Tassal Operations Pty Ltd

MF279 WEST OF WEDGE ISLAND

EL10211/1

ANNUAL ENVIRONMENTAL REVIEW

August 2022

Document Status

Revision	Date	Author	Comments	Approved
Draft 1	31/08/2022	LH	Submitted for internal review	Joel Cooper
Final	31/08/2022	LH	Finalised for Submission to EPA	

Table of Contents

Section 1: Introduction

In accordance with Environmental Licence EL10211/1 (EL), environmental monitoring is undertaken in the waters of Storm Bay. Tassal is authorised to undertake finfish farming in State Waters to the west of Wedge Island, within Marine Farming Lease 279 (MF279). Figure 1 below displays the sites included within the environmental monitoring program. Table 1 provides further detail of each site.

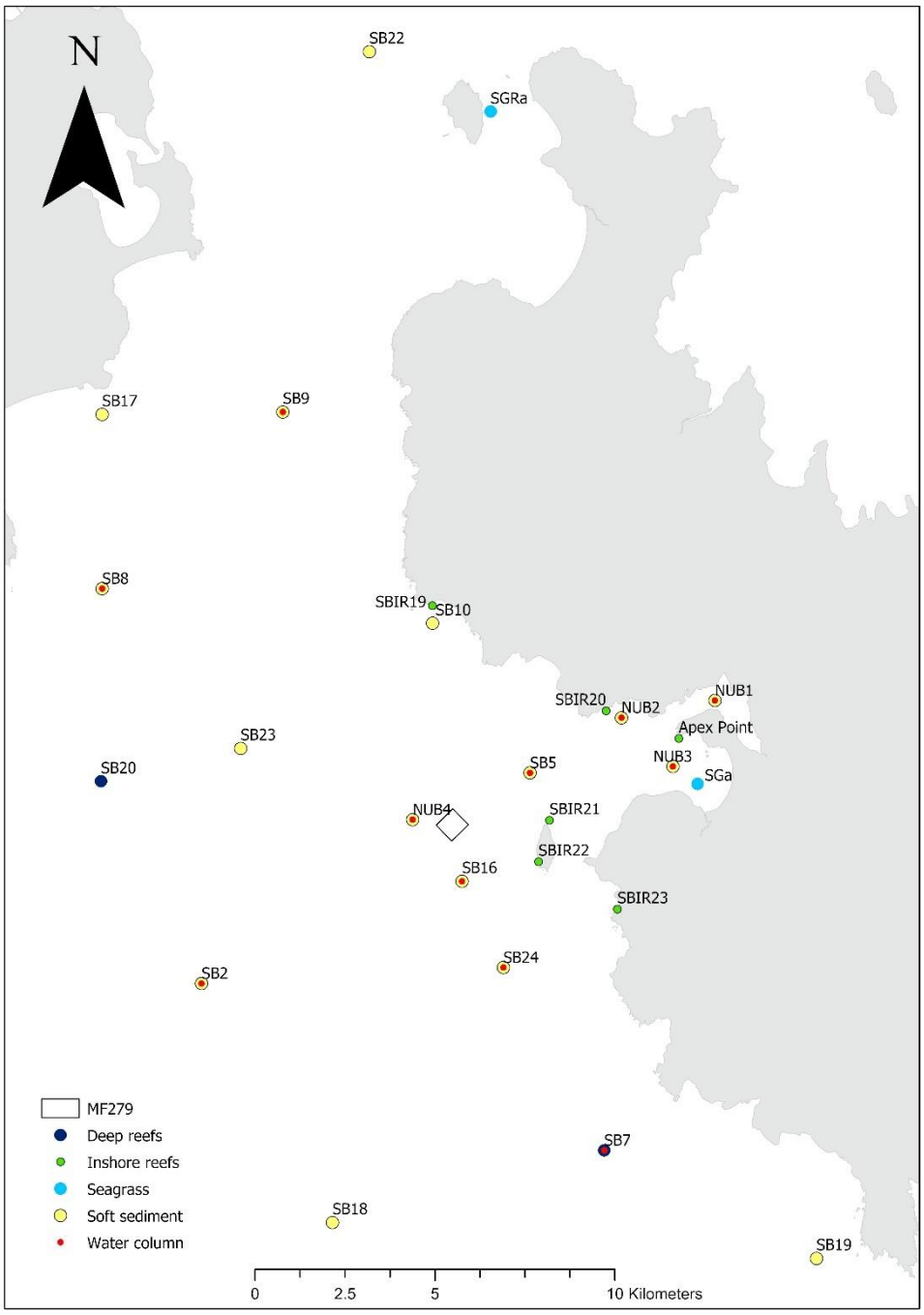

Figure 1: Map of the sites surveyed from May 2021 to April 2022 for EL 10211/1. Details of each site are given in Table 1.

Table 1: Details of sites surveyed in Storm Bay from May 2021 to April 2022. *Denotes the compliance site for water quality monitoring.

Site	Location	Easting	Northing	Matrix
SB-2	Mid Storm Bay	545112	5220157	Water column, Soft sediment
SB-5*	North of Wedge Island	554239	5226021	Water column, Soft sediment
SB-7	Storm Bay at Darts Reef	556300	5215510	Water column, Deep reefs
SB-8	South East of Betsey Island	542350	5231150	Water column, Soft sediment
SB-9	South West of North West Head	547371	5236067	Water column, Soft sediment
SB-10	South of Outer North Head	551531	5230187	Water column, Soft sediment
SB-16	South East corner of west of Wedge zone	552350	5223000	Water column, Soft Sediment
SB-17	South of Cape Contrariety	542350	5236000	Water column, Soft sediment
SB-18	Mid southern Storm Bay	548750	5213500	Water column, Soft sediment
SB-19	West of cape Raoul	562200	5212500	Water column, Soft sediment
SB-20	Central Storm Bay	542318	5225789	Water column, Deep reefs
SB-22	Fredrick Henry Bay	549775	5246100	Water column, Soft sediment
SB-23	East of Petuna lease	546200	5226700	Water column, Soft sediment
SB-24	West of Tumbledown point	553500	5220600	Water column, Soft sediment
NUB1	Nubeena (Parsons Bay)	559377	5228036	Water column, Soft sediment
NUB2	Nubeena (Creeses)	556780	5227554	Water column, Soft sediment
NUB3	Nubeena (White Beach)	558210	5226198	Water column, Soft sediment
NUB4	Nubeena (Storm Bay West of Wedge)	550977	5224716	Water column, Soft sediment
SB-IR15	Curio Bay Southern side	557789	5218057	Inshore reefs
SB-IR16	Cape Contrariety	542325	5236677	Inshore reefs
SB-IR17	Lobster Point	554390	5243100	Inshore reefs
SB-IR18	Mt Zion (north)	550845	5234620	Inshore reefs
SB-IR19	Outer North Head	551522	5230673	Inshore reefs
SB-IR20	Lory Point	556353	5227748	Inshore reefs
SB-IR21	North Wedge	554780	5224699	Inshore reefs
SB-IR22	Outside Wedge	554475	5223548	Inshore reefs

SB-IR23	Crooked Billet Bay	556670	5222225	Inshore reefs
SB-IR24	Eastern Betsey Island	539715	5233430	Inshore reefs
SB-IR25	Northern Betsey Island	538580	5234155	Inshore reefs
SB-IR26	Western Betsey Island	538880	5232820	Inshore reefs
SGRa (Transect 1)	Sloping Island	553146	5244436	Seagrass
SGRa (Transect 2)	Sloping Island	553089	5244052	Seagrass
SGRa (Transect 3)	Sloping Island	553071	5243516	Seagrass
SGRa (Transect 4)	Sloping Island	553520	5244100	Seagrass
SGRa (Transect 5)	Sloping Island	553825	5244642	Seagrass
SGRa (Transect 6)	Sloping Island	553887	5244096	Seagrass
SGRa (Transect 7)	Sloping Island	553856	5243665	Seagrass
SGa(Transect 1)	White Beach	558895	5225714	Seagrass
SGa (Transect 2)	White Beach	559059	5225480	Seagrass
SGa (Transect 3)	White Beach	559383	5225392	Seagrass
SGa (Transect 4)	White Beach	559335	5225219	Seagrass
SGa (Transect 5)	White Beach	558878	5225317	Seagrass
SGa (Transect 6)	White Beach	558719	5225560	Seagrass
SGa (Transect 7)	White Beach	558863	5225497	Seagrass
SGa (Transect 8)	White Beach	559118	5225282	Seagrass

As required by condition G3(8) of the EL, an Annual Environment Review Report (AER) must be submitted to the Director by 31 August of each calendar year, or another date previously approved in writing. The reporting period is the 12-month period up to and including April of each reporting year. For this review, the reporting period is from May 2021 to April 2022. The report must satisfy the information requirements outlined in the EL (summarised in table 2) and also must be made publicly available by the EPA. This document represents the second AER for EL10211/1. All studies referenced in this report can be found in the appropriate full report (i.e. the Storm Bay BEMP, Annual Water Quality report or the Benthic Report).

As presented in the following sections, this AER provides a summary of all relevant monitoring parameters surveyed between May 2021 to April 2022, for EL 10211/1. The report includes an assessment of, or summary of:

- Water quality performance and measurements
- Benthic surveys
- Lease hydrodynamics
- Reef monitoring
- Sediment dispersion modelling
- Water dispersion modelling
- Benthic video surveys, and
- Seagrass monitoring

All monitoring required for the annual report was conducted by suitably qualified and experienced professionals. Monitoring fieldwork was conducted by the Institute of Marine & Antarctic Studies (IMAS), Aquenal Pty Ltd (Aquenal) and Fulcrum Robotics Pty Ltd (Fulcrum; video surveys only).

Table 2: Information Requirements of the Annual Environment Report

Type of information	Relevant section in EL 10211/1	Information requirements	Frequency / timing	Notes
Water quality performance report	G2, 1 & 2	• Comparison of water quality results recorded at the compliance site against investigation trigger limits specified in Table 1. • Use rolling annual median as compliance metric. • Box and whisker plots should be utilised to illustrate monitoring results and to provide a comparison with investigation trigger values. • Analysis of performance in the context of stocking cycles and feed inputs to be provided. • Summary of adaptive management measures implemented in response to trigger value exceedances.	Data for 12 month period, up to and including April of each year, to be analysed	For first annual report, data available at that time to be utilised and median values to be calculated on that basis.
Benthic surveys (broad-scale monitoring)	3F2	Results of benthic infauna and sediment surveys undertaken at BEMP monitoring sites. Sites are specified in Attachments 7/8/9.	Results relating to surveys undertaken in Spring of the reporting year.	
Water quality measurements	3F3	Results of water quality monitoring, including nutrients, field parameters and phytoplankton to be summarised and analysed.	Data recorded for 12- month period, up to and including April of each year, to be summarised and analysed, with consideration to be given to illustrating seasonal and other relevant effects.	Refer to Attachments 13 and 14 for guidance on data presentation and analysis. For first annual report, data available at that time to be reported.
Water currents (hydrodynamics)	3F4	Summary of real-time, in-situ ADCP measurement. Interpretation of hydrodynamic patterns and associated adaptive management decisions.	Data recorded for 12- month period, up to and including April of each year, to be summarised and analysed.	Refer to Attachments 13 and 14 for guidance on data presentation and analysis.
Ecology – reef & seagrass monitoring	3F5 3F6	Findings of reef and seagrass surveys to be analysed. Interpretation of observed changes against background conditions to be provided.	Rapid Visual Assessment reef surveys are to be undertaken bi-annually (late Winter and late Summer). Edgar-Barrett reef surveys are to be conducted every 5 years. Seagrass surveys to be undertaken annually in late Spring.	
Modelling – dispersion water quality	3M2	Outputs from water quality dispersion modelling to be included.	Model to incorporate at least 6 months' ADCP data.	Guidelines outlining specific modelling requirements to be issued by Director, EPA
Modelling – sediment dispersion	3M3	Outputs from DEPOMOD sediment modelling to be included.	As above.	As above.
Video surveys (compliance sites)	3V	Summary of main findings of video surveys undertaken in reporting period.	Surveys undertaken every 12 months or in accordance with stocking and fallowing regime. Surveys must be conducted within 30 days of peak production.	Note: detailed video survey reporting not required for AER, as submission is already a requirement under 3V9.
Benthic surveys (compliance & control sites)	3V12	Results of benthic infauna and sediment surveys undertaken at compliance and control sites including those shown in Table 5.	Surveys undertaken every 12 months or in accordance with stocking and fallowing regime. Surveys must be conducted within 30 days of peak production	Sampling and reporting to occur on an annual basis.

Section 2: Far Field Environmental Monitoring

2.1 Benthic Surveys (Broadscale Monitoring)

2.1.1 Information Requirement

EL 10211/1 Condition 3F2

Results of benthic infauna and sediment surveys undertaken at BEMP monitoring sites during Spring of the reporting year.

2.1.2 Summary of Findings

Note – Further detail on methodologies and findings is provided in the annual BEMP report (submitted 31st August 2022). A summary of findings is provided below.

Soft sediments: Benthic Infauna Abundances and Communities

For all surveys (2019, 2020 and 2021), sediment samples were dominated by the arthropod families Aoridae, Bodotriidae, Phoxocephalidae and Philomedidae, the annelid families Spionidae, Lumbrineridae and Trichobranchidae, the molluscan families Cardiidae, Verneridae and Anabathridae, and the echinoderm families Ophiuridae and Loveniidae. There was, however, a notable decrease in abundances and the number of families at many of the sites in 2021 relative to the 2020 and 2019 surveys. There was also a decrease in species diversity at several sites. The driver of these declines is unclear but appear unrelated to farming and more likely reflect lower productivity in the system relative to previous years. Importantly, all the faunal metrics remain indicative of healthy macrofauna communities across the region.

Of the species known to respond to highly enriched conditions (e.g. *Capitella* spp., *Dorvilleid* sp. *Nebalia* sp.) only *Nebalia* sp.1 was common in 2021 and only at one of the sites, NUB2, where it has been observed in previous years. Of note, the overall abundance of annelids (an indicator of organic enrichment) in the sediments decreased in spring 2021 relative to the 2020 and 2019 surveys. There were seven introduced species recorded in the 2021 survey, down from eight in 2020 and nine in 2019. All introduced species were found in low numbers.

Soft Sediments: Visual Assessment and Sediment Chemistry

The visual descriptions of the sediment cores from the October 2021 survey showed the dominant colour was either varying tones of brown, olive or grey. The sediment type was sand at most sites. The exceptions was SB18 which contained more coarse sand or silt than the other sites. No odour or gas bubbles were detected from any core. Only one core NUB1.1 had a sulphurous smell.

In the sampling event, the mean redox values and sulphide concentrations at all sites were consistent with low levels of organic enrichment and healthy sediments (Macleod and Forbes, 2004).

2.2 Water Quality Measurements

2.2.1 Information Requirement

EL 10211/1 Condition 3F3

- *Results of water quality monitoring, including nutrients, field parameters and phytoplankton to be summarised and analysed. Data recorded for the 12-month period, up to and including April of each year, to be summarised and analysed with consideration to be given to illustrating seasonal and other relevant effects.*
- *Comparison of water quality results recorded at the compliance site against investigation trigger limits specified in Table 1 of the EL (and table 3 of this report).*
    - *Use rolling annual median as compliance metric*
    - *Box & whisker plots should be utilised to illustrate monitoring results and to provide a comparison with investigation trigger levels*
    - *Analysis of performance in the context of stocking cycles and feed inputs to be provided*
    - *Summary of adaptive management measures implemented in response to trigger value exceedances*

2.2.2 Summary of Findings

Note – Further detail on methodologies and findings is provided in the annual BEMP report (submitted 31st August 2022 to EPA) and the BEMP Water Quality Performance Report (Submitted 31st August 2022 to EPA). Analysis of results against investigation trigger limits is also specified in the above reports. A summary of findings is provided below.

Water Column: Physicochemical Parameters and Nutrients

Throughout the sampling, the water temperature, nitrate, dissolved reactive phosphorus showed seasonal trends, with elevated concentrations of nutrients and lower temperatures from May – September and lower levels of nutrients and higher temperatures from October – April. The increase in nutrients during spring and winter coincides with the strengthening of the sub-Antarctic current which is rich in nitrogen and/or increased inputs via river flow and runoff from land. During late spring and summer, the remaining nitrogen is rapidly absorbed from the surrounding environment by phytoplankton. Dissolved oxygen concentrations also continue to follow a seasonal pattern with concentrations increasing through autumn -winter due to greater solubility with the cooling temperatures and increased weather driven atmospheric inputs and vertical mixing.

Although the seasonal trend is not as clear, both salinity and silica concentrations in surface waters are on average higher in the winter months, particularly at sites in closer proximity to the major freshwater inputs (i.e. the Derwent Estuary). By contrast, there were only weak or no clear seasonal patterns for the concentrations of TAN, total nitrogen, total phosphorus, and silica. Notably, the TAN concentrations in the surface, 10 m and bottom waters which were elevated in 2020 had returned to concentrations more comparable to previous reporting periods.

Water Column: Phytoplankton Biomass and Communities

The biomass of chlorophyll *a* showed a weak seasonal trend with higher values recorded in late winter – spring and autumn of some years. Like TAN concentrations the biomass of chlorophyll *a* was elevated in 2020, but in the current reporting period, the biomass in winter-spring 2021 was lower and more similar to the preceding years. The phytoplankton communities, as described from cell counts, were dominated by diatoms. A very small proportion of the cell counts, or species recorded were harmful algae species.

Water Column: Performance against Investigative Trigger Levels

Table 3: Water quality investigative trigger levels for compliance site SB5 (As extracted from the EL)

Parameter	Level
Ammonia (surface)	9.0 µg/L
Ammonia (10m)	6.0 µg/L
Ammonia (bottom)	17.0 µg/L
Total Nitrogen (surface)	330.0 µg/L
Total Nitrogen (10m)	328.0 µg/L
Total Nitrogen (bottom)	340.0 µg/L
Nitrite & Nitrate (surface)	15.0 µg/L
Nitrite & Nitrate (10m)	15.0 µg/L
Nitrite & Nitrate (bottom)	35.0 µg/L
Total Phosphorus (surface)	40.0 µg/L
Total Phosphorus (10m)	38.0 µg/L
Total Phosphorus (bottom)	40.0 µg/L
Dissolved Reactive Phosphate (surface)	8.0 µg/L
Dissolved Reactive Phosphate (10m)	6.0 µg/L
Dissolved Reactive Phosphate (bottom)	12.0 µg/L
Oxygen (surface)	7.8 mg/L (lower limit)
Oxygen (10m)	7.8 mg/L (lower limit)
Oxygen (bottom)	7.5 mg/L (lower limit)
Chlorophyll[1]	3.6 mg/m^3 and 2.2 mg/m^3

[1] The EPA identified an error made when calculating chlorophyll *a* level for SB5. The value specified in EL10211/1 is 3.6 mg/m^3 which is 3× the average. The correct value should be the 80th percentile which is 2.2 mg/m^3. Until this variation to the EL is formally approved, both values are shown in table 3.

Throughout the monitoring, the values of nitrate, nitrite + nitrate and dissolved reactive phosphorus in the seawater showed seasonal trends, with higher concentrations through the winter – spring compared to summer – autumn. Concentrations of these nutrients were typically highest in the bottom waters of sites located in Storm Bay with lower values in the mid (10 m) or surface waters and at the inshore Nubeena sites. At some of the consistently monitored sites through time the values of nitrate (SB2, 4 and NUB1-3) and dissolved reactive phosphorus (SB2 and 7) in the bottom water were higher in March 2022 than the preceding years but returned to lower values in April 2022. The seasonal increase in bottom water nutrients during winter and spring coincides with the strengthening of the sub-Antarctic current which is rich in nutrients and/or run off from land (Buchanan *et. al.*, 2014).

The total ammoniacal nitrogen (TAN) concentrations showed weak seasonal patterns increasing during October – April, relative to the rest of the year with higher concentrations in the bottom waters than the mid or surface waters. In the bottom waters, the values of TAN at the consistently sampled sites (SB2, SB5, SB7, SB8 and SB9) were higher in October – April in 2021/2022, 2020/2021 and 2019/2020 than 2018/2019.

The biomass of chlorophyll *a* also showed weak seasonal trends increasing between July – September each year. However, there was considerable variation in the biomass of chlorophyll *a* between years. The biomass of chlorophyll *a* throughout July – September 2021 was lower than in 2020, and more similar to the values recorded in 2019.

2.3 Water Current – ADCP Data

2.3.1 Information Requirement

EL 10211/1 Condition 3F4

Summary of real-time, in-situ ADCP measurement. Interpretation of hydrodynamic patterns and associated adaptive management decisions.

2.3.2 Summary of Findings

West of Wedge has a relatively flat bathymetry with water depth across the lease ranging between 36 – 42 m. Flow was monitored by a Nortek WPR 2697 Sensor 15 minute intervals. Additional data, including wave height, direction and velocity were also collected by the unit. The sensor was bottom mounted at 552115.5/5224971.6, within the NW corner of the lease. Data was collated for the period beginning December 2021 to June 2022. This period captured most of the production cycle for the lease (June 2021-January 2022), and does include peak biomass (December 2021). The analysis showed that flow at WoW had a bimodal directional distribution indicating a tidal component, influenced by factors likely including wind and river flow. The single surface bin (group 18) showed increased velocity, and a more variable direction indicating wind action creating surface currents which did not translate down through the water column. All ADCP data has been submitted to the Department in conjunction with this report.

Table 4: Summary of mean flow rate and mean direction.

Date	Mean Flow Rate (ms^{-1})	Mean Direction (°)
17/12/2021-20/6/2022	Bottom 0.07 Mid-water 0.08 Surface 0.11	Bottom 310 Mid-water 305 Surface 310/130

Figures 2a, 2b and 2c below provide a more detailed description of the range of speeds and directions at three depths (surface, mid-water and bottom) for the period of data examined. Table 5 below provides a breakdown of relevant summary statistics.

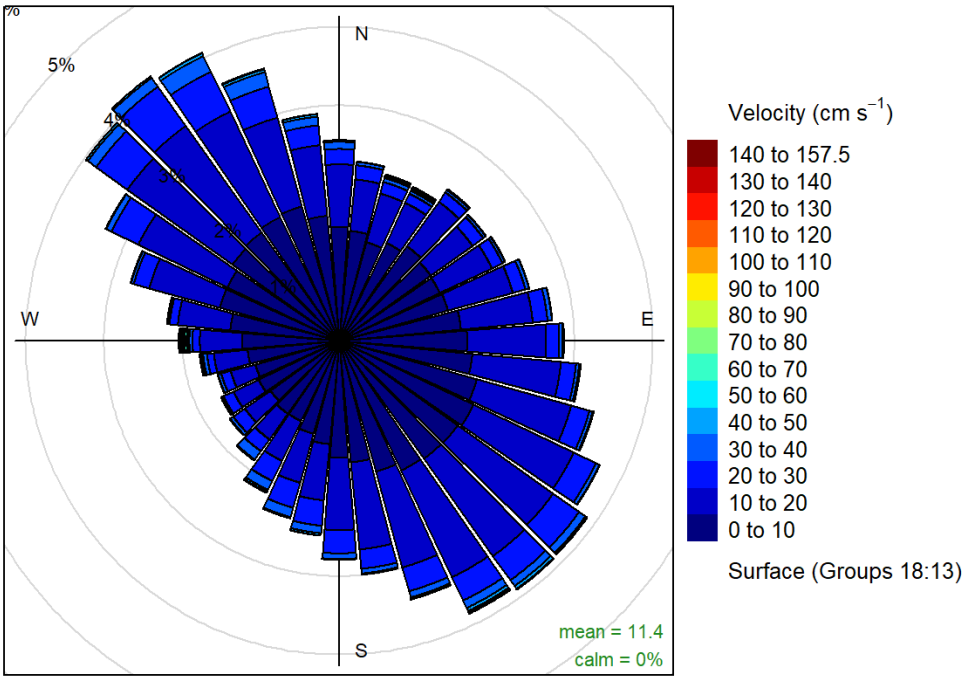

Figure 2a: Water currents (speed & direction) for surface waters at West of Wedge – December 2021 – June 2022.

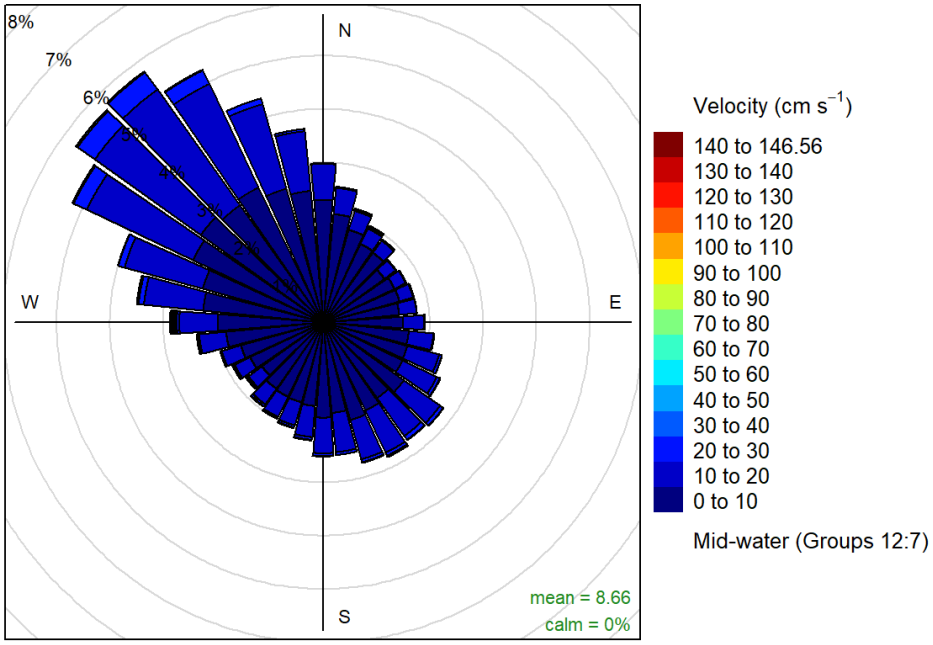

Figure 2b: Water currents (speed & direction) for mid waters at West of Wedge – December 2021 – June 2022.

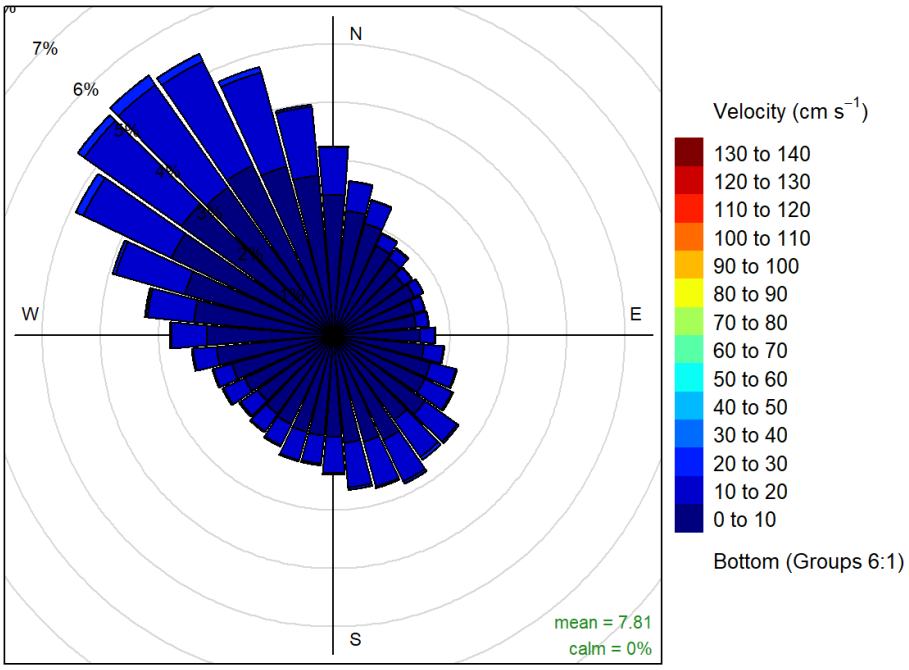

Figure 2c: Water currents (speed & direction) for bottom waters at West of Wedge – December 2021 – June 2022.

Table 5: Breakdown of relevant summary statistics

	Flow Velocity at 2.5m Depth ($cm.s^{-1}$) **Group 18**	**Flow Velocity at 6.5m Depth ($cm.s^{-1}$)** **Group 16**	**Flow Velocity at 10.5m Depth ($cm.s^{-1}$)** **Group 14**	**Flow Velocity at 20.5m Depth ($cm.s^{-1}$)** **Group 9**	**Flow Velocity at 36.5m Depth ($cm.s^{-1}$)** **Group 1**
Minimum	0.18	0.11	0.11	0.11	0.05
Maximum	60.05	147.20	157.50	110.49	58.18
Average	20.13	9.92	9.32	8.71	6.89

2.4 Inshore, Deep Reef & Seagrass Survey Results

2.4.1 Information Requirement

EL 10211/1 Condition 3F5 & 3F6

Findings of reef and seagrass surveys to be analysed. Interpretation of observed changes against background conditions to be provided.

2.4.2 Summary of Findings

Note – Further detail on methodologies and findings is provided in the annual BEMP report (submitted 31st August 2022 to EPA). A summary of findings is provided below.

Inshore and Deep Reefs

At all inshore reef sites, the algae community was dominated by canopy-forming species. The percentage cover of canopy forming algae was above 50% for both the winter 2021 and summer 2022 surveys. When enrichment parameters were considered, only epiphytic algae was consistently recorded across all sites. Only limited occurrences of other enrichment status species (i.e. filamentous algae, nuisance green and nuisance red) were recorded. Through time, the percentage cover of canopy-forming macroalgae at sites on the eastern side of Storm Bay was consistently higher in the summer and lower in the winter whereas there were no distinct seasonal trends at the sites on the western side of Storm Bay. For both regions, there were no consistent trends in the percentage cover of epiphytic algae through time.

The deep reef benthos was dominated by erect coarse and fine branching red algae species and sponges of massive, erect branching, erect laminar, cup and barrel forms. The most common fish species were Butterfly perch (*Caesioperca lepidoptera*), Barber perch (*Caesioperca razor*) and Rosy

wrasse (*Pseudolabrus rubicundus*). In the baseline and ELs surveys the fish community was consistently dominated by these species.

Seagrass

The percentage cover of *Zostera* spp. varied considerably between sites and through time. In spring 2021, at the East of Sloping Island site where *Zostera* spp. was recorded, percentage cover averaged between 20-50%. Qualitative and quantitative assessments indicated that the percentage cover of epiphytic algae was "low" to "high" at 23.5-67.5% at East of Sloping Island. Through time the percentage cover of epiphytic algae increased from "very low" or "low" to "medium" or "high" were recorded at the two sites. The temporal variation in the percentage cover of epiphytic algae between the baseline survey and EL surveys could be linked to a range of factors including seasonal and natural variability and differences in survey methods.

Section 3: Modelling

3.1 Sediment Dispersion - DEPOMOD

3.1.1 Information Requirement

EL 10211/1 Condition 3M2

Outputs from water quality dispersion modelling to be included.

3.1.2 Summary of Findings

CSIRO are currently responsible for the scope of work necessary to satisfy the requirements of condition 3M2 of the EL. This is being covered by the FRDC 2017-215 project (Storm Bay Biogeochemical Modelling and Information System: Supporting sustainable aquaculture expansion in Tasmania). Water quality dispersion modelling, on a regional and local scale, and was required to be completed by December 2021. A report outlining the findings of the modelling was required to be submitted by July 2022. However, CSIRO have been delayed in providing the final report. This will be submitted as soon as possible.

3.2 Sediment Dispersion - DEPOMOD

3.2.1 Information Requirement

EL 10211/1 Condition 3M3

Outputs from dispersion modelling to be included.

3.2.2 Summary of Findings

Note – Further detail was provided in the Depositional Modelling Final Report (2021), submitted to the EPA on 4th August 2021. A summary of findings was provided in the Annual Environmental Review submitted for EL10211/1 on the 10th of September 2021.

Section 4: Near Field/Lease Environmental Monitoring

4.1 Benthic Compliance Video Survey

4.1.1 Information Requirement

EL 10211/1 Condition 3V

Summary of key findings of video surveys undertaken in reporting period

4.1.2 Summary of Findings

Note – Further detail was provided in the MF279 Annual Video Survey Report (December 2021), submitted to the EPA on the 14th January 2022. A summary of findings is provided below.

Benthic footage was taken by Fulcrum Pty Ltd of 35m out-of-lease compliance positions and the four stocked pen bays, as determined by the EPA, on the 17th December 2021. MF279 lease is one of four leases within a shared zone at the offshore West of Wedge site. At the time of the survey, the lease was fully stocked with four 168m circumference pens stocked on a customised 4 pen bay grid style mooring system. All out of lease compliance showed normal benthic conditions with no visible impacts from farming observed at the survey. All pen bays showed minimal levels of feed and faeces on the seafloor, however, remained compliant with condition G1.2 of the EL. Conditions within the lease and at out of lease compliance positions showed normal sandy sediments and sediments for this high energy offshore location.

4.2 Benthic Sediment Survey

4.2.1 Information Requirement

EL 10211/1 Condition 3V12

Results of benthic infauna and sediment surveys undertaken at compliance and control sites

4.2.2 Summary of Findings

Note – Further detail was provided in MF279 West of Wedge Island Benthic Survey Report (2021), submitted to the EPA on the 31st August 2022. A summary of findings is provided below.

Benthic sediment surveys are conducted annually, within 30 days of lease peak production. The benthic sediment survey requirements are outlined in section 3V1 of the EL, and the sites, methodologies and reporting guidelines are described in 3V10, 3V11 and 3V12, respectively.

There was no significant difference in mean redox or sulphide values between control and compliance sites in this survey. Furthermore, all compliance site means are above and below the

threshold values identified in the Environmental Licence conditions for redox (0 mV) and sulphide (250 µM), respectively.

Compared to the baseline survey conducted in November 2019, redox potential was higher at compliance sites but identical at control sites. Sulphide concentration was very similar at compliance sites but higher at control sites in the current survey in comparison.

In line with condition G1 of EL10211/1, when compared against the baseline data, the findings from the present survey do not indicate:

- a 20 time increase in the total abundance of any individual taxonomic family relative to the reference sites,
- an increase at any compliance site of greater than 50-times the total Annelid abundance at reference sites,
- a reduction in the number of families by 50 percent or more relative to reference sites,
- or a complete absence of fauna.

No taxonomic family increased by 20 times or more at compliance sites when compared to baseline reference conditions. The largest increase was ~3 times, observed in the cnidarian family Edwardsidae. For total annelid abundance, the largest increase at any compliance site was 2 times (CP8) relative to reference conditions in the baseline survey (a decrease in annelid abundance was observed at most compliance sites). There was a ~31% reduction in the mean number of families at the compliance sites (22 families per grab) relative to the reference conditions in the baseline survey (32 families per grab). However, there was an equivalent decrease (~45%) observed at control sites in this survey (15 families per grab) compared the baseline survey (22 families per grab).