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Discharge to water

ECOLOGICAL & BENTHIC STUDY OF WHEKENUI BAY & A REVIEW OF THE EFFECTS ON THE RECEIVING WATERS FROM THE DISCHARGE OF THE PROPOSED PAUA FARM

Prepared by

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For

Arapawa Sea Farms Ltd

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1.0 Introduction

Arapawa Seafarms Ltd wishes to develop a land based paua farm in Whekenui Bay, Tory Channel. Up to 25l/sec of seawater will be drawn from the bay, used to rear the paua and then pass through a settling pond before discharging into the intertidal zone via a sub-surface drainage channel. This report describes the status of the receiving environment, discusses the quality of the effluent and the potential effects of the discharge on the receiving environment.

Land based marine farms are not common in New Zealand and those currently operating produce relatively high quality effluent which is often similar to the receiving waters (see Appendix 1 attached).

Effluent from Arapawa Seafarms will be partially treated before discharge by;

- nutrient stripping by algae and seaweeds in the settlement pond
- settlement of solids in the settlement tank
- screening of water discharging from the settlement pond, and
- the action of denitrifying bacteria in the underground discharge channel

There is insufficient knowledge on the movement of water in the bay to predict to predict effluent dispersal, however at peak tides Tory Channel is recorded as flowing at speeds of up to 9 knots.

Whekenui Bay is the western half of the first embayment on the northern coastline of Tory Channel when approaching from Cook Strait. The bay is cresent shaped and is open to Cook Strait to the south. The eastern portion is called Okakuri Bay. Whekenui Bay is open to southerly weather passing through Cook Strait (2m swells can be experienced) and is constantly modified the sea state and the wash of large sea going vessels and ferries passing through the Channel. (See photo 1). The foreshore of the Bay has been modified since the introduction of the fast ferries (pers comm Mrs Bishop).

The landscape behind the shoreline is dominated by open farmland (grazing), forestry and an area of lighthouse reserve which contains the two navigation lights marking safe entry into Tory Channel. Okakuri provides moorings for inshore fishing vessels and access to a number of houses. The bay is clearly a working Bay and once housed a war time coast guard camp.

The foreshore reserve in the area in front of the woolshed (the area of the discharge channel) comprises grass with a 7m band of grass, stones, rubble and weeds immediately above MHWL. This area contains no obvious features of ecological significance (see photo 2).

2. Seabed Survey

In an effort to gauge the effects of the discharge from the paua farm on the receiving environment a seabed survey was undertaken on 20 February 1999.

2.1 Methods and Materials

The proposed site was qualitatively investigated using underwater observations by randomly free diving the area from the intertidal zone out 60m into Whekenui Bay. (See Figure 1).

The point of the observations was to establish the ecological values contained in the coastal marine area immediately in front of the woolshed and in the area where the effluent would mix with receiving waters.

Depth, distance, substrate, habitat and associated conspicuous surface dwelling macro-fauna and flora were recorded. An estimate of the abundance of conspicuous bottom dwelling organisms observed during the dive was recorded using the scale
R = rare (one or two individuals recorded)
O = occasional (low abundance: not a zone , bed or school)
C = common (large numbers over the entire study area or a zone, bed or school)

Density data of specific species of particular scientific and ecological importance as outlined in the Department of Conservation's "Guidelines for Ecological Investigations of Proposed Marine Farm Areas" (DC 1995) were not collected due to their absence or low abundance.

3.0 Results

Results from the dive across random parts of the proposed intertidal discharge zone are;

- substrate present: fine sand and silt, occasional stones.
- no outcropping bedrock or other such hard substrate was recorded.
- the numbers of observable benthic organisms was almost zero.
- no large macro algae were present.
- no brachipods, scallops, sea eggs or horse mussels were observed.
- soft bottom substrata (sand/silt) dominated the area observed out to a distance of 60m from the shoreline.
- occasional green algae (sea lettuce) was observed associated with the stones.
- castes of polychaete worms (unobserved) were the dominant feature of the seafloor.

The dive was terminated 60m from the shoreline. The composition of the substrate did not change over this distance. Figure 2 shows the approximate path of the observed area.

Species observe from the free swim in Whekenui Bay.

COMMON NAME	ORGANISM	HABITAT
Flatfish juvenile, R	*Rhombosolea sp (?)*	sand
Hermit crab, O	*Pagurus sp*	sand
Sea lettuce, O		in association with occasional stones, suspected drift weed

5.0 Discussion of results

Consultation with locals and fishers recorded that Whekenui Bay was continuously modified by ocean swells and the wash from the inter island ferries. Mrs Bishop (pers comm) stated that the intertidal zone can change from sand to stone overnight and that the foreshore can be totally covered with drift seaweed washed up from Cook Strait.

The benthos and substrate of Whekenui Bay supports these comments with the total lack of sedentary marine species, shellfish and seaweed.

6.0 Impact of intake pipes and intertidal discharge on the receiving waters

6.1 Intake pipes

The intake pipes will be attached to the outer line of jetty piles and will extend to approximately 1.0m above the seabed. The pipes will be covered with a course intake screen to prevent the intake of marine organisms. The intake pipes will not impact on the fauna and flora in and around the jetty.

6.2 Discharge water

The water in the farm will be used to rear sensitive marine organisms and any decrease in water quality during the farming process will adversely effect the paua under culture. The discharge water will exit the foreshore reserve via the underground seepage chamber.

The key attributes of the effluent which could potentially have an adverse impact on the receiving waters are:

- temperature
- salinity
- dissolved oxygen
- ammonia and other nutrients
- organic matter and suspended solids
- farm chemicals

Monitoring from New Zealand land based paua farms suggest that these facilities produce relatively high quality effluent (Ecological effect of a proposed hatchery discharge in Kakapo Bay, Port Underwood, Cawthron Report 343 1996, Rainbow Abalone Limited Monitoring Programme Annual Report, Taranaki Regional Council Technical Report 96 - 7). It should be noted that the Taranaki farm does not have a settlement pond or a filtration system, yet it still satisfies local water quality criteria.

Typical effluent readings from a plant holding adult and juvenile paua would be a BOD_5 of 0.5 - 2g.m^{-3} and suspended solids of 5 -20g.m^3. Ammonia levels at existing paua farms are highly variable, but never reached toxic proportions. No environmentally significant results were found for temperature, pH, salinity or chlorine. These figures could vary greatly depending on water inflow quality, in farm water use systems, water treatment and rearing densities. The applicants farm will use Tory Channel water in a once through system.

4.4 Effluent treatment

Effluent from the farm will be treated by;

- the settlement of solid matter in the settlement pond
- the stripping of nutrients from the effluent by the seaweeds growing in the settlement pond
- the screening of the discharge water leaving the settlement pond
- the stripping of nutrients from the discharge water by bacteria as it travels through the underground seepage channel
- the filtering of suspended solids by the gravels and sand in the underground seepage channel

At an average flow of 6l/m per tank the resident time of the water in the settlement tank will be 4hrs 40minutes. This is adequate for particles greater than 20 microns in diameter to settle in 1.0m of water.

The combined impact of the other filtering and stripping activities in the proposed effluent treatment system is complex, however, the impact of each stage of the treatment process will improve the quality of the discharge water.

Given the findings of other paua farm discharges and the additional complex biological stripping processes planned at Arapawa Seafarms Ltd it is expected that the effluent water will generally be of a similar quality to the receiving waters in the bay.

4.5 Physical mixing of effluent with the receiving water

Given the dilution effect of Tory Channel and the mixing effect of the Cook Strait storms and the inter ialand vessels it is not anticipated that there will be any adverse impact of the discharge water on the receiving waters of Whekenui Bay.

4.6 Discussion of the key effluent components and their potential environmental effects

4.6.1 Temperature

The water used in the farm will not be heated and will therefore remain at ambient temperature. Accordingly, no adverse effects are expected as a result of temperature differences between the effluent and the receiving water.

4.6.2 Salinity

Large changes in salinity can adversely effect many marine species. Salinity will not be of concern with regard the farm effluent as the discharge will be marine water into the marine environment.

4.6.3 Dissolved oxygen

Paua require high levels of dissolved oxygen for survival and growth. The level of dissolved oxygen in the growing tanks and the effluent water will not drop below 90% saturation (RMA recommendation 80% above saturation). It is likely that oxygen levels will increase in the settlement tank due to photosynthesis and it is therefore unlikely that the level of dissolved oxygen level in the effluent will have an adverse impact on the receiving water.

4.6.4 Ammonia and other nutrients

Ammonia is the main form of nitrogenous waste produced by fin fish and invertebrates. Ammonia is toxic to marine organisms at high concentrations (eg $1.3g.m^3$ total ammonia at pH 8, 15 degrees C). Ammonia is not anticipated to reach toxic levels in the effluent as it will be necessary to keep it at non toxic levels in the growing tanks. Similarly ammonia and other nutrients will be stripped from the effluent water by the seaweeds in the settlement tanks. These chemicals are not likely therefore to have an adverse impact on the receiving waters.

4.6.5 Organic matter and suspended solids

Suspended solids comprise organic and inorganic particles. In the farm inorganic matter will be derived from particles of sand and silt in the inflow water. These are not of concern as they will settle out in the settlement pond or become trapped in the underground seepage channel.

Faeces and waste food will be the major sources of organic particles from the farm. Organic particles will be collected at the pond screens, in the settlement pond and in the underground seepage channel.

Should the settlement pond become overloaded with organic matter over time, it is the intention of the applicant to discharge this over the forestry development at the rear of the property.

4.6.6 Farm chemicals

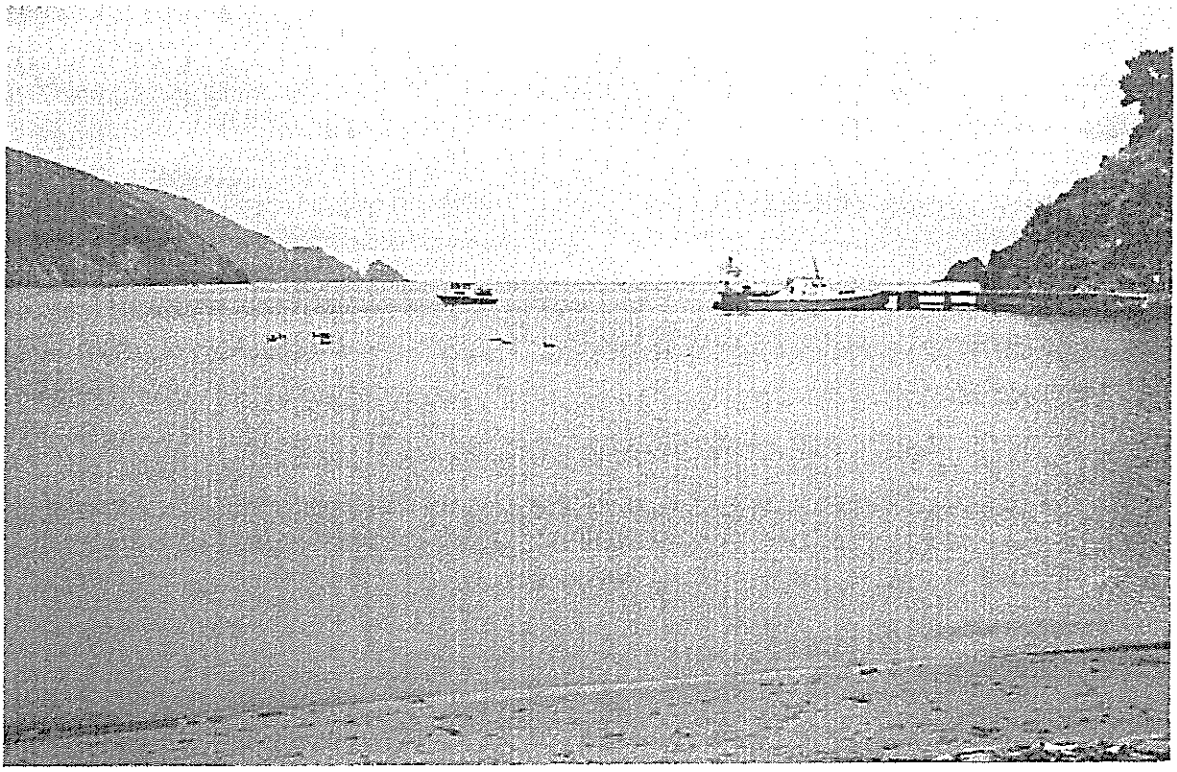
Most paua farms use chlorine compounds (bleach) in freshwater to disinfect equipment. The recommended starting concentrations is $10g.m^{-3}$. Chlorine compounds are converted to chloramines in the presence of nitrogenous substances. In the absence of nitrogen, chlorine is converted to non toxic chloride ions by reaction with organic matter and seawater. Any chlorine discharged from the farm will be converted to chloride ions or chloramines prior to discharge. Chloramines can be detected after several days in seawater but are not long lived in the environment.

It is important to remember that these chemicals are used for sterilising equipment only and the impact of the chemical will be greatly diluted when discharged with the rest of the farm effluent. The form of chlorine used is similar to household detergent.

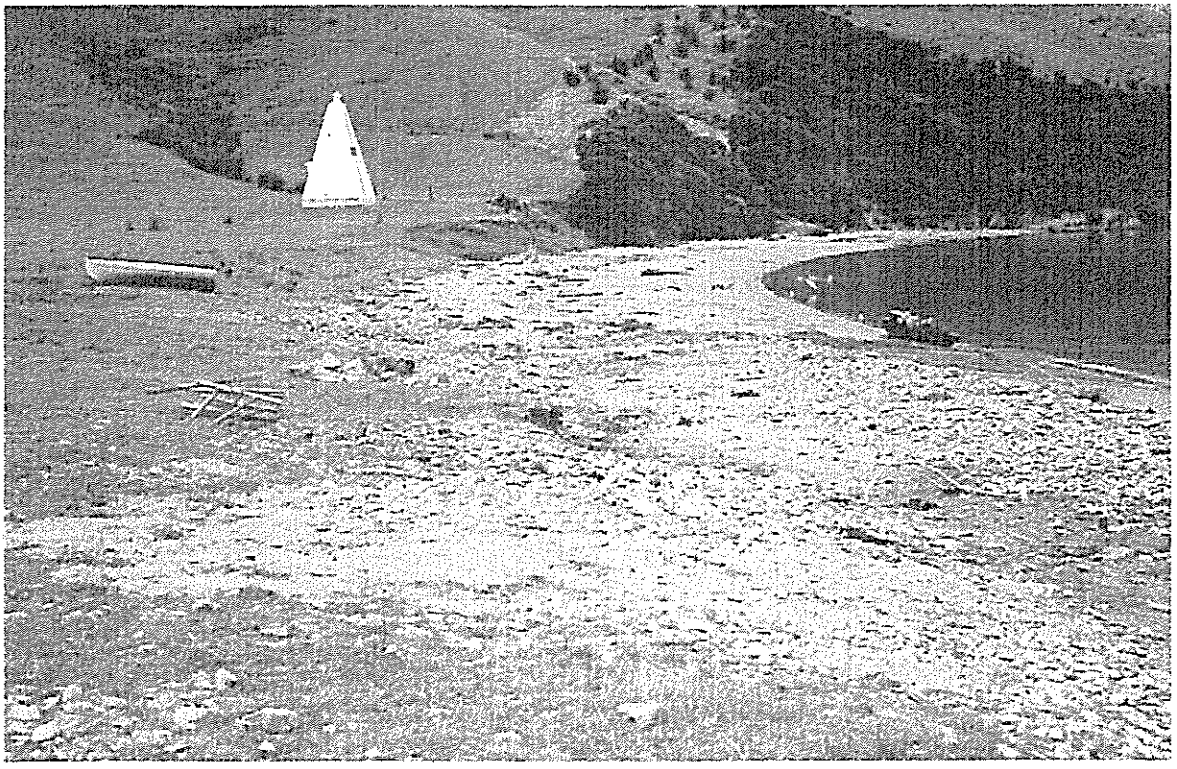
Anaesthetics, antibiotics and various therapeutic chemicals can be used in paua farms. Arapawa Seafarms Ltd does not know which, if any, of these chemicals will be used. It is important to note that these chemicals are used to treat stressed animals without causing death so they are unlikely to have any adverse impact on feral organisms.

4.7 Suggested monitoring

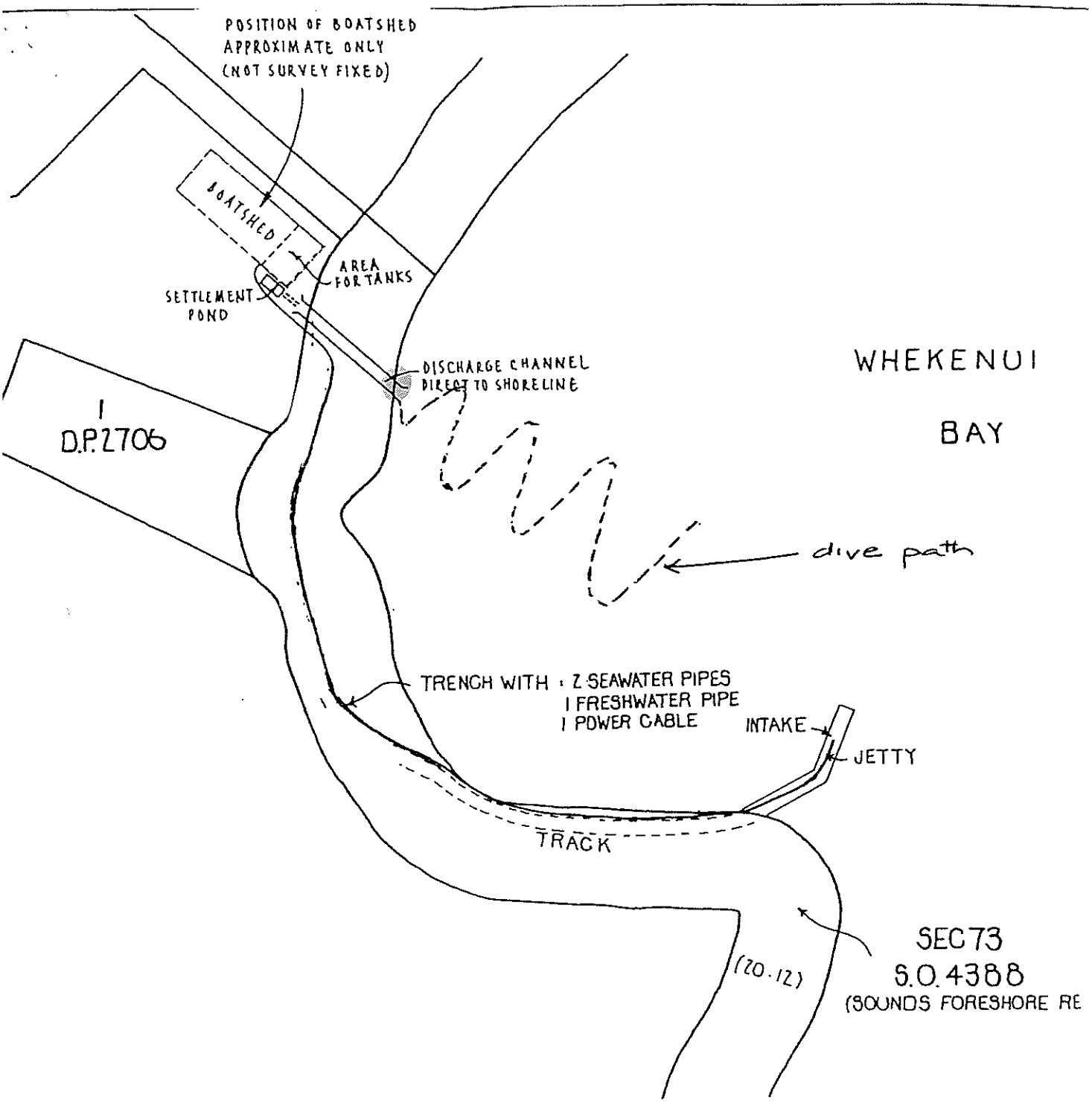
Given the low level of benthos in the mixing zone adjacent to the discharge it is not considered worthwhile proposing benthic surveys as means of measuring effects. Similarly, the changing nature of the bay means that measurements (of organic loads) in the sand would be pointless. It is suggested therefore that any monitoring programme, if required at all, should look at the quality of the effluent water at the outlet of the settlement pond. Such a programme should record dissolved oxygen, BOD, pH, ammonia and suspended solids. Monitoring intervals should be monthly until fill stocking densities are reached and then reviewed on an annual basis.



Photogragh 1. Whekenui Bay looking south to Cook Strait at the point of discharge.



Photograph 2. View of the intertidal zone and foreshore reserve at the location of the proposed discharge channel.



APPLICATION FOR RESOURCE CONSENT – PAUA FARM
ARAPAWA SEA FARMS LIMITED – WHEKENUI BAY – TORY CHANNEL

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FIGURE 1. Approximate path of the benthic survey, Whekenui Bay.

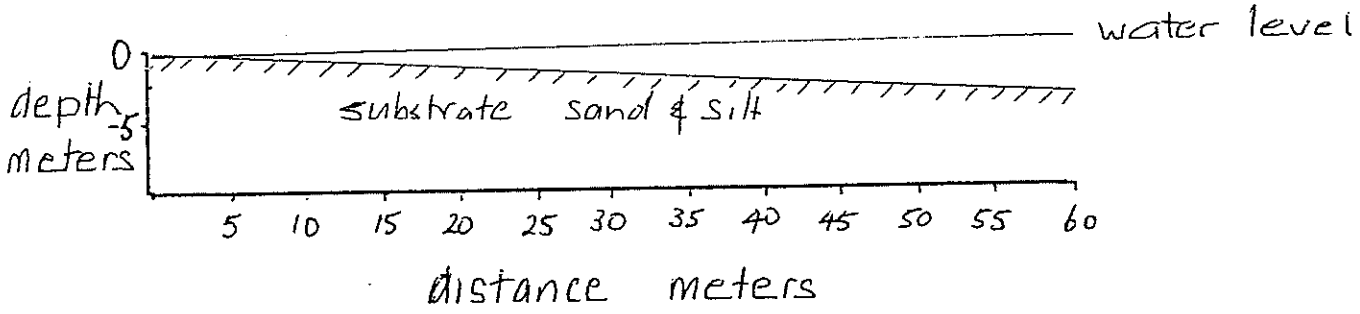

FIGURE 2. Transect of benthic survey, Whekenui Bay.

APPENDIX 1.

Rainbow Abalone Limited
Monitoring Programme
Annual Report 1995/96

Technical Report 96-7

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July 1996

Executive summary

Rainbow Abalone Limited, a paua farm, hold resource consent 4290 to discharge waste seawater into the Tasman Sea at Port Taranaki.

Culturing activities at Rainbow Abalone consist primarily of the spawning, hatching and rearing to juvenile stage of *Haliotis iris* (black foot paua). Diatoms are cultured on site as the primary food for juvenile paua. Paua larger than 15 mm are fed on artificial feeds. No problems in the operation of the aquaculture facility were noted during an annual inspection

Chemical analysis of influent and waste seawater indicated that the aquaculture facility produces an effluent of high quality very similar in composition, for the parameters measured, to the influent seawater. The results of chemical monitoring indicate that no adverse effects on the receiving environment will occur due to the wastewater discharge. This was confirmed by an inspection of the foreshore in the vicinity of the discharge.

This report recommends that monitoring at the site and chemical monitoring of influent and waste seawater should remain at its present level.

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1. Introduction

Rainbow Abalone Limited operates a specialist paua hatchery/juvenile facility at Port Taranaki. This operation involves abstracting seawater, circulating that water through hatchery, nursery and rearing tanks and then discharging the seawater to the Tasman Sea.

The water intake is located approximately 200 m east of the lee breakwater at Port Taranaki and seawater is pumped through an underground pipe to the paua farm facility. There is also an intake pipe located within Port Taranaki, however this is only operated as an emergency intake. Seawater excess to that required is pumped to ensure a constant supply of water and avoid the need to balance intake with requirements. Excess water drains to the discharge drains after all intake water passes through a cyclone filter to remove sand and other large particle debris. After the cyclone filter the seawater also passes through a sand filter and diatomaceous earth filters, in addition, water used in the hatchery area passes through an ultra-violet treatment unit.

The wastewater is discharged to the Tasman Sea within the confines of Port Taranaki. The discharge pipe is located adjacent to the main building of the facility. Wastewater from the hatchery area drains to the municipal sewage system as a number of chemicals are used in the spawning process. No chemicals are used in rearing tanks and the cleaning of these tanks is done by physical rather than chemical means.

Culturing activities at this facility concentrate primarily on the spawning, hatching and rearing to juvenile stage of *Haliotis iris* (black foot paua). Some of these paua are sold at a size of approximately 20-25 mm to other paua rearing facilities for further on-growing to harvestable size (approximately 80 mm) while others are retained at Rainbow Abalone for on-growing. The spawning and hatching process consists of the spawning of adults, hatching, a pelagic (free-swimming) stage and then settlement at which stage the paua are transferred from the hatchery room to the main nursery tanks. A limited number of nursery tanks have temperature control units associated with them as a means to induce spawning in the adult breeding stock.

Resource consent 4290 allows Taranaki Aquagardens Limited:

> *"to discharge up to 8000 cubic metres/day [100 litres/second] of wastewater from a marine farm at Port Taranaki into the Tasman Sea."*

Special conditions on this consent relating to the monitoring programme are as follows:

3) THAT the discharge of wastewater shall not cause alteration of the temperature, turbidity, suspended solids or coloration of the receiving waters to a conspicuous extent, defined as:

   i) temperature shall not exceed ambient seawater temperature by more than 2 degrees C.

   ii) turbidity shall not exceed ambient seawater turbidity by more than 10 nephelometric turbidity units [NTU].

   iii) suspended solids shall not exceed ambient seawater suspended solids by more than 10 grams per cubic metre.

   iv) any conspicuous change in the colour or visual clarity.

4) THAT physical and chemical monitoring of the wastewaters shall be undertaken to the satisfaction of the General Manager, Taranaki Regional Council.

7) THAT there shall be no significant adverse effects on aquatic life by reason of the effect of this discharge.

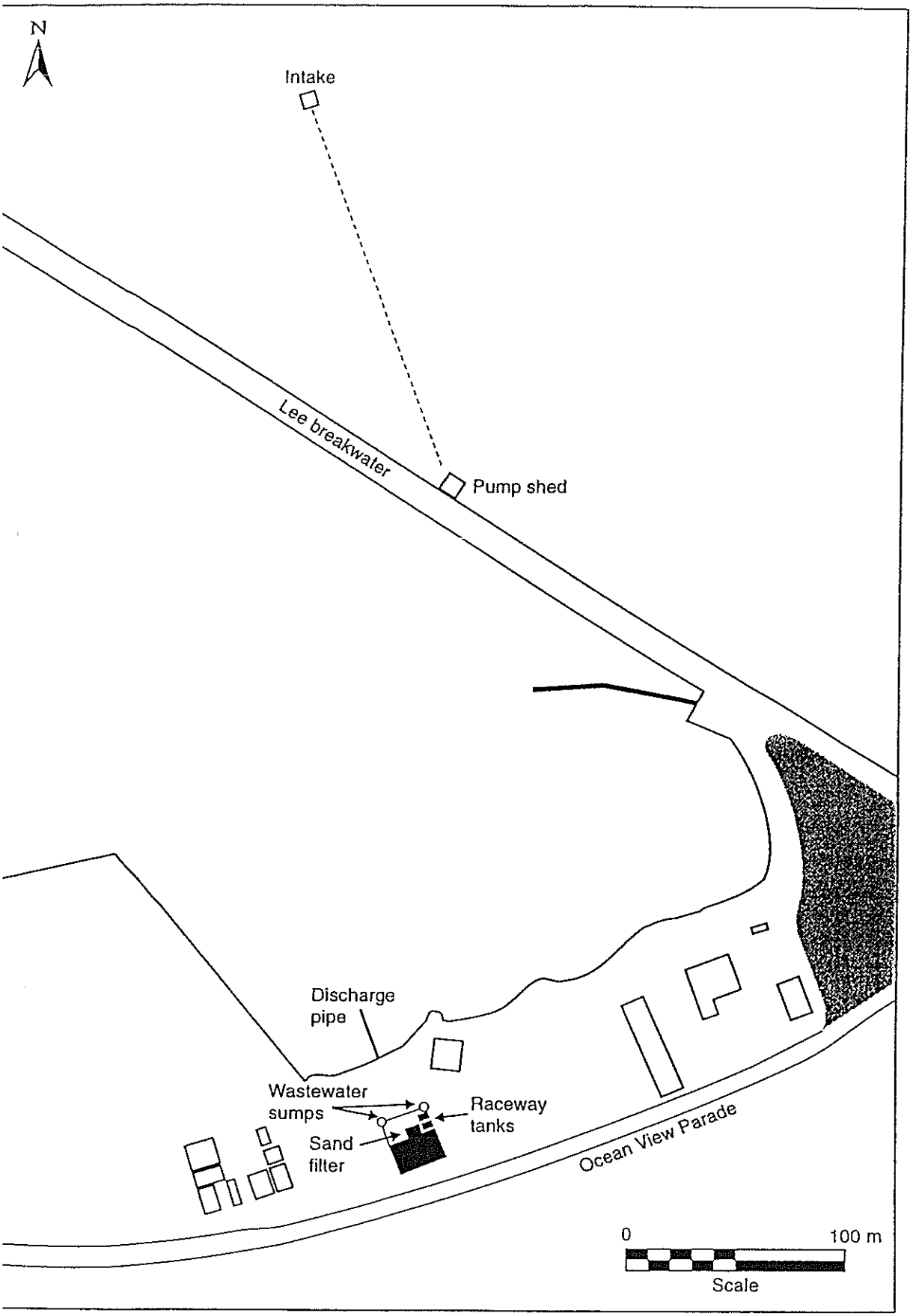
A full copy of consent 4290 is contained in Appendix I.

Rainbow abalone also hold consent TRK 4565 which was granted in June 1994. This consent allows for the construction and maintenance of the intake and discharge structures within the coastal marine area.

1.1 1995-96 monitoring programme

The 1995-96 monitoring programme consisted of an inspection of the aquaculture facility and chemical sampling of the influent and effluent seawater. Two samples were taken, one sample of the raw seawater, after it had passed a cyclone filter but before it underwent any other filtration or treatment, and one of the waste seawater before it was discharged to the Tasman Sea. Both samples were analysed for pH, alkalinity, turbidity, salinity, ammonia, chlorine, suspended solids and BOD_5.

The location of Rainbow Abalone is shown in Figure 1.



ıure 1: Location of Rainbow Abalone Ltd

2. Monitoring results

2.1 Inspection

In accordance with the monitoring programme an inspection of the aquaculture facility was conducted on 10 May 1996. This inspection was conducted in conjunction with sampling of the influent seawater and the waste seawater as prescribed in the monitoring programme.

Spawning had not started at the time of the inspection as staff were waiting for new brood stock to arrive.

A number of outside tanks were being set up for the ongrowing of paua to harvestable size. These tanks were not yet in use. There are also plans to build a second building for use as a spawning and hatchery building and in a further two years a third building for ongrowing.

The site inspection included an inspection of the rearing tanks and seawater intake and discharge systems. An additional discharge line had been commissioned since the last inspection (March 1995). Previously all wastewater was discharged via a single discharge line which discharges below low water. Due to problems with open drains overflowing, an overflow line is now being used on a permanent basis as a second discharge line. This line discharges at the high tide level. The second discharge line takes wastes from the tanks within the building. The original discharge line takes waste from the overflow from the sand filter and the two outside concrete tanks. Consent 4290 requires the discharge to be under water at all times. The consent holder was advised that this second discharge line does not meet this condition and undertook to extend the discharge line to the low tide level.

An inspection of the intertidal zone in the vicinity of the discharge was also made. No evidence of adverse visual or ecological effects due to the discharge were identified.

2.2 Chemical analysis

Grab samples of the influent seawater (SEA 902057) and of the wastewater before discharge via the outfall (IND 002018) were taken at the time of the inspection. The results of the chemical analyses of these samples are shown in Table 1.

Table 1: Results of chemical analyses performed on influent seawater and wastewater samples (10 May 1996)

Parameter	Units	Influent seawater (SEA 902057)	Wastewater (IND 002018)
pH	pH	7.8	8.0
Salinity	ppt	37.5	37.6
Turbidity	NTU	5.1	1.6
Suspended Solids	g/m^3	19	16
Biochemical Oxygen Demand	g/m^3	<0.5	4.1
Ammoniacal Nitrogen	g/m^3-N	0.021	0.020
Total Alkalinity	g/m^3CaCO_3	107	114
Free Chlorine	g/m^3	<0.1	<0.1
Total Chlorine	g/m^3	<0.1	<0.1
Temperature	°C	16.2	15.8

The results from the analysis of the two samples show small increases in total alkalinity, biochemical oxygen demand and ammoniacal nitrogen due to the addition of paua faecal material. There are also small decreases in turbidity and suspended solids between the influent and effluent samples due to the filtration of the influent seawater before it is used within the facility.

These results indicate that the quality of wastewater discharged from the facility is very similar to that of the natural seawater in the area.

3. Discussion

3.1 1995/96 Monitoring period

Rainbow Abalone Limited began operating at the Port Taranaki site in November 1993. The 1995-96 monitoring period was the second that a monitoring programme was performed in relation to activities at the aquaculture facility.

The present activities at Rainbow Abalone Ltd give little cause for concern regarding potential adverse effects of the waste seawater on the receiving environment. A number of chemicals are used in the spawning process but the wastewater from the hatchery areas drains to the municipal sewage system rather than to the main wastewater discharge. No chemicals are used in rearing tanks and the cleaning of these tanks is done by physical rather than chemical means.

During the yearly inspection of the facility it was noted that an overflow line was being used on a permanent basis as a second discharge line. This was done due to the overflowing of open drains leading to the original discharge line. This overflow line discharges at the high tide level, however consent 4290 requires that the discharge point shall be underwater at all times. The consent holder undertook to extend this overflow line to the low tide level when advised that it did not meet the conditions of the consent.

The results of the chemical analyses performed on the influent and effluent seawater in May 1996 show few differences in the quality of the waste seawater in comparison to the influent seawater.

In summary, the wastewater discharged by Rainbow Abalone Limited shows insignificant waste loadings and for the parameters measured is not markedly different to the influent seawater. The present activities at Rainbow Abalone give little cause for concern as to potential for adverse effects on the receiving environment. However, the potential for changes in culturing techniques and for increased production necessitates the need for a residual level of monitoring.

3.2 Recommendations from 1994/95 Annual Report

The following recommendation was made in the 1994/95 annual report for Rainbow Abalone Limited:

> THAT monitoring of the wastewater discharge from Rainbow Abalone in the 1995-96 year continue at the same level as in 1994-95.

This recommendation was complied with by the completion of the 1995-96 monitoring programme for Rainbow Abalone Limited.

4. Recommendations

Based on the results of the 1995-96 monitoring programme for Rainbow Abalone, the following recommendation is made:

> THAT monitoring of the wastewater discharge from Rainbow Abalone Limited in the 1996-97 year continue at the same level as in 1995-96.

Bibliography

Taranaki Regional Council 1995: Rainbow Abalone monitoring programme annual report 1994/95. TRC Technical Report 95-50.