MARLBOROUGH
DISTRICT COUNCIL

RESOURCE CONSENT APPLICATION

U150355

The New Zealand King Salmon Company Limited

Ngamahau Bay, Tory Channel,
Queen Charlotte Sound

Submissions Close

5.00 pm Thursday 4 June 2015

ISO 9001:2000
Document Number:
RAD0038-CI1307

Resource Consent Application

This application is made under Section 88 of the Resource Management Act 1991

MARLBOROUGH DISTRICT COUNCIL

Please read and complete this form thoroughly and provide all details relevant to your proposal. Feel free to discuss any aspect of your proposal, the words used in this form or the application process with Council staff, who are here to help.

This application will be checked before formal acceptance. If further information is required, you will be notified accordingly. When this information is supplied, the application will be formally received and processed further.

You may apply for more than one consent that is needed for the same activity on the same form.

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Document Number:
RAF0002-CI1248

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Receipt No. 1726629

Consent No.

Case Officer:

1. Applicant details *(If a trust, list full names of all trustees.)*

Name: The New Zealand King Salmon Co. Limited

Mailing address: c/- Gascoigne Wicks
P O Box 2
Blenheim 7240

Email Address: qdavies@gwlaw.co.nz

Phone: (Daytime) 578-4229 Phone: (Mobile) Fax: 578-4080

2. Agent Details *(If different from above or if your agent is dealing with the application.)*

Name: Quentin A M Davies

Mailing address: P O Box 2
Blenheim 7240

Email Address:

Phone: (Daytime) Phone: (Mobile) Fax:

3. Type of Resource Consent Applied for

☑ **Coastal Permit** ☐ **Discharge Permit** ☐ **Land Use** ☐ **Subdivision** ☐ **Water Permit**

4. Brief Description of the Activity

Consent to move a barge between consented salmon farms in the Marlborough Sounds

Date Received

RECEIVED
22 APR 2015
MARLBOROUGH DISTRICT COUNCIL

5. Property Details

The location to which the application relates is (address): Ngamahau Bay

Legal description (i.e. Lot 1 DP 1234): Marlborough District Council marine farm site number 8634

(Attach a sketch of the locality and activity points. Describe the location in a manner which will allow it to be readily identified e.g. house number and street address, Grid Reference, the name of any relevant stream, river, or other water body to which application may relate, proximity to any well known landmark, DP number, Valuation Number, Property Number.)
(Please attach a copy of the Certificate of Title.)

The names and addresses of the owner and occupier of the land (other than the applicant):	N/A

Please attach the written approval of affected parties/adjoining property owners and

Note: That as a matter of good practice and courtesy you should consult your neighbours about your proposal. If you have not consulted your neighbours, please give brief reasons on a separate sheet why you have not.

6. Assessment of Effects on the Environment (AEE) *(Attach separate sheet detailing AEE.)*

I attach, in accordance with the Fourth Schedule of the Resource Management Act 1991, an assessment of environmental effects in the detail that corresponds with the scale and significance of the effects that the proposed activity may have on the environment.

Note: Failure to submit an AEE will result in return of this application.

7. Other Information

Are additional resource consents required in relation to this proposal? If so, please list and indicate if they have been obtained or applied for.	NO

I attach any other information required to be included in the application by the relevant Resource Management Plan, Act or regulations.

Declaration

I *(please print name)* _____ agree

(i) That I am liable for all fees and charges relating to this application.
(ii) The lodgement fee is to be paid at the time of lodging the application for resource consent.
(iii) That payment is due within 30 days of the issue date of any additional charges.
(iv) That Council will charge me interest on any overdue invoices at 15% per annum from the date of issue of the invoice to the date of payment and Council may stop processing my application until an overdue invoice is paid in full. In the event of non-payment the applicant and/or agent will be liable for all legal and other costs of recovery.
(v) That where this application is completed and signed by an agent, all communication regarding this application will be with the agent.
(vi) The information provided in this application and the attachments to it are accurate.

Signature of applicant or authorised agent _____ Date 22/4/15

Privacy Information

The information you have provided on this form is required so that your application can be processed and so that statistics can be collected by Council. The information will be stored on a public register and held by Council. Details may be made available to the public about consents that have been applied for and issued by Council. If you would like access to or make corrections to your details, please contact Council .

Reset Form

Marlborough District Council
PO Box 443
Blenheim 7240

Telephone: (03) 520 7400
Website: www.marlborough.govt.nz
mdc@marlborough.govt.nz

MARLBOROUGH DISTRICT COUNCIL

Gascoigne Wicks LAWYERS

Partners:
Brian Fletcher LL.B
Paul Gibson LL.M, BCA
Quentin Davies LL.M (Hons), B.Sc (Hons)
Alison Weaver LL.B (Hons), BA

Associates:
Scott Wight LL.B
Laurie Murdoch LL.B, BA (Hons)

22 April 2015

Marlborough District Council
P O Box 443
Blenheim 7240

Attention: Anna Eatherley

Barge Consent – New Zealand King Salmon Co Ltd

Please find attached application for resource consent regarding the above.

Yours faithfully
GASCOIGNE WICKS

Quentin Davies
Partner
Email | qdavies@gwlaw.co.nz

Application for resource consent pursuant to Section 88 of the Resource Management Act 1991

APPLICANT:	The New Zealand King Salmon Co. Limited (NZ King Salmon)
SITES OF APPLICATION:	Ngamahau Bay; Waihinau Bay; Forsyth Bay; Ruakaka Bay (Marlborough District Council marine farm site numbers 8634, 8085, 8110 and 8274).
PROPOSAL:	An application for resource consent pursuant to s 88 of the Resource Management Act 1991 for consent to move a barge between consented salmon farms in the Marlborough Sounds.

Summary

1. This document supports an application by The New Zealand King Salmon Co. Ltd (NZ King Salmon) to use an existing barge from either the company's Waihinau Bay/Forsyth Bay salmon farm[1] or Ruakaka Bay salmon farm on the Ngamahau Bay salmon farm. Consent is sought for a 20 year term.

The Applicant

2. NZ King Salmon was formed in 1996 as the result of a merger between Regal Salmon Ltd and Southern Ocean Seafoods Ltd, and is now the largest producer of Chinook (King Salmon) in the world. The company is majority owned by the Oregon Group Limited (whose parent company is the Tiong Group) and Direct Capital.

3. NZ King Salmon's combined farms approximately 6,500 tonnes of Chinook King Salmon and has consent for eleven salmon farms, located across the Marlborough Sounds.[2] The company's operations generate significant regional and national economic benefits. In addition, NZ King Salmon provides contributions to support services such as charter boats, freight, road, sea and air haulers, specialist divers, hardware suppliers, engineering services, science providers, professional services and a host of other local and New Zealand based companies.

[1] These sites are farmed on a rotational basis with only one site used at any time.
[2] Located in Otanerau Bay, Forsyth Bay, Wahinau Bay, Te Pangu Bay, Ruakaka Bay, Clay Point, Crail Bay (two sites), Richmond Bay, Waitata Bay and Ngamahau Bay.

Application

Overview of Application

4. This application seeks to use an existing barge from either NZ King Salmon's Waihinau Bay/Forsyth Bay salmon farm or Ruakaka Bay salmon farm at the company's new site in Ngamahau Bay.

5. The purpose of the application is to facilitate the establishment of the first of NZ King Salmon's new farms at Ngamahau Bay. The consent for the Ngamahau site (U140296) requires the construction of a specific barge.[3] Construction of that barge is likely to take some time, not efficiently use existing resources and has the potential to delay the development of the site. NZ King Salmon has existing barge infrastructure which it would prefer to use.

Overview of Barge Structures

6. If NZ King Salmon was to construct a new barge, its present intention would be to construct a barge in accordance with the conditions imposed by the EPA. As these barges have a finite working life this application will only be a temporary change.

7. The Waihinau/Forsyth barge is a two story structure typical of NZ King Salmon's Tory Channel farms. The barge is approximately 20m x 9.5m and sits 8.3m above the waterline when lightly loaded. That height would be reduced to approximately 7.5m when fully loaded. A copy of the plans and images of the barge are **enclosed**.

8. The Ruakaka barge is approximately 20m x 12.4m and sits less than 7.5m above the waterline. Images of the barge are **enclosed**.

9. Above water elements of the barges are painted a recessive Karaka Green to blend into the environment.

10. This application seeks to enable the barge to be placed on the north east end of the farm or the south west end of the farm. NZ King Salmon's preference is to locate the farm at the north east end, further from the Pinder property.

Summary of Consented Barge for Ngamahau Bay

11. The conditions for the construction of a new barge at Ngamahau Bay are set out in Appendix 11 of the Board of Inquiry decision.The relevant conditions are:

    a. The maximum footprint should be 280m^2;[4]

    b. The maximum height should be 7.5m above water level;[5]

[3] Condition 14 of U140296.
[4] At [13].
[5] At [13].

c. The exterior design should be "generally in accordance with the design produced by HMA, King Salmon feed barge drawing, SK09, 9th August 2012";[6]

d. The roof and all ancillary features should be finished in non-reflective materials and painted in a dark colour such as karaka green. Dark coloured curtains, blinds or shutters are to be provided for the windows of rooms used for staff accommodation;[7]

12. This reflects the existing environment from which the application should be assessed.

Status of the Application

13. This proposal is comprised of two separate aspects:

a. Removal of an existing barge from the Waihinau/Forsyth or Ruakaka site; and

b. Relocation of an existing barge to the Ngamahau site.

14. Removal of a barge from the Waihinau Bay/Forsyth Bay or Ruakaka salmon farm for the duration of the proposed consent is unlikely to require resource consent.[8] If a barge is removed from Waihinau Bay/Forsyth Bay, the site will be serviced remotely, or possibly replaced with the "Kaiwaka", a small flat deck service barge which does not provide accommodation facilities. Use of the "Kaiwaka" is permitted under the existing consents for the sites.[9]

15. Consent will be required to site the existing barge at Ngamahau. This farm falls within the Coastal Marine Zone 3 (CMZ3) under the Marlborough Sounds Resource Management Plan (MSRMP). As a result, placement of an alternative barge structure at the site requires resource consent as a **non-complying activity** pursuant to rule 35.5 (point 1) as the Waihinau/Forsyth barge exceeds the discretionary activity height limit by 80cm.[10]

16. Movement of barges between farms is authorised by section 27 of the Marine and Coastal Area (Takutai Moana) Act 2011.

[6] At [14] (copy annexed).
[7] At [15].
[8] A consent can always be exercised to less than its maximum extent.
[9] MFL001 and U021247 (Ruakaka); MFL239 and U040412 (Forsyth) and MFL456 (Waihinau).
[10] This application is unable to be assessed as a discretionary activity due to non-compliance with performance standard 35.4.2.10.1(f) (height of structures). Accordingly, the application falls to be considered as a non-complying activity pursuant to rule 35.5 (point 1).

Consultation

17. NZ King Salmon have had informal discussions with Te Atiawa and with Rob Schuckard in relation to this application. Prior to lodging the application NZ King Salmon will provide the application Te Tau Ihi Iwi and to the Pinders who own a property which overlooks this site.

Assessment of Environmental Effects

18. In assessing the effects of this application it must be recognised that its scope is limited to the movement of a barge between salmon farms. The application will not result in the number of traditional style salmon farm barges increasing.

Social & Economic Effects

19. The proposed application will have positive social and economic benefits.

20. The Ngamahau farm has been recognised as having local, regional and (to a lesser extent) national significance.[11] Allowing the use of an existing barge at the site will enable NZ King Salmon to get the second of its new farms up and running as soon as possible, bringing forward the economic and social benefits of the proposal, including employment opportunities.

Cultural Effects and Tangata Whenua Values

21. This application is unlikely to result in adverse effects on matters of significance to Tangata Whenua.

22. The applicant is aware that Ngāti Apa ki te Rā Tō, Ngāti Kuia, Rangitāne o Wairau, Ngāti Kōata, Ngāti Rārua, Ngāti Tama ki Te Tau Ihu Te Ātiawa o Te Waka-a-Māui and Ngati Toa Rangatira all have Statutory Acknowledgements in the area of Ngamahau Bay, which formally recognise the cultural, spiritual, historical and traditional associations of these iwi to the area. In preparing this application NZ King Salmon has had regard to the Statutory Acknowledgments and has reviewed the statements of association for each iwi. No areas of conflict have been identified.

23. There are no identified wahi tapu, taiapure or mataitai reserves in the area of the Ngamahau Bay site, nor are there any areas of customary marine title or protected customary rights (as defined in the Marine and Coastal Area Act).

24. The company understands this application will be notified to iwi with Statutory Acknowledgements in the area and is happy to discuss the application further with iwi representatives.

[11] Board of Inquiry decision.

Public Access & Recreation

25. This application will not restrict public access in any significant way. The barge is proposed to be located wholly within the existing farm area boundary under consent U140296, and has a smaller footprint than the currently consented barge. In that sense, any effect on public access is likely to be positive.

Seabed Disturbance, Structural Safety & Navigation

26. Use of the Wahinau Bay/Forsyth Bay barge or Ruakaka Bay barge at Ngamahau Bay will not result in significant disturbance to the seabed. The barge will be moored to the salmon farm pens and to the seabed by way of screw anchors.

27. The disturbance to the seabed associated with the screw anchors will be minimal and highly localised. To the extent that there is an effect, there is no difference between barge types. No significant adverse effects are anticipated. It is proposed that the barge moorings should comply with the engineering conditions of the existing consent for the Ngamahau farm.

28. Use of an existing barge at Ngamahau is also not anticipated to have any navigational impact which is more than authorised at present. The proposed barges both have smaller footprints than the consented barge. Navigational lighting is proposed to be approved by the Harbourmaster under his delegated authority under the Maritime Transport Act 1994, if required.

Natural Character, Landscape and Visual Amenity

29. The use of the existing Wahinau Bay/Forsyth Bay barge at Ngamahau is unlikely to have a significant impact on natural character, landscape or visual amenity values.

30. The Ngamahau farm is not recognised as being within an area of outstanding natural landscape or outstanding natural character.[12]

31. In terms of visual effects, it is arguable that the proposed barges are slightly more prominent than that permitted under the existing consent. However, both barges have a smaller footprint than the consented barge and, in the applicant's view, any minor effects are able to be adequately mitigated. In particular:

    a. It is proposed that the barge consented pursuant to U140296 will not be in place while the Waihinau/Forsyth barge or Ruakaka barge is on site.

    b. The barges proposed are consistent in design with the existing barges sited on the Te Pangu and Clay Point salmon farms in Tory Channel.

[12] MSRMP, 2009 Boffa MIskell Landscape Study. Natural Character of the Marlborough Coast Report (2014).

c. The existing barges are painted a recessive Karaka green to blend with the surroundings of the Ngamahau site;

d. There will be some limited mitigation through removal of a traditional barge from the Waihinau/Forsyth farm or Ruakaka Farm while a barge is located at Ngamahau, although it is recognised that use of the Kaiwaka service barge at Waihinau Bay/Forsyth Bay may reduce the benefit[13].

32. There are two residences in close proximity to the Ngahamau site. The first is immediately adjacent to the farm.[14] That property is subject to a reverse sensitivity encumbrance in favour of NZ King Salmon. As the proposed Ruakaka and Waihinau/Forsyth barges are slightly taller than the barge provided for under the existing consent, there may be some minor impact on this property. The height difference which will be 80cm when the barge is lightly loaded will not be noticeable in practice.

33. The second property, owned by Clare and Martin Pinder, is located further away at approx 1.5km from the barge, on the southern headland to Deep Bay. The Board of Inquiry that considered NZ King Salmon's application for the Ngamahau bay farm accepted that the proposed farm would have high adverse visual effects on the view from the Pinder house.[15] However, the Board held that overall, the adverse effects on visual amenity would be low.[16]

34. While the barges now proposed are slightly taller than that consented under U140296 they have a smaller footprint, is likely to be located at the far end of the salmon farm and any increased visual amenity impact to the Pinder household over and above what is already consented is likely to be imperceptible.

Noise

35. The barge will comply with the CMZ3 noise limits when in place at the Ngamahau farm.[17] Noise levels are not anticipated to differ from those associated with the barge authorised by the existing consent. A noise report was commissioned as part of the application for the Ngamahau site in 2011. A copy of that report is **enclosed**.

[13] The Kaiwaka is unlikely to be used at Ruakaka, although such use would be permitted by the consent.
[14] This was referred to as the "Gledhill Property" in the Board of Inquiry decision. It has since changed ownership.
[15] Board of Inquiry Decision at [776].
[16] As above.
[17] 35.4.2.10.1(k) MSRMP.

Greywater

36. NZ King Salmon has an existing consent to discharge greywater from a barge on the Ngamahau site.[18] As a result, no further consent is sought for the discharge of greywater as part of this application. A copy of the greywater assessment undertaken as part of NZ King Salmon's application for the Richmond, Waitata and Ngamahau farms in 2011 is **enclosed**.

Harvesting and Investment of Consent Holder

37. Harvesting of marine farm produce is not sought as part of this application, but forms part of the existing consent for the site.

38. As this is not an application affected by ss 124 or 165ZH(1)(c), the value of investment of the consent holder is not relevant. However, the value of investment of the consent holder is approximately $22m per surface hectare per year in turnover.

Biosecurity

39. The movement of structures between Pelorus and Queen Charlotte Sound is something which NZ King Salmon undertakes periodically. The methods by which that is undertaken is provided for in NZ King Salmon's Biosecurity Management Plan. NZ King Salmon will clean the barge prior to moving it between Sounds and will otherwise comply with its Biosecurity Management Plan.

Policy Analysis

Part II Matters

40. Part II of the Resource Management Act 1991 is given effect through the New Zealand Coastal Policy Statement 2010, Marlborough Regional Policy Statement and Marlborough Sounds Resource Management Plan. Recent cases have cautioned against separate Part II analysis where these sections are appropriately given effect through other policy documents.

41. Part II considerations are considered in the discussion below and the table annexed. In the applicant's view, that analysis supports the position that the proposal is consistent with Part II of the Act.

Section 6

42. Section 6(a) provides that in considering this application the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from

[18] Refer condition 45 of U140296.

inappropriate subdivision, use, and development is a matter of national importance which must be recognised and provided for.

43. This application is not anticipated to have an appreciable effect on natural character. While natural character in the area of the Ngamahau site has been recognised as 'high', it is not 'very high' or 'outstanding' and the difference between the proposed and consented barges is minimal.

44. The area of the Ngamahau farm is not identified as having outstanding natural features or landscapes. Accordingly, considerations under s 6(b) do not arise.

45. There are no areas of signficiant indigenous vegetation or significant habitats of indigenous flora that will be affected by this application under s 6(c).

46. The footprint of the proposed barge is smaller than that consented for Ngamahau and the barge will be sited wholly within the existing farm boundaries. Effects on public access to and along the coastal marine area (if any) are therefore anticipated to be positive.

47. Consideration of the matters set out in s 6(e) are considered above under the heading 'cultural effects and tangata whenua values'. Effects are not anticipated.

Section 7

48. In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to –

    a. Kaitiakitanga:

    b. The efficient use and development of natural and physical resources:

    c. The maintenance and enhancement of amenity values:

    d. Intrinsic values of ecosystems:

    e. Recognition and protection of the heritage values of the sites, buildings, place, or areas:

    f. Maintenance and enhancement of quality of the environment:

    g. Any finite characteristics of natural and physical resources:

    h. The protection of the habitat of trout and salmon.

49. In terms of the matters raised under s 7, this application is not anticipated to have significant effects.

New Zealand Coastal Policy Statement 2010

50. The New Zealand Coastal Policy Statement 2010 is of general relevance to this application and all policies have been considered in the development of the proposal. Policies of specific relevance are considered below.

51. In terms of Policy 2, the applicant recognises that Ngāti Apa ki te Rā Tō, Ngāti Kuia, Rangitāne o Wairau, Ngāti Kōata, Ngāti Rārua, Ngāti Tama ki Te Tau Ihu Te Ātiawa o Te Waka-a-Māui and Ngati Toa Rangatira have Statutory Acknowledgments in the area of the application site. Those acknowledgements have been considered during the preparation of this application, as outlined above. The applicant has also reviewed the iwi management plans of Ngāti Kōata and Te Ātiawa o Te Waka-a-Māui. No areas of conflict have been identified.

52. There are no taiāpure or mahinga mātaitai in the area of the application. There are also no established areas of protected customary rights or customary marine title within the meaning of the Marine and Coastal Area (Takutai Moana) Act 2011.

53. The applicant is happy to discuss the proposal further with iwi representatives.

54. Policy 8 of the NZCPS provides for the recognition of the significant existing and potential contribution of aquaculture to the social, economic and cultural wellbeing of people and communities by:

    a. Including in regional policy statements and regional coastal plans provision for aquaculture activities in appropriate places in the coastal environment, recognising that relevant considerations may include:

        i. The need for high quality water for aquaculture activities; and

        ii. The need for land-based facilities associated with marine farming.

    b. Taking account of the social and economic benefits of aquaculture, including an available assessments of national and regional economic benefits; and

    c. Ensuring that development in the coastal environment does not make water quality unfit for aquaculture activities in areas approved for that purpose.

55. This application will assist with the establishment of the Ngamahau salmon farm which is recognised to have regional and national economic benefits. It will not result in any change to water quality which might impact on aquaculture activities.

56. Policy 11 relates to protecting the indigenous biological diversity of the coastal environment. This application is not anticipated to have any effect on indigenous biological diversity.

57. Policy 13 provides for the avoidance of significant adverse effects on areas of the coastal environment with outstanding natural character and the avoidance, remediation and mitigation of other adverse effects on natural character. Effects on natural character have been considered above in the context of s 6(a). No significant effects are anticipated.

58. Policy 15(a) provides for the avoidance of adverse effects of activities on outstanding natural features and outstanding natural landscapes in the coastal environment. Policy 15(b) provides for the avoidance of significant adverse effects and the avoidance, remediation, and mitigation of other adverse effects of activities on other natural features and natural landscapes in the coastal environment.

59. The Ngamahau site is not within an area of outstanding natural landscape. Any effects on natural features and natural landscapes in the area are anticipated to be minor.

Regional Policy Statement/Marlborough Sounds Resource Management Plan

60. Certain provisions of the Marlborough Regional Policy Statement have relevance to this application and are considered in **Appendix A**.

61. The Marlborough Sounds Resource Management Plan contains a number of provisions that are relevant this application. An assessment of the application against the requirements of the plan is contained in **Appendix B**.

62. Taken overall, the application is not contrary to the relevant objectives and policies of the Regional Policy Statement and Marlborough Sounds Resource Management Plan.

Conclusion

63. NZ King Salmon is applying for consent to relocate a barge from its Waihinau/Forsyth farm or Ruakaka farm to the farm in Ngamahau Bay. In the applicant's view, granting this application is consistent with the Act's sustainable management purpose, not contrary to the objectives and policies of the plan and is not anticipated to have environmental effects that are more than minor.

Appendix A: Marlborough Regional Policy Statement – Policy Analysis

Objective	Policy	Assessment
5.3.2: That water quality in the coastal marine area be maintained at a level which provides for the sustainable management of the marine ecosystem	5.3.5: Avoid, remedy or mitigate the reduction of coastal water quality by contaminants arising from activities occurring within the coastal marine area.	This application will not result in the introduction of any contaminants into the coastal marine area. Discharge of greywater is provided for under the existing consent.
5.3.10: The natural species diversity and integrity of marine habitats be maintained or enhanced	5.3.11: Avoid, remedy or mitigate habitat disruption arising from activities occurring within the coastal marine area.	This application will not result in any significant habitat destruction. Any disruption associated with mooring the barge will be minor in scale and transitory in nature.
7.1.9: To enable present and future generations to provide for their wellbeing by allowing use, development and protection of resources provided any adverse effects of activities are avoided, remedied or mitigated.	7.1.10: To enable appropriate type, scale and location of activities by: • clustering activities with similar effects; • ensuring activities reflect the character and facilities available in the communities in which they are located; • promoting the creation and maintenance of buffer zones (such as stream banks or 'greenbelts'); • locating activities with noxious elements in areas where adverse environmental effects can be avoided, remedied or mitigated.	This activity is located within the CMZ3 zone. The barge will be 'clustered' with the existing salmon farming activity.
	7.1.12: To ensure that no undue barriers are placed on the establishment of new activities (including new primary production species) provided the life supporting capacity of air, water, soil and ecosystems is safeguarded and any adverse environmental effects are avoided, remedied or mitigated.	This is an enabling policy which can be seen to support the development. In the applicant's view the life supporting capacity of air, water, soil and ecosystems is safeguarded by the application and appropriate in the locality. Adverse effects cannot be entirely avoided but will be mitigated through the use of the recessive Karaka green colour and partially mitigated through removal of a traditional style barge from Waihinau/Forsyth or Ruakaka while the barge is in

		place at Ngamahau.
7.2.7 The subdivision use and development, of the coastal environment, in a sustainable way.	7.2.8: Ensure the appropriate subdivision, use and development of the coastal environment.	This application is within the CMZ3 zone, which was considered by an Environmental Protection Authority Board of Inquiry to be appropriate for salmon farming. In the applicant's view this proposal is an appropriate development in the locality.
	7.2.10(a) - (d)	As above. This application represents appropriate allocation of coastal space.
7.3.2: Buildings, sites, trees and locations identified as having significant cultural or heritage value are retained for the continued benefit of the community.	7.3.3: Protect identified significant cultural and heritage features	No sites of cultural or heritage significance have been identified on the area of the application site.
8.1.2: The maintenance and enhancement of the visual character of indigenous, working and built landscapes.	8.1.3: Avoid, remedy or mitigate the damage of identified outstanding landscape features arising from the effects of excavation, disturbance of vegetation, or erection of structures.	This proposal is not within an identified outstanding natural feature.
	8.1.5: Promote enhancement of the nature and character of indigenous, working, and built landscapes by all activities which use land and water.	This application will not be detrimental to the nature and character of indigenous, working or built landscapes.
	8.1.6: Preserve the natural character of the coastal environment.	Natural character of the coastal environment will not be significantly affected by this application.

Appendix B: Marlborough Sounds Resource Management Plan – Policy Analysis

Objective	Policy	Assessment
Ch 2, 2.2, Obj 1: The preservation of the natural character of the coastal environment, wetlands, lakes, and rivers and their margins and the protection of them from inappropriate subdivision, use and development.	Policy 1.1: Avoid the adverse effects of subdivision, use or development within those areas of the coastal environment and freshwater bodies which are predominantly in their natural state and have natural character which has not been compromised.	This application is not set in an area which is predominantly in its natural state. Ngamahau Bay has been extensively modified through high water traffic and the presence of land based development.
	Policy 1.2: Appropriate use and development will be encouraged in areas where the natural character of the coastal environment has already been compromised, and where the adverse effects of such activities can be avoided, remedied or mitigated.	Ngamahau Bay has been extensively modified through high water traffic and the presence of land based development. The development is consistent with the salmon farming activities consented on the site and effects will be mitigated through the use of dark recessive colouring and partially mitigated through removal of a traditional style barge from Waihinau/Forsyth or Ruakaka.
	Policy 1.3: To consider the effects on those qualities, elements and features which contribute to natural character, including: a) Coastal and freshwater landforms; b) Indigenous flora and fauna, and their habitats; c) Water and water quality; d) Scenic or landscape values; e) Cultural heritage values, including historic places, sites of early settlement and sites of significance to iwi; and f) Habitat of trout.	These matters have been considered in the assessment of environmental effects. Taken overall, the application is consistent with the policy.

	Policy 1.4: In assessing the actual or potential effects of subdivision, use or development on natural character of the coastal and freshwater environments, particular regard shall be had to the policies in Chapters, 3, 4, 5, 6, 12, 13 and Sections 9.2.1, 9.3.2 and 9.4.1 in recognition of the components of natural character.	Considered elsewhere as/where appropriate. The application is not anticipated to have a significant impact on the components of these policies which impact natural character values.
	Policy 1.6: In assessing the appropriateness of subdivision, use or development in coastal and freshwater environments regard shall be had to the ability to restore or rehabilitate natural character in the area subject to the proposal.	Any residual impact on natural character would immediately rehabilitate on removal of the barge from the site.
	Policy 1.7: To adopt a precautionary approach in making decisions where the effects on the natural character of the coastal environment, wetlands, makes and rivers (and their margins) are unknown.	The effects of this application are not unknown and are discussed elsewhere in the assessment of environmental effects. A precautionary approach is not justified.
Ch 4, 4.3, Obj 1: The protection of significant indigenous flora and fauna (including trout and salmon) and their habitats from the adverse effects of use and development	Policy 1.2: Avoid, remedy or mitigate the adverse effects of land and water use on areas of significant ecological value.	The barge is not proposed to be sited over an area of significant ecological value.
Ch 5, 5.3, Obj 1: Management of the visual quality of the Sounds and protection of outstanding natural features and landscapes from inappropriate subdivision, use and development	Policy 1.1: Avoid, remedy and mitigate adverse effects of subdivision, use and development, including activities and structures, on the visual quality of outstanding natural features and landscapes, identified according to criteria in Appendix One.	The application site is not within an area of outstanding landscape value identified in the plan.
Ch 6, 6.1.2, Obj 1: Recognition and provision for the relationship of Marlborough's Maori to their culture	Policies 1.1-1.5	In preparing this application, the applicant has had regard to the Statutory Acknowledgments and has reviewed the statements o

and traditions with their ancestral lands, waters, sites, waahi tapu and other taonga.		association for each iwi. No areas of conflict have been identified. The applicant understands there are no known wahi tapu, taiapure, mataitai or other areas of significance to Maori in the vicinity of the application.
Ch 8, 8.3, Obj 1: That public access *to and along* the coastal marine area, lakes and rivers be maintained and enhanced.	Policy 1.2: Adverse effects on public access caused by the erection of structures, marine farms, works or activities in or along the coastal marine area should as far as practicable be avoided. Where complete avoidance is not practicable, the adverse effects should be mitigated and provision made for remedying those effects, to the extent practicable.	There are not anticipated to be adverse effects on public access caused by the barge. The barge will remain solely within the consented area of the site.
	Policy 1.3: To prevent the erection of structures and marine farms that restrict public access in the coastal marine area where it is subjected to high public usage.	The barge is proposed to be located solely within the already consented area of the site. While the site is within the Tory Channel, which is an area of high public usage, effects on public access are not anticipated.
	Policy 1.8: Public access to and along the coastal marine area should be maintained and enhanced except where it is necessary to [circumstances do not apply].	There will be no detriment to public access to and along the coastal marine area as a result of this application. The barge is proposed to be sited within the existing farm area. There are no moorings or casual anchorages in the area which could be affected. Access is accordingly maintained.
Ch 9, 9.2.1, Obj 1: The accommodation of appropriate activities in the coastal marine area whilst avoiding, remedying or mitigating the adverse effects of those activities.	Policy 1.1: Avoid, remedy and mitigate the adverse effects of use and development of resources in the coastal marine area on any of the following: a) Conservation and ecological values; b) Cultural and iwi values; c) Heritage and amenity values; d) Landscape, seascape and aesthetic values;	The way in which adverse effects on the stated values will be avoided, remedied and mitigated is addressed elsewhere in the assessment of environmental effects. Overall, the proposal is consistent with this policy.

	e) Marine habitats and sustainability; f) Natural character of the coastal environment; g) Navigational safety; h) Other activities, including those on land; i) Public access to and along the coast; j) Public health and safety; k) Recreation values; and l) Water quality.	
	Policy 1.2: Adverse effects of subdivision, use or development in the coastal environment should as far as practicable be avoided. Where complete avoidance is not practicable, the adverse effects should be mitigated and provision made for remedying those effects to the extent practicable.	The potential adverse effects of this proposal cannot be entirely avoided. Effects will be mitigated through the use of dark recessive colours on the barge and removal of a traditional style barge from the Waihinau/Forsyth farm or Ruakaka farm for a corresponding term.
	Policy 1.3: Exclusive occupation of the coastal marine area or occupation which effectively excludes the public will only be allowed to the extent reasonably necessary to carry out the activity.	The applicant has attempted to minimise exclusive occupation to the extent necessary. Exclusive occupation is only sought over the physical space occupied by the barge itself and such space as is necessary to secure mooring lines, consistent with the consent for the Ngamahau farm.
	Policy 1.6: Ensure recreational interests retain a dominant status over commercial activities that require occupation of coastal space and which preclude recreational use in Queen Charlotte Sound, including Tory Channel, but excluding Port and Marina Zones.	Ngamahau Bay is not an area of significant public recreation. This application will not result in commercial activities dominating over recreational activities in Tory Channel.
	Policy 1.7: Avoid adverse effects from the occupation of coastal space in or around recognised casual mooring areas.	The Ngamahau Bay area is not recognised as an area for casual mooring.

	Policy 1.12: To enable a range of activities in appropriate places in the waters of the Sounds including marine farming, tourism and recreation.	Policy 1.12 enables marine farming in appropriate places. Ngamahau is zoned CMZ3, and the characteristics of the site suggest the location is appropriate. Overall, the application appears to be consistent with this policy.
Ch 9, 9.3.2, Obj 1: Management of the effects of activities so that water quality in the coastal marine area is at a level which enables the gathering or cultivating of shellfish for human consumption (Class SG).	Policies 1.1 to 1.11	This application is not anticipated to have any impact on shellfish quality.
Ch 9, 9.4.1, Obj 1:	Policy 1.1: Avoid, remedied or mitigate the adverse effects of activities that disturb or alter the foreshore and/or seabed on any of the following: [criteria specified in Plan].	Any disturbance to seabed associated with mooring the barge will be transitory in nature.
Ch 9, 9.4A.1, Obj 1:	n/a	These policies are no longer relevant due to abolition of AMAs through legislation.
Ch 19, 19.3, Obj 1: Safe, efficient and sustainably managed water transport systems in a manner that avoids, remedies and mitigates adverse effects.	Policy 1.1: Avoid, remedy or mitigate the adverse effects of activities and structures on navigation and safety, within the coastal marine area.	No significant effects on navigation and safety are anticipated. The applicant will comply with any lighting/marking requirements of the Harbourmaster.
Ch 22, 22.3, Obj 1: To avoid, remedy and mitigate the adverse effects of unreasonable noise, while allowing for reasonable noise associated with port activities.	Policy 1.1: Avoid, remedy and mitigate community disturbance, disruption or interference by noise within coastal, rural, and urban areas.	The application is not anticipated to result in significant noise effects.

Section 88 Barge Application - Proposed Conditions of Consent

Coastal Permit

To relocate and operate existing feed storage/accommodation barge on marine farm site 8634.

Expiry

1. This consent shall expire on 20 years from commencement.

Occupancy

2. Occupancy shall be limited to within the area identified as the "proposed farm area boundary" ("Farm Boundary") on Figure 1 of U140296.

Structures

3. The structures shall be limited to a barge and associated anchors, ropes, lights and other necessary navigational aids. The barge shall be situated and secured so as to remain within the Farm Boundary at all times.
4. The barges used shall not exceed the following maximum dimensions:
   a. 20m x 9.5m (the "Forsyth/Waihinau Barge") and 8.3m when lightly loaded;
   b. 15m x 12m (the "Ruakaka Barge") and 7.5m when lightly loaded;
5. All above water elements of the barges shall be painted Karaka green.
6. Dark coloured curtains, blinds or shutters are to be provided for the windows of rooms used for staff accommodation.
7. The mooring systems used to secure the barges shall meet the requirements of conditions 20 to 31 of U140296, which relate to navigational information, navigational safety and structural engineering design, installation and maintenance.
8. The placement of barge lighting and marking shall be approved by the Harbourmaster under his Maritime Delegation from the Director of Maritime Safety pursuant to Sections 200, 444(2) and 444(4) of the Maritime Transport Act 1994. An approved lighting plan will be provided by the Harbourmaster, if required.
9. For the avoidance of doubt, no more than one barge shall be on site at any time at the Ngamahau farm.
10. Prior to shifting a barge between the Pelorus and the Queen Charlotte Sounds/Tory Channel, NZ King Salmon will ensure that the structure has been appropriately cleaned and provide evidence of this on request to the Marlborough District Council. NZ King Salmon will comply with its Biosecurity Management Plan, a copy of which is to be made available to the Marlborough District Council on request.

Report No. 2021
September 2011

CAWTHRON

The New Zealand King Salmon Company Limited: Assessment of Environmental Effects - Greywater

RESEARCH BASED SOLUTIONS

The New Zealand King Salmon Company Limited: Assessment Of Environmental Effects - Greywater

Paul Barter

Prepared for

New Zealand King Salmon Company Ltd

Cawthron Institute
98 Halifax Street East, Private Bag 2
Nelson, New Zealand
Ph. +64 3 548 2319
Fax. + 64 3 546 9464
www.cawthron.org.nz

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EXECUTIVE SUMMARY

New Zealand King Salmon Ltd (NZ King Salmon) currently operates seven salmon farm sites in the Marlborough Sounds (the Sounds) and is proposing to expand their operations by establishing additional farms. As part of an Assessment of Ecological Effects (AEE), the Cawthron Institute (Cawthron) has been contracted to prepare a series of reports on potential effects from various aspects of the existing operations. This report addresses the possible effects to coastal waters as a result of greywater discharges from the existing and proposed farms. By definition, greywater is all domestic wastewater with the exception of toilet wastes and includes baths/showers, hand basins, washing machines *etc.*

To date, the discharge of greywater from the NZ King Salmon farms has been assumed to be a permitted activity under the Marlborough District Council resource management plan, and as such, there has been no monitoring of existing greywater quality or quantity. This assessment has therefore drawn on the wealth of published and popular literature for greywater characterisation with supplementary information supplied by NZ King Salmon on site-specific parameters, such as numbers of personnel and volumetric estimates. This desktop approach was considered feasible because the composition and characterisation of greywater is both well understood and documented.

The approach to the assessment was firstly to characterise both the volumes and concentrations of greywater currently being discharged, and to assess potential effects from existing and future operations, based on these characteristics. To supplement the assessment, a cursory review of other sources (*e.g.* wastewater treatment facilities, private septic systems, rivers *etc.*) and their respective loads into the Marlborough Sounds was also undertaken.

Our review of greywater production concluded that volumes of 100 litres per capita per day (L/c/d) would serve as a reasonable approximation for all farms since it matched both the NZ King Salmon potable water-use estimates as well as published values. With regard to concentrations, we adopted published values even though there was reason to believe that these values might be higher than the actual NZ King Salmon greywater concentrations. Despite using these 'worst-case' concentrations, our estimation of loads showed that the NZ King Salmon greywater contribution is negligible compared to the myriad other point-source and non-point source discharges of similar constituents into the Sounds.

Our review of the regulatory frameworks identified several key constituents present in the greywater that are specifically managed and, if present in high enough concentrations or volumes, could give rise to either adverse ecological or aesthetic effects. These were: increased temperature; reduced oxygen; nutrient enrichment; bacteriological indicators; and aesthetics like foams and floatables.

In all cases, it was determined that either the concentrations or loads (or both) were low enough that none of these parameters have the potential to cause significant adverse effects. In almost all instances, the concentrations or loads were so low that any effects were unlikely outside a radius of only a few metres from the discharge point.

Finally, while some additional mitigative measures might help further reduce the potential for adverse effects, there is no immediate necessity for implementing them.

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1. INTRODUCTION

New Zealand King Salmon (NZ King Salmon) currently operates seven salmon farm sites (Figure 1) in the Marlborough Sounds (the Sounds) with production being limited to six of these sites at any given time. In addition, NZ King Salmon is proposing to expand their operations in the Sounds by establishing an additional nine farms which will involve Resource Consent applications as well as a Plan Change to the existing Marlborough Sounds Resource Management Plan (MSRMP 2004).

As part of a wider Assessment of Ecological Effects (AEE), the Cawthron Institute (Cawthron) has been contracted to prepare a series of reports on potential effects from various aspects of the existing operations (*e.g.* benthic ecology, water quality, hydrodynamics *etc.*) and proposed expansion.

This report focuses specifically on greywater discharges from NZ King Salmon facilities and the potential adverse effects to aquatic ecosystems that may arise as a result. Readers are directed to the other Cawthron reports (Gillespie *et al.* 2011; Keeley & Taylor 2011; Sneddon & Tremblay 2011) or the NZ King Salmon Plan Change AEE itself for potential effects from other farming-related activities.

To date, NZ King Salmon has been operating and discharging greywater as a permitted activity under the MSRMP, but it is possible that this designation will change for both the existing operations as well as the proposed new farms. It is understood that previous work conducted by Cawthron (Roberts 1993a; 1993b) was influential in the previous decision to allow greywater discharge under the permitted activity rules. This current assessment updates this information and provides additional analysis of characteristics and potential effects from greywater discharge.

2. GREYWATER CHARACTERISATION

2.1. Definition

Wastewater sources can be largely grouped into two major categories[1]: (i) blackwater and (ii) greywater, with the principal difference being the presence of faecal material and higher concentrations of pathogens in blackwater. The focus of this assessment is on greywater since all blackwater is contained on-site and removed via barge to wastewater treatment facilities in Havelock and Picton.

Given that the discharge of greywater has been a permitted activity and not subject to any stipulated monitoring in any of the existing NZ King Salmon resource consents, there is a paucity of site-specific data for both quantity and quality of the greywater discharges from any of the sites. Nevertheless, given the increased interest both nationally and internationally in greywater treatment and re-use, there is a wealth of both published and popular literature on greywater composition (*e.g.* (Siegrist 1978; Dixon *et al.* 1999; Nolde 2000; Al-Jayyousi 2003; Friedler 2004; Jefferson *et al.* 2004) which shows that greywater production tends to be fairly consistent with regard to both volumes and concentration. Therefore, this assessment draws on both the external information as well as specific information provided by NZ King Salmon related to potable water and cleaning/personal hygiene product use.

[1] Blackwater and greywater are generic terms used to differentiate the source of a wastewater and generally refer to toilet wastes (or sewage) and other domestic wastewater (or sullage) respectively. The principal difference is the presence of human wastes or faecal material in blackwater whereas greywater comprises of other sources like laundry, showers, hand basins *etc.* Most domestic effluent is a combination of both greywater and blackwater, but if they can be separated at the source. Greywater can be much more easily re-used or discharged given its lower potential for containing pathogenic organisms and lower levels of some common wastewater constituents. In addition, greywater does not tend to carry the same cultural or perceived public health stigma as blackwater.

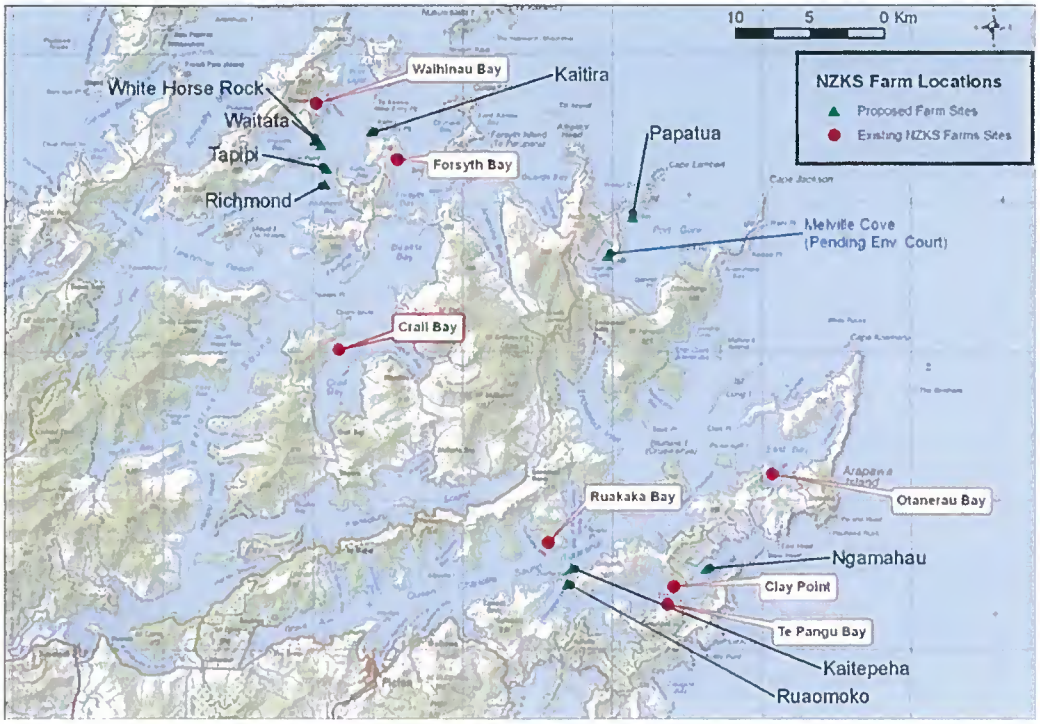

Figure 1. Map showing locations of existing and proposed NZ King Salmon farm sites in the Marlborough Sounds.

2.2. Volumes on a per capita per day basis

Of the seven existing NZ King Salmon farms, only five have fixed feeding and accommodation barges (Table 1). The Crail Bay site is serviced by the vessel *Chinook*, which also acts as accommodation for site staff. This vessel has a holding tank for combined grey- and blackwater which is pumped out on a regular basis in either Havelock or Picton for disposal to the respective wastewater treatment system. The other six locations house between two and four individuals with some minor seasonal changes to that number at the Otanerau and Te Pangu sites. Estimates of greywater production per site are based on the total potable water use minus the amount of blackwater removed on a monthly basis. While these are clearly estimates, the calculated daily usage of greywater is approximately 100 litres per capita per day (L/c/d) (*i.e.* 98 ±41 L/c/d) which correlates well with the published literature. For example, Friedler (2004) recorded an average greywater production of 98 L/c/d with reference to international studies showing a range of 68-134 L/c/d. Therefore, for the purposes of this assessment, rather than focusing on the inter-farm variability which, in all likelihood is due to estimation variation, a value of 100 L/c/d greywater production will be used.

Table 1. Summary of personnel and water use for each existing NZ King Salmon farm.

Site Name	Lic. No	Barge ID	Permanent Personnel[a]	Personnel Variation	Water use[b]		Blackwater	Greywater
					L/month	L/day	L/month	L/c/d[c]
Clay Point	8407	B-8	3	n/a	16,000	533	2000	155
Otanerau	8396	B-34	2	0 in Jan-Mar	8,000	267	2000	100
Ruakaka	8274	B-1	3	n/a	8,000	267	1850	68
Te Pangu	8408	B-9	4	+ 2 in Mar	16,000	533	2000	116
Forsyth / Waihinau	8110 / 8085	B-5	4	n/a	8,000	267	2000	50

a Permanent live aboard personnel, does not include day visitors/workers

b Estimates only based on water delivery, usage includes both greywater and blackwater

c Litres of greywater per capita per day (Total water use – blackwater removed / permanent personnel)

2.3. Composition and characterisation

As mentioned above, the composition and characterisation of greywater is both well understood and documented. Contrary to a common misconception, typical greywater concentrations can be as high as, or higher, than corresponding blackwater concentrations for most of the typical wastewater constituents. These typical greywater concentrations (taken from Friedler 2004) show relatively high concentrations of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total suspended Solids (TSS), and faecal coliforms. While it can be argued that the NZ King Salmon farms will produce a lower strength greywater[2] than corresponding international studies, these values (Table 2) still serve as a valuable worst-case scenario for assessing affects in the following sections. The loads, in grams per capita per day (g/c/d), have been calculated using the estimated greywater generation of 100 L/c/d described in Section 2.2.

Table 2. Typical greywater concentration and load (from Friedler 2004)

Parameter	Concentration (mg/L)	Load (g/c/d)
Biochemical Oxygen Demand (BOD)	477	47
Chemical Oxygen Demand (COD)	822	82
Total suspended Solids (TSS)	298	30
Total Organic Carbon (TOC)	270	27
Ammonia (NH4-N)	1.6	0.16
Phosphate (PO4-P)	61	6.1
Total oil	193	19
Anionic detergents (MBAS)	37	3.7
Faecal Coliforms (cfu/100mL)	2.50E+06	2.50E+09
Daily Discharge Volume (L/c/d)	68-134	

[2] NZKS has been diligent in sourcing and using biodegradable cleaners and personal hygiene products which can have much lower BOD, COD and TSS concentrations that corresponding non-biodegradable alternatives.

Given the very low permanent population on the NZ King Salmon barges, load calculations are of particular importance because they can put the scale of the discharge into perspective with other inputs. A synopsis of some of the other wastewater loads to the Sounds is discussed in Section 2.4.

2.4. Other loads

As shown in Table 1, the total permanent population on the five existing barges operated by NZ King Salmon is sixteen people with a maximum of four permanent personnel at the Te Pangu[3] and Forsyth/Waihinau farms. In contrast, the discharge from the Picton Sewage Treatment Plant into Queen Charlotte Sound serves a permanent population base of approximately 5,000 but is designed to cater to peak holiday loads in excess of 20,000 people. While this wastewater is very well treated, the loads are still orders of magnitude above those discharged via greywater from the NZ King Salmon sites. Other permanent 'point source' discharges into the Sounds include the Havelock municipal wastewater scheme and private schemes operated by Furneaux Lodge and the Portage Resort Hotel (MDC 2008).

Although the Marlborough Sounds does not have significant riverine inputs, the Pelorus River which discharges to the western sounds. This river is known to be a significant source of nutrients (Gibbs *et al.* 1992) with an estimated annual load of over 300 tonnes of dissolved inorganic nitrogen into Pelorus Sound. Advection from Cook Strait is also a significant source of nutrients to Pelorus Sound with an estimated annual load in excess of 11,000 tonnes (Gibbs *et al.* 1992). In contrast, the total load of nitrogen from greywater discharges from all the NZ King Salmon farms combined is estimated to be one kilogram annually (*i.e.* 0.001 tonnes).

Non-point source flows and loads to the Sounds are much more difficult to quantify but it is acknowledged that there are significant inputs, both licit and illicit, from the numerous recreational and commercial vessels that ply the Sounds, particularly in the summer months (MDC 2008). These discharges include the release of both greywater and sometimes blackwater, even though there are specific national regulations prohibiting such discharge. Another considerable non-point source input of greywater and blackwater to the Sounds is through the inefficient treatment of small-scale, on-site (septic) systems that are immediately adjacent to the coastal marine area.

The combination of all of these other loads would make it very difficult to quantify the total load for any given region in the Sounds and even more difficult on a Sounds-wide basis. Nevertheless, it can be easily concluded that the incremental increase to the Sounds as a result of the discharge of greywater from all of the existing (and proposed) NZ King Salmon farms is insignificant in comparison.

[3] Te Pangu can have as many as six permanent personnel during the month of March but this increase will have little to no affect on the overall assessment or comparison to other loads.

3. REGULATORY FRAMEWORK

3.1. Framework for assessing effects

Our assessment process primarily involves prediction of receiving water quality in relation to accepted regional, national or international guidelines, and draws on knowledge of the effects of similar discharges both within the Sounds and elsewhere.

An important aspect of the assessment is the interpretation of the significance of the predicted water quality changes and their implications for aquatic life and other values of the receiving environment. To make this assessment, we draw on a variety of information sources but primarily various environmental quality guidelines at regional or national levels. Key documents are Marlborough District Council's (MDC) Marlborough Sounds Resource Management Plan (MSRMP 2003), the Resource Management Act (RMA 1991), and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000).

While considerable guidance is provided in MSRMP and under the RMA, there are a number of instances where this is in narrative form only. In these situations we have usually deferred to the more quantitative guidance available in ANZECC. An overview of the most relevant information from each of these sources is provided below.

3.1.1. Marlborough Sounds Resource Management Plan (MSRMP 2003)

The discharge of greywater to marine receiving waters is not specifically addressed under the MSRMP. To date, NZ King Salmon has been operating under the decision that the discharge of greywater is a permitted activity; however, recent discussions with MDC have indicated that the discharge of greywater will be considered a discretionary activity for any future resource consent applications or renewals. These discretionary activities are covered in Chapter 35 of the MSRMP (Coastal Marine Zones), under section 35.4 and the nearest reference to greywater is the limited discretionary activity of 'discharges to water' which cover all discharges to coastal receiving waters in the Sounds.

These receiving waters are subject to meeting water quality class SG (being water managed for cultivation or shellfish-gathering) under the MSRMP. The SG limits are outlined in Table 3 and the compliance requirement applies outside a 'zone of reasonable mixing'. Criteria listed in the MSRMP to determine the extent of the zone of reasonable mixing, includes:

a) The need to minimise the size of the mixing zone

b) The need to avoid, remedy or mitigate adverse effects within the mixing zone, and

c) The characteristics of the discharge and receiving environment including:

- design of the outfall (*e.g.* single or multi-point diffuser)
- depth of water over the outfall

- density difference between the effluent (usually freshwater-based) and the receiving water (often saline) which determines its buoyancy, and
- speed and orientation of currents across the outfall.

Table 3. Conditions for water quality class, SG, as listed in the MSRMP.

SG - Water managed for the gathering or cultivation of shellfish for human consumption		
Temperature	Shall not be changed by more than 3 °C	
Dissolved oxygen	Shall exceed 80% of saturation	
Suitability of fish for human consumption	Shall not be rendered unsuitable by the presence of contaminants	Median faecal coliform concentration of not less than five samples, taken within any consecutive 30 day period, shall not exceed a Most Probable Number (MPN) of 14 per 100mL (or Colony Forming Units (cfu) per 100mL), and not more than ten percent of samples taken within any consecutive 30 day period shall exceed an MPN of 43 per 100mL (or 43 cfu per 100mL) as a result of any discharge of a contaminant or water. Samples shall not be taken on the same or consecutive days.

The assessment criteria for discharges to water are covered under Section 35.4.2.10.1.1 of the MSRMP and include assessing '*...the effect of the discharge having regard to the effect of currents, tides, waves, and winds on horizontal transport and vertical mixing of the contaminant.*' In addition, the assessment should consider the effect of the discharge having regard to:

- temperature
- BOD5
- suspended solids
- pH
- the chemical content of the discharge, including any heavy metals or other toxic substances
- dissolved solids
- marine farm, and
- the effectiveness of any mitigation measures.

3.1.2. Resource Management Act (RMA1991)

The most relevant standards are in Section 107 of the RMA. In relation to waste-water discharges, Section 107 places restrictions on the granting of consents if, after reasonable mixing, the discharge is likely to give rise to any or all of the following effects in the receiving waters:

- The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials
- Any conspicuous change in the colour or visual clarity
- Any emission of objectionable odour
- The rendering of freshwater unsuitable for consumption by farm animals, and
- Any significant adverse effects on aquatic life.

3.1.3. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000)*

The (ANZECC 2000) guidelines cater for a site-specific risk-based approach to setting environmental quality criteria for the protection of aquatic life and other values. For situations such as the PSTP outfall, where site-specific information from which such criteria could be developed are unavailable, guidance is provided on default trigger values for a variety of physical stressors and chemical toxicants. Trigger values are essentially conservative criteria (*e.g.* for water or sediment quality) that, if complied with, ensure that specified environmental values are protected. Note, however, that the converse is not necessarily true (*i.e.* exceedance of trigger values does not necessarily suggest environmental damage) hence the intent of these values is to act as a trigger for more intensive assessment if they are not met. A key feature of ANZECC (2000) is that the trigger levels differ or are applied differently for different types of ecosystem at three levels of disturbance ranging from pristine to highly disturbed. For the purposes of this report, we consider the trigger values for 'Condition 2' ecosystems to be most appropriate. Condition 2 systems are an intermediate category defined in the ANZECC guidelines (p. 3.1) as "*...slightly to moderately disturbed*".

4. PREDICTED IMPACTS

In reviewing both the greywater characterisation and the regulatory framework, there are several key parameters that could give rise to either adverse effects on water quality or conspicuous visual effects. For example, the MSRMP (2003) SG water quality class has specific receiving water limits for temperature, dissolved oxygen and indicator bacteria (*i.e.* microbiological). Additionally, S107 of the RMA has several narrative standards with regard to visual amenity and aesthetics (*e.g.* foams, films, floatables and colour). Each of these parameters, with specific reference to the NZ King Salmon greywater discharges will be discussed in turn in this section.

4.1. Temperature

Changes in coastal water temperature are a natural phenomenon and generally occur as a result of seasonal, or even diurnal, fluctuations in solar radiation. More rapid and acute changes can occur from upwelling of cooler subsurface waters, inputs from cold freshwater sources like rain or snow melt and even heated inputs from hot springs or hydrothermal vents. While most marine organisms are well adapted to these types of changes, acute variations of several degrees Celsius or more in water temperature can have a marked, and sometimes lethal, effect on individuals as well as more subtle effects on aquatic ecosystems. In discussing thermal effects on aquatic systems, ANZECC (2000) splits these effects into two categories:

- *influences on the physiology of the biota (e.g. growth and metabolism, reproduction timing and success, mobility and migration patterns, and production may all be altered by changes to the ambient temperature regime)*
- *influences on ecosystem functioning (e.g. through changes in the rate of microbial processes and altered oxygen solubility).*

However, while the types of effects are well understood, ANZECC recognises that there is paucity of information available on the specific thermal tolerance of New Zealand aquatic organisms. This is why guidelines such as the MSRMP (2003) and RMA (Schedule 3) tend to defer to a conservative limit of *"...no greater than 3 °C change..."* in the receiving waters after reasonable mixing. Likewise for the purposes of this assessment, a 3 °C change criterion will be addressed.

The temperature of greywater discharged form the NZ King Salmon farms will be highly variable depending on the source of the greywater being produced. Unquestionably, the source of greywater that has the potential to produce the largest temperature effect with be from showering/bathing where relatively large quantities of warm water are produced. Conservatively, the temperature of greywater from a shower or bath could be as high as 40 °C, but is likely to be much lower, given the cooling that takes place in the pipes before discharge. Flows will depend on shower duration and type of shower head but can conservatively be set at 10 litres per minute for the duration of the shower.

For comparison, a recent study (Sneddon 2009) into temperature effects on shallow coastal receiving waters showed that a thermal discharge from a heat exchanger was having very little effect on surface water temperatures. Results from this study showed that the temperature effect was significantly attenuated within 6 m from the discharge point with the change from ambient temperature generally less than 2 °C.

This study serves as a particularly good comparison since the discharge water was the same temperature (*i.e.* 40 °C) as the 'worst-case' greywater, and discharge was end-of-pipe into surface coastal waters, and subject to similar tidally reversing currents. The comparison is also very conservative since the volumes were much greater (*i.e.* 830 L/min) than the greywater discharge (*i.e.*10 L/min). This means, if a 40 °C discharge into surface waters with 80 times the volume does not have an effect on temperature outside a 5-10 m radius of the discharge point, it can be assumed that the greywater discharge will have negligible effect on temperature of the receiving waters within a metre or two of the discharge point.

4.2. Oxygen demanding substances

Excessive discharge of organic rich wastewaters (including greywater) can result in oxygen depletion in the water column and seabed sediments, with associated effects on aquatic life, and proliferations of attached heterotrophic organisms (*e.g.* bacterial mats). In the case of the NZ King Salmon greywater discharges, sediment enrichment/anoxia effects and heterotrophic growths can be discounted without further assessment due to the low volumes of discharge and depth above the seabed where the discharge occurs (*i.e.* >10 m) . However, given the Biochemical Oxygen Demand (BOD_5) of greywater in general (*i.e.* 477 g/m^3 from Table 2), a limited discussion on oxygen depletion in the water column is warranted.

Oxygen is the single most important component of surface water for self-purification processes and the maintenance of aquatic organisms that use aerobic respiration. Oxygen solubility (or oxygen saturation) in water is governed by a complex set of physical conditions that include atmospheric and hydrostatic pressure, turbulence, temperature and salinity. Predicting the effects from a discharge on the dissolved oxygen (DO) levels within receiving waters involves more than a consideration of wastewater dispersion and dilution, since effects on DO reflect processes (*e.g.* rate of reoxygenation through algal photosynthesis and atmospheric exchange) that take place over greater spatio-temporal scales than reflected by considerations of effluent behaviour in the vicinity of a barge for example.

Nevertheless, NZ King Salmon greywater discharges are of a sufficiently small volume (200-400 L/day) and load (47 g BOD/c/d), that even in the lower energy sites like Ruakaka and Otanerau, mixing alone is sufficient to reduce potential DO effects and overrides the more subtle processes discussed above.

For example, most DO guidelines are based on a receiving water maximum DO deficit of less than 20% (*i.e.* maintaining at least 80% DO saturation). Even in protected coastal waters like the Marlborough Sounds, oxygen saturation values are expected to be at or near saturation. For

instance, results from the 2010 monitoring of the Clay Point Salmon Farm (Dunmore *et al.* 2010) showed DO values at or near 100% saturation values even in the near bottom waters around the farm where seabed enrichment is often expected to reduce DO concentrations.

In the case of the NZ King Salmon barges, any oxygen deficit that is potentially introduced by the small loads of greywater effluent will be quickly reversed by mixing, small wave action and other processes. It is worth noting, that this re-oxygenation will not only take place in the vicinity of the discharge but as the greywater is mixed and dispersed through the water column. This is an important factor, since oxygen depletion effects are not instantaneous and are based on microbial activity which takes time (*i.e.* hours to days versus minutes) to initiate.

4.3. Nutrients

Though small in concentration compared to seawater's major constituents, nutrients, primarily nitrate (NO_3^-) and phosphate (PO_4^{3-}), are extremely important to the biology of the oceans. In some cases, iron (Fe) and silica (Si) may also act as limiting nutrients. While iron is important in some regions, particularly open ocean regions distant from land, in most productive coastal regions the limiting nutrient is nitrogen. Excess nutrients are capable of greatly increasing plant growth, potentially resulting in algal blooms whose subsequent decay can have flow-on effects to aquatic systems (*e.g.* oxygen depletion). In order to avoid over-enrichment with nutrients (eutrophication), their input load must not exceed the assimilative capacity of the coastal receiving environment. The assimilative capacity is a complex function of biotic and abiotic characteristics and includes such factors as its flushing, light regime and temperature.

Nitrogen in seawater is mainly present as nitrate (NO_3^-) and in some inshore coastal areas as ammoniacal nitrogen (consisting of ammonium plus ammonia). In general, these concentrations are lower in summer and higher in winter, and are low and variable at the sea surface and increase with depth. The low surface levels in summer are caused by phytoplankton growth. The sum of NO_3-N and ammoniacal-N is termed dissolved inorganic nitrogen (DIN), which is a key constituent of interest since coastal marine algae are generally limited and regulated by its supply.

Guidance on acceptable levels of nutrients in inshore coastal waters is minimal. (Eppley *et al.* 1969) suggested that coastal phytoplankton typically reach maximum specific growth rates at nitrate and ammonium concentrations of about 70-140 mg/m^3, with half-saturation of DIN uptake rate at about 7-70 mg/m^3. The previous ANZECC (ANZECC 1992) water quality guidelines provided indicative nitrogen saturation levels for New Zealand waters of 10-60 mg/m^3 NO_3 and <5 mg/m^3 ammonium. The latest ANZECC (2000) guidelines for Condition 2 ecosystems defer to default trigger values for South East Australia of 20 mg/m^3 for DIN, with no specific water quality guidance for New Zealand. Experience has shown that this value can be significantly exceeded in nearshore coastal waters in New Zealand and highlights the need for relevant national guidelines rather than relying solely on an Australian limit.
While these guidelines are useful for comparing appropriate levels in open near-shore coastal environments, their relevance to the NZ King Salmon greywater discharges is questionable. A

more realistic means of assessing the effect is on nutrient loads rather than concentrations. Section 2.4 shows that the nutrient load from all the NZ King Salmon greywater sources combined, is insignificant in comparison to the myriad other inputs (*e.g.* point source discharges, other vessels, septic systems, river inputs, coastal exchange *etc*). For example, the combined annual load of nitrogen from all the NZ King Salmon greywater sources is estimated around one kilogram, whereas the other sources are orders of magnitude greater and generally measured in tonnes.

4.4. Indicator bacteria – microbiological

Domestic wastewater, including greywater, can contain high concentrations of disease-causing pathogens (*e.g.* viruses, protozoans, and bacterial pathogens such as *Salmonella*). Health risks associated with activities in contaminated waters arise primarily from water ingestion during contact recreation (*e.g.* swimming, surfing, kayaking) and from consumption of filter-feeding shellfish (*e.g.* oysters, mussels) which have accumulated bacteria and other pathogens in their bodies.

Assessing this risk posed by the presence of these pathogens is neither straightforward nor 100% reliable since the relative levels of pathogens in the greywater/wastewater are dependant on the health status of the contributing source(s) at any given time. Furthermore, the level of treatment (if any), dilution/dispersion and die off within the environment, as well as exposure route[4], together play significant roles in determining the level of risk. Indicator bacteria are generally used since the generation of site-specific data regarding actual pathogen levels in a discharge is costly and difficult. Moreover, given the nature of microbiological data, measurements of pathogens at levels at or near detection limits are not always sufficient to adequately estimate their probability distributions.

To overcome these obstacles, a 'weight of evidence' approach is often employed and the level of detail used in assessing risk is commensurate with the environment into which the discharge takes place and with the activity or concern. In other words, a high volume poorly treated wastewater discharging near a popular recreational shellfish area would require a much more stringent human health assessment than a low volume wastewater or greywater discharging offshore.

In the case of the NZ King Salmon greywater discharges, there is little or no contact recreation that takes place in the immediate vicinity, and while the literature suggests that faecal coliform counts can be as high as 10^6 in greywater, many of these studies were for much larger population bases and varied sources (*e.g.* houses with small children) which can have a marked effect on the quality of the greywater. These factors have been considered as part of our assessment.

[4] Exposure route can be through either direct ingestion of contaminated water or indirect like the ingestion of contaminated shellfish.

For shellfish-gathering waters, the MSRMP (2004) states that: "*Fish shall not be rendered unsuitable by the presence of contaminants and median faecal coliform concentration of not less than five samples, taken within any consecutive 30 day period, shall not exceed a Most Probable Number (MPN) of 14 per 100mL (or Colony Forming Units per 100mL), and not more than ten percent of samples taken within any consecutive 30 day period shall exceed an MPN of 43 per 100mL (or 43 Colony Forming Units per 100mL) as a result of any discharge of a contaminant or water. Samples shall not be taken on the same or consecutive days*".

This median of 14 and 90th percentile of 43 cfu/100mL is taken directly from the section on shellfish-gathering in the Bacteriological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE & MoH 2003).

The nearest shellfish-gathering to any of the NZ King Salmon farms is going to be in the adjacent commercial mussel farms which, in some cases like Ruakaka, can be within approximately 300 m. In order to assess the level of risk this poses from greywater discharges, rather than focusing on possible concentrations in the discharge itself, it is first worth considering the nature of the discharge. As stated above, the level of risk can be directly dependant on the health status or level of disease in the population contributing to a discharge. When there is an outbreak or epidemic within a population (or community) the overall risk from waterborne disease can increase by orders of magnitude. For the NZ King Salmon greywater discharges, the very small population base (*i.e.* maximum four to six people) means that there will be an equally small denominator when calculating the potential risk. This is inherently problematic when dealing with estimating overall risk. For example, if one of the four people on board a barge was ill, this is the mathematical equivalent of having an outbreak in 25% of a larger population. This small denominator is both a blessing and curse. For instance, a single sick person could be easily relocated from a barge to shore, but relocating 25% of a town's population would not be possible. What this demonstrates is that typical risk based methods are not directly applicable for the NZ King Salmon situation, and using them would have to be undertaken with a host of different caveats.

Therefore, rather than trying to assess the risk using traditional methods (with comparison to standard guidelines), it is easier and arguably more appropriate to look at the source(s) and assess the risk by source. Clearly, the biggest risk would be from the discharge of blackwater, but this has already been dealt with through separation and removal of blackwater offsite. The other sources are the typical greywater components (*e.g.* shower, wash basin, washing machine *etc.*) which are lower risk and directly related to the health status of the source. Since the source is such a small number of people, it is much easier to mitigate any exposure by merely evacuating sick personnel. This is likely to be common practice already.

As far as potential risk during normal periods where all personnel are healthy, the NZ King Salmon greywater will likely contain very low, or non-existent, numbers of pathogenic organisms and therefore pose no risk to either contact recreation or shellfish-gathering waters. While it is still possible to initiate a sampling programme to ascertain whether or not the

receiving waters around the farms meet the MSRMP (2004) bacterial guideline levels, the benefits and efficacy of conducting such a programme are questionable.

Regardless of the level of risk for discharging greywater, there are steps that can be taken to reduce the volume of discharge. Perhaps the simplest is to capture and re-use greywater for the flushing of toilets. While this has been suggested previously, the overall volume of discharge is still low enough that it is unlikely warranted at this stage.

4.5. Aesthetics – films, foams, and floatables

Conspicuous adverse effects from greywater discharges on surface water quality are usually the result of two different types of compounds: (i) Oils and grease; and (ii) surfactants. Both of these types of compounds will be discussed in turn.

(APHA 2005) defines oil and grease as groups of substances with similar physical characteristics that are determined quantitatively on the basis of their common solubility in an organic extracting solvent (previously Freon, but recently replaced by *n*-hexane). The oils and greases present in greywater can be classified as 'polar' or 'non-polar'. Polar oils and greases, usually biodegradable, originate from animals or vegetables and may include waxes, fatty acids, fats, oils, and soaps. Non-polar oils and greases, less readily biodegradable, usually come from petroleum products and may include light hydrocarbons such as gasoline and jet fuels or heavy hydrocarbons such as crude oils, diesel fuel, asphalt, lubricants and cutting fluids.

The oil and grease component of the NZ King Salmon greywater fits the polar category. In general, the potential for environmental effects from polar oils and greases is much less than for non-polar, because they mix with water and are generally non-toxic to humans or aquatic life. Where possible, NZ King Salmon has selected and is using cleaning and personal hygiene products that are both biodegradable and non-toxic. The full set of Material Safety Data Sheets (MSDSs) for all of these products is presented in Appendix 1.

Another component that can give rise to foams and floatables is artificial surfactants, the most common of which is in the form of anionic detergents (also referred to as methylene blue active substances or MBAS). Synthetically produced surfactants in greywater are commonly found in cleaning products such as detergents, shampoos, toothpaste etc. Historically detergents were non-biodegradable and are known to be responsible for persistent foam near wastewater treatment plants and other point sources where large quantities could be released into receiving waters.

Early formulations of these detergents also contained phosphorus as a water softener. There were documented problems of freshwater algal blooms with these phosphorus-containing products, which resulted in a change to more biodegradable detergents containing sulfates. The most ubiquitous synthetic surfactants currently in use (and those used by NZ King

Salmon) are linear alkylbenzenesulfonates (LAS), commonly known as sodium or ammonium laureth or lauryl sulfate.

The main risks associated with discharge of a greywater with a high oil and grease or surfactant content are: a greasy coating on the surface of plants and animals restricting factors such as buoyancy, insulating capacity, mobility, feeding and respiration; and adverse aesthetic effects of visible slicks, and fouled shorelines and beaches. For New Zealand, the only recognised environmental quality standard that relates to such effects is the narrative requirement in the RMA (1991) Section 107 to avoid *"...the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials..."*, after reasonable mixing. This same requirement is reflected in the MSRMP (2004).

When assessing adverse aesthetic effects (*i.e. "...the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials..."*), the most ambiguous aspect is the use and definition of the word 'conspicuous'. This is further confounded by the fact that foams and floatables are a naturally occurring and common phenomenon in all coastal waters and differentiating between these naturally occurring events and those brought about by anthropogenic sources can be problematic. Natural sea foams are generally the result of the presence of organic material (chiefly proteins) in the seawater which is 'whipped up' to create the foam. For foams to occur, a combination of organic material plus the energy to mix the water with air and create foam is required. A common comparison is likening it to water running into a bubble bath. The organic material in sea water decreases the surface tension and winds and/or waves mix the water to create the foam. Rows of foam on the water are often the result of Langmuir circulation (also called windrows) where small circular cells that rotate in alternate directions in the water column are formed and cause foam (or other flotsam) to gather in rows on the surface.

Given that foams are a natural and common component in coastal waters, their relative conspicuousness is far less than if they were uncommon. For instance, in the unlikely event that an NZ King Salmon greywater discharge created foam, it is possible that a passerby might interpret it as natural (hence inconspicuous). However, the opposite also applies where natural foam could drift past a farm and be incorrectly attributed to the greywater discharge.

Perhaps the best indication that the greywater is unlikely to be causing any conspicuous changes to surface water quality is the track record of the farms to date. In the fifteen or so years that NZ King Salmon has been operating and discharging greywater, there have not been any reportable instances of the production of conspicuous foams, films, or floatables and there have been no complaints to Council regarding conspicuous foams or conspicuous changes in colour or clarity of surface waters around the farms.