 2010 (NCPS), in particular whether significant adverse effects are 'avoided'; and whether other adverse effects are avoided, remedied or mitigated; as required by the policy; "

Response: = "A response for each of the six matters was provided."

(v) Some comment on the use of the area by Stewart Island and Foveaux shag would be helpful to address relevant aspects of the NZCP.

4.10 Hazardous substances (page 22)

Response is acceptable.

4.11 Biosecurity (page 23)

Comments: Confirmation the applicant would abide by any restrictions imposed by regulatory authorities should be included as a condition in any granted consent. The applicant's willingness to advise authorities of issues is commendable.

4.12 Maintenance (page 24)

ES asked for a maintenance schedule.

Comments:
I do not believe this is feasible as farmers traditionally replace equipment on a case by case basis as equipment shows signs of wear. Line breakages can occur (e.g. tsunami) but these are rare and will snap even the best maintained lines. A common-sense approach to maintenance is suggested. Navigational aids do however, require a checking schedule (e.g. every three months).

4.13 Draft conditions (page 24)

Response: "The applicant advises they wish the standard conditions for the marine farms in BGB be applied. In regard to shellfish farming, the emphasis was on site selection, farming densities and "housekeeping" to control and limit potential adverse effects."

Comments:
In general, the literature and monitoring in BGB has shown that mussel farms do not result in adverse benthic impacts. Adverse impacts can occur if farms are placed in water space of sensitive species. The important aspect of this is whether that is considered acceptable or not acceptable. This review has identified a small number of aspects that need further clarification (i.e. giant lampshell, Stewart Island and Foveaux shag foraging) in order that the latter question can be better addressed.

4.14 Technical review (page 25)

The following section outlines the questions asked by Davidson Environmental in a science review and comments on the aspects that I consider still require comment from a science expert with experience in BGB.

Comments:
Most of the requests for more information have been outlined in the planner's response and the helpful statement from the applicants. There remain, however, biological aspects that required a response from a science expert (see below). These do not require additional field work, instead comments based on the literature and the expert's experience are likely sufficient.

The Davidson review stated
"Of note is the presence of *Neothyrus lenticularis* (giant lampshell). In Marlborough this species is negatively impacted by mussel farming activities (Davidson and Richards, 2014). This species is however, widespread over many areas in Paterson Inlet (Richardson 1981; Davidson, 2002). Some discussion about the relevance of adversely impacting this species should the farms be approved is suggested (i.e. how does their decline in abundance under the farms relate to the bigger picture of Big Glory Bay and Paterson Inlet). Would the loss be regarded as significant to this species in the Inlet or are they so common and widespread it would represent a small or minor loss?"

"Based on NIWA and other data presented or mentioned in the application, there appears to be a biological pattern from inner to outer Big Glory Bay. This trend appears to influence grain size as well as surface and within sediment dwelling invertebrates? A brief overview of bay-wide patterns based on a variety of reports and data would be helpful. Questions such as: are the application sites similar to inner, low diversity epifaunal sites or more similar to higher diversity epifaunal sites in the outer bay?"

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