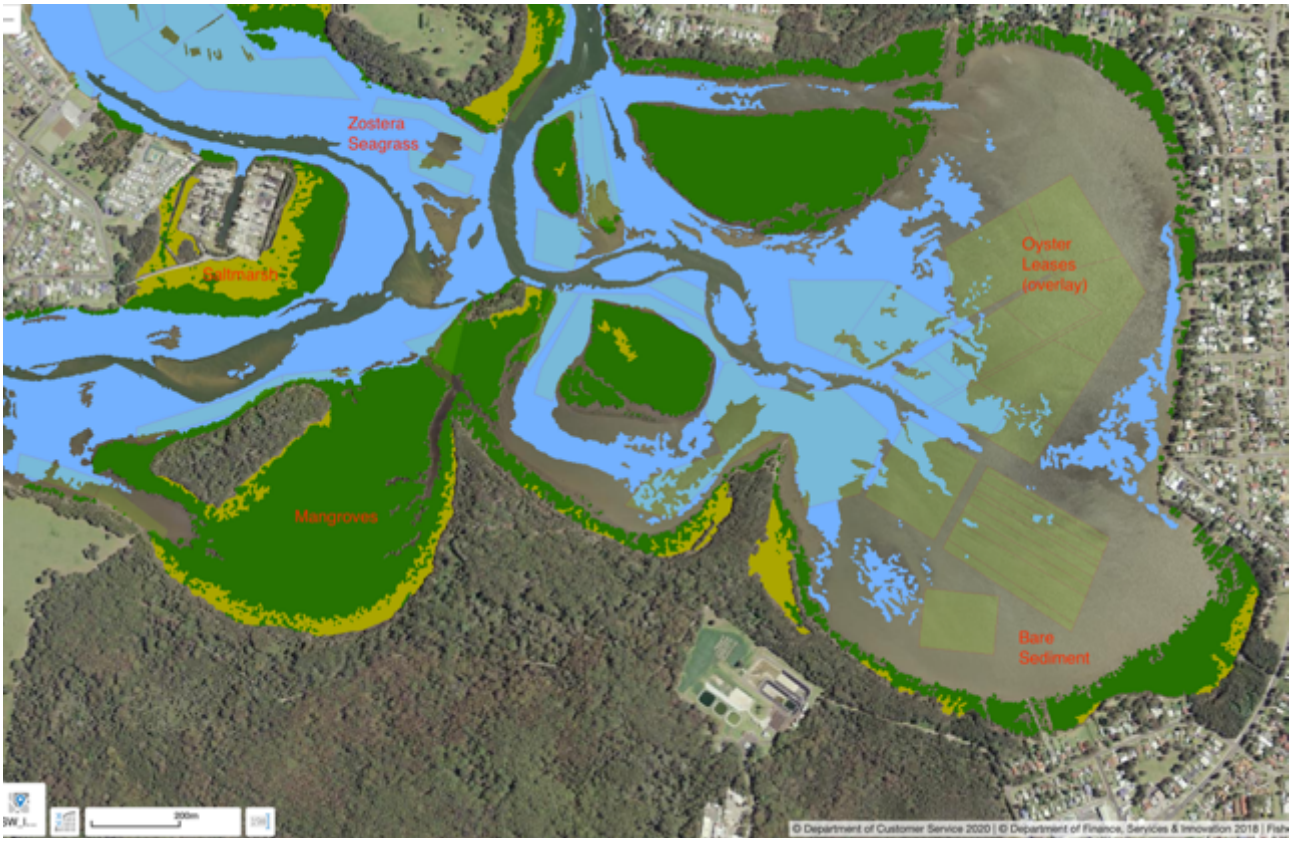
WEST CULBURRA MIXED USE DEVELOPMENT APPROVAL CONDITIONS OF CONSENT -

BASELINE MONITORING PROGRAM FOR CoCs C17 & C18 AQUATIC ECOLOGY REQUIREMENTS



Key Fish Habitats & Oyster Leases in Crookhaven River Estuary & Curleys Bay (NSW DPI Fisheries 2009).

Prepared for Sealark Pty Ltd

Final Monitoring Report (Post Pilot Studies)
Marine Pollution Research Pty Ltd November 2022

1 INTRODUCTION

State Significant Development Application SSD3846 is a concept proposal for a staged, residential and commercial development located on the northern side of Culburra Road between the Crookhaven River Estuary and Lake Wollumboola. The concept proposal was approved subject to the conditions annexed and marked "Annexure A" in the *Section 34(3)(a) and (b) of Land and Environment Court Act 1979 Agreement between parties* dated 29 October 2021.

1.1 Scope of Aquatic Ecological Study (CoCs C17 and C18)

Marine Pollution Research Pty Ltd (MPR) has been requested by the proponent Sealark Pty Ltd to prepare a report on the methodology for undertaking the initial concept proposal baseline aquatic ecology monitoring obligations as set out in the Approved Conditions of Consent (CoCs) C17 and C18. Note that this methodology report does not include C18d oyster lease water quality sampling methodology which is described by Martens & Associates in their companion Water Quality Methodology Report (Martens & Associates 2022).

As the construction project itself is to be staged with each stage subjected to separate Environmental Assessment and Approval, monitoring program(s) will also be staged, and accordingly, this present monitoring methodology report addresses the first 18-month Concept Approval baseline monitoring requirement, with the intention that information gathered in this baseline monitoring can be drawn on for subsequent staged construction and operation monitoring program(s), as stipulated in C17f and C18f.

This methodology scoping report has been prepared to meet the initial *methodology reporting* aspects of C17f and C18f and, once baseline sites plus detailed methodologies are fully settled and agreed, a final methodology report can be submitted *during the baseline period*, as per C17f and C18f.

1.1.1 Independent Expert (CoCs C17a & C18a)

As per the requirement that the monitoring program be designed *by a suitably qualified and experienced independent expert, whose appointment has been endorsed by the Council,* Shoalhaven City Council has endorsed Paul Anink of Marine Pollution Research Pty Ltd as one of two nominated independent experts for designing and undertaking the water quality and aquatic ecological aspects of this baseline program. **Annexure A** provides a CV and Capability Document for Paul Anink, and a copy of the Council's Independent Expert's Endorsement letter dated 6 May 2022. This methodology report has been prepared by Mr Anink.

1.2 Integration of Monitoring Programs & Control Site Locations (C16c,e, C17c,e & C18c)

COCs C16 (Water quality), C17 (Aquatic Ecology) and C18 (Oyster Aquaculture) require water quality and aquatic ecology monitoring at a fixed set of sites that are described similarly in each of the COCs. Wherever possible the Aquatic Ecology monitoring sites have been located and integrated with, or with reference to, both the Water Quality Monitoring sites for C16 and Oyster Monitoring sites for C18.

Conditions C16c, C17c and C18c also require sampling from estuarine sites in 'Control Locations', defined as 'locations selected outside of any potential influence from the project'. Curleys Bay is clearly defined in these CoCs as 'the area of potential influence from the project' and this area coincides with the Curleys Bay Shellfish Harvest Area, (see **Figure 1**). Accordingly, it is proposed that Control Sites be positioned in Crookhaven River with Control Up (Cup) sites located in the *Crookhaven River Shellfish Harvest Area* upstream of Curleys Bay Harvest Area and Control Down (Cdn) sites located in the *Goodnight Island Shellfish Harvest Area* downstream from Curleys Bay Harvest Area.

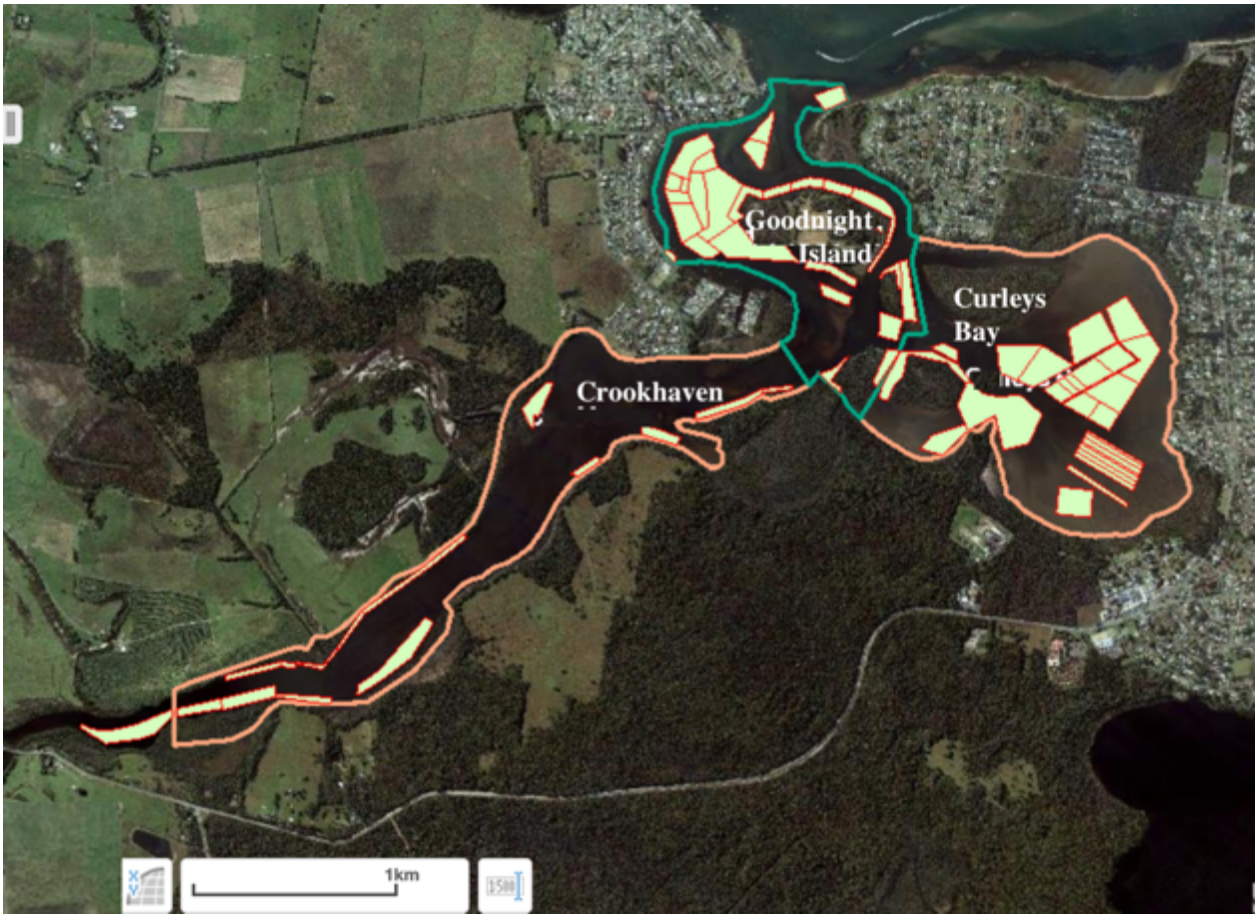


Figure 1 ***Designated*** Shellfish Harvest Areas in the Crookhaven River (Fisheries NSW Spatial Data Portal).

1.3 C17c,e & C18c Locations and Sites

For the purposes of the Crookhaven River Estuary nested sampling design there is a distinction drawn between the use of the terms *sites* and *locations* for the COCs:

- For C17c there are **five** geographically described Crookhaven Estuary sampling *locations*, with two *sites* required per *location*. These geographical descriptions have been given the following *location* naming conventions:
    - Three Curleys Bay *Locations* (named Billys Bay BB, South West Bay SWB, and South East Bay SEB). Sites are designated by Number - e.g., BB1 and BB2).
    - Two River Estuary Control *Locations (Cup upstream and Cdn downstream*) in Crookhaven River. with *sites* also designated by number, e.g., Cup1 and Cup2.
- C18c requires sampling at Crookhaven River *high use and opportunistic leases* and at two leases in northern Curleys Bay plus two leases each at two control sites.
    - In keeping with the integrated sampling concept provided in **Section 1.2** above and the intertidal estuarine monitoring siting rational described above, nominated leases have been selected to be as close to, or *tidally downstream* of selected intertidal aquatic ecology sampling sites.
    - High Use Leases are located at BB1, BB2, SWB1, NB2 and the two downstream river controls at Cdn. Whilst the Cup leases are considered *high use*, they are also more likely to have high variation in usage due to their location in the upper reaches of the estuary and are thus included as *opportunistic* leases.
    - remaining opportunist leases are all located in Curleys Bay Harvest Area; South West Bay (SWB2), South East Bay (SEB1 & SEB2) and at NB1.

Figure 2 provides the provisional Crookhaven Estuary aquatic ecology location/site map where intertidal aquatic ecology *discharge treatment* monitoring sites (red lines) have been located (i) at the base of natural overland drainage lines for sub-catchments as defined in the EIS Aquatic Ecology Addendum Report (MPR 2020) Annexure A Map 01 (map prepared by Martens & Associates) and (ii) to be close to (and paired) with oyster lease/seagrass sampling sites (orange dots):

- Sites BB1, BB2, SWB1, SWB2 and SEB1 are downstream of the Concept Proposal.
- Site SEB2 and Site Cdn1 are located downstream of urban development.
- Sites Cup, Cup2 and Cdn2 are located downstream of mixed cleared and forested agricultural land.
- Note that the red dots in **Figure 2** indicate the two additional Northern Bay oyster-flesh lease monitoring sites as required by C18c.

For Lake Wollumboola freshwater aquatic ecology sampling, Condition C17e requires sampling in three *locations*; Wattle Creek and two other creeks draining to Lake Wollumboola. Aside from Wattle Creek which is nominated, the two other creeks selected for both water quality and aquatic ecology sampling are Downs Creek and the un-named Southern Creek arm of Downs Creek (see **Figure 3** for these locations):

As detailed in the project EIS and Addendum Aquatic Ecology reports (MPR 2020, 2021), the upper sections of Wattle Creek below Culburra Road comprise overland swale runoff with no incised creek features, and incised creek sections are confined to the lower sections of Wattle Creek, are ephemeral and are known to dry out completely during extended dry periods. WC *downstream* freshwater site selection is also constrained by the high variation in lake water levels in response to varying flood and lake entrance opening and closing behaviours that result in a large variation in the location of the actual discharge of the creek to the lake.

A freshwater site selection program for the C17(e) Lake Wollumboola creek sampling requirements in September 2022 confirmed that the only aquatic habitats in Wattle Creek comprised the incised creek sections restricted to the lower limits of Wattle Creek catchment downstream of the lower track crossing. Site selection for the Consent Condition C17(e) Lake Wollumboola macroinvertebrate and fish monitoring requirements was therefore concentrated in this lower Wattle Creek. with the similarly spaced paired reference sites then located in Downs Creek and South Creek.

Given the restricted length of ephemeral incised creek line actually available for sampling in Wattle Creek, and the requirement for at least one sample site at the lower end of the creek, two Wattle Creek nominated sites have been spaced to be as wide apart as possible in the available actual incised creek length. Accordingly, Site WCup site is located below the Paperbark Swamp inflow confluence, and the WCdn freshwater sampling site is located just above the highest lake flood level creek discharge point. Sites in the other creeks are located to match the elevations of the two Wattle Creek sites.

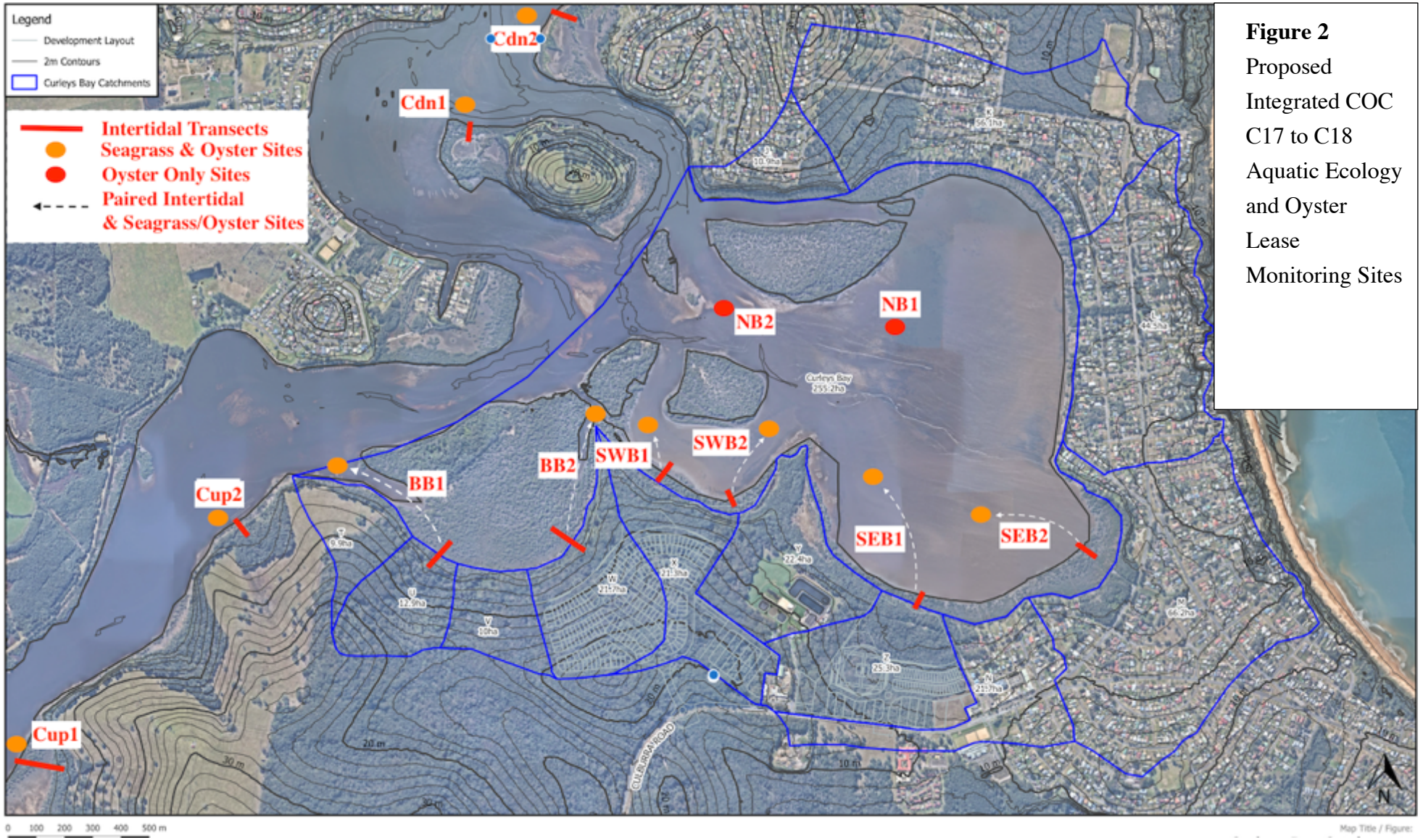


Figure 2
Proposed Integrated COC C17 to C18 Aquatic Ecology and Oyster Lease Monitoring Sites

Figure 2 CoC17c and CoC18c Nominated Aquatic Ecology and Oyster Condition Sampling Sites (Base map Map 01 Curleys Bay Catchment prepared by Martens & Associates 29 June 2021). White dashed arrows indicate general ebb tide drainage 'pairing' of intertidal and sub-tidal sites.

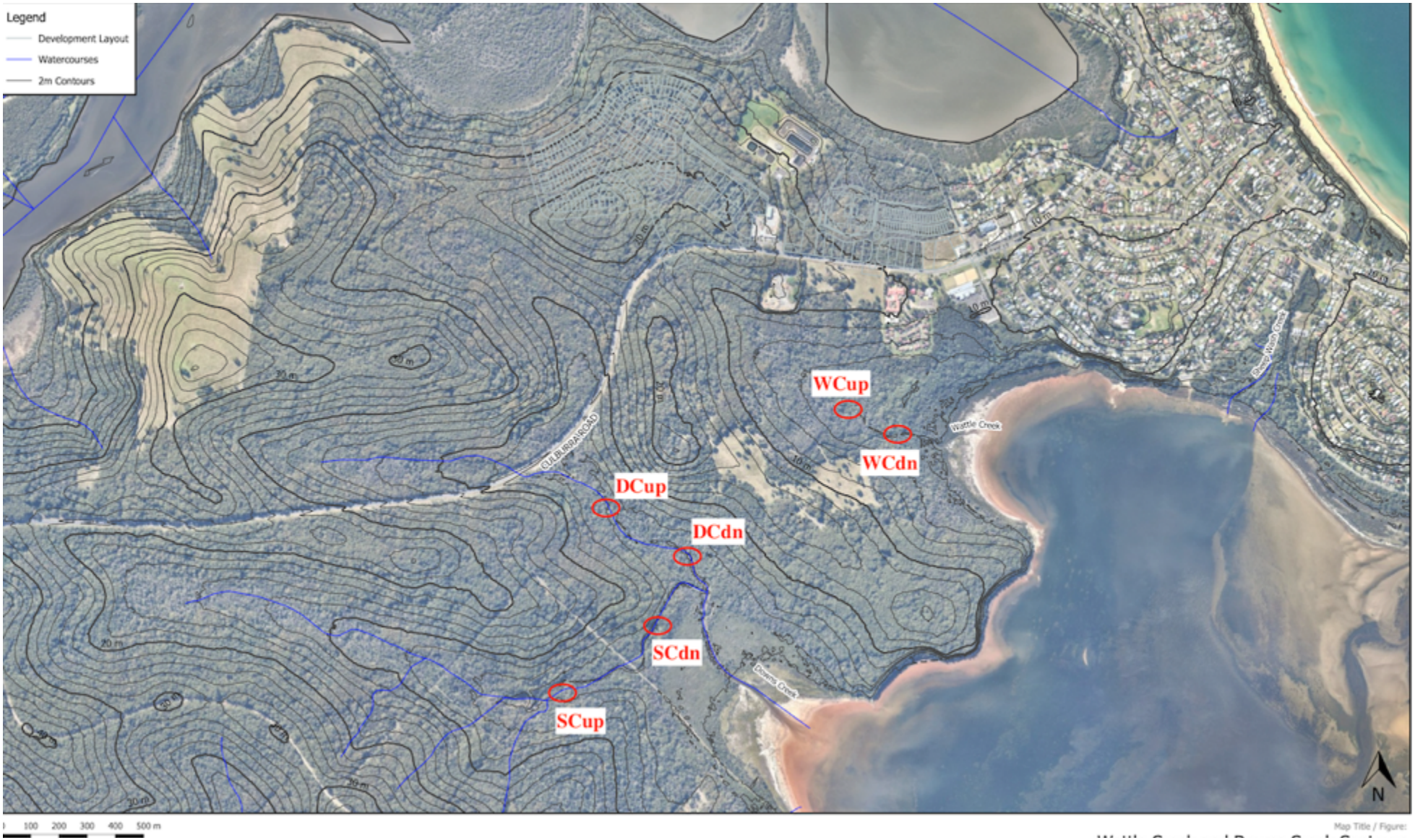


Figure 3 CoC C17 Lk Wollumboola Sample Creeks and C16 Creek Water Quality and Biota Monitoring Sites.

2 PROPOSED C17 & C18 AQUATIC ECOLOGY & OYSTER MONITORING METHODOLOGY

In relation to C17d, the Revised Culburra Beach Concept Plan Aquatic Ecology Assessment Report (MPR 2020) and the subsequent Aquatic Ecology Assessment Report Addendum (MPR 2021), noted that for the most part, sub-catchment stormwater discharges from the proposal site are not confined to incised or eroded defined creek lines but rather flow down through the forest buffer via vegetated swales. Accordingly, the two reports recommended that monitoring for possible project associated impact on adjacent estuarine intertidal habitats and near shore seagrass habitats plus associated oyster leases should be predicated on the possibility of increased surface and groundwater runoff volume/frequency plus altered water quality, principally increased sediment and nutrient loads, that would be directed through the 100m buffer zone to the intertidal zone habitats via *existing site woodland/forested sub-catchment discharge swales*.

In consequence, the reports recommended the use of fixed replicate shore normal "ladder" transects for intertidal habitat zonation and profile variation monitoring, with transects located at the bottom of individual terrestrial buffer zone sub-catchment swale locations below the proposal footprint and at other individual sub-catchment swale locations not under the project footprint (see also for example Chapman & Roberts 2004). This procedure has been adopted and extended for the base-line estuarine intertidal monitoring program as detailed below.

2.1 C17d Estuarine Intertidal Habitat Monitoring

As potential project related impacts would be related to stormwater flow quality and quantity discharging from the project development area generally directed to the intertidal zone via the existing 100m wide buffer forest sub-catchment discharges, each Estuarine Intertidal Habitat Monitoring **site** has been split into two **sub-sites** based on the presence or absence of sub-catchment swale or creek stormwater discharges and **Table 1** provides a summary of sub-site characteristics in terms of present riparian buffer type, overall sub-catchment land use and present sub-catchment stormwater runoff characteristics (swale/creek or unconfined stormwater discharge).

At each intertidal estuarine sub-site, the following monitoring is proposed:

- Replicated fixed sub-site ladder transects (2 ladder transects per sub-site, 2 m wide, 2m apart and variable length determined by local tidal zoning:
    - The decision to utilise this configuration arises from pre-inspection of the proposed discharge sites in relation to different swale or channel drainage character - where the width of sub-catchment confined discharge zones varied from around 5m for swales with no eroded channel characteristics but some piping failure erosion,

through to 7m width for urban stormwater channelled discharge. Possible sampling impact/bias via trampling within the ladder transect is reduced by confining the ladder transect width to 2m as transects and quadrats can be set and analysed from outside the area of potential influence.

Table 1 Estuarine Intertidal Sampling Site Characteristics

Location	Site	Below Project Footprint	Sub-site characteristics		
			Buffer	Land use	Discharge
River Up	Cup1	No	Forest	Grazing	Swale
River Up	Cup1	No	Forest	Grazing	unconfined
River Up	Cup2	No	Forest	Grazing	Incised Swale
River Up	Cup2	No	Forest	Grazing	unconfined
Billys Bay	BB1	No	Forest	Forest	Swale
Billys Bay	BB1	No	Forest	Forest	unconfined
Billys Bay	BB2	Yes	Forest	Forest	Swale
Billys Bay	BB2	Yes	Forest	Forest	unconfined
SW Bay	SWB1	Yes	Forest	Forest	Swale
SW Bay	SWB1	Yes	Forest	Forest	unconfined
SW Bay	SWB2	Yes	Forest	Forest	Swale
SW Bay	SWB2	Yes	Forest	Forest	unconfined
SE Bay	SEB1	Yes	Forest	Forest	Channel
SE Bay	SEB1	Yes	Forest	Forest	unconfined
SE Bay	SEB2	No	Forest	Urban	Channel
SE Bay	SEB2	No	Forest	Urban	unconfined
River down	Cdn1	No	Grass Land	Urban Buffer	Swale
River down	Cdn1	No			unconfined
River down	Cdn2	No	Forest	Rural residential	Swale
River down	Cdn2	No	Forest		unconfined

- The Ladder transects will be utilised for measuring landscape, topography (heights AHD and distance offshore from fixed pegs) and sub-site zone condition monitoring to measure change over time for overall sub-site riparian edge condition and stability, shading cover and extent, upper intertidal saltmarsh key plant and zone limits, saltmarsh to mangrove transition zone limits, upper extent of estuarine crab and gastropod mollusc occupation, and limits of mangrove seedling occupation.
- The *transect point-intercept zonation **height** monitoring* (using laser dumpy level plus surveyor staff set along the ladder transect survey tape lines) will be undertaken at the **beginning and end** of the 18 month sampling program with heights measured relative to the start pegs, and, as overall changes in physical site characteristics (erosional impacts via storm runoff and wave erosion) would be most likely to occur during significant storm events, zonation height monitoring will be also be undertaken **following three significant wet weather events** to meet the requirements of Condition C17b.

- All relative heights will be reduced to AHD once registered surveyors have fixed the start peg heights (also at both start and finish of the 18-month program).
- *Transect point intercept habitat **zonation** measurements* along the four sub-site transect lengths will be undertaken **every 2 months** as per Condition C17b.
- In relation to the C17b requirement for three wet weather sampling events, immediate post wet weather sampling of point intercept zonation will **only** be undertaken if the wet weather transect zonation height surveys described above indicate actual storm-mediated erosion or deposition. Otherwise, and given that plants would still require some time to adjust to any particular wet weather, it is considered that the 2-monthly sampling requirement will provide sufficient post wet weather point-intercept impact information.
- Replicate fixed ladder quadrat diversity, cover and density changes over time for riparian, saltmarsh and mangrove transition zone plant diversity, mangrove seedling and sapling/dwarf mangrove density, and for crab hole density for riparian edge, upper saltmarsh, saltmarsh-to upper mangrove and upper mangrove zoned habitats will be established via use of three randomly placed replicate quadrat within each combined sub-site ladder transect zone. Quadrat monitoring will also be undertaken every **two months** as per Condition C17b.

Estuarine intertidal monitoring for each nominated Sub-site is to be conducted in the following manner:

- Each replicate ladder transect will comprise two surveyor tapes run out shore-normal from fixed and surveyed in (location and AHD height) deep set (permanent) star-pickets.
- The start star pickets will be set *at least* 2m back from the riparian edge, in stable riparian land upslope of the riparian edge to facilitate monitoring of *riparian edge shape and stability*. The initial peg heights will also be used as references for subsequent ladder transect zone height profile stability measurements over time.
- Each transect will be run out from the riparian over the upper intertidal to the inshore edge of the mature mangrove zone at which there are no longer any mangrove seeds and seedlings, only mature mangroves. The end of transect locations will also be marked with permanent star pickets - to facilitate accurate resetting for each monitoring period.
- Shoreline riparian edge, *intertidal zone stability and intertidal vegetation zonation change* will be assessed via transect line profiles based on each ladder transect edge line (i.e. two profiles per each sub-site ladder edge for nominated recognizable depth zones and zone overlaps (e.g., riparian edge, upper saltmarsh, saltmarsh-to upper mangrove and upper mangrove zoned habitats.
- Individual key riparian, saltmarsh and mangrove species upper and lower limits will also be determined.

- Canopy shading of intertidal habitats will be assessed by width of relevant habitat shaded by overhanging riparian vegetation (mainly *Casuarina*) inshore and mainly by mangrove canopy widths off-shore.
- Smothering/shading (primarily by accumulated wrack along the high tide line) will also be recorded.
- Changes in riparian, saltmarsh and inshore mangrove habitat plant assemblages will be assessed via species diversity measures in three randomly placed replicate quadrats within each fixed ladder zoned area (i.e, in riparian edge, saltmarsh, saltmarsh-to upper mangrove and upper mangrove zoned habitats).

2.2 C17d Subtidal Seagrass Monitoring

The project Aquatic Ecology reports (MPR 2020, 2021) recommended that seagrass blade habitats represented the most sensitive sub-tidal habitat in relation to potential changes in stormwater runoff, with epiphytic sediment deposition, algae growth and encrusting faunal growth being the most sensitive measures for potential increased sedimentation, nutrient and contamination concentrations (see also for example Morgan & Kitting 1984, Michael et al 2008 and Nelson 2018). As the Curleys Bay and Crookhaven River *Zostera* seagrass[1] beds are naturally (and highly) susceptible to seasonal plus flood related die-off cycles, the use of natural seagrass blades for long term epi-biota measurements can be compromised by these losses. This limitation can be overcome by the use of replicate Seagrass Blade Artificial Sampling Units (Seagrass ASUs) that are placed at each monitoring site for fixed or variable periods then recovered for collection and processing of epibiota and sediment loads (see for example Bologne & Heck 1999, Kendrick & Lavey 2001, Lavey et al 2007, Pete et al 2015 and for ASU contemporary local use see Haine et al 2013):

- The Condition C17(c) requirement for seagrass monitoring will be met by monitoring changes in seagrass blade epiphytic sediment, and biota (mainly algae) densities utilising replicated Seagrass Artificial Sampling Units (ASUs) at estuarine sites that are located at the estuary water quality and infrastructure oyster monitoring sites, as described in **Section 1.3** and shown on **Figure 2**.
- From the wide range of ASU descriptions in the literature it is clear that the main criteria for Seagrass ASU design are matching seagrass blade number and dimensions (width, length). For matching epiphyte loads between natural and ASU seagrass it is recommended that the ASU blades rigidity match the particular mimicked plant rigidity.

[1] Most legislation refers to Family *Zostereacea* or *Zostera* seagrass, generally meaning *Zostera capricorni*. This name is currently regarded as a synonym of *Zostera muelleri* subsp. *capricorni* (Ascherson) S.W.L.Jacobs, (See Jacobs et al 2006), and is retained for this report.

  - MPR has been trialling several potential Seagrass ASU arrangements and has adopted the ASU arrangement shown in **Figures 4 to 5** below.
  - At each Seagrass site two ASU brick supports each with six replicate *Zostera* ASU shoots distributed randomly in the available ten brick inserts (to mimic variable density) will be deployed for six to seven weeks immersion within each two monthly monitoring period.
- After retrieval, the 12 Shoot ASUs from the two bricks per site will be randomly allocated into three replicate samples for processing, each sample comprising four shoot ASUs with a total 16 leaves per replicate sample - that will be analysed for total epiphyte and sediment load.
- Sample collection and laboratory analysis methods for epiphytic and sediment loads will follow the detailed methodology provided by Kendrick and Lavery (2010) Section 10.6, who recommend dry weight for total epiphytic cover load estimates plus ash free dry weight to provide an estimate of the algae to inorganic epiphyte biomass proportions.

Figure 4 Pilot Seagrass ASU with four replicate *Zostera* ASUs at initial deployment.

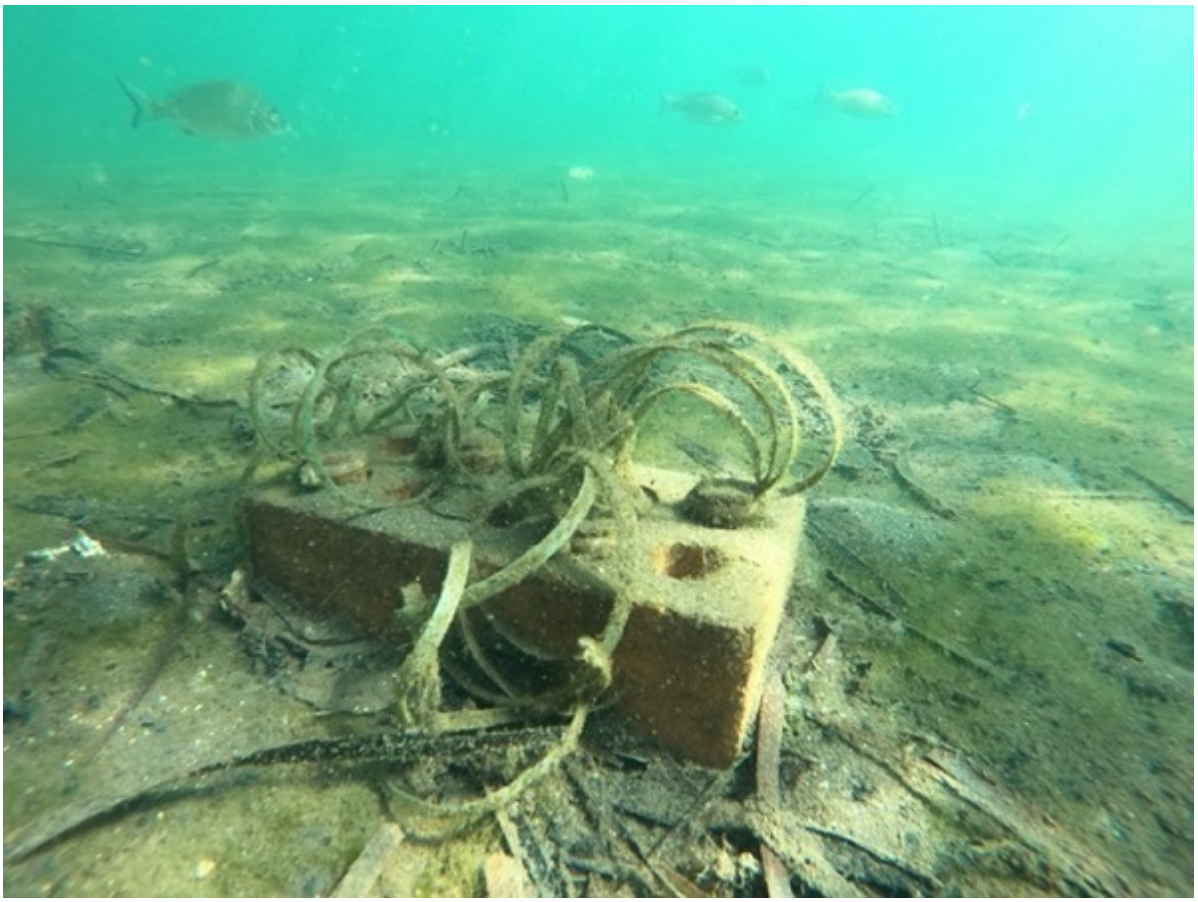


Figure 5 Pilot Seagrass ASU after four weeks immersion.

2.3 C17e Lk Wollumboola Freshwater Biota Monitoring

Condition C17e requires quantitative sampling for freshwater macroinvertebrates, prohibits rapid sampling methods such as AusRivAS and requires electrofishing sampling for fish:

- Given the shallow and intermittent nature of Wattle Creek drainage line compared to the more permanent nature of the two control creeks, comparable macro-invertebrate sampling as required by C 17e will be achieved by use of macro-invertebrate Artificial Sampling Units (ASUs) - bundles of 'chop-sticks' -deployed and retrieved at each sampling time (see additional methodology information below).
- Where it is feasible, fish sampling will be undertaken using back-pack electrofishing as proscribed in C17(e). Given the nature of upper Wattle Creek intermittent pools that are characterised by boggy to very shallow water with dense growth of *Gahnia*, where electro-fishing cannot be undertaken, hand meshing would be deployed. Electrofishing methods would follow well established practice codes, manuals and guides (e.g., NSW Fisheries 1997, US Fish & Wildlife 2000 and Queensland DES 2018)
- Site Habitat descriptions will use standardised RCE methods as defined in the West Culburra EIS and Addendum Aquatic Ecology reports (MPR 2020, 2021).

Review of freshwater ASU deployment for East Coast Australia uses indicated that the Cardno (2010) study was the most appropriate for consideration of ASU construction for the West Culburra study. It is noted that this study used ASUs made from bundles of chopsticks (3cm diameter x 20cm length) tied to concrete weights, designed to simulate plant structures (e.g., cumbungi *Typha* stems), and these were deployed for seven weeks duration. These structures did not however, provide interstitial space between the sticks for colonisation by larger invertebrates, which limits the potential abundance and range of taxa that utilise the structures. Accordingly, a project-specific pilot study was commenced in early August 2022 to establish optimum freshwater ASU construction for the West Culburra project study.

Four prototype ASUs were trialled for the pilot study. The aim of the ASU design trial was to evaluate a range of structures that are capable of providing both refuge from predators and foraging habitat for resident aquatic macroinvertebrates, and which mimic natural structures found in Lake Wollumboola tributary streams (i.e., detritus, *Gahnia* stems and leaves, emergent macrophyte stems). Each of the prototypes were made of readily available, biodegradable materials in configurations that can be reproduced repetitively to produce a standardised habitat area. The prototypes consisted of the following designs:

- Type 1: Split wooden disposable chopsticks (Figure 6a), which were joined as pairs by merging the pair via the split (Figure 6b), and then bundled together in groups of 8 pairs with cable ties (Figure 6c).
- Type 2: As per Type 1, however with 2 short lengths of stick inserted perpendicular to each other to create larger interstitial spaces within the structure (Figure 6d).
- Type 3: 63 x 35cm bamboo skewers inserted into a wooden base plate with drilled holes (Figure 7a).
- Type 4: Three bundles of 50 x 10cm bamboo cocktail skewers (Figure 7b).

Given that the pilot study could be extended over a whole season, prior to deployment, all ASUs were conditioned in unfiltered, aerated creek water for 5 days to allow periphytic microbial and algal communities to colonise the structures, enhancing the potential habitat complexity and foraging resource for scraper communities (e.g., mayflies, midge larvae).

Three replicates of each ASU prototype were deployed, with one replicate of each prototype tethered to a weight (common brick) using cable ties and curtain cord. Each brick was tethered to a 30cm tent peg anchor point which was fixed to the bank. ASUs were deployed in Floods Creek, Somersby on the NSW Central Coast in mid-August 2022. The ASUs were positioned at the stream edge in backwaters containing undercut banks and overhanging trailing bank vegetation. **Figure 6 & 7** show two prototypes after 3 weeks submersion.

After 43 days all remaining ASUs were recovered and subsequently processed for macroinvertebrates. While the diversity and abundance of macroinvertebrate specimens was comparable between prototypes, the efficiency of sample processing (construction, retrieval, ASU dismantling and sample extraction (rinsing)) resulted in the Type 2 ASU being chosen for the Culburra Freshwater monitoring program, with the three ASU replication number adopted for the study and the optimum immersion time set for 6 to 7 weeks deployment.

As per the C17(e) requirement, the Lake Wollumboola freshwater aquatic ecology assessments will be undertaken seasonally, with seasons timed as per the AusRivAS protocols (i.e., Spring is from mid-September to mid-December, etc), with the first (Spring 2022) ASU deployments in October for seven weeks deployment, and ASU recovery plus electro-fishing in mid-December 2022, followed by similar seasonal deployments plus recovery for the remaining 18-month sampling period. Note that this sampling scheme schedule also allows for the minimisation of sampling requirements over Christmas holiday periods.

Figure 6 Type 2 ASU *in situ* after 3 weeks of deployment (early September).

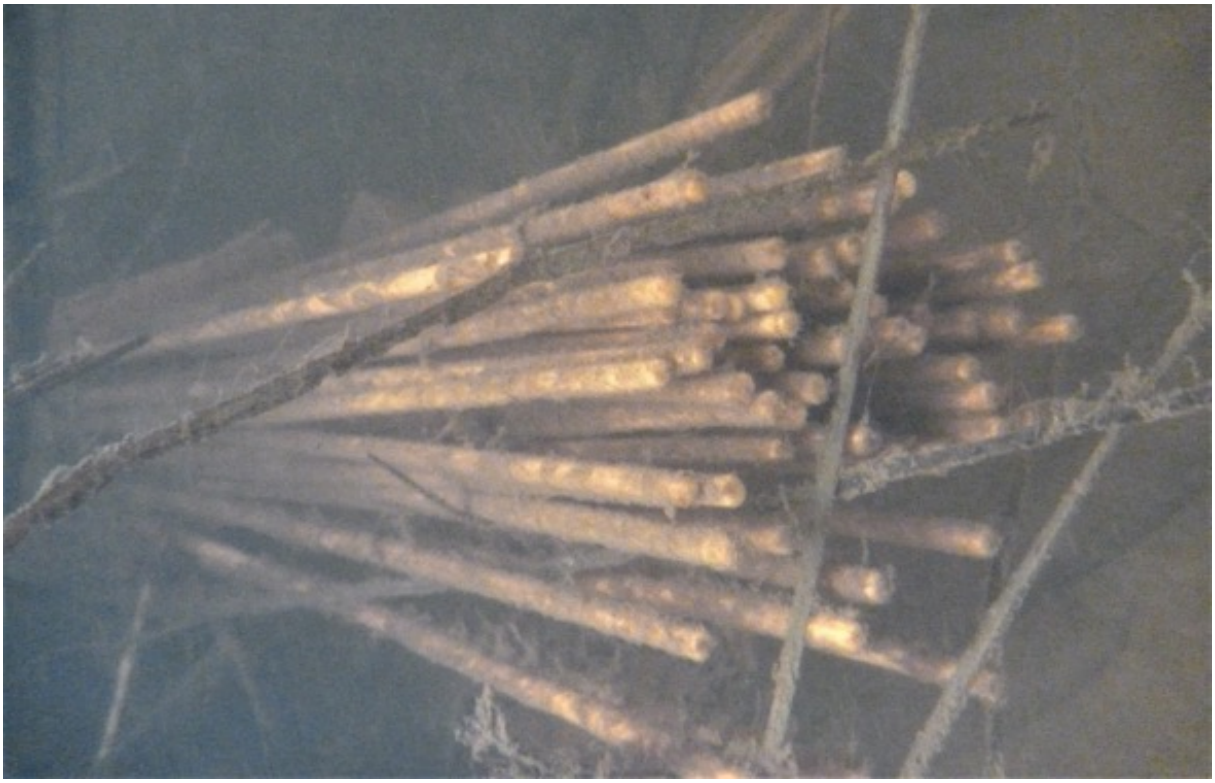


Figure 7 Type 3 ASU after 3 weeks of deployment.

To meet the C17(e) requirement for additional sampling following two wet weather events and following a possible fire event, additional ASUs will be kept aside to be deployed for up to six weeks following each wet weather event prior to recovery. Electro-fishing for wet weather events would be undertaken at the time of post wet weather ASU deployments, to test for changes in fish diversity and abundance that may have resulted from fish migrations during the flood period.

Preliminary metered water quality for the some of the lower pools in Wattle Creek during site selection field work in August-September 2022 indicated that bottom waters at the downstream site were more saline than surface waters; likely indicating groundwater upwelling into the creek:

- This stratification will be taken into account for initial Spring 2022 placement of ASUs by deploying two replicate sets (3 ASUs per set) at all Creek Downstream sites; one set tethered but floating (to sample the upper freshwater layer) and another set tethered to the pool bottom (to sample the more saline layer).
- There is no salinity layering for upstream sites so only one replicate set of three ASUs will be deployed tethered to the bottom at each site.
- Electro-fishing activities and all seasonal ASU sampling will include metered water column water quality sampling for the purposes of interpreting the macroinvertebrate and fish sampling results.

Processing of freshwater macroinvertebrate ASUs will be undertaken using the following procedures, as developed for the pilot study:

- Each replicate ASU is retrieved separately from the tethered weights and placed individually into labelled plastic bags and preserved in 70% ethanol.
- In the lab, sample contents are rinsed through a 0.5mm sieve and transferred to labelled sample jars prior to processing.
- Prior to processing and due to the large number of small (<1mm) midge fly (Chironomidae) larvae specimens, samples are rinsed through a 1mm sieve to reduce the processing time for retained macroinvertebrates. The rinse water contents are then inspected separately to retrieve any other (non-chironomid) taxa.
- All sample macroinvertebrate specimens are identified and counted in the laboratory using a Leica MZ95 binocular microscope.
- Organisms are identified (as a minimum) to the appropriate taxa level as per AusRivAS protocols. Most specimens were identified to Family (most invertebrate taxa), sub-Family (chironomids), sub-Order (water mites) or Class (freshwater worms and seed shrimps).

2.4 C18 Proposed Crookhaven Estuary Aquaculture Oyster Monitoring

Condition C18 requires an oyster monitoring program of environmental indicators and oyster condition in the Crookhaven River estuary, C18d specifies water quality monitoring at nominated oyster lease sites and C18e requires laboratory chemical analysis of lease oysters:

- Condition C18c specifies sampling of oysters at "high use and opportunistic leases as specified by Marine Pollution Research". Whilst the condition C18c does not specify the number of Curleys Bay high use and opportunistic leases, it does specify two leases each for the other (Control and Northern) locations, which implies sampling two high use and two opportunistic leases in Curleys Bay. Pairing of oyster lease sites to estuary monitoring sites resulted in 12 *possible* lease sites available for Oyster condition sampling (as shown in **Figure 2),** and **t**he Project pilot survey in October 2022 found that there was no suitable lease infrastructure for the two SEB potential lease sites and accordingly the remaining 10 lease sites shown on **Figure 2** will be utilised for meeting the Condition C18e oyster flesh chemical analysis requirements (see Table 2 and further Condition C18e discussion below).
- The Oyster Aquaculture water quality monitoring requirements of C18(c) have been integrated into the combined water quality sampling program, with sampling and other details provided in the companion Martens and Associates Baseline Water Quality Monitoring Plan, and, as per **Section 1.3** above, the C16c estuarine water quality sites, C17c,d seagrass ASU monitoring sites and the C18c oyster lease water quality monitoring sites have all been grouped together to provide more powerful statistical assessment ability

for integrated monitoring data. These water quality results will then be used for the interpretation of estuarine and freshwater monitoring results arising from this Aquatic Ecology Monitoring program.

Table 2 CoC C18 Oyster Lease Descriptions

Location	Site	Site Designation	Type
C1	Cup1	River Control Up W	Opportunistic
	Cup2	River Control Up E	High
BB	BB1	West Billys Bay W	High
	BB2	West Billys Bay E	High
SW	SW1	South West Bay W	Opportunistic
	SW2	South West Bay E	Opportunistic
SE	SE1	South East Bay W	piles only
	SE2	South East Bay E	piles only
N	N1	North Bay East	Opportunistic
	N2	North Bay West	High
C2	Cdn1	River Control Dn W	High
	Cdn2	River Control Dn E	High

In relation to oyster flesh chemical analysis monitoring, Condition C18e suggests that at least six cultivated oysters be collected from each lease for chemical analysis and if this cannot be achieved natural oysters from other substrates should be collected and analysed:

- As described in the EIS Aquatic Ecology Reports (MPR 2021, 2022) in regard to actual oyster farming practice in the Crookhaven River estuary, there is a low expectation of cultivate oysters actually being available on many of the Curleys Bay and upper river Harvest Area opportunistic leases, plus there are the confounding problems for impact assessment arising from not knowing how long cultivated oysters have been on any particular lease when collected, nor where they may have been located in the river prior to placement on the particular lease being sampled.
- Accordingly, the first bimonthly project pilot sampling period was utilised to determine wild oyster sample collection opportunities and oyster sample size for chemical analysis. The aim of the October 2022 pilot study was to collect six wild oysters from both the nominated lease infrastructure and from in-shore mangrove peg roots for submission to the nominated NATA registered chemical laboratory for the required C18e chemical analysis.
- The pilot study revealed the following limitations:
  - Many of the nominated opportunistic leases did not have sufficient infrastructure to yield sufficient wild oysters for the pilot study. For the upper Control Site and the two SE Bay sites there were no infrastructure oysters available for sampling.
  - The pilot study also indicated that wild oyster densities on some lease infrastructures were so low that the leases would be unlikely to provide sufficient wild oysters to allow for two-monthly repeat sampling over the 18-month sampling period.

- There was a very wide variation in oyster size on mangrove peg roots and to a lesser extent on lease infrastructure which would likely confound analysis results to the extent that actual sample sizes would need to be increased.
- The laboratory found that they could not undertake the required analyses on single oysters (as was first proposed) and, based on from their matching of actual submitted oysters from the pilot study to the analysis requirements for individual analyses, future analysis will require batches of between 6 (large) to 10 (small) oysters for each *E.coli* analysis and the same batch number will be required for the remaining combined metals, PAH and OC analysis.

Based on the limitations arising from the pilot study results, it is concluded that as there is little likelihood of being able to collect sufficient required oysters from lease infrastructure or from mangrove peg root sources to meet the Condition C18e requirement for chemical analysis. Accordingly it is concluded that the Condition C18e requirements will be best achieved by utilising a *biomonitoring program* approach using commercially cultivated Sydney Rock Oysters *Saccostrea glomerata* (SROs) obtained from Crookhaven River (see for example Scanes and Roach 1999, Robinson et al 2005 and Gall et al 2012 for NSW estuary biomonitoring for heavy metals using cultivated SROs, Idowu et al 2020 for NSW estuary biomonitoring for PAHs and Scanes 1996 for NSW SRO Organochlorine biomonitoring). Specifically, batches of commercially sourced SROs will be deployed at the 10 nominated leases for a period of up to six weeks within each two monthly monitoring period and will then be harvested and processed for submission to the project NATA registered laboratory for the required C18e analysis:

- For each two-monthly oyster bioaccumulation program, 30 commercially grown & large SROs of uniform size and weight will be required per lease (300 oysters total):
  - For each lease batch of 30 oysters, six will be selected at random and processed immediately for submission to the laboratory for determination of pre-deployment flesh heavy metal, PAH and OC concentrations.
  - The remaining 24 oysters per lease will be placed into standard floating oyster baskets tethered to the nominated lease locations and left for up to six weeks deployment in each two monthly monitoring period.
- Following the nominated deployment period, the oysters from each of the 10 sites will be harvested, with each lease batch placed on labelled bags and placed on ice for transport back to the Culburra laboratory then kept refrigerated for immediate processing.
  - In the lab, each lease batch of 24 oysters will be split into four separate sub-batches of 6 randomly selected oysters, each placed into labelled plastic bags:
  - Two of these *batches* will be nominated and labelled as two replicate samples for lab *E.coli* analysis and the other two batches will be nominated and labelled as two replicate samples for lab heavy metal (As, Cr, Cu, Hg, Pb, Se and Zinc), PAH and OC analysis.

- The following Condition Index measures will be made for all oysters in each of the four separate batches; individual shell length, un-shucked wet weight, shucked flesh wet weight and post shucking shell weight.
- The four batched sets of shucked oyster flesh per site will then be placed back and sealed in their labelled plastic bags and frozen for transport to the nominated chemical analysis laboratory.

Conditions C18(b) requires bimonthly sampling to include three wet weather sampling events for Crookhaven Estuary oyster monitoring. As oysters are filter feeders, they have a relatively fast response to changing water quality conditions and accordingly, if there is a significant wet weather event during any of the nominated two-monthly sampling events, sampling of the oysters subjected to the wet weather event will be left *in-situ* for a full week after the event has ceased and then harvested for analysis. This wet weather timing arrangement will override the normal dry weather timing arrangement for that particular bi-monthly biomonitoring event.

2.5 Reporting (Conditions C16f, C17f and C18f)

Conditions C16f, C17f and C18f all require a progress report when the final methodology for the baseline has been determined and approved by the ER and then requires progress reports at six monthly intervals to the end of the baseline period. The indicative timetable for reporting is provided in **Table 3** below and the relationship of the reporting to actual monitoring study timetabling is shown in **Table 5** in **Section 3** below.

Table 3 Project Reporting Requirements

Report	Requirements	Recipient(s)	Submission timeline
Monitoring Report	Draft Report for submission and approval for overall monitoring requirements.	Client and ER	Prior to monitoring program start date
Final Monitoring Report	Final Recommended Monitoring Report incorporating requirements from EA and adjustments arising from the first pilot monitoring study	Client and Environmental Representative (ER)	Following receipt of ER requests and comments and after preliminary pilot studies completed - mid October to early November 2022
Fist Six Monthly Reports	Document and analysis of results of the previous 6 months of monitoring. Document methodology appropriateness and justify any methodology changes during the period or required for on-going monitoring.	Client and Environmental Representative (ER)	Within 2 months after the first six months data acquisition.
Second - 12 Months Report	Document and analysis of results of the previous 6 months of monitoring. Analysis of data against previous 6 months data.	Client and Environmental Representative (ER)	Within 2 months after the second six months data acquisition.

	Provision of the 12 months data to date. Document methodology appropriateness and justify any methodology changes during the period or required for on-going monitoring.		
Third - 18 Months Report	Document and analysis of results of the previous 6 months of monitoring. Analysis of data against previous 12 months data. Provision of the 18 months data. Document methodology appropriateness and document plus justify any methodology changes during the period. Provide recommendations regarding the appropriateness of the monitoring program elements for Staged Construction Monitoring and/or make recommendations for amendments for Construction monitoring.	Client and Environmental Representative (ER)	Two months after the third six months data acquisition period.

Upon completion of the baseline period, a report will be prepared including methods, rigorous statistical analyses comparing temporal and spatial factors and recommendations for further work. The findings of the baseline will be presented to NSW DPI (Fisheries, NSW DPI, NSW EPA, and as part of the Community Engagement Strategy and made available on the Project website.

3 PROJECT TIMETABLE AND STAFFING

CoCs C17b and C18b set two monthly sampling timetables for both estuarine and oyster aquaculture sampling and C17e sets out seasonal (i.e., four monthly) aquatic ecology sample requirements for the Lake Wollumboola freshwater biota sampling. All sampling programs include post wet weather sampling requirements and/or post bush-fire sampling. COC C17f,g plus C18f specify similar reporting requirements for the Aquatic Ecology and Oyster Aquaculture monitoring programs. **Table 4** summarises monitoring requirements detailed in **Section 2**.

Table 4 Summary of Aquatic Ecology & Aquaculture Oyster Monitoring Program Sample Siting and Timing

Condition	Habitat/ Component	Locations	Sites	Sub-sites	Sample Events		
					Dry	Wet*	Fire*
Curleys Bay & Crookhaven Estuary Habitats							
C17b,c,d	Zonation & Heights	5	2	2	2	3	
C17b,c,d	Saltmarsh habitat	5	2	2	9	up to 3	
C17b,c,d	Mangrove habitat	5	2	2	9	up to 3	
C17b,c,d	Seagrass	5	2		9	up to 3	
Lake Wollumboola Catchment Creeks							
C17e	Macroinverts	3	2		6	2	1
C17e	Fish	3	2		6	2	1
Crookhaven River Oyster Aquaculture							
C18b,c,e	Oyster Chem	5	2		9	up to 3	
Note *	See detailed monitoring program for wet weather monitoring arrangements						

The total 18-month monitoring period requires six dry weather seasonal sampling events in Lk Wollumboola creeks plus nine bi-monthly dry weather sampling events in Crookhaven River Estuary with several of the dry-weather sampling events expected to meet the wet weather sampling criteria. **Table 5** (below) provides the proposed Aquatic Ecology project timetable for the first 12 months of sampling that incorporates all the proposed seasonal and bi-monthly sampling plus reporting time-tabling details based around a regularly spaced sampling program, on the assumption that several of the regular sampling programs will meet the post-wet weather monitoring requirements and/or post-bushfire monitoring requirements and that other wet weather sampling requirements can be slotted into non-regular sampling periods where and if required.

The complete program indicates that for each ten-week period there will be a requirement for six weeks field and laboratory work and 4 weeks data reduction and data entry over the full 18-month period. Staffing estimates indicate that each six-week field period will require 2 persons for at least two weeks for field work and one person for four weeks to undertake data reduction and data entry over the full 18-month period. These persons will be field staff with a minimum BSc aquatic ecology degree requirement. Production of required preliminary pre-start report, two data reports plus post-program final reporting will require a mix of the full-time project field person plus more senior MPR staff for analysis, statistical analysis and reporting.

Table 4 Field Samping and Reporting Schematic Months 1 to 12.

Project month	Pre-start	1	2	3	4	5	6	7	8	9	10	11	12
Start Annual week	36 38	40 42	44 46	49 51	1 3								
Month	Sep	October	November	December	January	February	March	April	May	June	July	August	September
Seasonal FW sampling	Winter	Spring		Summer.				Autumn		Winter			Spring
Pilot studies	FW ASUs pilot study												
FW ASUs (6-7 weeks)		Wk 42 in											
FW Electro Fish													
2 Wet Weather ASUs & 2 Wet Electro Fish					To be deployed as required as req								
Bi-monthly Est sampling		Months 1 & 2		Months 3 & 4		Months 5 & 6		Months 7 & 8		Months 9 & 10		Months 11 & 12	
Pilot studies													
Start I/T Transect Hts		Set ladder transects & zone limits				Survey in transects & zone limits							
Post Wet I/T transect Hts (3)								as req					
I/T Point intercept measures													
I/T Zone quadrat measures													
Oysters In and Out		Pilot Study		In	Out	In	Out	In	Out	In	Out	In	Out
Seagrass ASUs (6 wks)	ASUs pilot study	Wk 42 in											
Reporting periods	Sep	October	November	December	January	February	March	April	May	June	July	August	September
Draft Monitoring Program	Draft to EA												
Final Monitoring Program		Post Pilot Study Final to EA											
First 6 Month Progress		Data Acquisition/Analysis		Data Acquisition/Analysis		Data Acquisition/Analysis		Prepare 6 month Report					
12 Months Progress								Data Acquisition/Analysis		Data Acquisition/Analysis		Data Acquisition/Analysis	

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ANNEXURE A

COC C16(a) C17(a) & C18(a) ENDORSED INDEPENDENT EXPERTS

Paul Anink CV and Capability Document

Shoalhaven City Council Endorsement Letter

CURRICULUM VITAE PAUL JOHN ANINK

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Date of Birth	22 December 1946
Nationality	Australian
Place of Birth	Amsterdam, Netherlands
Tertiary Qualifications	Electronics & Communications Certificate 1969 B.Sc.(Invertebrate Zoology) University of NSW. 1974 M.Sc. (Prelim), University of Sydney. 1980
Other Qualifications	Australian Seagoing Masters Certificate (Master V) Australian Commercial Diving Certificate (SCUBA & SS)
Languages	Fluent in English and Dutch
Present Position	Managing Director Marine Pollution Research Pty Ltd
Australian Experience	Marine, Estuarine and Freshwater Aquatic Studies in NSW and along the Australian East Coast – range Adelaide SA, plus NSW and Queensland from Eden to Cairns.
Overseas Experience	Netherlands, Greece

Relevant Experience Paul Anink is an aquatic ecologist specialising in the investigation of marine and freshwater aquatic ecosystems. Paul Anink has more than thirty-five years' experience in the fields of water pollution and environmental studies, gained whilst undertaking and managing marine and freshwater aquatic environmental research at James

Cook University, North Queensland, NSW State Pollution Control Commission (now NSW Environment Protection Authority) and Marine Pollution Research Pty Ltd (MPR). Paul is Managing Director of MPR, an NSW-based aquatic environmental consultancy, which he formed in June 1988.

Paul Anink has a broad practical expertise plus extensive consulting and management experience in the fields of marine and freshwater aquatic biological environmental sciences and has specialised in studying the effects of developments and of water borne pollutants on near-shore marine, estuarine and riverine ecosystems, in a range of tropical to temperate environments. Paul Anink has produced an extensive list of report publications covering marine and freshwater biological environments, pollution assessment and control, environmental impact assessment and planning.

MPR Maritime Project Experience

With regard to marine development projects Paul has provided specialist aquatic ecology plus water quality investigations and environmental project co-ordination for large scale marine developments over 35 years including the Sydney Harbour Tunnel construction project, Sydney's Deep Water Ocean Outfall project, Sydney Harbour Ferry Wharf upgrade project, Queensland Gold Coast Side Casting Sand and Beach Nourishment Project, Sydney Airport Expansion (Third Runway project), Sydney (Botany Bay) Port Expansion (several projects), Ausgrid Botany Bay Cable Project Dredging and Cable Laying, several Port Kembla Expansion Projects, and numerous housing and recreational developments on coastal rivers and coastal foreshores in NSW and southern Queensland.

Paul has been undertaking specialist Introduced Marine Species (IMS) Investigations for Vessels (Dredgers, Cranes, Cable Laying Barges and other plant and equipment coming to Botany Bay for both Port Expansion and Ausgrid Cable Projects, with vessel inspections undertaken in Queensland, Victoria, West Australia and offshore Sydney. MPR also provided specialist marine ecological services for monitoring of *Posidonia* seagrass recovery and rock rubble armour colonisation for the recently completed Ausgrid high tension underwater cable project across Botany Bay (Kurnell to La Perouse).

Paul undertakes impact assessments for new or upgrade marinas in Port Hacking, Georges River, Sydney Harbour, Pittwater, Brisbane Waters, Hawkesbury River and south plus central coast lakes with marina projects from Twofold Bay (Eden) to Burnett Heads (Queensland). with Paul ataged pre- and post-construction monitoring studies at Trinity Point, Lake Macquarie. For the Shellharbour Marina proposal Paul also undertook a three-year pilot study for establishing saltmarsh communities as an ecological offset for loss of degraded saltmarsh to the marina construction, then supervised construction and monitored the success of *de novo*

offset saltmarsh habitat construction over a further three years. Paul is currently supervising pre- to during-construction marine waters water quality and aquatic ecology monitoring studies for the Sydney Superyacht, Shell Cove and Trinity Point Marinas.

MPR has been undertaking aquatic ecology impact assessments for the RMS/TfNSW Sydney Ferry Wharf Upgrade Project for wharves between Parramatta and Manly since 2010; Pack 1 Stage 1 wharves 2010 to 2012, Stage 2 wharves 2013 to 2015 and Pack 2 Tranche 1 wharves 2015 to 2016), with additional specialist pre-and post -construction monitoring for ferry wharf demolition/construction through 2016 and 2017. Paul also undertook the aquatic ecology impact studies for the Barangaroo Ferry Interchange and provided a Constraints and Opportunities Report for Ferry Wharf options in Botany Bay.
Paul also complied an Aquatic Ecology Risk Assessment REF for the RMS public wharf maintenance program in Sydney Harbour (in 2015) and now undertakes regular specialist pre- and post-maintenance monitoring as required under the 2015 REF Aquatic Ecology Risk Assessment Matrix. Currently Paul is assisting RMS with approvals for pile maintenance works at Manly Wharf in relation to the protection of nesting Little Penguins at the Wharf.

MPR is also undertaking aquatic ecology impact assessment studies for wharf, jetty and seawall demolition and refurbishment projects throughout Sydney Harbour, with recently completed surveys or pre- to post construction monitoring at Goat Island, Berrys Bay, Glebe Island, Jones Bay, West Balmain, Mosman Bay, Watsons Bay, Darling Pont and King Street Darling Harbour and Walsh Bay. A number of these studies (including the Ferry Wharf replacement project) have involved the requirements for our specialist services to capture and relocate Syngnathid fish (seahorses and pipe fish), undertaken by MPR staff under Paul's supervision. Many of these studies also require our specialist services to design and undertake estuarine or marina water and sediment monitoring programs with recent or on-going projects in Rozelle Bay, Neutral Bay and Pittwater.

Paul has extensive experience in the production of Aquatic CEMPs and OEMPs relating to major marine infrastructure projects (most recently for the Ausgrid Botany Bay Cable Project and Trinity Point Marina construction), with experience in developing water, sediment and aquatic ecology monitoring programs, and compiling management plans. As an example, the Ausgrid Botany Bay Cable Project required the following Management Plans (MPs) that were compiled by Paul and MPR; Marine Mammal MP, *Caulerpa taxifolia* MP, Service Vessel MP, Cable Laying Barge Anchor MP (all for protection of rocky reefs at La Perouse and Watts Reef off Kurnell and of seagrass beds plus in-shore reefs off Kurnell), a Seagrass EMP, an Introduced Marine Species (IMS) MP, an Horizontal Directional Drilling HDD MP (for rocky reef at La Perouse). Aquatic CEMPs and OEMPs are also routinely prepared for most marine projects, from private jetty proposals through to major wharf refurbishment projects.

In relation to the West Culburra Project Paul provided expert opinion, and MPR undertook additional Modified EIS studies and Section 34 reporting for the Concept Plan housing development refusal - June 2019 and subsequently approved late 2021.

Paul also provides expert witness evidence for development application refusals or objections in the Land & Environment Court (LEC), appears for both prosecution or defence for water pollution or aquatic ecological impact related charges in the LEC. Paul also acts as a Court Appointed expert for the LEC. For example, he assessed the combined environmental impacts and proposed marine ecological offsets of proposed pearl oyster aquaculture on the marine environments of Post Stephens, including in particular impacts on local seagrass beds and impact on marine mammals and reptiles, with an emphasis on resident dolphin populations.

Paul and MPR also have extensive experience in relation to oyster and shellfish aquaculture projects with mussel farming proposals and approvals for Jervis Bay, and research plus investigations associated with oyster farmer Permit variation requests to enable mixed Sydney Rock plus Pacific Oyster Growing permits in the following estuaries; Tweed. Richmond and Manning Rivers plus Wallis Lakes to the north, Hawkesbury River and Botany Bay for metropolitan estuaries, Shoalhaven River, Clyde River plus Merimbula and Wapengo Lakes to the south.

MPR Freshwater Ecology Expertise

MPR undertakes integrated freshwater fish and macroinvertebrate aquatic ecology surveys and water quality environmental assessments in NSW river catchments for a wide and diverse range of projects including:

- Establishment of an integrated water and aquatic ecology monitoring program to guide the river freshwater rehabilitation program for the Karuah River Catchment Management Committee.
- Detailed aquatic habitat rehabilitation and management plans for urban rivers and streams in relation to housing and sub-division development proposals (e.g. Sydney north west and south west growth areas) with recent studies in Catherine Hill Bay (2019), and three Nepean-River based projects at Cranebrook, Oakdale and South Windsor (also 2019).
- MPR provided freshwater aquatic ecology assessments for the West Culburra proposed land sub-divisions in the Crookhaven River and the Lake Wollumboola catchments (2019 to 2021.
- Monitoring, environmental assessment for mineral mining proposals and operations (Coxs and Yass River systems).
- Road plus rail bridge development proposals (Tweed, Orara, Bellingen, Hunter,

Nepean Rivers, Murray River and various south coast freshwater streams).

- Water supply and dam refurbishment developments (Orara and Bellinger Rivers, and the Barwon River at Walgett),
- Land and Environment Court related fish and aquatic habitat monitoring and reporting (Lachlan, Peel, Tweed, Hunter, Karuah, Nepean, Hacking, Goulburn, Parramatta and Murrumbidgee River catchments, plus various NSW south coastal draining streams in 2019 to 2022, with additional court-related habitat assessments in Victoria (Castlemaine 2019). Court-related studies included specialist investigations for proposed sand mining expansion on Nepean River in relation to river aquatic ecology and possible occurrence of Sydney Hawke Dragonfly (2019). That study found and expanded the known range plus habitat descriptions for the listed Sydney Hawke Dragonfly.
- In 2001 Paul Anink, Principal Aquatic Ecologist of MPR, was the author of the aquatic ecology monitoring program and the senior editor for the Illawarra Coal Integrated Environmental Management Plan (IEMP) prepared for DPI (Minerals) to meet monitoring obligations for monitoring of long-wall mining impacts (initially Elouera and Dendrobium Stage 3 mines) under Sydney Catchment Authority (SCA) lands in the Illawarra. MPR implemented the IEMP aquatic ecological monitoring program for the two BHP mines and subsequently adopted the IEMP for monitoring study design for coal mining projects in the Hunter, Newcastle and Western Coal regions, many still under way in 2020). The IEMP has been subsequently adopted as the basis for most mining aquatic ecology (streamhealth) monitoring programs in NSW.
- MPR undertook both the original and present (approved) aquatic ecology impact assessments for the Award-winning Bowmans Creek Diversion project ((Hunter River, 2001 and 2010), has assessed the construction phase and is now evaluating the post-construction Bowmans Creek fish and aquatic ecology habitat development. The project also resulted in a publication on design requirements for large woody structures in creek-line rehabilitation (Gipple & Anink 2012).
- MPR undertook integrated impact assessment for Berrima Coal on Wingecarribee River that included fish and macroinvertebrate aquatic ecology surveys, ecotoxicology, stygofauna and pollution fate assessments (in sediments and biota – fish and macroinvertebrates) in relation to several appeals in the Land and Environment Court.
- Long-term monitoring of stream ecosystem water quality and stream-health response to integrated land release and development in the Narrabeen Lagoon Warriewood Land Release catchment (underway since 2002).
- Specialist investigations of proposed house development in relation to protection of the endangered Fitzroy Crayfish (Wildes Meadow, Fitzroy Falls, 2019).
- Specialist investigations for Sydney Water of proposed Picton Waste water disposal to the Nepean River in relation to protection of the endangered Sydney Hawk Dragonfly (2020 and on-going).

Shoalhaven City Council

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Council Reference: 3A10/1003 (D22/186812)
Your Reference:

06/05/2022

By email only: mattphilpott@allenprice.com.au

Dear Mr Philpott,

West Culburra Concept Proposal – State Approved Development (SSD 3846)
Part Lots 5 & 6 DP 1065111, Culburra Rd, Culburra Beach
Conditions of Development Consent – C16(a), C17(a) and C18(a)

Reference is made to your letter requesting Council's endorsement of the independent expert in response to conditions of development consent.

Condition C16(a) states:

> *Receiving Water Quality*
>
> *C16. Prior to construction of any stage of the Concept Proposal, the Applicant must prepare a water quality monitoring program for baseline monitoring, construction monitoring and post-construction monitoring of surface waters in the Crookhaven River estuary and in the catchment of Lake Wollumboola and sections of lake fringe at appropriate locations. The program must:*
>
> *(a) be designed by a suitably qualified and experienced independent expert, whose appointment has been endorsed by the Council;…..*

Condition C17(a) states:

> *Aquatic Ecology*
>
> *C17. Prior to construction of any stage of the Concept Proposal, the Applicant must prepare an aquatic ecology monitoring program for baseline monitoring, construction monitoring and post-construction monitoring of aquatic ecology in the Crookhaven River estuary and in the catchment of Lake Wollumboola and sections of lake fringe at appropriate locations. The program must:*
>
> *(a) be designed by a suitably qualified and experienced independent expert, whose appointment has been endorsed by the Council; ….*

Condition C18(a) states:

> *Oyster Aquaculture*
>
> *C18. Prior to construction of any stage of the Concept Proposal, the Applicant must prepare an oyster monitoring program for baseline monitoring, construction monitoring and post-construction monitoring of environmental indicators and oyster condition around selected oyster leases in the Crookhaven River estuary. The program must:*

(a) be designed by a suitably qualified and experienced independent expert, whose appointment has been endorsed by the Council; …..

The conditions require the preparation of certain programs and monitoring prior to any stage of construction. As it stands, the Development Applications for the various stages have not been lodged. These are yet to be lodged, assessed and determined. Thereafter the Subdivision Works Certificates can be issued, assuming all is in order.

We understand that it may take some time to develop the programs required by the concept approval and the consent requires monitoring no less than 18 months (oysters) prior to the commencement of construction.

It should be noted that whilst the condition contains specific requirements for the programs and monitoring, it is possible that the subsequent consents *may* raise other issues impacting on these programs and monitoring regimes.

With respect to your nominated independent experts (having regard to the definition of expert contained in the Development Consent), being Paul Anink from Marine Pollution Research Pty Limited and Dr Daniel Martens from Martens and Associates Pty Limited, Council does not object and endorses the appointment of the experts Mr Paul Anink and Dr Daniel Martins.

Thank you for writing to us. If you have any further enquiries, please contact Cathy Bern on 4429 3111 citing, 3A10/1003.

Yours faithfully

Cathy Bern
Development Services Manager