Wilson Bay Interim Aquaculture Management Areas (AMAs) Final Evaluation Report

October 2009

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16 October 2009

Daniel Lees
Aquaculture Manager
Ministry of Fisheries

FINAL EVALUATION REPORT – ENVIRONMENT WAIKATO, WILSON BAY INTERIM AQUACULTURE MANAGEMENT AREAS, FIRTH OF THAMES

1. Purpose

1 This report provides you with a final evaluation of the request by Environment Waikato for an aquaculture decision on the Wilson Bay Interim Aquaculture Management Areas ("Interim AMAs") under section 37 of the *Aquaculture Reform (Repeals and Transitional Provisions) Act 2004* ("Reform Act").

2. Recommendation

2 This report recommends you:

(a) **Read** the contents of this report and all its attachments;

(b) **Note** that after having regard to all the matters required under the Reform Act, considering the submissions by persons and organisations you consider represent the classes of persons having a customary, commercial, or recreational fishing interest in the Interim AMAs, and assessing the relevant information, the Ministry of Fisheries ("MFish") does not consider the Interim AMAs would have an undue adverse effect on fishing or the sustainability of fisheries resources; and

(c) **Agree** to make a final decision for a **determination** over all the Interim AMAs if you are satisfied the activities contemplated in the Interim AMAs would not have an undue adverse effect on fishing or the sustainability of fisheries resources.

3. Executive Summary

3 Environment Waikato has requested an aquaculture decision under section 37 of the Reform Act in relation to the Interim AMAs.

4 A preliminary decision for a determination over all of the Interim AMAs was made on 30 March 2009 and released on 9 April 2009, inviting comments from interested and affected parties before a final decision was made.

5 Following on from the preliminary decision, MFish has again assessed the Interim AMAs having regard to all the matters under section 40 of the Reform Act, and considering all the submissions made by those consulted.

6 Based on this assessment, MFish is satisfied the Interim AMAs will not have an undue adverse effect on fishing or the sustainability of fisheries resources, and recommends that you make a determination in line with that assessment.

4. Wilson Bay Interim AMAs

7 On 20 March 2008, Environment Waikato requested that MFish make an aquaculture decision in relation to areas in Wilson Bay, Firth of Thames declared as the Wilson Bay Interim AMAs (refer Appendix 1 for the request and Order in Council).

Firth of Thames

8 The Firth of Thames extends north from the Hauraki Plains into the Hauraki Gulf. Its eastern boundary is the Coromandel Peninsula. The Firth is a large, shallow estuary, fed by several rivers (notably Waihou and Piako) at its southern end and opens onto the Hauraki Gulf at its northern end. Water depths vary between 0 m and 10 m in the southern half of the Firth but increase to between 10 m and 40 m further to the north. Mud dominates the floor of most of the estuary, giving way to sands as it opens onto the Hauraki Gulf.

Wilson Bay Marine Farming Zone

9 The Wilson Bay Marine Farming Zone (WBMFZ) is located in the Firth of Thames, around 1.75 km offshore of Kereta (Figures 1 and 2).

10 The Wilson Bay Marine Farming Zone comprises two subzones of marine farming space, with a 1 km gap between the two subzones. The two subzones are:

(a) Area A—totals around 1,400 ha, including 690 ha of existing farm blocks (deemed AMAs) and around 710 ha of access ways that lie between each marine farm block.

(b) Area B—totals around 1,072 ha; 520 ha of proposed farm blocks and 552 ha of access ways to lie between each marine farm block.

11 The total farmable space within the WBMFZ is 1,210 ha. However, with the access way requirements, the actual space covered by the Marine Farming Zone is around 2,473 ha.

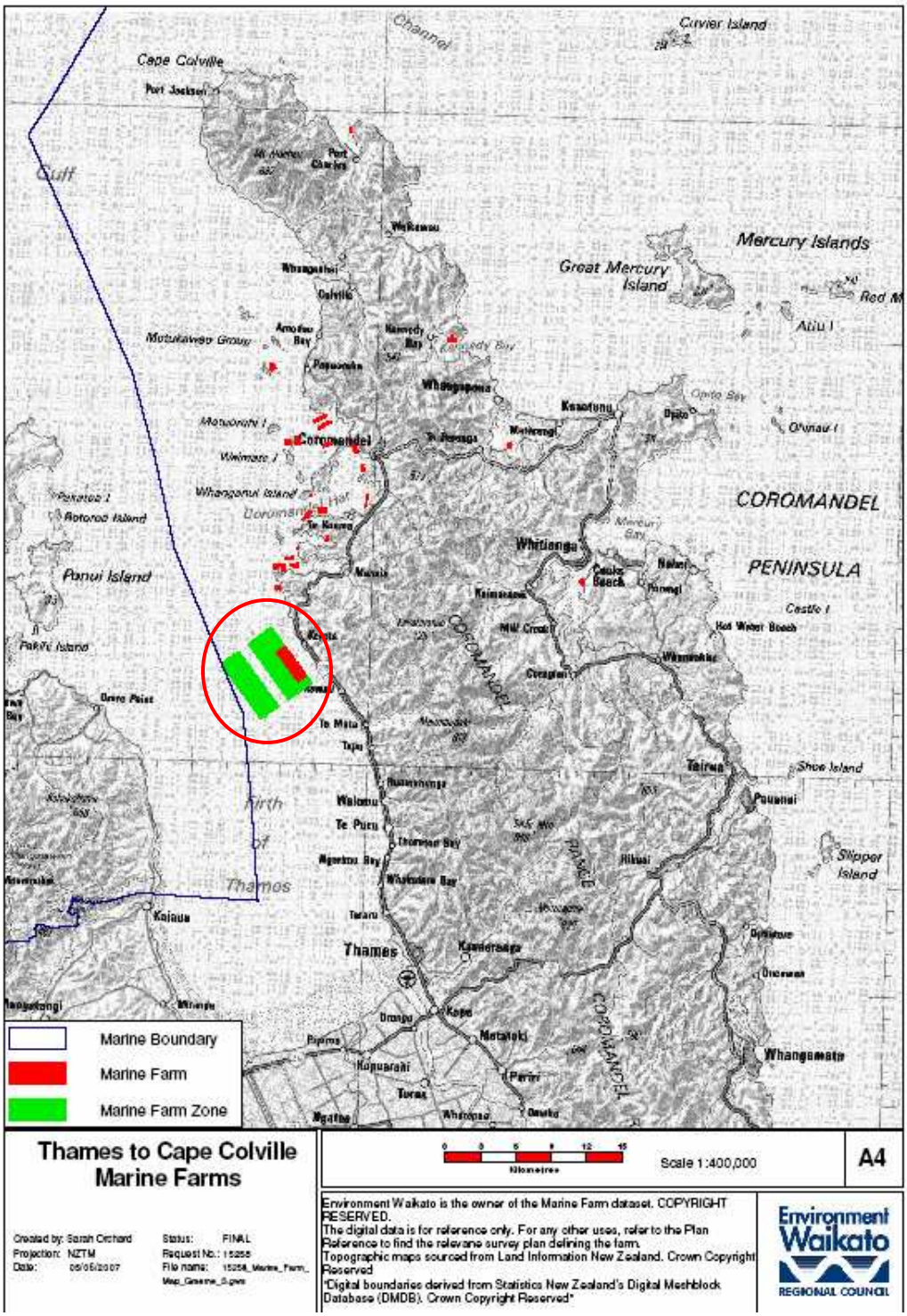

Figure 1: The location of the Wilson Bay Marine Farming Zone in the Firth of Thames, circled red.

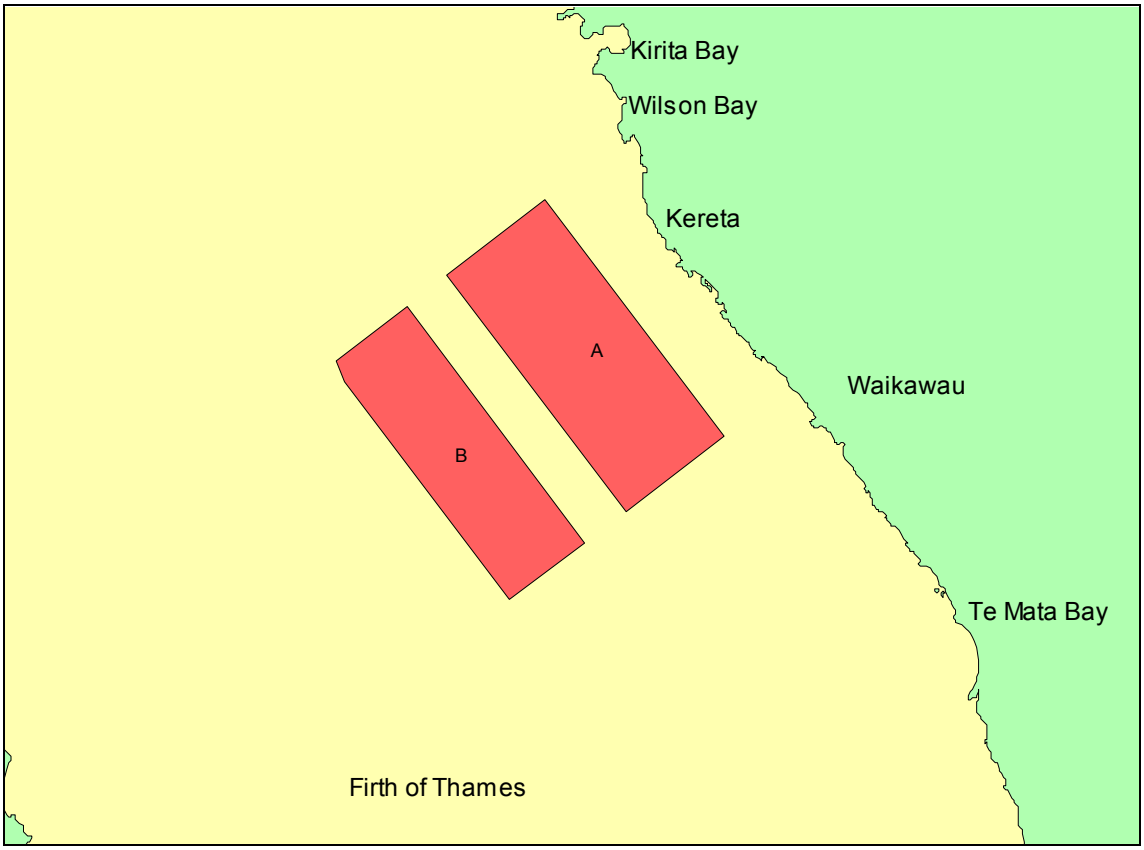

Figure 2: The location of the Wilson Bay Marine Farming Zone, at a finer scale.

Wilson Bay Interim AMAs

12 The Interim AMAs consist of (Figure 3):

(a) The area between and around the existing authorisations (around 710 ha) within Area A[1]; and

(b) All of Area B (1,072.56 ha), of which 520 ha is farmable space.

13 Environment Waikato's operative Regional Coastal Plan currently limits aquaculture within Area A and Area B to mussel farming and spat catching, and oyster farming. The plan also stipulates that new farms within Area B will be a maximum of 12.5 ha, with an access way of 75 m between each adjacent marine farm. And, under staged development rules, the council will only allocate 260 ha of farms first (ie, half of the 520 ha of farmed space allowed in Area B).

[1] This area will not contain new structures.

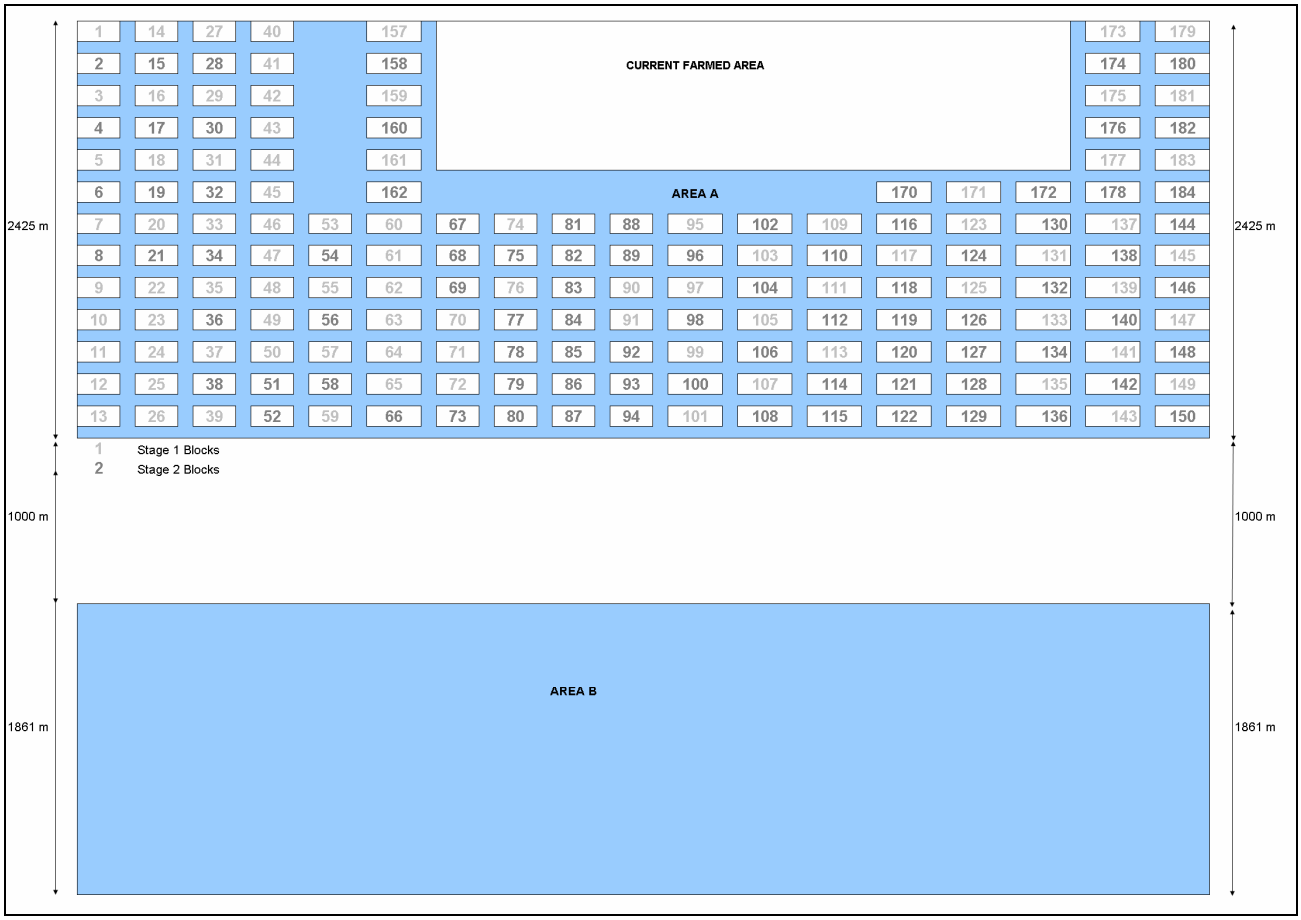

Figure 3: The Wilson Bay Interim AMAs is the blue shaded areas around existing farm blocks in Area A and all of Area B. Note this diagram is not to scale.

Future Regional Coastal Plan Changes

14 Under rule 16.5 of the Waikato Regional Coastal Plan, existing marine farming space can only be used for shellfish farming (more specifically mussel farming, spat catching, and oyster farming) provided it complies with the standards and terms for the activity in Rules 16.5.3 or 16.5.4.

15 Environment Waikato is considering a plan change to allow other types of aquaculture including finfish farming in the existing marine farms. Finfish farming is currently a prohibited activity by virtue of Rule 16.5.6 of the Waikato Regional Coastal Plan.[2] In making an aquaculture decision, MFish has considered the matters required under the Reform Act in the context only of shellfish farming, as currently provided by the Regional Coastal Plan.

16 Pursuant to section 41(1) of the Reform Act, if an aquaculture decision is a determination based on a rule in the Regional Coastal Plan relating to the character, intensity, or scale of the occupation of the Interim AMAs by aquaculture activities, then the rule may not be revoked or amended until the chief executive makes a further aquaculture decision in relation to the area

[2] Rule 16.5.6 of the Waikato Regional Coastal Plan provides that the erection, placement, use of, or occupation of space by any marine farming structure that is not otherwise provided for by Rules 16.5.1, 16.5.2, 16.5.3, 16.5.4, 16.5.5 or does not comply with the standards and terms for an activity in Rules 16.5.3 or 16.5.4 is a prohibited activity for which no resource consent shall be granted.

affected by the revocation or amendment. Therefore, if Environment Waikato proposes to revoke or amend rule 16.5.6 of the plan to allow, for example, finfish farming in the existing marine farms, or marine farming within the accessways, then the chief executive will be required to make a further aquaculture decision in relation to Interim AMAs or parts of the Interim AMAs affected by the revocation or amendment.

5. Statutory considerations

17 An aquaculture decision in relation to an Interim AMA is made under the Reform Act. The purpose of the Reform Act is to provide for transitional matters relating to the ending of the moratorium under the Resource Management Act 1991. Sections 34 to 44 of the Reform Act focus specifically on Interim AMAs.

18 Section 38 requires the chief executive to make an aquaculture decision.

> **Section 38 - Chief executive to make aquaculture decision**
>
> (1) Within 6 months after receiving a request for an aquaculture decision under section 37, the chief executive must—
> (a) make a determination; or
> (b) make a reservation; or
> (c) make 1 or more determinations or reservations or both in relation to different parts of the area.
>
> (2) The chief executive may request the regional council that requested the aquaculture decision and any person whose interests may be affected to provide him or her with further information about the effects that the interim aquaculture management area would have on access to or displacement of fishing or the sustainability of fisheries resources.
>
> (3) For the purposes of subsection (1), the period beginning on the day when a request for further information is made and ending on the day when the information is provided is excluded from the 6-month period referred to in subsection (1).
>
> (4) Before making an aquaculture decision, the chief executive must—
> (a) consult the persons and organisations that the chief executive considers represent the classes of persons having a customary, commercial, or recreational fishing interest in the interim aquaculture management area; and
> (b) consider any submissions made by those persons and organisations.

19 A 'determination' in relation to an Interim AMA is defined in section 35 as 'a decision by the chief executive that he or she is satisfied that the interim aquaculture management area will not have an undue adverse effect on fishing or the sustainability of fisheries resources'.

20 A 'reservation' in relation to an Interim AMA is defined in section 35 as 'a decision by the chief executive that he or she is not satisfied that the interim aquaculture management area will not have an undue adverse effect on fishing or the sustainability of fisheries resources'.

21 Section 40 establishes mandatory considerations for the chief executive in making an aquaculture decision in relation to an interim AMA:

> **Section 40 - Matters to be considered by chief executive**
>
> In deciding whether to make a determination or reservation, the chief executive must have regard only to the following matters:
>
> (a) the effect of the interim aquaculture management area on—
> (i) the biological diversity of the aquatic environment:
> (ii) the productivity and biological abundance of fisheries resources:

(iii) habitats of known significance for fisheries management:

(b) the location of the interim aquaculture management area in relation to areas in which fishing is carried out:

(c) the effect of the interim aquaculture management area on fishing of any fishery, including the proportion of any fishery likely to become affected:

(d) the degree to which aquaculture activities within the interim aquaculture management area will lead to the exclusion of fishing:

(e) the extent to which fishing for a species in the interim aquaculture management area can be carried out in other areas:

(f) the extent to which the interim aquaculture management area will increase the cost of fishing:

(g) the cumulative effect on fishing of any previous aquaculture activities.

22 Section 41 establishes the requirements for an aquaculture decision.

Section 41 - Requirements for aquaculture decision

(1) An aquaculture decision must—
- (a) be in writing; and
- (b) define the areas that are subject to the decision; and
- (c) provide reasons for the decision; and
- (d) If the decision is a determination based on a rule in a regional coastal plan or proposed regional coastal plan that relates to the character, intensity, or scale of occupation of the interim aquaculture management area by aquaculture activities,—
  - (i) specify the rule; and
  - (ii) state that the rule may not be revoked or amended until the chief executive makes a further aquaculture decision in relation to the area affected by the revocation or amendment; and
- (e) be notified to the regional council.

(2) If the chief executive makes a reservation, the reservation must also include—
- (a) whether the reservation relates to customary, recreational, or commercial fishing or a combination of them; and
- (b) if the reservation relates only to commercial fishing, the stocks and areas concerned, specifying any stocks subject to the quota management system, any stocks or species specified in Schedules 4C and 4D, and any stocks for species not subject to the quota management system; and
- (c) any other matters required by regulations to be included.

6. Undue Adverse Effects on fishing or the sustainability of fisheries resources in relation to the Interim AMAs

23 Neither the phrase "undue adverse effect" nor that of "adverse effect" is specifically defined in the Reform Act. The ordinary meaning of "adverse effect" would mean a contrary or injurious result or consequence.[3] In the context of an aquaculture decision in relation to an Interim AMA, "adverse effect" would generally mean a contrary or injurious result or consequence on fishing or the sustainability of fisheries resources by the Interim AMAs under consideration.[4] Turning to the phrase "undue adverse effects", the ordinary meaning of "undue" is "unwarranted or inappropriate because excessive or disproportionate".[5] In such circumstances, an undue adverse effect will

[3] The Concise Oxford Dictionary (10th Edition) provides the meaning of "adverse" as "contrary or injurious", whilst the meaning of "effect" is provided as "result or consequence".

[4] The Fisheries Act 1996, which also regulates aquaculture, may be considered part of the contextual framework for the interpretation of the Reform Act. The Fisheries Act defines "adverse effect" in relation to fishing to mean "to restrict access for fishing or to displace fishing" (see section 186C).

[5] The meaning of "undue" in the New Zealand Oxford Dictionary (2005) means "excessive or disproportionate".

necessarily need to be significantly more than an effect that is just contrary or otherwise injurious as a result of the Interim AMAs under consideration. Rather, any such adverse effect would need to be unwarranted or inappropriate because excessive or disproportionate.[6]

24 The test for "undue adverse effects" on fishing and the sustainability of fisheries resources requires the chief executive to consider relevant matters as provided in legislation from which the test arises. Section 40 of the Reform Act provides the matters which must be properly considered by the chief executive in making an aquaculture decision in relation to the Interim AMAs. The chief executive must also consider any submissions made by persons and organisations consulted under section 38(4), before making his decision. The weight to be given to each relevant matter is a matter of discretion for the chief executive to satisfy himself that adverse effects (if any) on fishing or the sustainability of fisheries resources are not undue.

25 The exercise of the chief executive's discretion is limited by the scope of the empowering provisions of the Reform Act and by principles of administrative law. Limits on the chief executive's discretion imposed by administrative law, include requirements that the decision must take into account relevant matters and not irrelevant matters; be fair and reasonable; not be made for an improper purpose (ie, one made outside the ambit of the empowering statute); and not apply a pre-determined policy without regard to the particular merits of the case.

26 In each case, the chief executive must use his subjective judgement in making his decision after all the relevant matters have been properly considered. If, in the exercise of his judgment, the chief executive is satisfied that the adverse effects are not undue, the chief executive will make a determination. On the other hand, if the chief executive is not satisfied that the adverse effects are not undue, the chief executive will make a reservation.

What constitutes an Undue Adverse Effect on the sustainability of fisheries resources?

27 An undue adverse effect by an interim AMA on the sustainability of fisheries resources would need to be significantly more than an adverse effect that is just contrary or injurious. Rather, such adverse effect by an interim AMA would need to be so excessive or disproportionate that the sustainability of fisheries resources could not be ensured.[7] In each case, the subjective judgement of the chief executive would need to be exercised carefully in balancing all the relevant matters in deciding the question of whether an adverse effect on the sustainability of fisheries resources is undue. Each assessment would be made on a case by case basis, ultimately depending upon the factual circumstances of each case.

What constitutes an Undue Adverse Effect on fishing?

28 An undue adverse effect by an interim AMA on fishing (commercial, customary and recreational) would need to be significantly more than an adverse effect that is just contrary or injurious. Rather, such adverse effect by an Interim AMA on fishing would need to be so excessive

[6] Similarly, in the context of the definition of "adverse effect" provided in section 186C of the Fisheries Act 1996, an undue adverse effect would necessarily need to be significantly more than just a restriction to access for fishing or to displace fishing. Rather, such restriction and/or displacement would need to be excessive or disproportionate.

[7] In this regard, it was observed in the context of the recent Tasman decision (page 104 of the final evaluation report) that "[a]n UAE on the sustainability of fisheries resources would be one that prevents the maintenance of the productivity of fisheries resources indefinitely, at a level which provides for continual use."

or disproportionate, that fishing would be unreasonably restricted or displaced.[8] In each case, the subjective judgment of the chief executive would need to be exercised carefully in balancing all the relevant factors in deciding the question of whether an adverse effect on fishing is undue. Each assessment would be made on a case by case basis, ultimately depending upon the factual circumstances of each case.

7. Consultation

29 Section 38(4) of the Reform Act requires the chief executive to consult – prior to making an aquaculture decision – with the persons and organisations that the chief executive considers represent the classes of persons having a customary, commercial or recreational fishing interest in the Interim AMAs. Following on from such consultation, the chief executive must consider any submissions made by those persons and organisations.

30 In the context of this application, MFish has placed utmost importance on meeting its consultation requirements and has therefore consulted extensively.

31 On 8 August 2008, MFish sent initial invitations for submissions to those persons and organisations the chief executive considered potentially affected by the Interim AMAs. Invitations also informed recipients about a public meeting to be held in Thames on 26 August 2008. A notice was also published by MFish in both the *New Zealand Herald* and the *Hauraki Herald* on 22 and 23 August 2008 respectively, notifying the public of MFish's consultation process, including the fact that a public meeting was to be held in Thames about the Interim AMAs on 26 August 2008. The public notice specifically stated that MFish was consulting on the Interim AMAs and was asking fishers with an interest in fishing or fisheries resources in the Firth of Thames to provide information on the effects that the proposed Interim AMAs would have on their fishing activities and fisheries resources. At that meeting, MFish representatives outlined the process to be followed for the decision on the Interim AMAs and made it known that MFish was wanting all and any relevant information from stakeholders to assist MFish as it started to consider the Interim AMAs. MFish also offered to meet individually with fishers, if so requested.

32 On 30 March 2009, MFish completed its preliminary evaluation on the Interim AMAs. The MFish preliminary decision was that a determination could be issued on the entire area of the Interim AMAs on the grounds that MFish was satisfied the Interim AMAs would not have an undue adverse effect on fishing or the sustainability of fisheries resources. (The complete preliminary report and decision is attached as Appendix 2).

33 The preliminary evaluation and decision on the Interim AMAs was released on 9 April 2009. All parties who had submitted or who had specifically requested to be notified of the release of the preliminary decision were notified by MFish accordingly. MFish also issued a press release and posted information on the preliminary decision on its website. (Copies of the notification and press release are attached in Appendix 3). Notification of the release of the preliminary decision specifically advised that further submissions could be provided before a final decision was made and that the deadline for submissions was 15 May 2009.

[8] In this regard, it was observed in the context of the recent Tasman decision (page 66 of the final evaluation report) that "[a]n UAE on fishing would be one where fishing would be negatively affected to an extent that could not be accommodated or adjusted for without significant net loss". It should also be noted that both quantitative and qualitative matters may be relevant when determining if an adverse effect is not undue or may be undue, and therefore a purely percentage based approach may not be appropriate in all circumstances.

34 In the lead-up to the deadline, MFish had numerous exchanges of correspondence with a number of parties and received a total of seven submissions from:

- Jodie Campbell (on behalf of the Leigh Commercial Fishermen's Association);
- Robin Brittan (on behalf of Fisheries Consultancy Services Ltd);
- Stephen Martin;
- Barry and Megan MacKie;
- Hamish MacKie;
- Ian James; and
- Graeme Bailey.

35 MFish also received a second late submission from Leigh Commercial Fishermen's Association (in addition to the submission from Jodie Campbell). (Full copies of all the submissions MFish received in respect of this matter after the preliminary decision was released are attached in Appendix 4).

8. Assessment of undue adverse effects of the Interim AMAs on the sustainability of fisheries resources (section 40 of the Reform Act)

36 In making an aquaculture decision, the Chief Executive must have regard only to the matters in section 40 (a) through (g) of the Reform Act when evaluating effects on the sustainability of fisheries resources.

37 This Part provides an assessment of the effect of the Interim AMAs on the sustainability of fisheries resources[9] having regard to the nine matters provided in section 40 of the Reform Act.

38 In reality, it is very difficult to analyse the effect of the Interim AMAs as provided under section 40(a)(i), (ii), and (iii) of the Reform Act because the natural environment is such a dynamic system and many factors influence the way in which the ecosystem, and aquatic species within it, respond. MFish accepts there will always be a degree of scientific uncertainty when assessing the effects of an Interim AMA on the sustainability of fisheries resources, and the decision maker needs to recognise and take this uncertainty into account when making the decision.

[9]The effects of marine farming on fisheries resources are explained in more detail in Appendix 5 of the preliminary decision (see Appendix 2 of this report). The specific effects identified are recognised as covering the range of potential effects of marine farming on the sustainability of fisheries resources and were developed as part of the document 'A Guide to Preparing a Fisheries Resource Impact Assessment' in 2002, listed in Technical Appendix I of that document.
The guide was developed to outline the ecological investigation requirements for marine farming and spat catching permit applications under s 67J and s 67Q of the Fisheries Act 1983. Although Interim AMAs are processed under s 40 of the Aquaculture Reform (Repeals and Transitional Provisions) Act 2004, the effects of marine farming on the aquatic environment remain the same. The guide was finalised after consultation with the aquaculture industry, tangata whenua, research providers and other interest groups.

Section 40(a)(i) of the Reform Act - The effect of the Interim AMAs on the biological diversity of the aquatic environment

39 The assessment of the effect of the Interim AMAs on the biological diversity of the aquatic environment is discussed in the following sequence:

(a) Seabed effects of the Interim AMAs on the biological diversity

(b) Water column effects of the Interim AMAs on biological diversity

(c) Effects of the Interim AMAs on the biological diversity of fishstocks

(d) Effects of the Interim AMAs on the genetic biological diversity of local mussel populations

(e) Effects of the Interim AMAs on the biological diversity of associated and dependent species

(f) Conclusion

(a) Seabed effects of the Interim AMAs on biological diversity

40 The existing benthic fauna and infauna observed at the Interim AMAs were not diverse and the community consisted of relatively common species typically found in mud habitat in the Firth of Thames and around New Zealand (NIWA 2008). Biodeposition may decrease the biological diversity of the benthic community by causing a decline in species intolerant to deposition or organic enrichment.

41 MFish considers the predicted peak quantities of biodeposition ($15g/m^2$/day and much less outside the boundaries of the farm[10]) are not substantial. Predicted flushing times for the Interim AMAs are reasonably fast, between 15 and 30 hours, depending on wind conditions. Currents around the Interim AMAs are relatively strong[11] and any reduction in currents from the placement of marine farming structures is likely to be small (refer paragraphs 108-109 of preliminary evaluation report for likely changes in current speeds; Appendix 2). With a relatively fast flushing time and good current speeds, MFish considers biodeposits would likely be relatively well dispersed and accumulation is unlikely to be substantial.

42 With relatively low quantities of biodeposition and good flushing, MFish considers there are unlikely to be major alterations to the benthic species composition. MFish notes there are already enrichment-tolerant species present in the benthic community at the site and this also suggests any change to the biological diversity of species at the site would likely be small.

43 Biodeposition is likely to be more intense directly beneath the longline structures than in the buffer areas between marine farming blocks. As such, any effects on biological diversity would likely be localised changes beneath the longline droppers rather than uniform changes across the Interim AMAs.

[10] NIWA has modelled the total faeces and pseudofaeces production rates as an average over the entire farming zone, including the buffer strips between marine farming blocks. The buffer areas are approximately 50% of the total area of Area B. Therefore, it is likely deposition would be even lower in some parts of the Interim AMAs than predicted.
[11] Around 23-25 cms^{-1}, up to 43 cms^{-1}.

44 MFish also notes natural sources of sedimentation into the Firth from river discharge provide the main source of sediment to the area of the Interim AMAs and, as such, MFish considers the effects of natural sedimentation is likely to outweigh the effects of biodeposition from marine farming. Additionally, MFish considers it likely the majority of species at the site are already tolerant of some sedimentation from natural sources and adding biodeposition from the Interim AMAs would be unlikely to substantially increase sedimentation.

45 In addition, sediments at the site have typical levels of organic matter content and are not anoxic. Monitoring of existing marine farming in Area A showed no anoxic conditions or substantial increase in organic matter content. Given the close proximity and similar environmental conditions experienced at the Interim AMAs, MFish considers large changes to biological diversity from changes in the sediments would be unlikely.

46 Submitters suggest biofouling species such as mussel whisker and sea squirt fall from the farm structures and create organic debris that accumulates on the seabed. MFish considers any biofouling species from the Interim AMAs would likely affect the same area currently affected by biofouling species from the existing farms (i.e. biofouling species would travel south along the shore with the current and tide). Although the quantity of biofouling species may increase, MFish considers the area affected would not significantly increase. This is because the prevailing currents and tides would remain the same and likely carry biofouling species from the Interim AMAs in a southerly direction and towards the shore.

47 The habitats potentially affected by the biofouling species footprint are common throughout the Firth and wider Hauraki Gulf. NIWA has observed few changes in the benthic community beneath the existing farms. Therefore, although biofouling species may accumulate in the area, it does not appear to have excessive or disproportionate effects on the benthic community.

48 MFish considers the organic debris would not prevent flatfish from migrating to the southern end of the Firth. Flatfish are known to swim across a range of habitats during their annual migrations. There is also a large corridor down the middle and western side of the Firth that is not affected by biofouling species along which flatfish could still travel. As such, MFish considers the biofouling species accumulation is unlikely to have undue adverse effects on the biological diversity of the aquatic environment.

49 Mussel clumps (including live mussels) and shell deposition on the seafloor could create new reef-like habitat that in turn may attract and support new communities that live on or in hard surfaces (see paragraph 138 of the preliminary evaluation report for more detail on specific species). Biological diversity may increase if the creation of reef-like habitat on the seafloor attracts species not present in the area. However, in areas where reef-like communities occur, there may also be some loss of soft sediment preferring species such as polychaete worms and heart urchins that become intolerant of the harder substrate. Whether there would be a net increase or decrease in biological diversity from the creation of reef-like habitat is unknown.

50 However, effects on biological diversity from shell drop are likely to be localised beneath and close to the longlines in the Interim AMAs as shell deposition is generally unlikely to spread outside the boundaries of the farmed areas. MFish considers it unlikely localised changes in biological diversity would adversely affect the sustainability of fisheries resources at a wider regional scale.

51 The new marine farming structures would cause some shading of the seabed. There would likely be some reduction in light levels reaching the seafloor. However, the benthic community at

the Interim AMAs does not comprise light dependent species, such as beds of macro-algae growing on the seafloor. As such, a reduction in light levels is unlikely to adversely affect the biological diversity of the fisheries resources at the Interim AMAs.

(b) Water column effects of the Interim AMAs on biological diversity

52 MFish has limited information on how uptake of plankton by mussels in the Interim AMAs would affect phytoplankton or zooplankton community composition, which plankton species would be most susceptible to uptake by mussels, or the extent to which uptake may occur. However, MFish recognises farmed mussels have the potential to alter phytoplankton and zooplankton community composition, either through direct uptake or competition with zooplankton for food resources. It is also possible plankton uptake by farmed mussels may decrease the diversity of some plankton life stages or some plankton taxa, particularly those zooplankton taxa that regenerate slowly. If this occurs, there could be a potential shift towards dominance of the community by fast growing taxa. But MFish considers any change in phytoplankton or zooplankton community composition would not be so excessive or disproportionate as to have undue adverse effects on the sustainability of fisheries resources.

53 MFish considers existing marine pest species in the Firth would probably create a localised diverse and productive fouling community on the structures in the Interim AMAs, increasing the diversity of fouling species in the Interim AMAs. However, MFish considers the new marine farming structures would be unlikely to introduce *new* pest species to the area. As such, there would not be large changes in biological diversity on a wider regional scale.

(c) Effects of the Interim AMAs on the biological diversity of fishstocks

54 MFish considers the Interim AMAs may result in some localised changes in the fish species present around the Interim AMAs. For example, new structures in the water column colonised by a diverse and productive fouling community may alter the area's suitability (positive or negative) for some fish species. But effects would probably occur in a species-, site- and region- specific way due to the different species that may be present and because each species would have unique responses to artificial habitat (Gibbs 2004; Cawthron 2009).

55 MFish considers there would likely be some effect on the composition of fish species around the Interim AMAs; however, in reality, whether the Interim AMAs would result in a net increase or decrease in biological diversity, or which species would be affected is unknown. But any changes to the biological diversity of fish would likely be localised effects and would not affect the wider composition or distribution of fish species found in the region because the structures would occupy only a discrete area of the Firth of Thames.

(d) Effects of the Interim AMAs on the genetic biological diversity of local mussel populations

56 Studies of genetic structuring within populations of *Perna. canaliculus* (green-lipped mussel) have consistently demonstrated high levels of genetic variation within the species (Cawthron 2009). Transferring and introducing stock from other parts of the country may affect the genetic distinctiveness of local wild mussel populations, potentially leading to a loss of fitness, adaptability, diversity or survival of the wild population.

57 However, research suggests transferring wild green-lipped mussel spat around the country would not have an undue adverse effect on the genetic integrity of wild green-lipped mussel populations for the following reasons:

- There is no evidence of a decline in population fitness of the wild green-lipped mussel population, even though mixing of green-lipped mussel populations may have already occurred in some areas; and
- Most mussel farmers harvest their stock before spawning; therefore chances of breeding events between wild and farmed populations are low.

58 Cawthron (2009) notes the industry is presently based on wild-sourced progeny with genetic diversity similar to mussels from two of the three main aquaculture areas.

59 The spat stock for farming green-lipped mussels in the Interim AMAs may come from locally sourced stock, or other spat-catching regions such as Kaitaia or Tasman/Marlborough. For the above reasons, MFish considers development of the Interim AMAs would not have undue adverse effects on the diversity of the genetic profile of wild mussel populations. MFish notes it is possible mussel farmers would use mussel spat caught locally within the Firth, minimising the risk of genetic changes to local wild mussel populations.

(e) Effects of the Interim AMAs on the biological diversity of associated and dependent species

60 The Interim AMAs may result in localised changes in the biological diversity of associated and dependent species (namely dolphins and whales[12]) that frequent the Firth of Thames because the longline structures are likely to exclude them from using the Interim AMAs for feeding, breeding, and as habitat.

61 The magnitude of effects on marine mammals from development of the Interim AMAs depends on the overall importance of the area to marine mammals for feeding, breeding, and as habitat. While the Firth of Thames and Hauraki Gulf are used by a range of marine mammals, Lloyd (2003) does not specifically identify the Firth as an area of special significance for marine mammals. Du Fresne Ecology Ltd (2008) also considers marine mammals do not use the Firth exclusively, or with high levels of residency. MFish has no site-specific information on use of the Interim AMAs by marine mammals. However, it is possible that some marine mammals use the area of the Interim AMAs and there is potential for marine farming to cause exclusion from the farmed area.

62 However, MFish considers the overall richness of dolphin and whale species using the Firth would not change. While there may be localised exclusion of dolphin and whale species, MFish

[12]See paragraphs 77-79 in the preliminary decision for the species found in the Firth.

considers the effect would most likely be minimal and not result in excessive or disproportionate change in the composition of dolphin and whale species present in the Firth. Marine mammals would likely shift their activities to use other parts of the Firth and Hauraki Gulf.

63 Seabirds that frequent the Ramsar site in the southern Firth of Thames[13] would not be directly affected by development of the Interim AMAs given the Ramsar site is roughly 25 km from the Interim AMAs. However, the Interim AMAs have the potential to indirectly affect seabirds. Plankton depletion could affect food sources, such as benthic filter-feeders, that wading birds feed on. In the worst-case scenario, this effect could have flow-on effects to the diversity of seabirds. However, modelling by NIWA (2008) shows plankton depletion effects from the Interim AMAs would be relatively small and undue adverse effects are unlikely (refer to discussion in paragraphs 75-82 below). Additionally, MFish notes the birds feed at the mudflats at the Ramsar site, not at the Interim AMAs.

64 For most taxa and fish species, it is more likely the relative abundance of species would be altered by the presence of the Interim AMAs rather than the diversity of species. Effects on the productivity and abundance of species are discussed in paragraphs 67-128 below.

(f) Conclusion

65 MFish considers the Interim AMAs may change biological diversity (in both positive and negative ways) in different parts of the aquatic environment through a number of processes. Because there are several effects occurring at once, it is difficult to know whether the Interim AMAs would have a net increase or decrease in biological diversity.

66 Nonetheless, on the balance of information, MFish is satisfied the effects of the Interim AMAs on the biological diversity of the aquatic environment would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on the sustainability of fisheries resources.

Section 40(a)(ii) of the Reform Act - The effect of the Interim AMAs on the productivity and biological abundance of fisheries resources

67 The assessment of the effect of the Interim AMAs on the productivity and biological abundance of fisheries resources is discussed in the following sequence:

(a) Seabed effects of the Interim AMAs on the productivity and biological abundance of fisheries resources

(b) Water column effects of the Interim AMAs on the productivity and biological abundance of fisheries resources

- Phytoplankton
- Limits of Acceptable Change Criteria for Phytoplankton
- Zooplankton
- Plankton modeling results

[13] See paragraphs 18, & 80-85 of the preliminary decision for information on seabirds of the Firth and the Ramsar site.

(c) Effects of the Interim AMAs on the productivity and biological abundance of fishstocks

- Snapper
- Rock lobster
- Finfish

(d) Effects of the Interim AMAs on the heterogeneity of local populations

(e) Effects of the Interim AMAs on associated and dependent species

- Dolphins and whales
- Seabirds

(f) Conclusion

(a) Seabed effects of the Interim AMAs on the productivity and biological abundance of fisheries resources

68 The existing benthic fauna and infauna observed at the Interim AMAs were not diverse and the community consisted of relatively common species typically found in mud habitat in the Firth of Thames and around New Zealand (NIWA 2008). The Interim AMAs may lead to a decline in abundance of species intolerant to biodeposition, or an increase in abundance of species that can tolerate or thrive in areas with elevated levels of organic materials. However, MFish considers changes in the abundance of species are unlikely to be large because species intolerant of deposition did not feature prominently in surveys of the site, and biodeposition quantities are not substantial. Current speeds and the predicted flushing time of the Interim AMAs is reasonably fast (15 to 30 hours, depending on wind conditions); fast flushing would help facilitate dispersion of biodeposits making substantial accumulation – and therefore substantial effects on fisheries resources – unlikely. Given any shift in species composition and abundance is unlikely to be large, MFish expects the change in productivity of benthic species at the Interim AMAs would not be undue.

69 Sediments at the site have typical levels of organic matter content, and are not anoxic. Cawthron (2009) notes in most cases slightly elevated levels of organic enrichment increase the productivity of coastal sediments without major disruption to community composition. Monitoring of existing marine farming in the area suggests anoxic conditions and a substantial increase in organic matter content in the Interim AMAs would be unlikely. MFish therefore considers any increase in anoxic conditions would be unlikely to have undue adverse effects on the productivity or abundance of fisheries resources.

70 A shift towards a more reef-like hard habitat may change the abundance of some species; the habitat may become less suitable for some soft-sediment dwelling species but more suitable for other species. In addition, mussels dropping from the longlines may act as a food resource for some (particularly fish) species. MFish does not know whether there would be a net increase or decrease in the abundance of fisheries resources at the Interim AMAs from the creation of reef-like habitat. However, the effects are likely to be localised beneath the longline droppers, and, as such, MFish considers wider regional effects on the sustainability of fisheries resources are unlikely.

71 The new marine farming structures would cause some shading of the seabed. There would likely be some reduction in light levels reaching the seafloor. However, the benthic community at the Interim AMAs does not comprise light dependent species, such as algae. As such, a reduction in light levels is unlikely to adversely affect the productivity or abundance of the fisheries resources at the Interim AMAs.

72 Submitters suggest biofouling species such as mussel whisker and sea squirt fall from the farm structures and create organic debris that accumulates on the seabed. MFish considers any biofouling species from the Interim AMAs would likely affect the same area currently affected by biofouling species from the existing farms (i.e. biofouling species would travel south along the shore with the current and tide). Although the quantity of biofouling species may increase, MFish considers the area affected would not significantly increase. This is because the prevailing currents and tides would remain the same and likely carry biofouling species from the Interim AMAs in a southerly direction and towards the shore.

73 The habitats potentially affected by the biofouling species footprint are common throughout the Firth and wider Hauraki Gulf. NIWA has observed few changes in the benthic community beneath the existing farms. Therefore, although biofouling species may accumulate in the area, it does not appear to have excessive or disproportionate effects on the benthic community.

74 MFish considers the organic debris would not prevent flatfish from migrating to the southern end of the Firth. Flatfish are known to swim across a range of habitats during their annual migrations. There is also a large corridor down the middle and western side of the Firth that is not affected by biofouling species along which flatfish could still travel. As such, MFish considers the biofouling species accumulation is unlikely to have undue adverse effects on the productivity and biological abundance of fisheries resources.

(b) Water column effects of the Interim AMAs on the productivity and biological abundance of fisheries resources

Phytoplankton

75 Mussel farming can enhance or reduce phytoplankton levels within the water column, depending on the time of year and the degree of nitrogen limitation[14] on phytoplankton growth. In summer, phytoplankton growth in the Firth is nitrogen-limited (NIWA 2008) so phytoplankton depletion effects are more likely to be seen at this time of year.

76 Modelling of plankton by NIWA (2008) shows (at the marine farming zone scale) that fast growing but maximally vulnerable plankton[15] experience less than 4% depletion under all scenarios[16]. The level of depletion increases as growing conditions deteriorate, with plankton growing under poor conditions showing highest depletion (up to 14%). However, it is important to note that NIWA used time-averaged results in their modelling; NIWA notes depletion could

[14]Nitrogen is released by mussels directly into the water as ammonium as well as through deposition of faeces and pseudo-faeces.

[15] Phytoplankton/protozoa growing under favourable conditions.

[16] The scenarios modelled are: no winds; winds from the NE; and winds from the SW for both winter and summer conditions. Five different plankton sub-classes were modelled for each hydrodynamic condition – phytoplankton/protozoa growing under favourable conditions, intermediate conditions, and unfavourable conditions, small copepod spp., and large copepod spp. Scenarios were run for both the existing farms and the existing farms with the Interim AMAs added.

sometimes exceed 10% around the Interim AMAs, but could also be substantially less than 10% at other times.

77 NIWA predicts chl-*a* depletion under the worst case scenario (winter, no wind, and moderate plankton growth rates) of up to 20% depletion around Wilson Bay and 10% over an extensive area of the Firth. In this situation, the modelling suggests the area covered by the phytoplankton depletion footprint would be reasonably large[17]. However, MFish considers the worst case depletion scenario is unlikely to occur frequently because in reality there is always some level of wind and therefore mixing of the water column. In reality, the extent of the depletion footprint would likely vary day-to-day because of changing wind-driven circulation patterns (NIWA 2008).

78 The relatively strong currents and fast flushing of the Interim AMAs suggests farmed mussels would have less time to extract particulate matter, including phytoplankton, from the water column. The good currents and flushing mean mixing of the water column and a continuous replenishment of nutrients to the site. MFish also notes the longlines within the marine farming blocks are likely to be aligned parallel with the predominant (alongshore) currents around the marine farming zone. Phytoplankton extraction by the mussels would likely be lower with shore-parallel longlines than if the longlines were aligned perpendicular to the predominant currents.

79 In addition, MFish notes the Firth of Thames is a naturally productive area for phytoplankton. Sampled phytoplankton biomass[18] in the Firth commonly falls into the 1.5-2.5µg l^{-1} range considered to be 'good' growing conditions. Phytoplankton biomass in the Firth is generally higher than within the Marlborough Sounds, although there are substantial inter-annual variations in phytoplankton abundance (NIWA 2002).

80 MFish acknowledges phytoplankton is an important food source for other species in the ecosystem. Phytoplankton depletion could affect higher trophic levels such as mesozooplankton[19] and larval fish. Direct mesozooplankton mortality from mussel predation could affect the ecological linkages that mesozooplankton make as grazers of phytoplankton, as predators of microzooplankton, and as prey for larval and adult fish (Zeldis *et al.* 2004). However, determining the direct effects of the Interim AMAs on these ecosystem interlinkages is complex at best, and as such, the actual flow-on ecosystem effects currently remain unknown.

81 MFish considers the Interim AMAs would not result in an excessive or disproportionate adverse change to the overall abundance of phytoplankton in the Firth. Rather, the greatest effects would likely largely be localised changes in the abundance of phytoplankton around the Interim AMAs. However, MFish notes even around the Interim AMAs there is likely to be a high degree of temporal and spatial variability in phytoplankton depletion. At times depletion could likely be as high as the worst case scenario predicted by the NIWA modelling, but MFish does not expect this scenario to occur very often.

82 Reducing the abundance of phytoplankton would have flow-on effects for the productivity of phytoplankton at the local farm scale, although the reduction in phytoplankton productivity

[17] NIWA (2008) does note though that, at a given far-field location in the modelling, the magnitude of depletion would likely often be lower than indicated by the time-averaged plots, but on occasions would be substantially higher.
[18] Phytoplankton biomass is estimated by the abundance of chlorophyll-*a* pigment in the water.
[19] Mesozooplankton is zooplankton between 200 µm and 2 mm in length.

specifically as a result of the Interim AMAs[20] is unknown. However, based on the relatively low predicted phytoplankton depletion levels for the Interim AMAs, a small, localised reduction in phytoplankton abundance is unlikely to result in an excessive or disproportionate alteration of the phytoplankton productivity of the Firth ecosystem. In addition, MFish notes most organic material ingested by mussels would be rapidly recycled into the water column as inorganic nutrients to stimulate phytoplankton production. So, there is the possibility the Interim AMAs may increase overall production rather than limit phytoplankton biomass.

Limits of Acceptable Change criteria for phytoplankton

83 Zeldis (2005) estimates phytoplankton biomass with the Wilson Bay Marine Farming Zone fully developed would be reduced by 5% over 10% of the Firth. The modelling done by NIWA (2008) predicts, on the Firth-wide scale, phytoplankton (chl-*a*) depletion with the existing farms and the Interim AMAs would be between 1-3%. Broekhuizen's (2007) preliminary modelling findings suggest this equates to around 7% depletion over about 7% of the Firth. The modelling results show the predicted chl-*a* depletion as a result of developing the Interim AMAs should not exceed the Limits of Acceptable Change (LAC) criteria[21].

Zooplankton

84 The major food source for farmed mussels is considered to be phytoplankton, but zooplankton may also comprise a large part of their diet at different times of the year (NIWA 2008) and can be consumed as efficiently as phytoplankton (Zeldis *et al* 2004). Research suggests mussels are unlikely to selectively consume either phytoplankton or zooplankton, or particular types of zooplankton, but rather filter whatever food is present in the water column (Alfaro 2006). Mussels may consume a variety of zooplankton (micro- and mesozooplankton, including mussel larvae and post-larvae; Alfaro 2006). Zooplankton depletion could impact fish populations either directly (through consumption of eggs/larvae by farmed mussels) or indirectly (competition with zooplankton for food resources).

85 Zeldis *et al* (2004) reports predation by farmed mussels on a variety of zooplankton up to 430 μm. Particles[22] most efficiently extracted are within an approximate size range of 5-200 μm, although particles as large as 600 μm can be retained, but this is likely to depend on the size of mussels[23]. NIWA (2004) considers zooplankton probably up to at least the size and mobility of adult copepods could be consumed. Adult copepods are a similar size to eggs and young larvae of many fish[24] and are much more mobile than fish eggs (NIWA 2004). As such, MFish considers the eggs and young larvae of some fish species are potentially vulnerable to uptake by mussels, although the relative vulnerabilities of specific zooplankton species to uptake are not well known. As an example, the Interim AMAs would possibly result in larger depletion zones for mesozooplankton than for phytoplankton and microzooplankton because mesozooplankton have

[20] For example, Zeldis *et* al (2008) concluded climatic forcing conditions largely control inter-annual variability in phytoplankton biomass and mussel yield in Pelorus Sound, Marlborough. Their results suggest reduced mussel yields between 1999-2002 were not related to particulate food depletion by cultured mussels (cited in Cawthron 2009).

[21] LAC criteria is that spatially and temporally averaged Chl-*a* depletion resulting from marine farming, and relative to un-impacted waters, should not exceed 20% over 10% of the area of the Firth of Thames.

[22] Particles include phytoplankton, zooplankton, protozoa, bacteria, detrital organic matter and inorganic sediment.

[23] Zeldis *et al* (2004) suggests growth stage, size, and mobility of zooplankton affects uptake. They note mortality could be more significant for mesozooplankton (e.g. copepods) than for phytoplankton or micro-zooplankton (e.g. ciliates) because mesozooplankton have longer generation times than phytoplankton and micro-zooplankton (weeks rather than days). But Alfaro (2006) observed that the number of microzooplankton mirrored the number of phytoplankton inside mussel stomachs, whereas mesozooplankton were always less abundant.

[24] For example, snapper eggs are 0.86-0.97 mm (cited in NIWA 2004).

longer generation times[25]. MFish does not have data to determine the likelihood or extent of these specific depletion zones.

86 MFish does not have field research data on the extent of zooplankton uptake, or how effectively mussels clear snapper eggs/larvae from the water column, to assess the effects of the Interim AMAs on the uptake of zooplankton. MFish's best indication of effects of the Interim AMAs is through NIWA's (2008) modelling of the potential uptake of snapper eggs and larvae for the Wilson Bay Marine Farming Zone fully developed, and NIWA's previous models of uptake of snapper eggs and larvae by marine farming in the Firth.

87 NIWA's (2008) modelling (at full development) shows, under the worst case scenario, fish egg and larvae depletion[26] of between 5% and 15% at the Wilson Bay Marine Farming Zone scale, roughly double that predicted for the existing farms (3-7%). On the Firth-wide scale, predicted fish larvae depletion is between 2% and 4% (an increase of 2% depletion under the worst case scenario). Slow growing plankton[27] minimally vulnerable to mussel predation show marginal depletion (less than 3%) when the Interim AMAs are added to the model. NIWA (2008) states it 'certainly cannot say at this stage that there are significant adverse effects associated with mussel farms consuming zooplankton'. NIWA's (2004) modelling simulations produced similar results, with predicted "mild depletion" (2-6%) of Firth-wide numbers of snapper larvae with the Wilson Bay farms fully developed.

88 The ecological consequences for recruitment into fishstocks of the modelled level of zooplankton depletion are not entirely certain. MFish acknowledges the Interim AMAs could potentially affect the productivity and abundance of zooplankton through uptake, particularly if zooplankton are vulnerable to uptake. However MFish considers, at this time, the modelling (taking into account the model assumptions) provides a good indication of the Interim AMAs likely level of effect on zooplankton depletion.

89 MFish also notes the density of zooplankton in the water column is likely to be lower than phytoplankton (tens of zooplankton individuals per litre typically, as opposed to thousands of phytoplankton cells per ml; Cole 2002). Strong currents and good flushing of the site would also result in the relatively rapid movement of zooplankton through the Interim AMAs, also influencing the likelihood of uptake by farmed mussels.

90 It is also important to note the natural mortality of snapper eggs and larvae is very high[28] and, in the Hauraki Gulf, there is huge variability[29] in the numbers of snapper recruiting into the fishery year to year (NIWA 2008). MFish acknowledges adding an additional source of mortality (in the form of uptake by farmed mussels) may have an effect on recruitment into the fishery. However, the massive quantities of spawning material released by snapper[30] during spawning compared to the much lower proportion of zooplankton that would likely come into contact with,

[25]However, effects would also be determined by the vulnerability of mesozooplankton to mussel predation and this depends on the vertical migratory behaviour of mesozooplankton, and the ability of mesozooplankton taxa and morphological stages to avoid capture when they encounter mussels (Zeldis *et al* 2004).

[26] NIWA used snapper as the archetype, although they state inferences drawn from the simulations will be applicable to any species which has similar egg/larval biology. i.e. length of period during which individuals are considered vulnerable to predation by mussels, and vertical distribution of the egg/larval populations relative to the mussel crop.

[27] Small and large copepod species.

[28] Mortality between spawning and hatching (~2 days) is estimated at 83% (Zeldis and Francis 1998) and between hatching and 8 days old at ~98% (Zeldis *et al.* 2005).

[29] 1+ year class varies more than 20-fold year to year (Francis 1993, cited in NIWA 2008).

[30]Snapper are serial spawners, releasing many batches of eggs over an extended season during spring and summer (MFish Plenary 2009).

and be consumed by, farmed mussels (given strong currents, good flushing and egg/larvae behaviour as discussed above) also suggests undue adverse effects on the snapper fishstock would be unlikely.

91 MFish does not have specific information about how the productivity or abundance of zooplankton communities would change with the introduction of the Interim AMAs, but recognises there is potential for adverse effects. NIWA (2008) considers changes to zooplankton species composition and abundance would be unlikely. MFish considers the overall abundance of zooplankton in the Firth is unlikely to change excessively, but there would likely be some localised effects. The localised effects would likely be variable (because zooplankton in the water column is naturally highly variable), but modelling suggests, overall, the magnitude of depletion is likely to be relatively small. MFish considers adverse effects to zooplankton productivity and abundance on a wider Firth-wide scale would be unlikely.

Plankton modelling results

92 NIWA (2008) described the datasets used in the models, assumptions and background detail to the modelling in Appendices 3 and 4 of the NIWA (2008) report. This information should be read in conjunction with the plankton sections above.

93 The natural environment is extremely variable and therefore modelling cannot be exact. For example, the natural spatial and temporal variation in phytoplankton and chl-*a* concentrations can be considerable. However, MFish considers the NIWA (2008) modelling results provide reasonable predictions of the level of depletion likely to occur. NIWA modelled the 'worst-case' scenarios (i.e. the extreme cases) and even under these scenarios, and taking into account a margin of error, modelled depletion is not at a level that would cause MFish to consider the effects on plankton uptake as being unduly adverse.

94 In fact, there is reason to believe the ichthyoplankton (fish egg/larva) modelling overestimates the likely level of depletion because the modelling assumes all ages of egg/larva weakly aggregate in surface waters at all times of the day (NIWA 2008). In reality, research suggests snapper larvae tend to avoid the surface waters during the day and at night become more evenly distributed. So, the model may over-estimate the proportion of time an egg/larva will find itself at a depth occupied by mussel-crop. NIWA suggests the degree of over-estimation could exceed two fold (NIWA 2008).

95 Another assumption of the modelling is perfect mixing within the modelled cells of water. In the natural environment perfect mixing is highly unlikely; mixing would vary depending on micro-scale variations in wind and circulation conditions at any given time.

96 On the other hand, NIWA notes it is possible the number of mussels that might be found in Area B is under-estimated if the dropper lines extend deeper than assumed and this needs to also be considered when relying on the modelled outputs.

97 As discussed below in paragraphs 131-136, we do not know the exact locations of the snapper spawning grounds. NIWA's modelling assumes spawning occurs between the 10 m and 30 m depth contours, and by age 8 days, larvae are found almost anywhere in the model domain (i.e. the Firth of Thames). Given our current knowledge of snapper spawning ground locations, MFish considers NIWA's assumption is robust and the most logical way to enable modelling of the effects on snapper eggs and larvae.

(c) Effects of the Interim AMAs on the productivity and biological abundance of fishstocks

98 Little is known about the effects of marine farming on the productivity and abundance of fishstocks. Sampling highly mobile and temporally variable finfish species is difficult. Gibbs (2004) notes it is reasonable to expect the presence of farms to change the distribution and abundance of fishes, although changes are likely to be species and site specific.

Snapper

99 Aspects of the effects of the Interim AMAs on the productivity and abundance of snapper have been addressed elsewhere:—effects on the abundance of plankton and snapper eggs and larvae (refer to paragraphs 84-91 above); and effects on the habitat of juvenile snapper (refer to paragraphs 137-146 below). As discussed in these sections, MFish considers that whatever changes might occur in relation to the abundance of snapper eggs and larvae, or changes to the seabed as habitat for juvenile snapper, would not have undue adverse effects.

100 Changes in the abundance of species in the benthic community at the Interim AMAs could affect snapper abundance around the Interim AMAs, if these benthic species are important as a food resource for snapper.

101 Recent work on juvenile snapper from northern North Island estuaries suggests increasing turbidity levels causes a change in the feeding strategy of juvenile snapper from active selection of pelagic prey (zooplankton) to larger, slower moving benthic prey (Morrison *et al* 2009). Feeding trials of juvenile snapper with mysid shrimps found higher weight loss and overall mortalities when there were higher turbidity levels. However, the Interim AMAs are likely to be more strongly influenced by natural sedimentation than by marine farming deposition effects.

102 Colman (1972) investigated the food of snapper in the Hauraki Gulf and found they had an extremely varied diet. Diet was dependent on the size of the fish and the food available to it. Crustaceans were identified as the most important item, though the type taken depended on the size of the fish. Polychaete worms, echinoderms, and molluscs featured in larger snapper. Colman states that in general, small snapper ate small or relatively soft-bodied animals, represented by small crustaceans and polychaete worms; bigger snapper ate larger and more hard-shelled animals (fish, molluscs, crabs and hermit crabs). Colman (1972) did not observe highly selective feeding.

103 MFish, therefore, considers species like the crustaceans, polychaete worms, heart urchin and bivalves found in the benthic community at the Interim AMAs probably contribute to the diet of snapper. However, MFish considers the magnitude of change to the composition of the benthic community is likely to be small and any flow-on effects on snapper diet (and abundance) are also likely to be small. In addition, farmed mussels would likely provide a new and abundant food resource for snapper, potentially having a positive effect on snapper numbers in the area. Although, whether the additional food resources would simply concentrate fish, or increase the overall productivity of the snapper population is largely unknown.

104 The new structures may also provide additional shelter for snapper and act as a refuge from predators. If this is the case, the productivity of the snapper population could possibly benefit from the Interim AMAs. However, MFish does not know if the structures would provide additional shelter or refuge from predators, and therefore the effects remain largely unknown.

Rock lobster

105 Marine farming has the potential to affect rock lobster abundance by providing artificial substrate for rock lobster pueruli settlement. Rock lobster pueruli develop in oceanic waters and then migrate towards shore at the end of their larval stage, settling on hard substrates. New marine farming structures (longlines, buoys, ropes) could provide artificial substrate for pueruli settlement. Mussel farms would also provide abundant food for juveniles.

106 NIWA data from the Hauraki Gulf and Firth of Thames shows pueruli larvae collected in collectors were very rare in samples; compared with data from the East Cape to Wellington region[31], settlement in the Hauraki Gulf is very low, perhaps by two orders of magnitude and highly variable (NIWA 2008). NIWA (2008) states pueruli larvae are unlikely to be present in any significant numbers in the vicinity of the Wilson Bay Marine Farming Zone and a negative impact on recruitment to sub-tidal areas cannot be substantiated at this stage. In addition, as the farmable area of the Interim AMAs covers a very small proportion of the Firth, MFish expects only a small percentage of pueruli would pass through the farm relative to the water column in the Firth.

107 MFish has no information about pueruli settling on the existing farms in Wilson Bay and has no information on the settling rate of pueruli on marine farming structures in Wilson Bay. However, given natural settlement is very low in the Firth of Thames area, it would follow that the quantity of rock lobster pueruli settling on the new structures is also likely to be very low. Anecdotal evidence at existing marine farming sites around New Zealand suggests it is rare to find large quantities of pueruli or juvenile rock lobsters on mussel farms, although significant settlement has been recorded during at least one year on farms in Port Underwood, Marlborough. However, Booth (2003) notes in low settlement areas, pueruli settlement in mussel farms may be even more critical to the inshore fishery.

108 MFish does not know how many pueruli would survive by settling on the mussel longlines or how many would survive to settle on inshore rocky habitat if they were not intercepted. However, MFish notes pueruli survival is naturally extremely low[32] and it is plausible settlement on mussel lines could add to the high natural mortality of pueruli. Whether survival rates would be different (better or worse) through settlement on marine farming structures as opposed to inshore areas is unknown.

109 Pueruli settling on the lines may not have found any other suitable habitat to settle on and hence would never have recruited into the fishery. But, mussel reef habitat that forms beneath the marine farms could provide suitable habitat for rock lobster to migrate to settle on. Similarly, a proportion of rock lobsters would have become prey for other species. There is rocky reef habitat along the coastline near Wilson Bay (Worley Consultants Ltd 1996) that has the potential to provide suitable habitat for rock lobster recruitment in inshore areas. Although, this rocky reef is roughly 5 km from the inshore side of the Area B farms, and whether this is a feasible distance for the juvenile rock lobster to successfully travel to settle is unknown.

[31]Levels of pueruli settlement have been followed for almost two decades along the east coast of the country and the pattern to emerge is that there is high settlement along the east coast, at least from East Cape to Cook Strait, and in some years as far south as Kaikoura. Levels of settlement measured on collectors have been much lower north of East Cape and south of Kaikoura, but in these regions there are likely to be occasional years of higher settlement (Booth 2003).

[32]For both *Panulirus Cygnus* and *P. argus* species it has been estimated around 1-4% survive settlement and the first year after; Booth 2003.

110 MFish considers uptake of phyllosoma larvae in the Interim AMAs is unlikely because of its location in the inshore waters in the Firth of Thames. The last phyllosoma stage[33] metamorphoses into the pueruli larvae, which then swim towards the coast to find suitable settlement substrate. The National Rock Lobster Management Group (2006) notes most late-stage phyllosoma larvae occur beyond the edge of the continental shelf, up to 1100 km from the coast. Given most phyllosoma larvae would likely have developed into pueruli by the time they reach the Firth of Thames, MFish considers the effects from uptake of rock lobster larvae by the mussel farms would not be undue. MFish also notes modelling of fish larvae by NIWA (2008) shows fish larvae depletion from Area A and Area B would be around 2-5% at the Firth-wide scale. Whether the modelling results directly apply to rock lobster, however, is uncertain[34], and the effects remain largely unknown because phyllosoma larvae has not been specifically modelled or studied in detail.

111 Despite this uncertainty, MFish considers effects on the productivity and abundance of rock lobster would not be undue given the low occurrence of rock lobster larvae and pueruli in the Firth of Thames.

Finfish

112 MFish does not have precise information about which fish species use the area of the Interim AMAs. However, some species will likely use the area for feeding, as habitat, and/or for spawning at various times, given species including flatfish, John dory, rig, school shark and snapper are relatively abundant within the Firth. For example, Coleman (1973) suggests sand flounder spawn in the area east of Waiheke and Ponui Islands, while yellow-belly flounder spawn in a belt extending from Tapu on the eastern side of the Firth of Thames, northwest towards Ponui Island, in the northern part of the Firth of Thames and into the inner Hauraki Gulf (refer Figure 1).

113 There have been very few quantitative studies of assemblages of fish living on and around mussel farms. Morrisey *et al* (2006) observed small abundances of fish on mussel lines, dominated by small, demersal species, notably triplefins and wrasse, characteristic of rocky reefs in the area. Few large, commercially or recreationally important fish species were recorded.

114 However, MFish notes marine farming may influence fish assemblages through the introduction of new artificial structures and associated biofouling communities potentially favouring fish that can use the new food sources and habitat. A localised increase in the abundance and diversity of some prey species around mussel farms may increase available food supplies for higher trophic level species (marine mammals, seabirds, fish), while a decrease in the abundance of preferred prey species may decrease the food supplies for other species.

115 If, and how, the fish assemblage would change would depend largely on the species that colonise the structures, and how suitable the area becomes for specific fish species. For some fish the farms may provide an additional food source and habitat. For example, there is anecdotal evidence of fish, mainly spotties, but also leatherjackets and snapper feeding on mussel spat on farms in the Marlborough Sounds (Morrisey *et al.* 2006). In the Firth of Thames, information suggests some species, such as snapper, are attracted to the mussel lines for food and shelter.

[33] Rock lobster eggs hatch as small nauplisoma larvae which metamorphose into phyllosoma larvae. Phyllosoma larvae develop during the time they spend in the ocean, between 10 and 20 months (National Rock Lobster Management Group 2006).

[34] NIWA used snapper as the archetype for the fish larvae modelling, although they state inferences drawn from the simulations will be applicable to any species which has similar egg/larval biology. i.e. length of period during which individuals are considered vulnerable to predation by mussels, and vertical distribution of the egg/larval populations relative to the mussel crop.

116 As with snapper, MFish is uncertain whether the Interim AMAs would increase or decrease the abundance of other mobile finfish species or simply attract fish to the area. Simply attracting fish from other areas would not alter the productivity or abundance of these species, but rather change localised abundance and distribution within the Firth.

117 In reality, the effect of the Interim AMAs on the local abundance of fish species would be highly variable. The effects on fish fauna composition at the Interim AMAs would be site specific, and depend on the available pool of species in the general area and the suitability of the farms as habitat for each species. The species composition and abundance would also likely vary over time. Some species may benefit, while other species may be adversely affected; each species is likely to have unique responses to the new artificial habitat. Finfish would be unlikely to associate exclusively with the farms; rather fish would intermittently or seasonally use the area. Whether the overall effect on the productivity and abundance of fish species is positive or negative is unknown; however, MFish considers localised changes in the productivity and abundance of fish species would not have adverse effects so large that it would prevent the maintenance of the productivity of fisheries resources indefinitely, at a level which provides for continual use at the wider ecological scale.

(d) Effects of the Interim AMAs on the heterogeneity of local mussel populations

118 Aquaculture could potentially affect the genetic profile of wild mussel populations. However, as with effects on biological diversity, MFish considers development of the Interim AMAs is unlikely to affect the productivity or abundance of local mussel populations by changing the strength of the genetic profile because the available research suggests the risk to the genetic profile is low (refer to paragraphs 56-59 for discussion). Also, natural beds of mussels in the Firth of Thames are far less extensive than they were previously, so the likelihood of mixing of genetic material of farmed and wild mussels is likely to be reasonably low.

(e) Effects of the Interim AMAs on associated and dependent species

Dolphins and whales

119 The Interim AMAs could affect the productivity and abundance of marine mammal species that frequent the Firth of Thames because the longline structures are likely to exclude them from using the Interim AMAs for feeding, breeding, and as habitat. However, the magnitude of effects on marine mammals from development of the Interim AMAs depends on the overall importance of the area to marine mammals for feeding, breeding, and as habitat.

120 While the Firth of Thames and Hauraki Gulf are used by a range of marine mammals, Lloyd (2003) does not specifically identify the Firth as an area of special significance for marine mammals. Du Fresne Ecology Ltd (2008) also considers marine mammals do not use the Firth exclusively, or with high levels of residency. MFish has no site-specific information on use of the Interim AMAs by marine mammals. However, some marine mammals may use the area of the Interim AMAs and marine farming could displace marine mammals from the farmed area.

121 But, MFish considers because the Interim AMAs do not appear to be specifically important for feeding, breeding, and as habitat, any displacement would likely result in the marine mammals shifting their activities to use other parts of the Firth and Hauraki Gulf rather than having excessive or disproportionate change to productivity or abundance. MFish notes development of the Interim AMAs would not exclude dolphins from the Firth to the extent that a farm could in smaller bays.

122 Mortality by entanglement in mussel longlines could alter the abundance of these species. MFish acknowledges entanglement of marine mammals in marine farming structures is possible and increasing marine farming space would likely increase the risk. However, MFish has no information to suggest problems with entanglement of marine mammals in the existing mussel farming structures and considers the additional risks to the abundance of these species from the Interim AMAs would not be large.

123 A greater volume of boats brings an increased risk of boat strike, which is a significant cause of injury or death for many marine mammals especially large whales (Lloyd 2003). Boat strike that kills marine mammals could affect the abundance of these species[35]. While it is likely the Interim AMAs would result in additional vessel traffic, MFish considers the additional volume of traffic would not be large as some vessels servicing the existing farms would also likely service farms within the Interim AMAs. Additionally, MFish considers the risk of effects from increased noise or boat strike from additional vessel traffic is low because the area does not appear to be especially important for marine mammals.

Seabirds

124 MFish is uncertain what species of birds, if any, specifically use the Interim AMAs for feeding activities. A range of species have been observed in the area of the Interim AMAs (refer paragraph 85 of the preliminary evaluation report for species). But MFish notes the water depth of the Interim AMAs (between 10-27 m) means seabirds would be unlikely to feed on benthic species. In any case, the benthic species found at the Interim AMAs are similar to other areas of the Firth where birds could still forage. In addition, MFish expects small pelagic fish species seabirds may feed on would not change.

125 Mussel farm structures may reduce foraging success for seabirds that feed in open water on schooling fish. However, MFish considers changes to the biological diversity, productivity and abundance of fish species would not be undue and seabirds that use the Interim AMAs to catch fish could still do so.

126 Seabirds that frequent the Ramsar site in the southern Firth of Thames[36] would not be directly affected by development of the Interim AMAs because of the distance of the Ramsar site (roughly 25 km) from the Interim AMAs. However, the Interim AMAs have the potential to indirectly affect seabirds. Plankton depletion could affect food sources, such as benthic filter-feeders, that wading birds feed on. In the worst-case scenario this could have flow-on effects to the productivity or abundance of seabirds. However, modelling by NIWA (2008) shows plankton depletion effects from the Interim AMAs would not have undue adverse effects at the Interim AMAs scale or a Firth-wide scale.

(f) Conclusion

127 MFish accepts the Interim AMAs would probably result in some changes to the productivity and biological abundance of fisheries resources (in both positive and negative ways) in different parts of the aquatic environment through a number of processes. There is likely to be a combination of effects occurring at the same time, along with seasonal variability in effects.

[35] Refer to paragraphs 159-161 of the preliminary decision for further details about boat strike.
[36] See paragraphs 80-85 of the preliminary decision for information on seabirds of the Firth and the Ramsar site.

128 Nonetheless, on the balance of information, MFish is satisfied the effects of the Interim AMAs on the productivity and biological abundance of fisheries resources would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on the sustainability of fisheries resources.

Section 40(a)(iii) of the Reform Act - The effect of the Interim AMAs on habitats of known significance for fisheries management

129 The assessment of the effect of the Interim AMAs on habitats of known significance for fisheries management is discussed in the following sequence:

(a) Effects of the Interim AMAs on snapper spawning grounds

(b) Effects of the Interim AMAs on juvenile snapper habitat

(c) Effects of the Interim AMAs on habitats of known significance for other fisheries resources

(d) Effects of the Interim AMAs on habitat for associated and dependent species

(e) Conclusion

130 MFish considers farming in the Interim AMAs would likely have an effect on habitat at the Interim AMAs, mainly through biodeposition (faeces, pseudo-faeces, shelldrop and biofouling species), but also potentially through changes to nutrient cycling within the sediments, creating anoxic conditions, and changing community composition.

(a) Effects of the Interim AMAs on snapper spawning grounds

131 The Interim AMAs are within the Hauraki Gulf region which likely contains important spawning grounds for finfish species. Spawning grounds are important for fisheries resources because they ultimately determine recruitment, and therefore size, of the fishstocks. NIWA (2002) states the Hauraki Gulf, and especially the Firth of Thames, are the main spawning grounds for New Zealand's largest snapper fishery (SNA1[37]). John dory, rig, school shark, and barracouta juveniles are also relatively abundant within the Firth.

132 There is little information to precisely identify the location of snapper spawning grounds in the Firth of Thames and the Hauraki Gulf, although there has been much research on snapper eggs and larvae within the Hauraki Gulf region (Cassie, 1955; Morrison *et al.,* 2002; Zeldis *et al.,* 2005; Zeldis *et al*, in review, cited in NIWA 2002). Surveys of snapper eggs and larvae within the greater Hauraki Gulf suggest the majority of snapper spawning takes place in waters less than 30 m deep (NIWA 2002). The Firth of Thames was consistently found to be the most important site for snapper spawning and larval survival of any area of the Gulf, and was also where larval survival was highest (Zeldis *et al*, in review, cited in NIWA 2002). However, while we know that much snapper spawning occurs in the Hauraki Gulf, there is little evidence to suggest the eastern Firth of Thames is particularly important when compared to other areas of the Firth of Thames or wider Hauraki Gulf.

[37] SNA1covers the inshore waters and harbours along the north-eastern coast of the North Island from North Cape to Cape Runaway. It includes the eastern coast of Northland, the Hauraki Gulf, the Coromandel and the Bay of Plenty.

133 MFish considers snapper in SNA1 are likely to spawn in many areas throughout the northeast coast of the North Island. MFish considers SNA1 comprises three biological stocks—east Northland, Hauraki Gulf and Bay of Plenty—that all have separate spawning grounds. Some mixing between these biological stocks may occur; for example, up to 30% of tag recoveries from fish tagged in the Bay of Plenty in the 1994 tagging programme were recovered in the Hauraki Gulf (MFish Plenary 2009). However, MFish considers the extent of mixing (i.e. from nursery areas within one biological stock to the adult population of another) is not known. While the Firth of Thames and perhaps even the Interim AMAs may form part of the spawning area in SNA1, they are not the *only* areas to contribute snapper stock to the SNA1 fishery.

134 Additionally, if snapper spawning is as widespread as MFish suspects, the filtering effect of a large mussel farm in the Firth is not likely to have a strong influence on recruitment of snapper. MFish acknowledges the Interim AMAs may reduce the density of snapper eggs and larvae in the vicinity of the farm, but on a Firth-wide scale, the predicted quantities of zooplankton uptake are likely to be very small (refer to paragraphs 84-91).

135 Recruitment of snapper in SNA1 varies a great deal between years, and this variation correlates with sea surface temperature. Water temperature appears to play an important part in spawning success and the success of recruitment (Bentley *et al*, 2004; Ministry of Fisheries 2009) particularly in the Hauraki Gulf stock (Bentley *et al.,* 2004). Strong year classes in the population generally correspond to warm years, while weak year classes generally correspond to cold years (MFish Plenary 2009). MFish considers the effects of the Interim AMAs would unlikely be anywhere near as big as the influence of natural population recruitment fluctuations.

136 On the balance of information, MFish is satisfied that even if the Interim AMAs are on snapper spawning grounds, the effects of the Interim AMAs on snapper spawning grounds would not be so excessive or disproportionate so as to constitute an undue adverse effect on the sustainability of fisheries resources because the Interim AMAs would only constitute a small part of the snapper spawning area in SNA1. In addition, MFish considers the effects of the Interim AMAs would unlikely be anywhere near as big as the influence of natural population recruitment fluctuations.

(b) Effects of the Interim AMAs on juvenile snapper habitat

137 Recent research strongly suggests most of the west coast North Island snapper population[38] originated as juveniles from the Kaipara Harbour (Morrison *et al.,* 2009). In light of this research, submitters suggest all snapper on the northeast coast of the North Island may come from the Firth of Thames.

138 However, there are some important differences between the west and east coast that would suggest the Firth of Thames, by itself, is unlikely to be as important as Kaipara Harbour for juvenile snapper. These factors are discussed below.

139 MFish considers juveniles for the SNA1 stock likely come from a wider variety of sources than seems to be the case in SNA8 because many more locations seem apparently suitable for juveniles. Snapper larvae do not settle onto the seabed until approximately four weeks post-spawn[39] (NIWA 2008). In the early juvenile phase, snapper seek seabed with some structure

[38] SNA8, from Cape Reinga to Wellington
[39] In their modelling, NIWA assumed the larvae become able to avoid ingestion by mussels from 8 days post-spawn.

such as horse mussel beds or (particularly subtidal) seagrass meadows; this association is found in the Kaipara Harbour (Morrison *et al* 2009).

140 The Interim AMAs are located over predominantly (98%) mud substrate and a largely featureless seabed (NIWA 2008); a habitat that is well represented in the Firth of Thames and the wider Hauraki Gulf. Historically in the Firth, there were extensive beds of mussels and oysters that would have provided the structure important for juvenile snapper, but these beds have been very much reduced. The mussel beds within the Firth were largely fished out by the 1960s (NIWA 2008). MFish notes surveys at the Interim AMAs recorded no beds of epifaunal shellfish, and as such MFish considers there is nothing to suggest the Interim AMAs are especially important as a nursery area when compared to the rest of the Firth of Thames.

141 MFish acknowledges the Firth is an important nursery area for snapper, but considers there are likely many other areas on the east coast that are also suitable for juvenile snapper and contribute juveniles to SNA1 stock. MFish considers the Firth of Thames is unlikely to be a highly dominant source of juveniles for SNA1, at least not to the extent the Kaipara Harbour is for SNA8.

142 Another difference between the west and east coast is that juveniles on the east coast (including the Firth of Thames) are caught in trawl surveys in many parts of the open coast shallower than about 20m, whereas juveniles seem concentrated in the harbours on the west coast and catch rates of juveniles on the open coast are very low. This difference suggests the harbours of the west coast are more important for juveniles than on the east coast where juveniles are more widespread, including on the open coast.

143 The Interim AMAs may have both positive and negative effects on the suitability of the seabed for juvenile snapper. Shell-drop from the Interim AMAs could create new reef-like habitat with increased structure and more complex habitat in the sediments that seems necessary for juvenile snapper. For example, structurally complex habitat appears to have a positive effect on the abundance of juvenile snapper with these areas preferentially utilised (Thrush *et al.*, 2002; Ross *et al.,* 2007; Morrison *et al*., 2009). Complex habitat (as well as the longline structures) may also provide additional shelter and protection from predators. In addition, mussel culture would likely provide an additional food source for juvenile snapper.

144 MFish accepts there may also be adverse effects from the Interim AMAs on the suitability of the seabed as habitat for juvenile snapper through sedimentation effects from faeces and pseudo-faeces. Morrison *et al* (2009) notes sedimentation (in reference to land-based sedimentation to coastal areas) may reduce the foraging abilities of finfish (such as juvenile snapper) which, long-term, may influence survival and recruitment to the fishstock. Feeding trials have shown increased suspended sediment levels can have negative effects on fish which may affect the productivity of fishstock populations (refer to paragraph 101 for discussion). The effects of deposition have been discussed above. Overall, MFish considers natural sedimentation would likely have a larger influence than biodeposition from the Interim AMAs at the site.

145 MFish accepts localised changes in the abundance of juvenile snapper may occur, if the habitat in the Interim AMAs proves to be less suitable for juveniles. However, MFish considers the mud habitat is not going to change so significantly that snapper would completely avoid using the area of the Interim AMAs as juvenile habitat. Therefore, MFish considers an excessive or disproportionate decrease in the abundance of snapper either on a localised or wider ecological scale is unlikely.

146 In addition, MFish notes the Interim AMAs are not the *only* area of suitable snapper habitat; there would still be a range of other unaffected areas in the region able to contribute stock to the SNA1 fishery to maintain the productivity and biological abundance of snapper as a fisheries resource in SNA1 at a level which provides for continual use.

(c) Effects of the Interim AMAs on habitats of known significance for other fisheries resources

147 The Interim AMAs are also likely to be in a region containing spawning grounds and habitat for a number of other fisheries resources, such as flatfish, John dory, rig, and school shark. However, the Interim AMAs are unlikely to be in an especially important area given it is located over predominantly mud substrate that covers most of the Firth of Thames. As with snapper, potential changes to the habitat from marine farming may also affect other fisheries resources. On balance of information, however, MFish considers changes to the habitat would be localised and not undue on a wider ecological scale.

(d) Effects of the Interim AMAs on habitat for associated and dependent species

148 The Interim AMAs are likely to result in a reduction of potential habitat available to marine mammals within the Firth. However, information suggests the Interim AMAs are not in an area of particular importance for marine mammals for feeding, breeding or as habitat.

149 MFish considers the Interim AMAs would not result in a reduction of habitat for seabirds.

(e) Conclusion

150 On the balance of information, MFish is satisfied the effects of the Interim AMAs on habitats of known significance for fisheries management would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on the sustainability of fisheries resources.

Section 40 (b) of the Reform Act - The location of the Interim AMAs in relation to areas in which fishing is carried out

151 MFish has considered this question with respect to the sustainability of fisheries resources and considers it is best answered in the fishing section below.

Section 40 (c) of the Reform Act - The effect of the Interim AMAs on fishing of any fishery, including the proportion of any fishery like to become affected

152 MFish has considered this question with respect to the sustainability of fisheries resources and considers it is best answered in the fishing section below.

Section 40 (d) of the Reform Act - The degree to which aquaculture activities within the Interim AMAs will lead to the exclusion of fishing

153 MFish has considered this question with respect to the sustainability of fisheries resources and considers it is best answered in the fishing section below.

Section 40 (e) of the Reform Act - The extent to which fishing for a species in the Interim AMAs can be carried out in other areas

154 MFish has considered this question with respect to the sustainability of fisheries resources and considers it is best answered in the fishing section below. MFish also notes it has no information to suggest the area of the Interim AMAs have distinctive fisheries resources or environmental characteristics that would make it a better place to fish than the rest of the Firth of Thames. Therefore, in terms of environmental characteristics, there is nothing to suggest fishers would not be able to catch the same fish elsewhere in the Firth.

Section 40 (f) of the Reform Act - The extent of which the Interim AMAs will increase the cost of fishing

155 MFish has considered this question with respect to the sustainability of fisheries resources and considers it is best answered in the fishing section below.

Section 40 (g) of the Reform Act - The cumulative effect on fishing of any previous aquaculture activities

156 The uptake of plankton by mussels has the potential to affect the abundance of fish eggs and larvae with potential flow-on effects for the recruitment and size of commercially harvested fishstocks. MFish considers it likely the existing farms in the Firth contribute to the removal of some phytoplankton and zooplankton.

157 However, the modelling of effects on fish eggs/larvae by NIWA (2008) takes into account the existing farms in the Firth. Cumulatively, the results of the modelling suggest the total marine farming space in the Firth (existing and the Interim AMAs) would remove a relatively small level of plankton from the Firth ecosystem. MFish acknowledges that in most plankton depletion scenarios, the level of depletion increases when the Interim AMAs are added. However, MFish considers, even with adding the Interim AMAs, cumulative effects on fishstocks important for commercial, recreational or customary harvest would not be large.

158 The Interim AMAs also have the potential to affect juvenile or adult fish by altering the suitability of the seabed for feeding, spawning, or as habitat. MFish considers it likely existing farms in FMA1 affect the seabed to some extent, and accepts the Interim AMAs would likely add to the existing effects. However, MFish considers effects from marine farming on habitat important for fishstocks would be localised. Existing marine farming does not cover a lot of space in FMA1 - there are around 5,500 ha of existing marine farming space in FMA1 (around 0.02% of FMA1). As such, MFish considers the cumulative effect on habitat for fish species important for commercial, recreational or customary harvest would not be large as there would still be a substantial area of habitat able to contribute stock to the fishery.

Conclusion for sustainability of fisheries resources in the context of section 40 of the Reform Act

159 In conclusion, and on the balance of information, MFish is satisfied that the range of matters that it has had regard to in the context of section 40 of the Reform Act are not so excessive or disproportionate so as to result in an undue adverse effect on the sustainability of fisheries resources.

9. Assessment of undue adverse effects of the Interim AMAs on customary, recreational and commercial fishing (section 40 of the Reform Act)

160 In making an aquaculture decision, the Chief Executive must have regard *only* to the matters under section 40 (a) through (g) of the Reform Act when evaluating the effects on fishing.

161 This Part assesses the effect of the Interim AMAs on customary, recreational and commercial fishing having regard to those nine matters provided in section 40 of the Reform Act.

Section 40 (a)(i)of the Reform Act - The effect of the Interim AMAs on the biological diversity of the aquatic environment

Commercial fishing

162 MFish considers the Interim AMAs may result in some changes in biological diversity, such as changes to the composition of fish species at the site, which could potentially impact on commercial fishing. However, MFish considers any changes would be localised and unlikely to have significant wide-scale effects on species important to commercial fishing.

163 The Interim AMAs could have positive or negative effects on biological diversity in the area. Marine farms can alter predator-prey interactions and introduce new species to the area through biofouling on structures, but effects are mostly localised within the farmed area rather than impacting on the wider ecosystem.

164 Deposition of faeces and pseudo-faeces and other debris and the decreased oxygenation of sediments could have negative impacts on benthic biodiversity. This in turn could have flow-on effects on species important for commercial fishing (eg flatfish and snapper) by changing the availability and composition of food for these higher-level fish species. On the other hand, the Interim AMAs could have positive effects on biological diversity from increased structure in the sediment provided by shell fall. This structure can be a focus for increased benthic biodiversity and may increase the suitability of the area for some species such as snapper.

165 Likewise, removing commercial fishing from the Interim AMAs could also change the biological diversity of species in the area. The displacement of commercial fishing could increase biological diversity of the benthos under the Interim AMAs, although the commercial methods deployed in SA007 that would be excluded within the Interim AMAs (longline and net fishing) likely have less impacts on benthic biodiversity than methods such as trawling.

166 Any positive and negative effects, however, would be variable and site-specific, and would be unlikely to have significant effects on commercial fishing at the FMA level. And, any changes in biological diversity from the Interim AMAs are unlikely to adversely affect the sustainability of commercial fishstocks in Fisheries Statistical Area (SA) 007 (comprising Hauraki Gulf and Firth of Thames) or Fisheries Management Area (FMA) 1. MFish therefore considers any changes to biological diversity would not be large and would not have an undue adverse effect on commercial fishing.

167 Also see discussion in *The effect of the Interim AMAs on the biological diversity of the aquatic environment* in paragraphs 39-66.

168 On the balance of information, MFish is satisfied the effects on the biological diversity of the aquatic environment from the Interim AMAs would not be so excessive or disproportionate so

as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on commercial fishing.

Recreational fishing

169 MFish considers any changes in biological diversity from the Interim AMAs could have both positive and negative effects on recreational fishing. However, changes in biological diversity are likely to be minor and are unlikely to have an undue adverse effect on species important to recreational fishing.

170 The Interim AMAs could have positive effects on biological diversity by increasing the variety of fish and crustaceans within the farmed area, including species sought by recreational fishers, such as snapper. Changes in the variety of species in the benthic community at the Interim AMAs could affect snapper abundance in the area, if these benthic species are important as a food resource for snapper. The Interim AMAs may also provide some sort of 'refuge' for a variety of species, which could have a positive effect on the availability of fish for recreational fishing.

171 On the other hand, deposition from the Interim AMAs could have negative effects on benthic biodiversity affecting other species targeted by recreational fishers, such as flatfish. But, as noted above, effects would be largely contained within the farm structures. Most of the seabed within the Interim AMAs is uniformly muddy and featureless like much of the Firth of Thames, with benthic species composition fairly consistent across the Firth. As any changes to biological diversity are likely to be site-specific, the Interim AMAs are unlikely to unduly affect recreational fishing in the Firth of Thames or at a wider scale.

172 On the balance of information, MFish is satisfied the effects on the biological diversity of the aquatic environment from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on recreational fishing.

Customary fishing

173 MFish considers any changes in biological diversity from the Interim AMAs would be minor and unlikely to have an undue adverse effect on species important to customary fishing.

174 For important customary fishing species, such as snapper and flatfish, the effects would be the same as discussed for recreational fishing (paragraphs 169-172). Customary fishing for mussels and cockles, also important for customary fishers, would not likely be adversely affected by changes to biological diversity within the Interim AMAs. This is because these species are not fished within the Interim AMAs; they are fished 5 km away close to shore, where the effect of localised changes to biological diversity is unlikely to occur.

175 On the balance of information, MFish is satisfied the effects on the biological diversity of the aquatic environment from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on customary fishing.

Section 40 (a)(ii) of the Reform Act - The effect of the Interim AMAs on the productivity and biological abundance of fisheries resources

Commercial fishing

176 MFish considers the Interim AMAs may result in changes to the productivity and biological abundance of fisheries resources. These changes could affect fishstocks important for commercial fishing. MFish is uncertain of the extent of potential effects, however, and whether effects would be positive or negative, because there has been little scientific research on the effects of marine farming on fishstocks. But, in weighing up the available information, MFish considers the effects from the Interim AMAs on fishstocks important for commercial fishing would likely be localised and not unduly adverse at the SA007 or FMA1 scale.

177 MFish does not expect changes in species composition, abundance or productivity of fauna and infauna are likely to be large. The existing benthic fauna and infauna at the Interim AMAs are not diverse and comprise relatively common species typically found in the mud habitat predominant in the Firth of Thames. Changes in the abundance of benthic species are unlikely to be large because species intolerant of deposition are not presently abundant at the site, and biodeposition levels from the Interim AMAs are predicted to be relatively low. The creation of reef-like habitat from mussel drop-off may change the abundance of some species, but, again, these changes will be localised and not unduly adverse on a Firth-wide scale.

178 MFish notes, however, the Interim AMAs may affect the abundance and productivity of fish species as discussed in the following sequence:

(a) Flow-on effects of plankton depletion;

(b) Changes in the availability of food resources for commercial stocks;

(c) Changes in fishing effort and pressure;

(d) Changes to habitat; and

(e) Conclusion.

(a) Flow-on effects of plankton depletion

179 Phytoplankton is the major food source for mussels; removing phytoplankton from the marine food web can potentially impact other organisms in the marine environment by reducing food resources for zooplankton or other filter feeders. This could have flow-on effects to fishstocks targeted by commercial fishers.

180 However, MFish considers the Interim AMAs would not substantially change the overall abundance of phytoplankton in the Firth, although there would be localised effects on phytoplankton around the Interim AMAs. Some changes in the phytoplankton species composition could also occur, although these changes would not be substantial either. MFish considers a small reduction in phytoplankton abundance is unlikely to result in a substantial alteration of the phytoplankton productivity of the Firth ecosystem.

181 The Interim AMAs could also affect the abundance of zooplankton in the Firth. Zooplankton depletion could impact fish populations either directly (through consumption of eggs/larvae by farmed mussels) or indirectly (reduction in phytoplankton as a food resource).

182 Removing eggs and larvae has the potential to affect zooplankton populations and community structure, which could in turn affect recruitment of species important to commercial fishers such as snapper and rock lobster.

183 The Firth of Thames and Hauraki Gulf are important spawning grounds for snapper. If the Interim AMAs are located over an area where fish such as snapper normally spawn, and spawning occurs beneath the site, mussels would possibly uptake some snapper eggs. Nonetheless, the Interim AMAs would constitute only a small part of the likely spawning area for SNA1[40]. Eggs that are spawned away from the Interim AMAs would become dispersed in currents and would not likely be consumed by mussels farmed within the Interim AMAs. Furthermore, recruitment of snapper in SNA1 varies a great deal between years, correlated with sea surface temperature. As such, MFish considers the filtering effect of a large mussel farm such as the Interim AMAs is not likely to be a strong driver of recruitment of snapper in SNA1, although it may reduce the density of eggs and larvae around the Interim AMAs.

184 MFish does not consider the Interim AMAs would likely impact on commercial rock lobster fishing through the direct uptake of larvae by mussels. The uptake of rock lobster larvae by mussels within the Interim AMAs is unlikely because the Interim AMAs are located in inshore waters in the Firth of Thames. Most rock lobster larvae would have developed into pueruli by the time they reach the Firth of Thames. Pueruli are less vulnerable to consumption by mussels than rock lobster larvae. Furthermore, research by NIWA (2008) suggests rock lobster larvae are unlikely to be present in any significant numbers around the Interim AMAs.

185 Mussels may directly consume a variety of zooplankton, both micro- and mesozooplankton. Large reductions in microzooplankton may cause declines in zooplankton abundance, with flow-on effects for other fisheries resources including fishstocks important for commercial fishing. However, from modelling and experience, NIWA (2008) considers the Interim AMAs are unlikely to result in significant reductions in phytoplankton and microzooplankton, or have flow-on consequences for other fisheries resources at the Firth-wide scale. MFish therefore considers an undue adverse effect on species composition, productivity and abundance of fishstocks is unlikely.

(b) Changes in the availability of food resources for commercial stocks

186 The Interim AMAs may attract fish from other areas seeking food. For example, changes in the abundance of species in the benthic community at the Interim AMAs could affect snapper abundance in the vicinity of the Interim AMAs, if these benthic species are important as a food source for snapper. For some commercial finfish species, the biofouling community that would accumulate around the farming structures may provide an additional food source, while for other fish the environment may become less suitable. The farmed mussels may also provide a new food source for some fish species.

187 MFish is uncertain whether the Interim AMAs would increase or decrease the abundance of more mobile fish species or simply attract fish to the area. Generally, however, MFish expects any changes to food resources from the Interim AMAs may affect localised abundance within the Firth, but is unlikely to alter the productivity or abundance of any species on a wider scale.

[40] There is little information about the detailed distribution of snapper spawning; however, they are likely to spawn in many areas throughout the northeast coast of the North Island.

(c) Changes in fishing effort and pressure

188 Excluding commercial fishing from the Interim AMAs may increase or concentrate fishing pressure in other areas of the Firth of Thames. Increasing fishing intensity elsewhere can result in localised depletion and could have adverse impacts on the sustainability of commercially harvested species, for example through habitat degradation or harvesting of juveniles. The consequences of marine farm development on the overall fishstock largely depend on the scale of development, the importance of the area to the overall distribution of a stock, and fishing effort in the area.

189 MFish considers the displacement of commercial fishing from the Interim AMAs and increased fishing pressure in alternative areas could result in localised depletion of some commercial fishstocks through over-fishing in the alternative areas. For example, rig and flatfish are vulnerable to localised depletion because they are likely to be patchily distributed within the Firth of Thames and Hauraki Gulf. Also, flatfish are more sedentary than other finfish species.

190 Localised depletion for other commercial species, such as snapper, trevally, and gurnard, is less likely because the fish are wide-spread across the Firth and Gulf. Adult fish are highly mobile and provide a reliable source of recruitment through high productivity and low natural mortality.

191 In the case of the Interim AMAs, however, MFish does not consider localised depletion would adversely affect the productivity or abundance of commercial species on a FMA level. The displacement of fishing from the Interim AMAs is unlikely to unduly concentrate or increase fishing pressure elsewhere in the Firth or Gulf, given the size of the Interim AMAs relative to the availability of fishing grounds in the wider FMA. Although spawning of some species, such as snapper, is thought to possibly occur in the area of the Interim AMAs, and juveniles may use the site, there are likely to be other productive spawning and nursery areas across FMA1. And, because commercial fishing within the Interim AMAs is restricted to longlining and set netting, shifting effort elsewhere would not increase degradation of habitat in the alternative areas. As such, MFish does not consider changes in commercial fishing pressure would significantly affect stock-level sustainability.

(d) Changes to habitat

192 The Interim AMAs could change the habitat in the immediate area, which could affect the productivity and abundance of commercial species. Effects could be either positive or negative. Either way, however, MFish does not consider effects would be large as any effect would be localised and not unduly adverse.

193 The effect of the Interim AMAs on habitats of known significance to commercial fishstocks is discussed further in paragraphs 206-215.

(e) Conclusion

194 The consequences of marine farm development on overall fishstock productivity and abundance depends on the scale of development, the importance of the area on fishstock biomass and distribution, and fishing effort in the area. If the Interim AMAs adversely impact on B_{MSY}[41], it would cause an adverse effect on commercial fishing by reducing the total allowable commercial catch (TACC) or through further regulatory measures.

[41] B_{MSY} is the average stock biomass or level corresponding to maximum sustainable yield (MSY). MSY is the largest annual catch that can be taken over time without reducing the fish stock's productive potential.

195 However, as discussed above, MFish considers the effects from the Interim AMAs on fishstocks important for commercial fishing would likely be localised and not unduly adverse.

196 Therefore, MFish considers the Interim AMAs are unlikely to have adverse effects on the productivity and abundance of fisheries resources at a level that unduly impact on commercial fishing. MFish does not consider any potential impacts would affect the ability of fishstocks to continue to produce at current levels. MFish does not consider the total yield from commercial fishstocks would be reduced from the Interim AMAs' development because of adverse effects on the productivity and biological abundance of fisheries resources. As such, MFish does not consider approving the Interim AMAs would result in a considerable reduction in snapper or any other fishstock on the North Island east coast, or result in further regulatory measures or cuts to TACCs.

197 On the balance of information, MFish is satisfied the effects on the productivity and biological abundance of the aquatic environment from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on commercial fishing.

Recreational fishing

198 MFish considers the Interim AMAs are unlikely to have undue adverse effects on the productivity or abundance of species that are important to recreational fishers.

199 Information suggests some finfish species important to recreational fishers, such as snapper, are attracted to the mussel lines for food and shelter. Fishing parties often fish near the existing farms in the Firth because they know they can catch fish there. Some charter operators specialise in taking fishing parties to the farms. MFish does not know if the farms simply concentrate the fish and make them easier to catch or if the farms increase the overall productivity of the snapper population in some way (eg by providing additional food and/or shelter from predators). The Interim AMAs could, therefore, have a positive or negative effect on the productivity or abundance of recreational finfish.

200 However, most of the finfish species caught by recreational fishers in the Interim AMAs are common throughout the Firth and Gulf, and widely dispersed and caught across the area. As such, MFish does not expect the Interim AMAs would have undue adverse effects on the productivity or abundance of recreational finfish stocks.

201 MFish does not consider the Interim AMAs would have adverse effects on productivity or abundance of other species targeted by recreational fishers in the Firth of Thames, such as rock lobster and shellfish. MFish has no information to suggest these species are fished within the Interim AMAs. Recreational fishers are more likely to fish for shellfish in coastal fringes of the Firth (5 km from the Interim AMAs) and fish for rock lobster around reefs (there are no reefs within the Interim AMAs).

202 On the balance of information, MFish is satisfied the effects on the productivity and biological abundance of the aquatic environment from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on recreational fishing.

Customary fishing

203 MFish considers the Interim AMAs are unlikely to have undue adverse effects on the productivity or abundance of species that are important to customary fishers.

204 For important customary finfish and shellfish species, and rock lobster, the effects would be the same as discussed above for recreational fishing. The Interim AMAs may have localised effects on the productivity and abundance of these species, but MFish does not expect effects would be unduly adverse or likely to impact on customary fishing.

205 On the balance of information, MFish is satisfied the effects on the productivity and biological abundance of the aquatic environment from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on customary fishing.

Section 40(a)(iii)of the Reform Act - The effect of the Interim AMAs on habitats of known significance for fisheries management

Commercial fishing

206 MFish considers the Interim AMAs could affect habitats of known significance for species targeted by commercial fishers. However, MFish does not consider the Interim AMAs would degrade essential habitat for fisheries resources in a way that would have an undue adverse effect on productivity or utilisation of commercial fishstocks on a FMA1-wide scale.

207 The Interim AMAs are located within habitat of known significance for fisheries management and commercial fishing—the Hauraki Gulf and Firth of Thames are important areas for snapper spawning and provide a protected environment for juvenile finfish, including snapper, John dory, rig, school shark, and barracouta.

208 However, the Interim AMAs are also located within habitat that is well represented in the Firth of Thames and the wider Hauraki Gulf—mud substrate and a largely featureless seabed. This habitat is common across the wider fisheries management area (FMA1), and many nursery or spawning areas likely contribute to the biomass and recruitment of these fishstocks across FMA1. The habitat within the Interim AMAs is not unique and therefore not especially significant when compared to the rest of the Firth or wider FMA. MFish also notes the Interim AMAs does not contain other known habitats of significance for fisheries management, such as shellfish or algal beds, or reefs or cobble habitat.

209 Marine farming within the Interim AMAs would likely have an effect on habitat under the site through biodeposition (faeces, pseudofaeces, and shelldrop) or changes to nutrient cycling within the sediments, creating anoxic conditions, and changing community composition. Alterations to habitat, through biodeposition, could have impacts (positive or negative) on the suitability of the benthic environment for commercial fishstocks.

210 Positive effects from biodeposition could include shell-drop from the Interim AMAs creating new reef-like habitat to provide additional shelter and food resources for juvenile fish, such as snapper. Negative biodeposition effects could include increased suspended sediment levels which may affect the productivity of fish populations.

211 Either way, MFish considers the effects of biodeposition on mud habitat would likely be small. The mud habitat beneath the Interim AMAs is unlikely to excessively change; most finfish species could still use the area to some extent for spawning or as juvenile habitat.

212 MFish notes biodeposition would likely have greater effects on flatfish habitat as flatfish are bottom dwellers, more sedentary and more patchily distributed across the Firth. However, there is no information to suggest the Interim AMAs are particularly important for flatfish populations within the Firth. Given the abundance of suitable flatfish habitat across the Firth and wider management area, effects on flatfish habitat from the Interim AMAs are unlikely to be unduly adverse on a FMA1-wide scale.

213 Submitters have suggested the Interim AMAs would alter benthic habitat through the accumulation of biofouling species in the form of 'mussel whisker', adversely impacting commercial flatfish fishing. Biofouling species may fall from farm structures, especially during harvest, onto the seabed and create organic debris. MFish considers organic debris from the Interim AMAs would adversely affect the benthic habitat at the site and could extend up to 13 km south of the Interim AMAs. However, debris from the Interim AMAs would likely affect the same habitat currently impacted by debris from the existing farms in Area A. While MFish accepts debris is likely affecting commercial flatfish fishing around the Interim AMAs, MFish does not consider the alterations to benthic habitat from debris is likely to have undue adverse effects on a SA007-wide, or FMA1-wide, scale.

214 The Interim AMAs may also provide artificial habitat affecting fish important to commercial fishing. For example, marine farming structures may provide an artificial substrate for rock lobster pueruli settlement and may therefore have some effect on the rock lobster fishery. Pueruli that does settle on marine farming structures may not recruit into the fishery through mortality or damage during mussel harvest or the inability to find suitable settlement habitat if they leave the mussel farm. However, data collection of pueruli larvae in collectors suggests natural settlement of rock lobster pueruli in the Hauraki Gulf and Firth of Thames would be very low. As such, MFish does not consider the Interim AMAs would provide an artificial habitat that would have an undue adverse effect on the total number of surviving rock lobsters recruiting into the fishery.

215 On the balance of information, MFish is satisfied the effects on habitats of known significance from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on commercial fishing.

Recreational fishing

216 MFish considers the Interim AMAs could affect habitats of known significance for species targeted by recreational fishers. However, for the same reasons as discussed in the commercial fishing section above (paragraphs 206-215), MFish does not consider the Interim AMAs would degrade essential habitat for fisheries resources in a way that would excessively affect productivity of fishstocks, or use by recreational fishers in the Firth area. MFish also notes the marine farming structures may create habitat attractive to snapper, enhancing recreational fishing opportunities for the highly valued recreational species.

217 On the balance of information, MFish is satisfied the effects on habitats of known significance from the Interim AMAs would not be so excessive or disproportionate so as to

constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on recreational fishing.

Customary fishing

218 MFish considers the Interim AMAs could affect habitats of known significance for species targeted by customary fishers. However, for the same reasons as discussed in the section on commercial fishing, MFish does not consider the Interim AMAs would degrade essential habitat for fisheries resources in a way that would excessively affect productivity of fishstocks, or use by customary fishers.

219 On the balance of information, MFish is satisfied the effects on habitats of known significance from the Interim AMAs would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on customary fishing.

Section 40 (b) of the Reform Act - The location of the Interim AMAs in relation to areas in which fishing is carried out

Commercial fishing

220 MFish notes:

- The Wilson Bay Interim AMAs are located in Fisheries Statistical Area 007 (SA007), one of the 10 inshore statistical areas that comprise Fisheries Management Area 1 (FMA1)—refer Figures 9 and 10 of the preliminary evaluation report, page 48.
- The quota management area for some fishstocks combines FMA1 and FMA9, eg flatfish (FLA1), rig (SPO1), and grey mullet (GMU1).
- SA007 is closed by regulation to trawling and Danish seining. The main commercial fishing methods in SA007 are long lining and set netting.
- Within FMA1, SA007 is particularly important for targeting flatfish and rig. From October 1995 to September 2008, SA007 provided 69% of the total flatfish catch in FMA1, 48% of rig, 17% of grey mullet, 9% of snapper, 8% of kahawai, 2% of red gurnard and 1% of trevally.
- Analysis of catch returns in 2007/08 showed that most vessels targeting flatfish in SA007 did not report latitude and longitude positions because they were less than 6 m in length. Vessels less than 6 m are not required to report latitude and longitude positions on statutory returns (they only report by statistical area).
- Only five commercial fishers submitted they fish in the area of the Interim AMAs, catching rig, flatfish, snapper, trevally, kahawai and grey mullet, by the methods of set netting and longlining. Catch returns showed these fishers primarily target flatfish in SA007, but MFish could not verify from catch returns if the fishers are fishing within the Interim AMAs because they are fishing from vessels less than 6 m in length.

221 MFish has received little new information in submissions from commercial fishers since the preliminary evaluation in relation to areas where commercial fishing is carried out.

222 For this report, MFish has updated the catch effort information for FMA1 and SA007 (from statutory reports from October 1995 to May 2009)[42] to confirm the proportion of FMA1 catch taken from SA007 as follows:

Table 1: Percentage of the total estimated catch weight in FMA1 harvested from SA007

Fishstock	% of total estimated catch in FMA1 harvested from SA007	% of total estimated catch in combined QMAs (FMA1 & FMA9) where relevant
Flatfish (FLA1)	69%	52%
Rig (SPO1)	48%	20%
Grey mullet (GMU1)	17%	3%
Snapper (SNA1)	9%	n/a
Kahawai (KAH1)	8%	n/a
School shark (SCH1)	6%	2%
Red gurnard (GUR1)	2%	1%
John dory (JDO1)	2%	1%
Trevally (TRE1)	1%	n/a
All inshore finfish species (excluding tuna)	**4%**	**n/a**

223 By volume, SA007 provided around 4% of all inshore finfish catch (excluding tuna) in FMA1 from October 1995 to May 2009 (refer Table 2). Statistical areas 009 provided the highest proportion of all FMA1 inshore catch (excluding tuna) during that period (32%).

Table 2: Percentage of the total estimated catch weight of inshore finfish species in FMA1 by statistical area from October 1995 to May 2009

Percentage of total estimated catch of inshore finfish species in FMA1 by statistical area	
Statistical Area	**Percentage**
009	32%
003	19%
002	14%
008	13%
010	6%
005	4%
007	**4%**
006	3%
001	2%
004	2%

224 MFish has also updated the latitude and longitude positional data that is available for SA007. Figure 4 shows the start positions for vessels fishing in SA007 from October 2007 to May 2009.

[42] The preliminary evaluation report used data from October 1995 to September 2008.

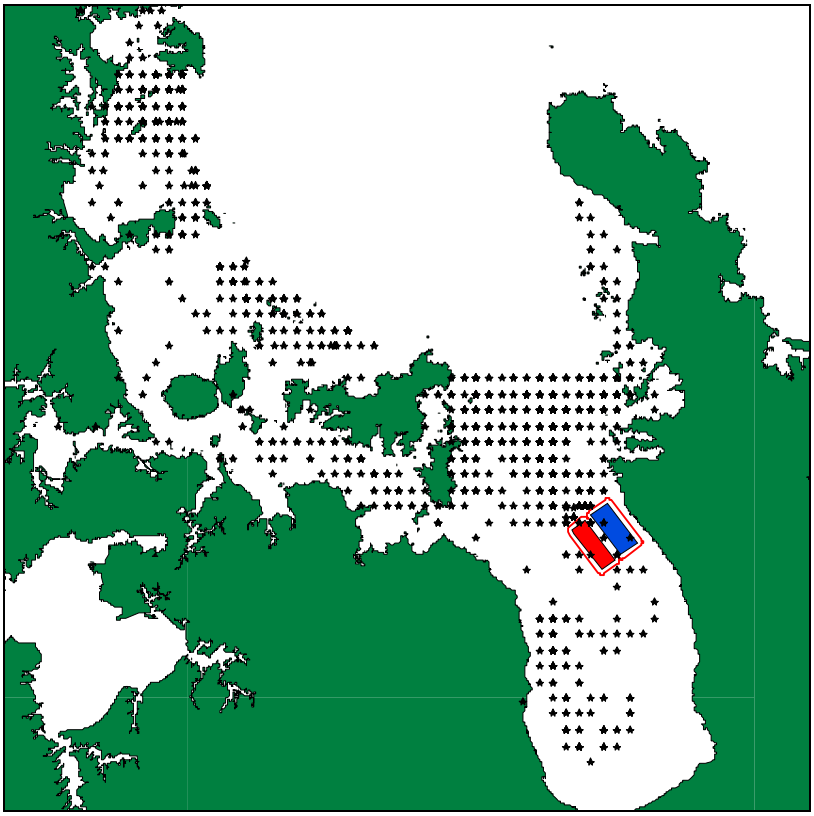

Figure 4: Map showing start positions for vessels fishing in SA007 and around the Interim AMAs and existing farms from October 2007 to May 2009

225 The latitude and longitude data shows fishing events are widely dispersed across SA007. MFish has used this data to roughly estimate the fishable area in SA007. Based on the latitude/longitude data and submissions, MFish estimates around 129,200 ha or 50% of SA007 is commercially fishable for inshore species by the methods of longlining and set netting[43]. The Interim AMAs cover around 1.5% of the estimated fishable area.

226 The latitude and longitude data plots a total of 1,427 trips (fishing events), which was about 20% of all trips in SA007 that occurred from October 2007 to May 2009, and 33% of the total estimated catch of all inshore finfish catch. MFish also notes:

- Most (92%) of the vessels (1,313 trips) in Figure 4 were targeting snapper by line, catching around 80% of the estimated snapper catch in SA007 during that period (October 2007 to May 2009).
- Around 6% of the vessels (92 trips) in Figure 4 were targeting rig by set net, catching around 50% of the estimated rig catch in SA007 during this period. None of the rig set netting trips occurred inside, or within 500 m of the boundaries of, the Interim AMAs.

[43] MFish considers the estimated fishable area is likely conservative because it excludes all area around the fringes where no or few start positions are recorded, an 11,000 ha area where some submitters state debris occurs from existing marine farms, the intertidal area at the southern area of the Firth and other intertidal estuaries/coastal inlets where MFish is aware some set and drag net fishing occurs.

- Only 1% of trips (21 trips) of the 1,427 trips plotted in Figure 4 took place inside, or within 500 m of the boundaries of, the Interim AMAs. These trips all targeted snapper by lining, and took less than 1% of the total estimated catch of snapper in SA007 from October 2007 to May 2009.

- Figure 4 plots around 86% of the total line fishing that took place in SA007 from October 2007 to May 2009. But Figure 4 only plots around 2% of the total net fishing that took place in SA007 during that period.

227 Figure 4 gives MFish a good picture of where line fishing takes place in SA007, particularly for snapper. Most snapper lining in SA007 does not occur inside the Interim AMAs.

228 MFish accepts it has little fine-scale information from statutory returns about where net fishing, particularly for flatfish and rig, occurs in SA007. Commercial fishers have submitted they set net in the area of the Interim AMAs. However, MFish considers the Interim AMAs likely form only part of the area these fishers set net. Stock assessment surveys do not suggest the Interim AMAs are particularly important for flatfish or rig populations within SA007. And, there is an abundance of mud habitat across SA007 and FMA1 that is suitable for flatfish and rig.

Conclusion s 40(b) commercial fishing

229 The Interim AMAs are located within an area of the Firth of Thames where commercial fishing occurs for species including flatfish, rig, kahawai, snapper, trevally and red gurnard. The area is fished by:

- Small vessels less than 6 m in length primarily catching flatfish and rig using set nets
- Larger vessels primarily taking kahawai, snapper, trevally and red gurnard using longlines.

230 Commercial fishing for these species would be adversely affected by the Interim AMAs. However, on balance of the information, MFish is satisfied that whatever effects the Interim AMAs might have on commercial fishing, they would not be so excessive or disproportionate to constitute (or even contribute, in the context of section 40 of the Reform Act more generally, to) an undue adverse effect on fishing.

Recreational fishing

231 MFish notes that no additional information or submissions on recreational fishing have been received since the preliminary evaluation. MFish considers:

- The Interim AMAs are located in a popular recreational finfishing area within the wider Firth of Thames/Hauraki Gulf/Coromandel fishing areas. Recreational fishing surveys suggest the existing mussels farms in Wilson Bay and the Coromandel are favourite spots for recreational fishers. Submitters suggest as many as 30,000 people every year fish around the existing Wilson Bay farms from charter boats because snapper are attracted to the mussel lines for food and shelter.

- The main species targeted by recreational fishers in the Firth of Thames are snapper, kahawai, gurnard, tarakihi, bluenose, kingfish, rig, John dory, groper, flatfish, trevally and grey mullet. MFish considers these species are likely found within the Interim AMAs, although grey mullet is more likely fished further inshore.

- The main recreational fishing methods in the Hauraki Gulf and Firth of Thames are rod and line fishing, and set netting.

- Recreational fishing for popular shellfish species such as cockles does not take place within the Interim AMAs; shellfish harvesting mostly occurs along shore, around 5 km from the Interim AMAs.

Conclusion s 40(b) recreational fishing

232 On the balance of information, MFish considers the Interim AMAs are located within areas where recreational fishing for a range of finfish species occurs. The existing marine farms in Area A are a popular recreational fishing site, however, and it is likely recreational fishers would also regularly fish in and around the Interim AMAs if approved.

Customary fishing

233 MFish notes that no additional information or submissions on customary fishing have been received since the preliminary evaluation. MFish considers:

- There is no site specific information to suggest the Interim AMAs are located in an area of particular importance (ie, high use or value) for customary fishing. But, if the existing farms in Wilson Bay are a popular area for recreational finfish fishing, the Interim AMAs are likely to be popular area for customary finfish fishing as well.

- The wider Firth is important to Hauraki iwi, hapu and whānau for kutāi (mussels), tuangi (cockles), snapper and patiki (flatfish), as noted by the one submission received on customary fishing.

Conclusion s 40(b) customary fishing

234 On the balance of information, MFish considers the Interim AMAs are located within areas where customary fishing for some species occurs. But, the Interim AMAs are not located in an area of any particular importance for customary fishing.

Section 40 (c) of the Reform Act - The effect of the Interim AMAs on fishing of any fishery, including the proportion of any fishery likely to become affected

Commercial fishing

235 In the preliminary evaluation report, MFish estimated the effect of the Interim AMAs on fishing of any fishery, including the proportion of any fishery likely to become affected[44]. These estimates are summarised in Table 3 below and were calculated using:

- The statutory returns for the five commercial fishing vessels smaller than 6 m whose owners had submitted they would be affected by the Interim AMAs; and

[44] MFish consulted publicly and openly on this application, giving all affected fishers the opportunity to provide information on their fishing in the area of the Interim AMAs. This consultation included writing directly to around 30 FLA1 fishers who live in the Firth of Thames region because MFish recognised it had little fine-scale catch information on flatfish fishing from locally-based small vessels (less than 6 m) in SA007. In 2006/07 and 2007/08, the 30 fishers to whom MFish wrote directly took around 85-90% of the total flatfish catch in SA007.

- The longitudinal/ latitude catch reporting of all commercial vessels greater than 6 m in length who had fished between October 2007 and September 2008[45] within 300m of the interim AMAs[46].

Table 3: Preliminary evaluation report's percentage of the total estimated catch weight that could be affected by the Interim AMAs (based on statutory returns lodged by submitters over a 9 year period and longitude/latitude provisional data from all vessels >6m in length from October 2007 to September 2008)

Fishstock	FMA[47]	MFish estimate in the preliminary evaluation report of total average annual catch affected
FLA1	1 & 9	2.98%
SPO1	1 & 9	0.98%
KAH1	1	0.51%
SNA1	1	0.10%
TRE1	1	0.05%
GUR1	1 & 9	0.01%
GMU1	1 & 9	0.00%

236 The affected commercial fishers, including the five fishers who submitted they fish in the area of the Interim AMAs, have not disputed MFish's estimates in Table 3 during consultation on the preliminary evaluation report.

Updating the estimates

237 For this final evaluation, MFish has updated the estimates summarised in Table 3 using the same methodology as in the preliminary evaluation report, but including the additional catch reporting information available since the preliminary decision to May 2009 (see Table 4). The updated estimates now include all vessels larger than 6 m that reported catch by longitude and latitude within 500 m of the Interim AMAs[48].

[45] The regulations requiring larger vessels to report by longitude and latitude came into force in October 2007. MFish notes that the longitude/latitude date used in the estimates in Tables 3 and 4 is limited because the data is only available for a short time period and may not provide a complete picture of all of the vessels that may have used the site in the past. But, this data represents the information available and in our judgement likely provides a reasonable estimate of current use. No submitters have provided better information on the use of the Interim AMAs by larger vessels >6m.

[46] MFish notes no commercial fishers operating vessels larger than 6 m submitted prior to the preliminary decision that they would be affected by the Interim AMAs. However, an analysis of the catches from these vessels was included to ensure our estimates of effects of the Interim AMAs on commercial fishing were as complete as possible.

[47] FLA1, SPO1, GUR1, and GMU1 are all managed under a single QMA that combines FMA1 and FMA9.

[48] In the preliminary evaluation, MFish only included fishing events that occurred within 300 m of the Interim AMAs, but we now consider 500 m is more cautious and provides a better estimate of potential catch losses given the spatial scale of longitude and latitude reporting and the nature and spatial scale of the fishing methods involved.

Table 4: Percentage of the total estimated catch weight that could be affected by the Interim AMAs (based on statutory returns lodged by submitters over a 9 year period and longitude/latitude provisional data from all vessels >6m in length from October 2007 to May 2009)

Fishstock	FMA[49]	MFish updated estimate of the total average annual catch affected
FLA1	1 & 9	2.98%
SPO1	1 & 9	0.99%
KAH1	1	0.52%
SNA1	1	0.11%
TRE1	1	0.05%
GUR1	1 & 9	<0.01%
GMU1	1 & 9	0.00%

238 The updated estimates in Table 4, using the new catch reporting information from September 2008 to May 2009, only differ slightly from the estimates in the preliminary evaluation report in Table 3. The updated estimates still show the biggest effect of the Interim AMAs would be on flatfish fishing, followed by rig fishing.

239 MFish notes the flatfish and rig catches affected by the Interim AMAs are taken almost exclusively by fishers operating small vessels less than 6 m in length. In the preliminary evaluation report, MFish stated our interpretation was that the estimated catch losses for rig and flatfish (using the submissions from the five affected small vessel fishers) included the effects of the Interim AMAs and the existing Area A farms. None of these five submitters have challenged MFish's interpretation. Therefore the estimates of rig and flatfish catch in Table 4 likely include the cumulative effects of the Interim AMAs and the existing Area A farms.

240 For the other affected species (ie.snapper, kahawai, trevally and gurnard) which are primarily taken using the longline method by vessels larger than 6 m that record catch by longitude and latitude, the estimates of affected catch in Table 4 do not include the effects of the existing farms in Area A. This is because we do not have information on the fishing by these larger vessels before the existing Area A farms were developed.

Concerns other small vessel fishers might be affected

241 One submitter is concerned there may be other commercial fishers using small vessels less than 6 m in length who would be affected by the Interim AMAs, but did not submit to the MFish process. However, they have not provided any names of other fishers who might be affected by the Interim AMAs.

242 MFish has received no indication through our public consultation process that other small vessels less than 6 m in length fish in or close to the Interim AMAs and would be adversely affected. This is despite providing fishers ample opportunity to make a submission.

243 MFish's judgment is that the consultation process has accounted for the majority if not all of the fishers using vessels less 6 m whose current fishing would be adversely affected. If we have missed someone it is likely because they have chosen not to come forward. In any event, our judgment is that impacts on their fishing activities would likely be minor. The decision maker will need to exercise his or her own judgment on this matter.

[49] FLA1, SPO1, GUR1, and GMU1 are all managed under a single QMA that combines FMA1 and FMA9.

Uncertainties in the available information

244 MFish recognises there are uncertainties in the data used to estimate the effects of the Interim AMAs on commercial fishing of any fishery, and the proportion of any fishery likely to become affected. For example, MFish cannot be certain we have accounted for every affected fisher using a vessel smaller than 6 m in length. Also, the fine-scale latitude/longitude positional data used as a basis for calculations is for a short timescale of 20 months. And, the fine-scale data latitude/longitude data is still only reported to the nearest minute, rather than second, ie 0.017°, which is equivalent to approximately 1 nautical mile. Despite these uncertainties, our judgment is that the available information provides a reasonable estimate of the quantum of catches affected.

Conclusion s 40(c) commercial fishing

245 MFish's best estimate from the analysis of submissions and catch reporting data is that the proportion of commercial catch affected is 2.98 % of FLA1, 0.99% of SPO1, 0.52% of KAH1, 0.11% of SNA1, 0.05% of TRE1 and < 0.01% of GUR1. MFish notes the estimates for FLA1 and SPO1 likely included the effects of both the Interim AMAs and the already approved Area A farms.

246 In such circumstances, and on the balance of information, MFish is satisfied that the effects on commercial fishing would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on fishing.

Recreational fishing

247 MFish does not have information to determine the proportion of any recreational fishery likely to be affected by the Interim AMAs. One recreational fisher submitted that 10% of his catch comes from the area of the Interim AMAs, but also noted the Interim AMAs would not impede or prohibit his normal fishing methods of rod and line fishing.

248 MFish notes that no additional information or submissions on recreational fishing have been received since the preliminary evaluation. Nonetheless, MFish does not consider the Interim AMAs would result in loss of catch for recreational fishers because:

- The main finfishing methods would not be excluded from the Interim AMAs.
- Anecdotal information suggests recreational finfishing would be enhanced for species commonly caught in the area of the Interim AMAs, such as snapper, because these species are attracted to mussel farms.
- Less than 1% of the Coromandel recreational scallop fishery is caught within the Firth of Thames, and therefore the Interim AMAs would unlikely have an adverse effect on that fishery[50].

Conclusion s40(c) recreational fishing

249 MFish considers the Interim AMAs are unlikely to adversely affect the recreational fishing of any species. Recreational fishing around marine farms in the Coromandel is a popular activity.

[50] Based on a summary of data from the five large scale fishing diary surveys: 1993/94, 1996, 1997, 1999/00, and 2000/01.

Customary fishing

250 MFish does not have information to determine the proportion of any customary fishery likely to be affected by the Interim AMAs. MFish notes that no *additional* information or submissions on customary fishing have been received since the preliminary evaluation. Nonetheless, MFish does not consider the Interim AMAs would result in loss of catch for customary fishers because:

- The Interim AMAs would not affect the harvest of mussels and cockles (identified as important for customary fishers) because the Interim AMAs are located around 5 km offshore over a mud habitat (not in waters associated with harvesting mussels and cockles).
- The main fishing methods for finfish species identified as important for customary fishing (set netting and lining for flatfish and snapper) would not be excluded from the Interim AMAs.
- Anecdotal information suggests fishing may be enhanced for species commonly caught in the area of the Interim AMAs, such as snapper, because these species are attracted to mussel farms.

Conclusion s 40(c) customary fishing

251 On balance of the information, MFish considers the Interim AMAs are unlikely to adversely affect the customary fishing of any species.

Section 40(d) of the reform Act - The degree to which aquaculture activities within the Interim AMAs will lead to the exclusion of fishing

Commercial fishing

252 Marine farms can affect commercial fishing through being sited directly over fishing grounds or by restricting vessel navigation (approach, departure, turning and towing capacity). Additionally, commercial fishing cannot occur immediately near to marine farms because of the risk of fishing gear entangling with marine farm structures.

253 The Interim AMAs are zoned for mussel farming, oyster farming and spat catching, all year round. Marine farming structures are, therefore, likely to be in the water all year round, meaning permanent exclusion for commercial fishers under the site (around 1,400 ha in Area A and 1,072 ha in Area B) and immediately near the site[51].

254 The two main methods used to catch fish in SA007 are longlining and set netting. A small amount of trolling also occurs. MFish does not consider alternative methods could be practically and legally used by commercial fishers to catch finfish within the Interim AMAs.

[51] Commercial fishing has already been excluded from the 710 ha of access ways in Area A due to the close proximity of the Area A farms when these are fully developed.

255 MFish considers commercial fishers (set netting, longlining, and trolling) generally would be excluded within 100 m[52] of the Interim AMAs. However, MFish also considers aquaculture activities within the Interim AMAs could exclude set net fishers targeting flatfish from a wider area. Some commercial fishers have suggested biofouling species fall from marine farming structures onto the seabed creating organic debris that accumulates on the seafloor. Fishers report that flatfish no longer live in this fouled area and fouled sets nets need to be replaced and repaired more often[53].

256 Submitters disagree on the spatial extent of the organic debris problem however. Fishers have variously reported the fouling zone from the existing farms in Area A extends from a few hundred metres to 13 km south (refer Figure 5).

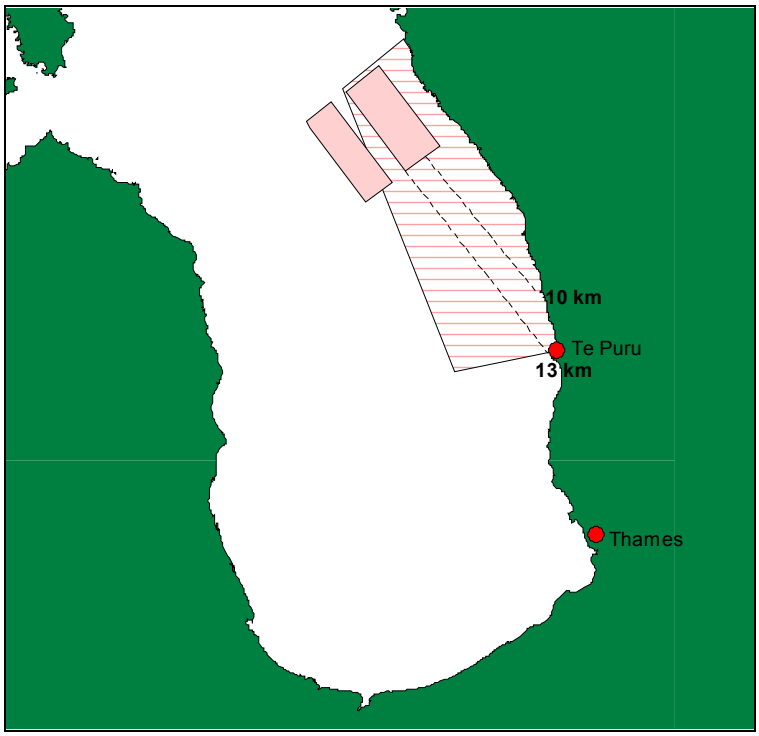

Figure 5: Map of area where submitters suggest debris could occur.

257 MFish considers commercial set net fishers could be excluded from area that is substantially impacted by the debris if debris clogs nets and flatfish avoid the affected areas. However, MFish considers the additional debris resulting from more farms within the Interim AMAs would likely affect the same area as already impacted by the existing farms. This is because the prevailing currents and tides would remain the same and likely carry debris from the Interim AMAs in a southerly direction towards the shore at Te Puru. The quantity of debris in this area, however, would likely increase.

[52] Although MFish considers set netting, longlining and trolling would generally be excluded within 100 m of the Interim AMAs, in the estimates of catch affected by the Interim AMAs (summarised in Table 4), MFish included in its calculations all fishing events within 500 m of the Interim AMAs (see footnote five for an explanation).

[53] The concerns about organic debris are based on submissions and anecdotal reports. NIWA did not observe any unusual accumulation of organic debris during their surveys at the Interim AMAs. However, MFish notes the NIWA survey did not include the areas where fishers state the biofouling is occurring. MFish considers from the consistency of submissions and from public meetings that fouling is probably occurring and is impacting set net operations.

258 MFish, therefore, considers aquaculture activities within the Interim AMAs could exclude some fishers from around 11,000 ha in the Firth of Thames. However, this debris exclusion area is already likely impacted by the existing marine farms. MFish also notes the debris exclusion area may not be a total exclusion area for all commercial fishing because:

- Some commercial set net fishers have submitted the fouling zone extends out to a few hundred metres from the existing farms only. Some set net fishers, therefore, likely fish within the 11,000 ha debris area.

- Fishers have not suggested that longline fishing for snapper would be excluded from the area impacted by debris. The latitude/longitude catch data also shows that some longline fishing occurs within the area fishers have suggested is impacted by debris.

259 MFish considers, however, that the estimates in Tables 3 and 4 include the likely effects of the debris exclusion areas in addition to the Interim AMAs. This is because:

- In the preliminary evaluation report MFish clearly stated that our interpretation was the five submitters operating smaller vessels appeared to have included the losses due to the debris exclusion in their estimates of the total catch affected by the Interim AMAs (based on their individual experience of the biofouling from the existing Area A farms). None of these five submitters has come back to MFish to say our interpretation was incorrect.
- The larger vessels reporting by longitude and latitude are almost exclusively fishing using the longline method which fishers have not suggested would be impacted by the debris.

Conclusion s 40(d) commercial fishing

260 Fishing for flatfish, rig, kahawai, snapper, trevally and gurnard using longlines and set nets would be excluded from the area of the Interim AMAs and within 100 m of the site boundaries. Set net fishing would also be excluded in areas affected by debris falling from the farms. Longline fishing, however, would not be affected significantly by this debris.

261 MFish considers the estimates in Table 4 of the catch affected by the Interim AMAs (ie 2.98% of FLA1, 0.99% of SPO1, 0.52% of KAH1, 0.11% of SNA1, 0.05% of TRE1 and < 0.01% of GUR1.) includes catch affected by the accumulations of debris on the seafloor. In such circumstances, and on the balance of information, MFish is satisfied that the effects on commercial fishing would not be so excessive or disproportionate so as to constitute (or even contribute, in the context of section 40 more generally, to) an undue adverse effect on fishing.

Recreational fishing

262 MFish notes that no additional information or submissions on recreational fishing have been received since the preliminary evaluation. Nonetheless, MFish does not consider the Interim AMAs would exclude the main recreational fishing methods in the Firth because:

- Rod and line fishing (eg for snapper) could still occur within marine farm structures, and set netting could still occur between blocks inside the Interim AMAs.

- Shellfish harvesting in the Firth would not be excluded by development of the Interim AMAs. Nearly 90% of the Coromandel recreational scallop fishery is caught by diving,

which would not be impeded by marine farming structures[54]. Other recreational shellfish harvesting occurs in the intertidal area approximately 5 km inshore of the Interim AMAs.

Conclusion s 40(d) recreational fishing

263 MFish does not consider the Interim AMAs would exclude any of the main recreational fishing methods used in the Firth of Thames.

Customary fishing

264 MFish notes that no additional information or submissions on customary fishing have been received since the preliminary evaluation. Nonetheless, MFish does not consider the Interim AMAs would exclude the main customary fishing methods in the Firth. The main customary fishing methods are likely to be the same as used for recreational fishing. As noted above, these methods would not be excluded from the Interim AMAs.

Conclusion s 40(d) customary fishing

265 MFish does not consider the Interim AMAs would exclude the main customary fishing methods used in the Firth of Thames.

Section 40 (e) of the Reform Act - The extent to which fishing for a species in the Interim AMAs can be carried out in other areas

Commercial fishing

266 MFish considers:

- Snapper, kahawai, trevally and gurnard caught from the Interim AMAs could be economically fished elsewhere in SA007 without any net loss of catch because these species are mobile, widely dispersed across SA007, and, in the most part, are currently taken by vessels in waters outside of the Interim AMAs.

- Flatfish and rig caught from the Interim AMAs could be fished in other areas, but there may be some catch loss of these two fishstocks if the Interim AMAs are approved. MFish noted in the preliminary evaluation report that rig and flatfish are patchily dispersed and fishers could only economically fish these stocks in congregation areas. The ability to fish alternative sites would be limited because flatfish and rig are relatively low value species, and fishing other areas could increase costs to an extent that would make fishing uneconomic. MFish also noted that submitters are concerned the recent regulatory set net bans in the Kaipara and Manukau harbours would increase fishing pressure in the Firth as affected fishers move into SA007. But MFish had no data available to determine if these closures were increasing fishing pressure in SA007.

267 There is little quantitative fine scale information to use to precisely specify the alternative areas where fishers can catch fish or how much fish could be taken from these alternative areas. Logically, however, MFish considers there are alternative areas within the Firth of Thames and SA007 where commercial fishers can fish because:

[54] Based on a summary of data from the five large scale fishing diary surveys: 1993/94, 1996, 1997, 1999/00, and 2000/01 (Ministry of Fisheries, *Draft Coromandel scallop fisheries plan, Appendix 1: Information Summary*).

- In terms of the seabed, water depth, water temperature, and species composition, there is little to distinguish the Interim AMAs site from the rest of the Firth of Thames or Hauraki Gulf.

- The Interim AMAs cover 0.7% of SA007 and 3% of the Firth of Thames.

- Finfish are mobile animals and are unlikely to remain exclusively beneath the Interim AMAs. The more mobile a species, the more likely it is that fishers will be able to catch their entitlement outside the Interim AMAs, compared to sessile or sedentary species. Snapper, trevally and gurnard, in particular, are widely dispersed across SA007. There is no information to suggest the Interim AMAs are located in a particular hotspot for finfish within the wider 71,000 ha Firth or 250,000 ha statistical area[55].

- The latitude and longitude positional data available for SA007 since October 2007 shows fish is caught across a wide range of SA007, and that other areas are more heavily fished, particularly for snapper (Figure 4).

- Some submitters have stated there are alternative sites available for them to fish, although fishing these areas will increase costs and fishing pressure, and reduce catch.

268 Because of the availability of these alternative areas, MFish considers not all finfish currently taken from within the Interim AMAs would be lost if the site was developed. Given the Interim AMAs cover around 1.5% of the estimated fishable area in SA007, MFish considers there would be adequate stock available in alternative fishing grounds outside of the Interim AMAs to ensure there is no significant reduction in the ability of fishers to continue to take their harvest allocation.

269 MFish notes there is less certainty about the extent to which flatfish fishing can be carried out in alternative areas because a substantial and variable proportion of FLA1 is taken from SA007[56]. Flatfish are bottom dwelling species and are more sedentary than many other finfish species. In addition, we have little fine-scale information on where commercial fishers are currently catching flatfish within SA007. And, there is likely to be less alternative areas available for flatfish set netting than other fisheries such as snapper longlining because flatfish set netting is more likely to be adversely impacted by the debris area that extends south from the Interim AMAs and existing mussels farms in Area A.

270 With flatfish and rig fishing, there is also the risk of localised depletion from concentrating fishing effort into smaller areas. Flatfish and rig are likely to be patchily distributed within SA007. Transferring effort from the Interim AMAs may cause localised depletion from over-fishing in the alternative areas. However, MFish does not consider increased fishing pressure is likely to impact on the sustainability of flatfish and rig at a wider QMA level.

271 MFish has also looked at the latest catch effort data to see if there has been any increase in fishing pressure in the Firth of Thames since 1 October 2008 as fishers affected by the regulatory set net bans in the Kaipara harbour may have moved into SA007. Catch effort data does not show any effort increase in SA007 since 1 October 2008. However, there is less than one year's data available and it is too early to draw any conclusions about the effects of the west coast set net bans

[55] MFish acknowledges not all of the 71,000 ha Firth and 250,000 ha SA007 is productive fishing grounds.
[56] The proportion of FLA1 catch taken by SA007 is variable, ranging from a low of 36% to a high of 65% over the last 14 years.

on fishing in SA007. MFish also notes that the new set net bans in the head of the Manukau harbour have not yet come into force due to a legal challenge of the Ministry's decision. MFish is unable to predict at this time the future effects of the set net bans in parts of the Kaipara and Manukua harbours and whether fishing effort might be displaced into SA007.

Conclusion s 40(e) commercial fishing

272 MFish considers flatfish and rig are patchily distributed and only some of the catch affected by the interim AMAs could be caught elsewhere in SA007 and FMA1. We are unable to quantify the catch that could be taken in alternative areas. However, we can say as a "worst case scenario" the net average annual loss of catch due to the Interim AMAs would be less than 0.99% of SPO1 and less than 2.98% of FLA1.

273 MFish considers kahawai, snapper, trevally and gurnard are all mobile species and fishing is widely distributed across the Firth of Thames. MFish considers it likely that the catch affected by the Interim AMAs could be caught elsewhere in SA007 and the QMAs for those species.

274 In such circumstances, and on the balance of information, MFish is satisfied that the effects on commercial fishing would not be so excessive or disproportionate to constitute (or even contribute, in the context of section 40 of the Reform Act more generally, to) an undue adverse effect on fishing.

Recreational fishing

275 MFish notes that no additional information or submissions on recreational fishing have been received since the preliminary evaluation. Nonetheless, MFish considers:

- Alternative areas for recreational fishing are available in the Firth of Thames, particularly to the south and west of the Interim AMAs, and the wider Hauraki Gulf.
- The species most likely targeted and caught by recreational fishers within the Interim AMAs, such as snapper, are mobile finfish species, common and widely dispersed across the Firth.

276 MFish also notes that the availability of alternative areas is less of a concern for recreational fishers given recreational fishing will not be excluded from the Interim AMAs. Anecdotal information, including submissions, suggests recreational fishers will continue to fish inside the Interim AMAs because they consider marine farms enhance recreational fishing for some species such as snapper.

Conclusion s 40(e) recreational fishing

277 MFish considers recreational fishing would not be adversely affected by the Interim AMAs. If, however, some recreational fishing is displaced, there are ample alternative fishing areas available for recreational fishing in the Firth of Thames and wider Hauraki Gulf.

Customary fishing

278 MFish considers the main customary fishing areas are likely to be largely the same as for recreational fishing. MFish notes no additional information or submissions on customary fishing have been received since the preliminary evaluation. Nonetheless, MFish considers alternative

areas for customary fishing are available in the Firth and the wider Hauraki Gulf for the same reasons as noted above for recreational fishing.

Conclusion s 40(e) customary fishing

279 MFish considers customary fishing would not be adversely affected by the Interim AMAs. If, however, some customary fishing is displaced, there are alternative fishing areas available for customary fishing in the Firth of Thames and wider Hauraki Gulf.

Section 40 (f) of the Reform Act - The extent of which the Interim AMAs will increase the cost of fishing

Commercial fishing

280 MFish considers the Interim AMAs would likely increase the cost of commercial flatfish and rig fishing. Having to use alternative sites to take the catch of FLA1 and SPO1 displaced from the Interim AMAs would likely increase fishers' operating costs through additional travel and reduced catch per unit effort (CPUE)[57]. Fishers would likely need to spend more time fishing to catch the same quantity of fish because of increased competition with other fishers already operating in the alternative areas. This would increase fuel and wage costs. Additionally, flatfish and rig are relatively low value species. Because profit margins are likely low the ability to fish alternative sites would be limited.

281 However, MFish did not consider the Interim AMAs would increase the costs of fishing for other species (snapper, kahawai, trevally and gurnard) because these fishstocks were caught throughout SA007 and were less concentrated in areas around the Interim AMAs. Using alternative sites was not expected to significantly increase travel costs or reduce CPUE when commercial fishing for these species.

282 MFish has not received any additional information since the preliminary evaluation about the extent to which the Interim AMAs would increase the cost of fishing. MFish has no quantitative information on the cost of set net or line fishing in the Firth of Thames and only has anecdotal information from submitters that costs would increase if the Interim AMAs was approved. Nevertheless, MFish still considers any change in fishing pattern could result in some additional costs for commercial fishing.

283 Commercial fishing is undertaken for profit and fishers will fish in areas where they expect to get the best returns, ie economically efficient fishing areas. If commercial fishers are fishing in the Interim AMAs, it is because they expect to catch fish there. In the short term, if they are displaced from the area, they would likely use more fuel or take more time searching for fish that were traditionally caught in the Interim AMAs. However, MFish does not consider that fishers would need to relocate far, given the availability of alternative fishing areas in Firth of Thames or SA007.

284 MFish notes the Interim AMAs could also increase fishing gear costs. Any increase in the quantity of debris from the Interim AMAs could increase the cost of set net fishing through time spent clearing gear of entangled debris, which reduces fishing time, and replacement of damaged

[57] Reduced CPUE may mean that more effort (eg metres of set net and/or length of net soak time) is required to catch the same volume of fish.

gear. However, fishers have suggested they are more likely to avoid fishing in the areas adversely affected by debris.

Conclusion s 40(f) commercial fishing

285 MFish considers the Interim AMAs would likely increase the cost of commercial flatfish and rig fishing. Because profit margins are likely low for the fishing of these species, the ability to fish alternative sites would be limited.

286 MFish does not consider the Interim AMAs would significantly increase the costs of fishing for snapper, kahawai, trevally and gurnard to an extent that would prevent the catch affected by the Interim AMAs being caught in alterative areas.

287 In such circumstances, and on the balance of information, MFish is satisfied that the effects on commercial fishing would not be so excessive or disproportionate to constitute (or even contribute, in the context of section 40 of the Reform Act more generally, to) an undue adverse effect on fishing

Recreational fishing

288 MFish does not have information to determine whether the Interim AMAs would increase the cost of recreational fishing. MFish notes that no additional information or submissions on recreational fishing have been received since the preliminary evaluation. Nonetheless, MFish considers the Interim AMAs would be unlikely to increase the cost of recreational fishing because recreational fishing would not be excluded from the Interim AMAs. MFish also notes the Interim AMAs could even have a positive effect on the cost of recreational snapper fishing if the additional marine farms attract snapper. Anecdotal reports suggest catch rates for snapper increase around marine farms, which could result in less fuel costs.

Conclusion s 40(f) recreational fishing

289 MFish considers the Interim AMAs would be unlikely to increase the cost of recreational fishing.

Customary fishing

290 MFish does not have information to determine whether the Interim AMAs would increase the cost of customary fishing. MFish notes that no additional information or submissions on customary fishing have been received since the preliminary evaluation. Nonetheless, MFish considers the Interim AMAs would be unlikely to increase the cost of customary fishing because customary fishing would not be excluded from the Interim AMAs. And, as noted above, customary fishing for snapper within the Interim AMAs could even have a positive effect on fishing costs if the additional marine farms attract snapper.

Conclusion s 40(f) customary fishing

291 MFish considers the Interim AMAs would be unlikely to increase the cost of customary fishing.

Section 40 (g) of the Reform Act - The cumulative effect on fishing of any previous aquaculture activities

Commercial fishing

292 In the preliminary evaluation report, MFish considered the cumulative effects on commercial fishing in FMA1 would likely be small because:

- For flatfish and rig, the 5,000 ha of existing farms in FMA1 were not located over significant flatfish or rig fishing grounds; and it was likely that catch losses to date would have been small and largely accommodated within the statistical areas where the marine farming development had occurred. MFish also noted in the preliminary evaluation report, in assessing cumulative effects, that the submissions on rig and flatfish from fishers operating vessels less than 6 m in length likely included the catch losses due to the Interim AMAs but also the existing "Area A" farm[58].
- For snapper, kahawai, trevally, gurnard and grey mullet, there would be no net loss of catch because the catch that traditionally comes from the Interim AMAs could be absorbed in alternative areas. The Interim AMAs would therefore not add to the cumulative adverse effects on fishing for these species in FMA1.

293 Following the preliminary decision, concerns have been raised by submitters about the cumulative effects of marine farming in FMA1, particularly the large Eastern Seafarms site offshore of Opotiki. FMA1 covers the exclusive economic zone between the easternmost point of North Cape at the top of the North Island and the northernmost point of Cape Runaway in the east—over 24 million ha of water space (MFish notes not all of this water space is fishable area). There are around 5,500 ha of marine farming space that exists in FMA1—around 0.02% of FMA1. The existing marine farming space (Figure 6) encompasses:

- 705 ha in the Northland region, mostly (96%) comprising small intertidal oyster farms
- 1,003 ha in the Waikato region, comprising 690 ha of mussel farms in Wilson Bay Area A and other small sites along the coastal ribbon in Coromandel
- 3,810 ha in the Bay of Plenty region, comprising 10 ha of small farms and the large 3,800 ha Eastern Seafarms site (as yet undeveloped).

[58] The flatfish and rig catches affected by the Interim AMAs are taken almost exclusively by fishers operating small vessels. In the preliminary evaluation report, MFish stated our interpretation was that the estimated catch losses for rig and flatfish (using the submissions from the five affected small vessel fishers) included the effects of the Interim AMAs and the existing Area A farms. None of these five submitters have challenged MFish interpretation. Therefore the estimates of rig and flatfish catch in Table 4 likely already include the cumulative effects of the Interim AMAs and the existing Area A farms. This is a relevant consideration for the assessment of the cumulative effects on these two stocks of any previous aquaculture activities.

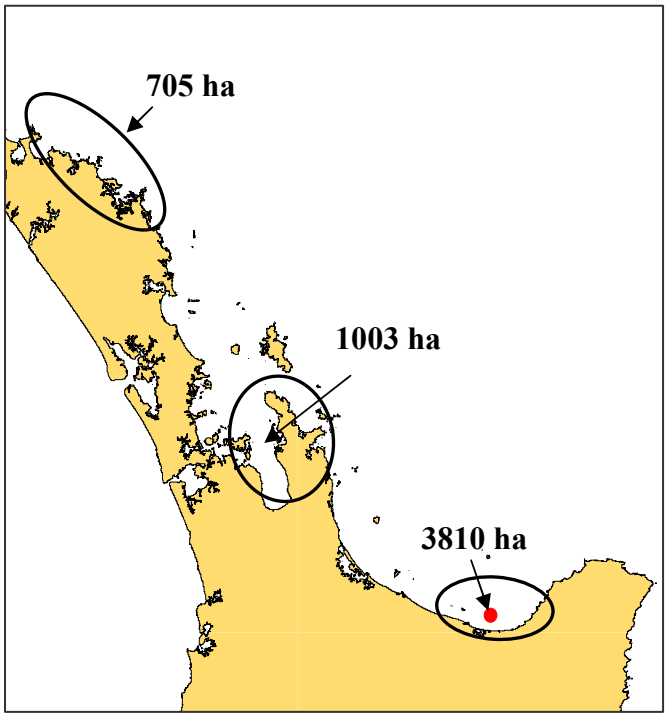

Figure 6: Map showing areas of marine farming activity in FMA1

294 Before approval of the 3,800 ha Eastern Seafarms site in December 2006, most marine farm sites in FMA1 were concentrated in the intertidal and coastal fringes of Northland and Coromandel, where little commercial fishing occurred. Although the Wilson Bay Area A site in the Firth of Thames (SA007) has displaced commercial set net and line fishing, fishing can largely be carried out in other areas within the Firth and FMA1 without significant increased cost. In this respect, our assessment in the preliminary evaluation report for the existing farms in Northland and Coromandel (as summarised above in paragraph 291) stands.

295 However, MFish considers the recent approval of the Eastern Seafarms site has increased the area occupied by marine farming structures in FMA1 by nearly 70% and the cumulative effects on fishing of this large farm needs further consideration.

Eastern Seafarms decision in December 2006

296 The Eastern Seafarms site is located in SA010 (refer Appendix 5) within an established trawl fishing ground—the Eastern Bay of Plenty coastal mixed trawl fishery. The main species targeted in that fishery, and in the Eastern Seafarms site, are snapper and trevally, with gurnard, John dory, and tarakihi also targeted[59].

297 The application for the Eastern Seafarms site comprised two blocks—a 3,800 ha northern block, and a 950 ha southern block. In December 2006, MFish made a final decision to approve the

[59] Overall, the main commercial fisheries in Bay of Plenty (biggest catches) are jack mackerel, English mackerel, skipjack tuna, kahawai, trevally, snapper, bluenose, and tarakihi. The dominant fishing methods are bottom trawling, purse seining, Danish seining, and bottom longlining.

northern block only[60]. MFish considered that approving both blocks totaling 4,750 ha would have significant impacts on the Eastern Bay of Plenty coastal mixed trawl fishery, and increase cumulative effects on commercial fishing in FMA1 to an unduly adverse level. However, MFish was satisfied the cumulative effects on commercial fishing in FMA1 would not be unduly adverse if the northern block of 3,800 ha alone was approved. MFish considered approving the northern block alone would result in catch losses of less than 5% of the average total annual finfish catch in FMA 1 and less than 5% of the average total annual catch of the individual fisheries affected in FMA1, including John dory, gurnard, snapper, tarakihi and trevally.

298 MFish did not consider commercial flatfish (FLA1) and rig (SPO1) fishing to be noticeably impacted by the Eastern Seafarms application. SA010 averages around 5% of FLA1 (mainly as bycatch in the mixed trawl fishery) and 2% of SPO1 catch. Fishers submitting on the Eastern Seafarms site did not highlight flatfish or rig fishing as species that would be adversely affected by the application.

New information

299 MFish considers approving the Interim AMAs would likely result in some loss of commercial catch, the exclusion of fishers from an area they traditionally fish, some concentration of fishing effort into alternative areas, and an associated increase in commercial fishing costs. However, the cumulative effect of marine farming on commercial fishing in FMA1 remains very difficult to quantify.

300 For the Eastern Seafarms decision in December 2006, MFish used catch effort information available at that time and a variety of mapping techniques to estimate that 6.5% of the bottom trawl catch in FMA1 would be excluded by development of the 4,750 ha application site[61]. Approving the northern block only reduced the excluded area by more than 3,000 ha (from 10,173 ha to 6,809 ha), resulting in a lower estimated catch loss. The reduced catch loss was not calculated in the final decision, but MFish was satisfied the catch loss would be less than 5% of FMA1 finfish catch.

301 For this assessment on the cumulative effects on commercial fishing in FMA1, MFish has used up-to-date latitude/longitude positional data to estimate the percentage of catch taken from trawls starting within 1 km of the Eastern Seafarms approved site[62]. The latitude/longitude positional data is available for all vessels trawling and lining in SA010 from October 2007 to May 2009 (ie fishing since the Eastern Seafarms decision was made), as plotted in Figure 7. Most (76%) of the fishing events shown in Figure 7 are trawling. Lining (typically for bluenose and ling) comprises 9%; tuna fishing (bigeye and skipjack) 10%; and netting (mostly flatfish) 5%.

[60] MFish was satisfied that approving the 3,800 ha northern block would not have an undue adverse effect on fishing or the sustainability of fisheries resources, but was not satisfied that approving both blocks totalling 4,750 ha would not have an undue adverse effect on fishing or the sustainability of fisheries resources.
[61] Final Decision, Eastern Seafarm Limited (C18-1037 & C18-1038), paragraph 258.
[62] MFish used a 1 km buffer because fishers stated in consultation on the Eastern Seafarms application that they would not fish within roughly 1 km of the application site boundaries due to risk of entanglement.

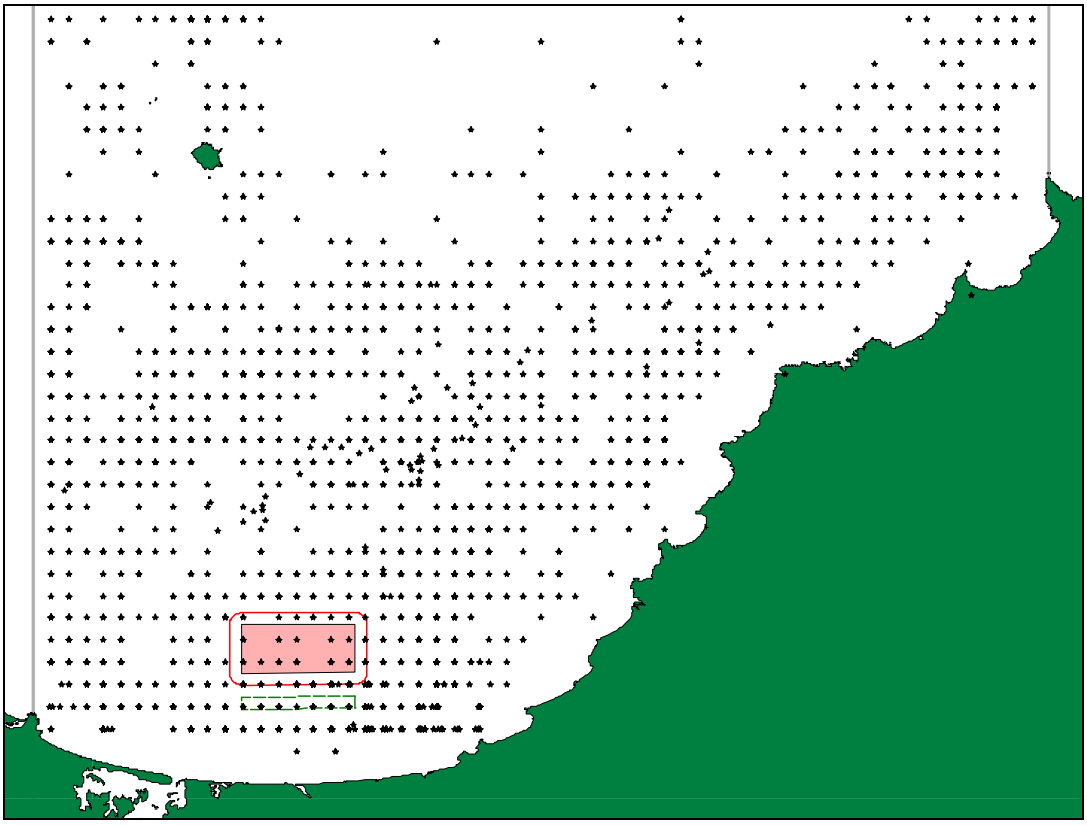

Figure 7: Latitude/longitude data of trawl and lining start positions in inshore region of SA010 from October 2007 to May 2009 (20 months). Pink block is the Eastern Seafarms approved site, with the 1 km trawl exclusion area outlined in red.

302 The new latitude/longitude positional data suggests:

- The fishable area in SA010 is likely larger than estimated in the Eastern Seafarms decision. For the Eastern Seafarms decision, MFish estimated 18% of SA010 is available for commercial harvest of inshore stocks, and that the application site would remove roughly 6.8% of the fishable area in SA010 (or 5% only for the northern block). Based on the new data, MFish now considers roughly 29% of SA010 is fishable area for trawling. The excluded area from the Eastern Seafarms site (the approved northern block only, with a 1 km buffer) is around 6,809 ha, which is roughly 3% of the fishable area in SA010.

- Only 3% of all events, and 4% of all trawl events, were started within the Eastern Seafarms excluded area.

- Only 2.8% of all estimated catch in SA010 (excluding tuna) was caught from events starting within the Eastern Seafarms site. 3.3% of the estimated catch of all fish caught by trawling in SA010 from October 2007 to May 2009 came from trawl events that started within the Eastern Seafarms excluded area. By individual fishstock, this equated to the following proportion of QMA1 catch:

Table 5: Percentage of estimated catch in SA010 and respective QMAs taken from Eastern Seafarms based on latitude/longitude positional data (October 2007 to May 2009)

Fishstock	% of estimated catch in SA010 caught from Eastern Seafarms site	% of estimated catch in QMA caught from Eastern Seafarms site
Flatfish (FLA1)	3.0%	0.0%
Kahawai (KAH1)	2.2%	0.1%
Rig (SPO1)	3.3%	0.0%
Snapper (SNA1)	8.1%	0.4%
Trevally (TRE1)	4.5%	0.8%
John dory (JDO1)	1.8%	0.1%
Gurnard (GUR1)	2.7%	0.1%
School shark (SCH1)	1.3%	0.0%
Grey mullet (GMU1)	0.0%	0.0%
Tarakihi (TAR1)	1.4%	0.2%

303 MFish accepts the latitude/longitude positional data is limited because it is available for a short period of time only, especially compared to the catch effort information and mapping techniques used in the Eastern Seafarms decision (October 1999 to September 2006). MFish also notes that impacts on trawling are greater than just displacement from the excluded area. The latitude/longitude positional data only shows trawl start positions and does not show the direction trawls are travelling. Realistically, the Eastern Seafarms site would shorten or interrupt a variety of traditional trawl lines. As such, catch affected by the Eastern Seafarms site is likely to include more than just catch taken from trawls starting within the excluded area.

304 Nevertheless, MFish considers the latest latitude/longitude positional data does suggest the Eastern Seafarms site has less adverse effects on catch than thought at the time the decision was made. The estimates of catch loss for Eastern Seafarms assumed all fish caught within the site would be lost. But, new information on trawl operations suggests small turns and changes in a trawl path to navigate around marine farming structures would unlikely have large impacts on swept area or trawl efficiency[63]. And, finfish such as snapper and trevally are mobile; although they may pass under a marine farm, they can still be caught outside of marine farming structures. So, while the Eastern Seafarms site would shorten or interrupt trawl lines and purse or Danish seining sweeps, MFish does not consider all the fish currently taken from the Eastern Seafarms site would be lost.

305 MFish also notes the Wilson Bay Interim AMAs and existing farms in Wilson Bay Area A would not affect trawl or seine fisheries because these methods are prohibited in SA007. As discussed, the Interim AMAs would have greater impacts on FLA1 or SPO1 set net fisheries, and no more than minor impacts on the fisheries most likely impacted by the Eastern Seafarms site (SNA1, TRE1 bottom trawl fisheries).

306 But, cumulative effects need to be considered across the whole of commercial fishing in FMA1. The most recent catch effort records show that SA010 provided around 6% of all inshore finfish catch (excluding tuna) in FMA1 from October 1995 to May 2009 (refer Table 2). The Eastern Seafarms site removes around 3% of the fishable area in SA010. Although the Eastern Seafarms site is located in a prime trawl area, it is unlikely to result in the loss of a large proportion of FMA1 catch, given its size relative to the fishable area in SA010 and in FMA1.

[63] See Appendix 5 "*Exclusion Distances for Commercial Trawling and Commercial Dredging*" of the Ministry of Fisheries final evaluation report for the Tasman Interim Aquaculture Management Areas

Conclusion s 40(g) commercial fishing

307 Ultimately, each application has to be approached on its own merits, on a case-by-case basis. As highlighted above, there are going to be some cumulative effects on fishing due to the Interim AMAs and previous aquaculture approvals (including Eastern Seafarms and Wilsons Bay Area A). MFish is, however, satisfied that on the balance of information the cumulative effects on commercial fishing would not be so excessive or disproportionate to constitute (or even contribute, in the context of section 40 of the Reform Act more generally, to) an undue adverse effect on fishing.

Recreational fishing

308 MFish notes that no additional information or submissions on recreational fishing have been received since the preliminary decision. Nonetheless, MFish considers the cumulative effects of marine farm development on recreational fishing in the Firth of Thames are minor. Furthermore, MFish does not consider the Interim AMAs would increase cumulative effects of marine farming on recreational fishing in the Firth because the Interim AMAs would not result in loss of catch for recreational fishers.

Conclusion s40(g) recreational fishing

MFish does not consider the Interim AMAs would increase the cumulative effects of aquaculture development on recreational fishing.

309 On the balance of information, MFish is satisfied the cumulative effect on recreational fishing of any previous aquaculture activities would not be so excessive or disproportionate so as to constitute an undue adverse effect on recreational fishing.

Customary fishing

310 MFish notes that no additional information or submissions on customary fishing have been received since the preliminary evaluation. Nonetheless, MFish considers the cumulative effects of marine farm development on customary fishing in the Firth of Thames are minor. Furthermore, MFish does not consider the Interim AMAs would increase cumulative effects of marine farming on customary fishing in the Firth because the Interim AMAs would not result in loss of catch for customary fishers.

Conclusion s40 (g) customary fishing

311 MFish does not consider the Interim AMAs would increase the cumulative effects of aquaculture development on customary fishing.

Conclusion for fishing in the context of section 40 of the Reform Act

312 In conclusion, and on the balance of information, MFish is satisfied that the range of matters that it has had regard to in the context of section 40 of the Reform Act are not so excessive or disproportionate so as to result in an undue adverse effect on fishing.

10. Conclusion

313 In summary, and having regard to all of the matters set out in section 40(a)–(g) of the Reform Act, MFish is satisfied that the activities proposed in the Interim AMAs would not have an undue adverse effect on either the:

(a) sustainability of fisheries resources; or

(b) commercial, recreational or customary fishing.

314 Accordingly, we believe that you can proceed to make a final decision for a determination over all of the Interim AMAs if you are also satisfied that the activities contemplated in the Interim AMAs would not have an undue adverse effect on fishing or the sustainability of fisheries resources.

Christine Bowden
Senior Fisheries Advisor
Ministry of Fisheries

Date: 16/ 10 /2009

Rachel Alexander
Fisheries Analyst
Ministry of Fisheries

Date: 16 / 10 /2009

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