

Realty Realizations Pty Ltd



Water Quality Monitoring Plan – Mixed Use Subdivision, West Culburra, NSW

ENVIRONMENTAL



WATER



WASTEWATER



GEOTECHNICAL



CIVIL



PROJECT
MANAGEMENT



P1203365JR03V02
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1 Introduction

1.1 Overview

This Water Quality Monitoring Plan (WQMP) has been developed to support a project Concept Application to the NSW Department of Planning and Infrastructure (DoPI), for a mixed use subdivision at Lot 61 DP 755971, and parts of Lots 5, 6 and 7 DP 1065111, Culburra Road, West Culburra, NSW.

1.2 Document Production Overview

This document been developed based on agency comments (June 21, 2013), particularly NSW Fisheries and NSW Office of Environment and Heritage (OEH).

A stakeholder consultation meeting was held on August 13, 2013 and attended by:

- Local oyster farmers
- Australia's Oyster Coast Inc.
- NSW Food Authority
- Southern Rivers Catchment Management Authority (CMA)
- Shoalhaven Water
- Shoalhaven City Council (SCC)
- NSW Environmental Protection Authority (EPA)
- NSW Fisheries
- The applicant and their consultants: Martens and Associates, and Allen Price and Associates.

The purpose of the meeting was to discuss stakeholder recommendations relating to monitoring of potential water quality impacts of the proposed development and specifically on the health of the estuary and aquaculture industry. It was resolved that a working group would subsequently meet to facilitate further stakeholder comment and input into various aspects of the proposed development including the preparation of this WQMP.

Further to that meeting a draft of this document was circulated to stakeholders by Australia's Oyster Coast Inc and a subsequent stakeholders meeting held on September 12. At that meeting additional stakeholder feedback was obtained and this monitoring program was amended to address stakeholder feedback.

1.3 Scope

The monitoring plan has been developed to address agency comments to the project EA submission and stakeholders expectation. Specifically it shall:

- Document the proposed water quality monitoring elements that make up the proposed monitoring plan.
- Provide a monitoring schedule for each element pre, during and post construction.
- Outline monitoring contingency plan and routine program review.
- Provide a Sediment and Erosion Control Plan (SECP) to manage impacts of construction on sensitive environmental receptors.

1.4 Proposed Development

The proposed development includes the following:

- Residential (including Torrens title lots, townhouses and 3-5 storey multiunit development)
- Commercial
- Industrial
- Tourist accommodation
- Retirement village
- Open space

1.5 Reference Documents

This document has been prepared in accordance, and should be read in conjunction with:

- SEPP 62 (2011) *Sustainable Aquaculture*
- NSW DPI (2006) *NSW Oyster Industry Sustainable Aquaculture Strategy* (OISAS)
- Martens and Associates (October, 2013) *Water Cycle Management Report* (Ref: P1203365JR01V04)

1.6 Development Description

The development is located on the northern side of Culburra Road, West Culburra, within the Shoalhaven City Council local government area (LGA) on lots:

- Lot 61 DP 755971
- Part Lot 5 DP 1065111
- Part Lot 6 DP 1065111
- Part Lot 7 DP 1065111

The 109 ha site consists of undeveloped vegetated land and some agricultural areas in Lot 5 DP 1065111 and Lot 61 DP 755971 (Figure 1, Attachment A).

A detailed site description is provided in the *Water Cycle Management Report* (Martens and Associates, 2013).

1.7 Sensitive Environmental Receptors

Water quality impacts arising from the proposed development has the potential to affect the following sensitive environmental receptors:

- Oyster leases (Attachment B).
- Groundwater.
- Crookhaven estuarine environment including: SEPP 14 Wetlands; mangroves; riparian vegetation; and seagrass.

This WQMP has been developed to ensure the ongoing health of these receivers through the construction and operation of the proposed development.

2 Water Quality Monitoring Plan

2.1 Overview

The following sections outline the procedures and protocols for water quality monitoring of identified monitoring elements. It provides contingencies should results not comply with monitoring objectives and outlines program review to ensure this document remains relevant with best industry practice.

2.2 Monitoring Elements

Due to the high variability of stormwater quality, direct sampling and testing of runoff from the site is not recommended as the sole method of site monitoring. The following key monitoring elements are recommended to be monitored as part of a long-term program at the site:

1. Groundwater quality
2. Estuary water quality
3. Shellfish monitoring
4. Stormwater quality improvement device (SQID) operation/integrity monitoring
5. Secondary indicator monitoring

The proposed monitoring regime for each element is discussed in the following sections.

2.3 Groundwater Monitoring

Groundwater monitoring shall be completed from 4 wells as shown in Attachment C. Note 'GW1' and 'GW3' are existing wells installed by Martens and Associates in 2011 that may, depending on condition and final location of stormwater treatment devices, be utilised for on-going monitoring. Where required wells shall be installed by hand to protect surrounding sensitive environment.

Groundwater monitoring shall include continuous water level recording through data loggers and be tested 3-monthly at each location including:

- Record groundwater level.
- Collection of groundwater samples for laboratory analysis of:
 - pH
 - Electrical conductivity
 - Temperature
 - Salinity
 - Dissolved oxygen
 - Nitrogen suite (including total kjeldahl nitrogen (TKN), ammonia and oxidised nitrogen (NO_x))
 - Total phosphorus (TP)

The monitoring shall commence no later than 12 months prior to construction works and continue throughout the duration of construction works. Once construction is complete, site performance monitoring shall continue for 3 years and cease only once results are acceptable.

2.4 Estuary Water Quality Monitoring

2.4.1 Overview

Estuary water quality monitoring is designed to fulfil monitoring requirements from a human health, oyster health and estuarine environment health perspective. It has been designed to complement and build on existing monitoring completed by SCC and local oyster farmers as required by SCC and the NSW Food Authority.

2.4.2 Existing Monitoring

Water quality within the Crookhaven estuary is routinely tested by local oyster farmers as part of industry requirements. As shown in Attachment A (Figure 2) a number of these sampling locations are in the general proximity of the site. Food Authority advises the following water sampling and testing regime is completed in the vicinity of the site as part of the Shellfish Quality Assurance Program (SQAP):

- Location '9' and '10':
 - Salinity
 - Temperature
 - Faecal Coliforms

Samples are collected following rainfall events of > 20mm in 24 hours (minimum 5 per annum) and in the event of a sewage spill from the adjacent Shoalhaven Water STP and pump stations.

- Location '35':
 - Phytoplankton - analysed fortnightly.
- Each oyster harvest/lease area (OL 76/092, OL 89/045, OL 67/287, OL 84/105):
 - Biotoxins – monthly. In the event of an algal bloom this increases to weekly.
 - Turbidity
 - pH -

Additionally, water sampling is completed routinely by SCC at sites '454', '455' and '456' (Figure 3, Attachment A) for:

- Dissolved oxygen
- Faecal coliforms
- Total phosphorus
- Total Nitrogen

2.4.3 Proposed Monitoring

Based on recommendations provided by NSW Food Authority and NSW OEH, the proposed development will require an additional:

- 3 water sample sites ('WQ1', 'WQ2', 'WQ3' shown in Attachment C) as for Location 9 and 10.
- 1 water sample site ('WQ4') immediately west of Cactus Point to complement existing Council monitoring sites (Attachment C). Samples shall be tested for parameters that provide an indication of estuary health and water quality including:
 - pH
 - Electrical conductivity (EC)
 - Total suspended solids (TSS)
 - Total nitrogen (TN)
 - Ammonia
 - Oxidised nitrogen (NO_x)
 - Total phosphorus (TP)
 - Chlorophyll a
 - Turbidity
 - Orthophosphate
 - Salinity
 - Temperature
 - Dissolved Oxygen
 - Faecal coliforms

As recommended by OEH monitoring from this site shall be monthly.

The following recommendations are made in relation to proposed additional water quality monitoring:

- Sampling is to be completed by a party approved by the Minister of DoPI in consultation with stakeholders.
- Monitoring to commence no less than 12 months prior to commencement of site works to establish baseline data.
- At least 2 rainfall events resulting in runoff from the site ('adverse conditions') shall be monitored prior to commencement of construction works.
- Water sampling and analysis of chlorophyll a and turbidity shall be completed in accordance with NSW OEH (2013) '*Assessing Estuary Ecosystem Health: Sampling, data analysis and reporting protocols*'.
- Analysis of all results should be completed in a statistically appropriate manner allowing determination of any impacts of the development.
- Monitoring shall be completed throughout the construction period and for 3 after completion of the development. After this, the sampling regime should be revised and adapted as required.

2.5 Shellfish Monitoring

2.5.1 Existing Monitoring

Oysters within the Crookhaven estuary are also routinely tested by NSW Food Authority as part of SQAP requirements. As shown in Attachment A (Figure 2) 4 sampling locations (Site 25: OL 76/092 and OL 89/045; Site 23: OL 67/287 and OL 84/105) are in close proximity to the site. According to NSW Food Authority, the following testing regime is completed at each location:

- Shellfish are tested for E.Coli following rainfall events of > 20mm in 24 hours (minimum 5 per annum) and in the event of sewage spill.
- Shell fish are tested for trace levels of heavy metals, pesticides, persistent pollutants (DDT, Aldrin, etc), PAH's and PCB's on approximately a three yearly basis. Monitoring was last completed in 2011 and is planned for 2014. Monitoring completed in 2011 was for the following parameters with stated practical quantification limits (PQLs):

- Aluminium – Target PQL = 0.2mg/kg
- Arsenic – Target PQL = 0.4 mg/kg
- Cadmium – Target PQL = 0.05 mg/kg
- Copper – Target PQL = 0.05 mg/kg
- Lead – Target PQL = 0.15 mg/kg
- Mercury – Target PQL = 0.01 mg/kg
- Selenium – Target PQL = 0.5 mg/kg
- Zinc - Target PQL = 0.2 mg/kg
- Organochlorine & Organophosphate Pesticides Target PQL = 0.1 mg/kg
- PCB's – Target PQL = 0.01 mg/kg
- PAH's – Target PQL = 0.01 mg/kg

2.5.2 Proposed Monitoring

Based on recommendations provided by NSW Food Authority, following the proposed development the following additional monitoring is required:

- Shellfish E.Coli sample site. The proposed sample site location (SF1) is provided in Attachment C.
- Monitoring of heavy metals , pesticides, PCBs and PAHs at an additional location adjacent to the development (location to be confirmed by NSW Food Authority at time of testing)

The following recommendations are made in relation to additional shellfish monitoring for E. Coli:

- Shellfish sampling is to be completed by a party approved by the Minister of DoPI in consultation with relevant oyster farmers.
- Sampling is to commence no less than 12 months prior to commencement of site works and continue throughout the construction period.
- Once the development is complete, monitoring shall continue for a period of 3 years. After this, the sampling regime should be revised and adapted as required.

The following recommendations are made in relation to additional shellfish monitoring for heavy metals etc:

- Shellfish sampling is to be completed by NSW Food Authority.
- Sampling is to be completed in conjunction with NSW Food Authority local testing program on approximately 3 yearly cycle.
- Once the development is complete, monitoring shall continue for a period of 3 years. After this, the sampling regime should be revised and adapted as required.

2.6 SQID Monitoring

A SQID Management Plan is to be prepared by a suitably qualified professional at Construction Certificate stage. It shall ensure that treatment measures required as part of the site stormwater management system (Martens and Associates, 2013) continue to provide sufficient treatment to site stormwater runoff such that the development continues to comply with water quality objectives, SEPP 62 and OISAS. The Plan should include:

- Inspection and maintenance of SQIDs in accordance with Table 1.
- SQID inspection and maintenance schedule.
- Periodic maintenance of site landscaped areas including management of vegetation, walkways, removal of litter etc.
- Periodic maintenance of 7(a) buffer and foreshore area.

Table 1: SQUID Monitoring and Maintenance.

Element	Inspection/Monitoring Frequency	Action	Notes
Basin/wetlands/bioretention swales	6 monthly	<ul style="list-style-type: none"> o Note any sediment accumulation and remove to ensure basin invert remains at original design level o Check for debris (e.g litter, bark, mulch and leaf) build-up and remove. o Remove any dead/dying vegetation and replace as required. o Remove any weeds in and around basin. o If basin infiltration rates have declined remediate basin base as per advice from civil engineer. 	Basin operation to be certified every 5 years by hydraulic engineer.
GPT/Enviropods	Monthly	<ul style="list-style-type: none"> o Check for litter/debris/sediment accumulation within pits; in GPT and at GPT outlet and remove as required. o Note weight of pollutants captured in trash basket system in GPT. 	<p>To comply with manufacturers specifications.</p> <p>Review after 12 months operation and modify frequency if appropriate.</p>
Outlet Structures	6 monthly	<ul style="list-style-type: none"> o Check for signs of erosion. o Check for evidence of litter/sediment accumulation at outlet. o Remediate erosion as required and as per engineer's direction. This may require additional rock armouring/revegetation. o Remove any accumulated sediment/litter at outlet. 	To be confirmed at detailed design stage when outlet structures are confirmed.

2.7 Secondary Indicator Monitoring

Secondary indicator monitoring is recommended to assist in documenting changes in the local environment over time and subsequently provide an indication if water quality impacts are arising as a result of the development. Given the high variability in stormwater monitoring results between and during storm flow events, secondary indicators are considered effective means of supporting estuary water quality and shellfish sampling in assessing water quality conditions.

During construction, the following shall be undertaken on a 3-monthly basis:

- A weed/exotic species survey in the vicinity of:
 - Bioretention basins and constructed wetlands.
 - Outlet structures.
 - Within the mangroves, particularly at discharge points.

The presence of weeds is an indicator of elevated levels of nutrients and environmental disturbance. Where identified weed management should be undertaken by an appropriately qualified professional.

- Any areas of scour and erosion in the following locations should be noted then rectified:
 - SQID inlets.
 - SQID outlets.
 - Discharge points into mangroves and seagrass areas.

Scour/erosion points indicate flows in the area are not being dissipated effectively, which may result in riparian quality and/or water quality impacts. The presence and extent of erosion and scour should be noted on a site plan and remediated as required. Remediation may include revegetation, placement of rip-rap or re-design of outlet structures.

- Any observed sediment plumes or areas of increased sediment deposition in the following locations should be noted:
 - Basin/constructed wetland outlets.
 - Discharge points.
 - Within the mangroves and seagrass.

Increased sedimentation may be an indicator of upstream erosion or SQID failure. Sediment plumes/deposits should be noted on a site plan and field measurements (such as area, depth and volume) made. Site contractor should organise inspection of SQIDs and outlet structures to determine the cause of sedimentation/source of sediments and remediation (if required) by an appropriately qualified professional.

If required, the stormwater management system may need to be revised to improve sediment removal or dispersion of flows (as relevant).

- Note the overall health of foreshore environments including riparian vegetation, seagrass, mangrove vegetation and SEPP 14 Wetlands. Any dying/dead vegetation should be noted and mapped. If extent of dying/dead vegetation increases over a 6 month period an additional water quality sampling round should be completed in the area. Sampling shall follow the regime as for WQ4, outlined in Section 2.4.3. If required, the stormwater management system may need to be revised to improve the quality of water released into receiving environments.
- To support the 3-monthly inspections photographs should be taken at designated photo points (Attachment C) to assist in quantifying any noted impacts.

Secondary indicator monitoring shall commence 12 months prior to construction works commencing and continue throughout the duration of construction works. Once complete, monitoring shall continue for a further 12 months and then be revised and adapted as required.

2.8 Monitoring Schedule Summary

Proposed monitoring recommended as part of the proposed development is summarised in Table 2.

Table 2: Proposed monitoring summary.

Element	Parameters	Locations	Monitoring Interval	Responsibility
Groundwater	pH, EC, Temperature, Salinity, DO, TN, TKN, Ammonia, NOx, TP	GW1, GW2, GW3, GW4 as per Attachment C.	3-monthly starting 12 months prior to construction and continuing for 3 years (minimum) after completion.	All works to be undertaken by a specialist approved by the Minister of DoPI in consultation with stakeholders. Site developer shall be responsible for funding.
Estuary Water Quality	Faecal Coliforms	WQ1, WQ2, WQ3 as per Attachment C.	Following a rainfall event of > 20mm in 24 hours (minimum 5 per annum) and in the event of a sewage spill. Start 12 months prior to construction and continuing for 3 years (minimum) after completion	
	pH, EC, TSS, TN, TKN, Ammonia, NOx, TP, Chlorophyll a, Turbidity, Orthophosphate, Salinity, Temperature, DO, Faecal Coliforms	WQ4 as per Attachment C.	Monthly starting 12 months prior (and including 2 adverse conditions sampling events) to construction and continuing for 3 years (minimum) after completion.	
Shellfish	E Coli	SF1 as per Attachment C.	Following a rainfall event of > 20mm in 24 hours (minimum 5 per annum) and in the event of a sewage spill. Start 12 months prior to construction and continuing for 3 years (minimum) after completion.	
	Heavy metals, pesticides, PCBs and PAHS	One laboratory samples location of collection determined by NSW Food Authority	Approximately 3 yearly.	
SQID	As per SQID Management Plan to be prepared at Construction Certificate Stage.			
Secondary Indicator	Weed/exotic species extent	Bioretention basins, constructed wetlands, outlet structures, mangroves	3 monthly starting 12 months prior to construction and continuing for 1 year (minimum) after completion.	
	Erosion and scour	Basin/constructed wetland inlets and outlets, discharge points into mangroves and seagrass	Secondary indicator monitoring to be supported by photographs taken at designated photo points (Attachment C).	
	Sediment plumes	Basin/constructed wetland outlets, discharge points, within the mangroves and seagrass		
	Foreshore health	All of the above		

2.9 Reporting

It is recommended that the results of water quality monitoring be documented in 6-monthly report (starting on commencement of construction works). Report to be provided to NSW DoPI, NSW OEH and NSW Food Authority. Documentation shall be prepared by a professional approved by the Minister of DoPI in consultation with stakeholders. Report shall include:

- Results of all water quality monitoring completed within the 6 months.
- A comparison of water quality results with collected baseline and past monitoring data.
- Summary of weather conditions, including rainfall, during the reporting period.
- Outline of any remediation works completed within the reporting period (e.g. modifications to SQIDs, revegetation works).
- Documentation of any contamination events (e.g. spills, erosion events).
- Recommendations for future monitoring.

When water quality monitoring is considered to be no longer required, a final report shall be prepared and issued to NSW OEH and NSW Food Authority summarising the above and providing justification on why the water quality monitoring program is no longer required.

It is intended that NSW Food Authority shall, as they consider appropriate, make available results of monitoring as data is developed. This information may be made available through an industry portal or through other means as acceptable to NSW Food Authority.

2.10 Contingencies and Program Review

In the event that water quality impacts are identified and the health of receiving environments is compromised, site works must cease pending assessment by an appropriately qualified environment professional. The stormwater management system and/or sediment and erosion control measures may need to be revised and the monitoring program adapted as required. The water quality monitoring program for individual monitoring elements shall be reviewed and revised as outlined in Sections 2.2.

It is intended that this water quality monitoring plan be maintained as a living document and be updated in consultation with the stakeholders. Review of the monitoring program shall be undertaken annually in response to the findings of the monitoring for the year prior. Amendments to the plan shall be made and, once approved by the project's consent authority, implemented as required.

Various elements of the monitoring plan proposed are intended to cease or be reviewed once development is "completed". As it is common for a development to retain lots which are not built on for extended periods of time it was agreed, in consultation with stakeholders, that the development or stages thereof shall be "complete" once 70 % of lots are built upon.

3 Sediment and Erosion Control Plan

3.1 Management Principles

The Sediment and Erosion Control Plan (SECP) has been prepared in accordance with the design guidelines provided in *Managing Urban Stormwater, Soils and Construction Volume 1*, 4th Edition (Landcom, 2004). It reflects current best management practices to mitigate the overall impact of the development during the construction phase. The following principles will apply to all areas and stages of the construction program:

1. Minimise extent of ground disturbance.
2. Implement erosion control strategies to prevent generation of sediment.
3. Implement sediment control strategies to prevent off-site pollution.
4. Progressive stabilisation following completion of each work area.
5. Monitoring of controls and strategies including maintenance requirements.

3.2 Engineering Plans

Concept engineering plans containing relevant erosion control measures are provided in Attachment D. These plans should be referred to for the location and detailed design of sediment and erosion control measures detailed in Section 3.3.

3.3 Staging

Given the proposed development will be staged this SECP is provided as a concept outline only. It shall be refined during subsequent consents and at Construction Certificate to ensure the estuary environment and water quality are protected appropriately during construction works for each stage of development.

3.4 Sediment and Erosion Control Measures

3.4.1 Overview

Sediment and erosion control structures have been designed and located in accordance with Landcom (2004). Measures shall be installed prior to commencement of any upslope construction works and remain until the site has been signed off by Martens as stabilised. Design of structures assumes all development works in a catchment shall occur concurrently. It is likely that multiple stages of land release shall occur in each area. Therefore the final size and need for structures are likely to change as only a portion of the catchment shall be disturbed. Detailed SECPs for each stage of development works shall be required based on design principles detailed in this plan.

3.4.2 Sediment Detention Basins

3.4.2.1 Design

Four sediment detention basins would be required to manage site runoff during the construction phase. Attachment D provides basin locations.

Sediment detention basins have been sized (Table 3) in accordance with Section 6.3.4 of Landcom (2004) and based on soil properties of the Greenwell Point soil landscape. Attachment E provides the basin sizing calculations sheet adopted from Landcom (2004).

Table 3: Sediment detention basin minimum design specifications summary.

Element	Basin A	Basin B	Basin C	Basin D
Storage Zone Volume (soil) (m ³)	1804	1721	384	422
Settling Zone Volume (water) (m ³)	6861	6275	2955	4542
Basin Total Volume (m³)	8665	7996	3339	4964

Detailed design of the sedimentation basins shall be undertaken in accordance with Landcom (2004) for 'Type F' basins. At a minimum, basins should have a settling zone depth of 600mm, a length/width ratio of 3:1 (Landcom, 2004), and include the following elements:

- Inlet rip-rap protection – to minimise erosion at the basin inlets;
- Internal flow baffles – to ensure even distribution of flow and maximise treatment time prior to discharge;
- Rip-rap outlet structure – to provide controlled discharge into wetland areas and minimise localised erosion and scour;
- Weir and spillway – to be designed to carry the 1 in 100 year ARI event.

3.4.2.2 Water Quality Monitoring

Monitoring of sedimentation pond waters shall be undertaken as follows.

- Sampling from the basins shall be completed for any event in which there is overflow from the basins.
- Samples shall be tested for total suspended solids.
- Where total suspended solids exceed 50 ppm investigation of impacts of such discharges shall be undertaken.

Where adverse impacts are observed additional measures shall be put in place to limit the discharge of sediments from the site to the estuary.

3.4.3 Earth Diversion Bunds

Earth diversion bunds are used across the site to temporarily divert water from construction areas to sediment detention basins for treatment. Construction of all earth diversion bunds is to be in accordance with Landcom (2004) and in particular Figure SD 5-5.

Locations of all bunds are provided in Attachment D.

3.4.4 Sediment Fences

Locations of all sediment fences are provided in Attachment D. They have been placed downstream of construction areas whose runoff is not directed to sediment basins by diversion bunds.

Installation should be in accordance with Figure SD 6-36 of Landcom (2004).

3.4.5 Energy Dissipaters

Energy dissipation structures are required at each of the sediment basin outlets and earth bank diversion outlets to ensure erosion, scour and sedimentation of downslope receiving environments does not occur. Construction shall be in accordance with Landcom (2004) Figure SD 5-8.

Location of each energy dissipater and specifications are provided in Attachment D.

3.4.6 Stabilised Site Entry

A number of stabilised site entrances shall be provided (Attachment D). All construction traffic shall enter and exit through these stabilised entrances which shall include the following:

1. A metal sediment shaker pad located within the site.
2. A minimum 15m long coarse gravel (minimum 75mm aggregate) bed, overlying a geotextile and adjoining the metal sediment shaker. All construction traffic shall exit over the gravel and then over the metal sediment shaker. Construction shall be in accordance with Section 6.3.9 and Figure SD 6-14 of Landcom (2004).

3.4.7 Revegetation

As works are progressively completed across the site, areas with exposed soil shall be revegetated with quick growing grasses. Rapid application and establishment measures should be utilised.

4 References

Australian Standard (1984) 1289.F3.2 *Determination of the Penetration Resistance of a Soil using the 9 kg Dynamic Cone Penetrometer*

Australian Standard 1796 (1993) *Geotechnical Site Investigations*.

Australian Standard 2870 (1996) *Residential Slabs and Footings*

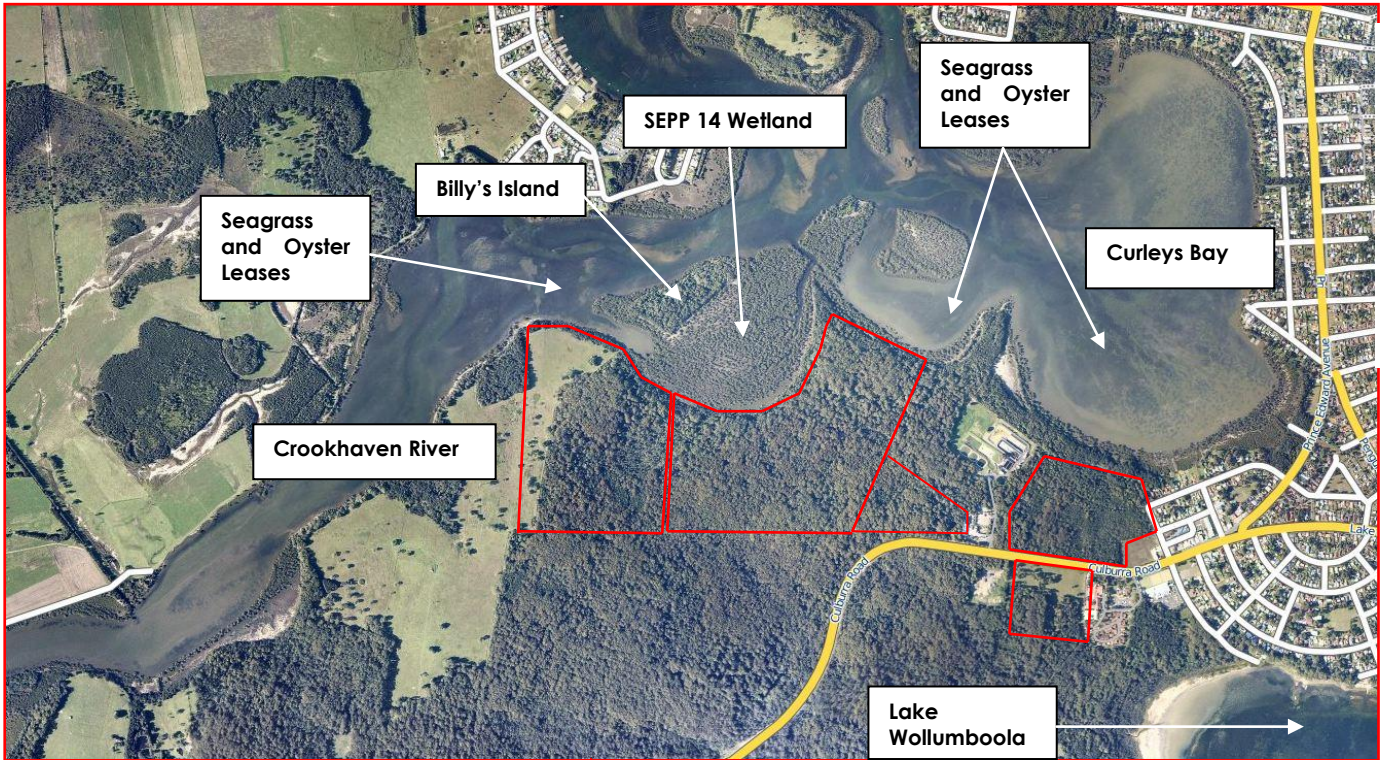
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5 Attachment A - Figures



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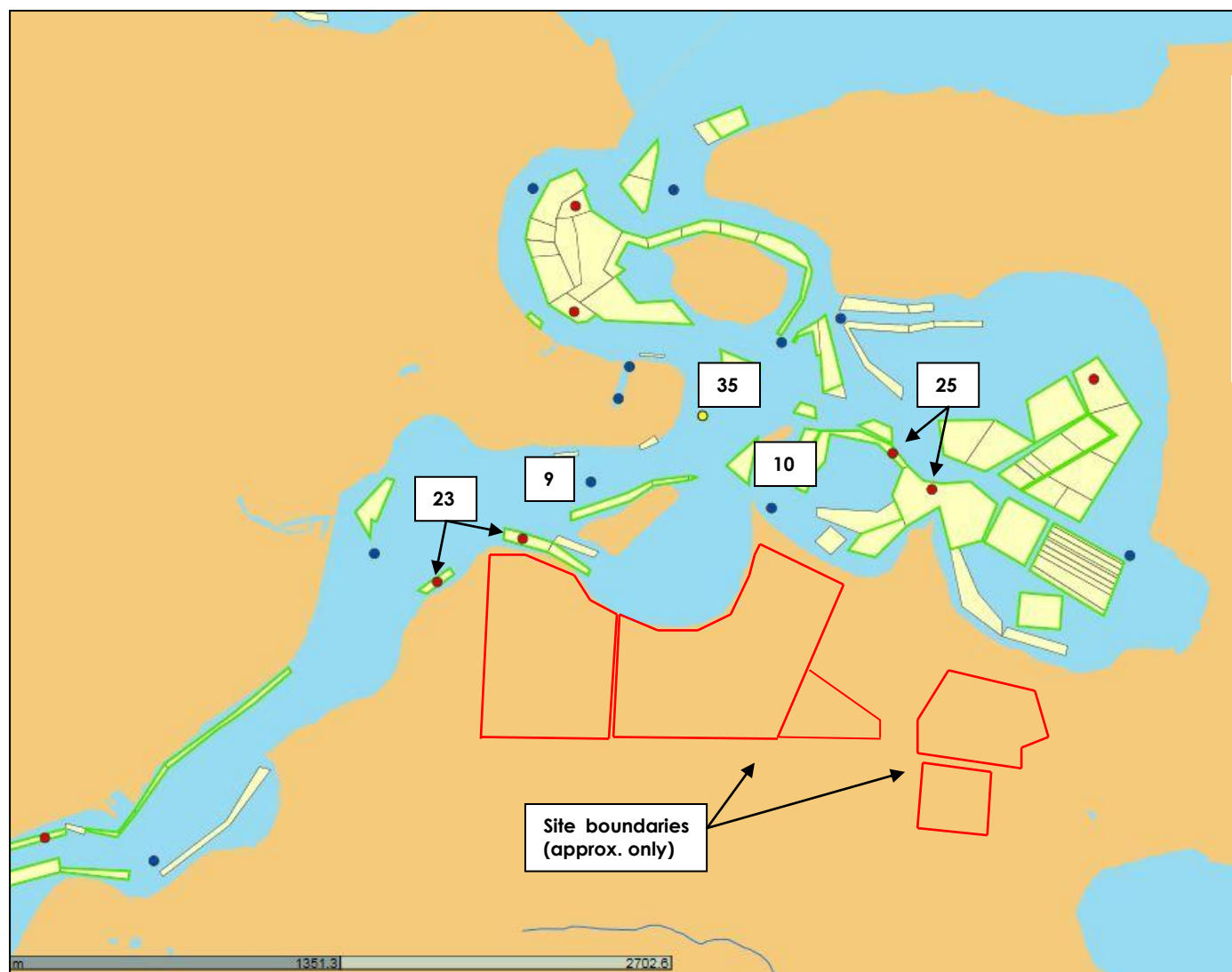
Environment | Water | Wastewater | Geotechnical | Civil | Management

Drawn:	MLK
Approved:	AN
Date:	23.08.2013
Scale:	NA

Site Locality and Regional Context

FIGURE 1

Job No: P1203365



☒ NSW Food Authority Shellfish Quality Assurance Program (SQAP)

☒ NSW SQAP Phytoplankton



☒ NSW SQAP Bacteriological

SampleType

● Shellfish

● Water incl. bacteriological

☐ NSW SQAP Heavy Metal sites

☒ NSW DPI Fisheries

☒ Oyster Industry Sustainable Aquaculture Strategy

OISAS category

Current leased area in National Park Estate

Current oyster Aquaculture leases to be phase out

Priority oyster aquaculture area

☒ Aquaculture Leases



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Drawn: MLK

Approved: AN

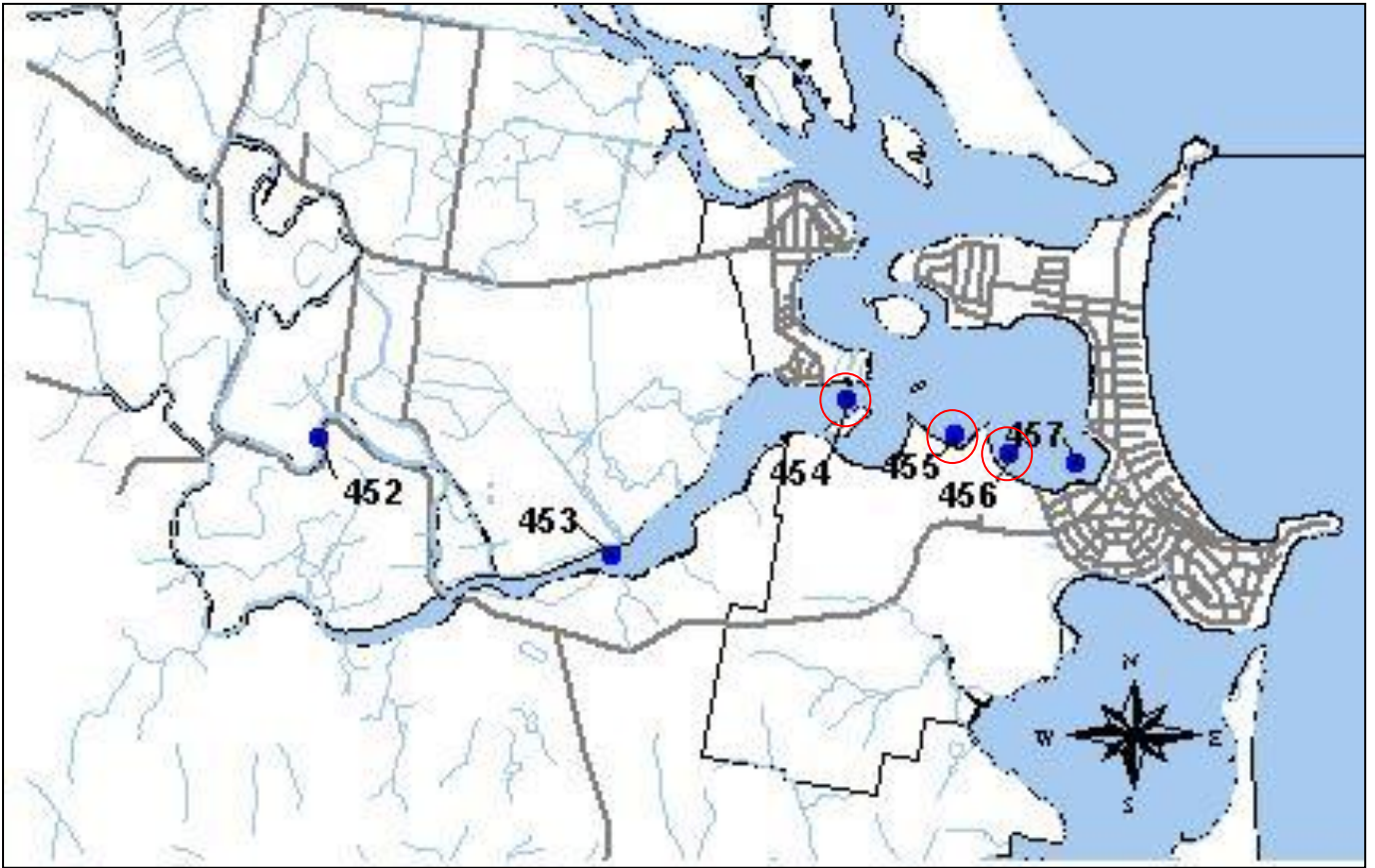
Date: 12.08.2013

Scale: As above

Crookhaven Water, Shellfish, Phytoplankton Sample Sites

FIGURE 2

Job No: P1203365

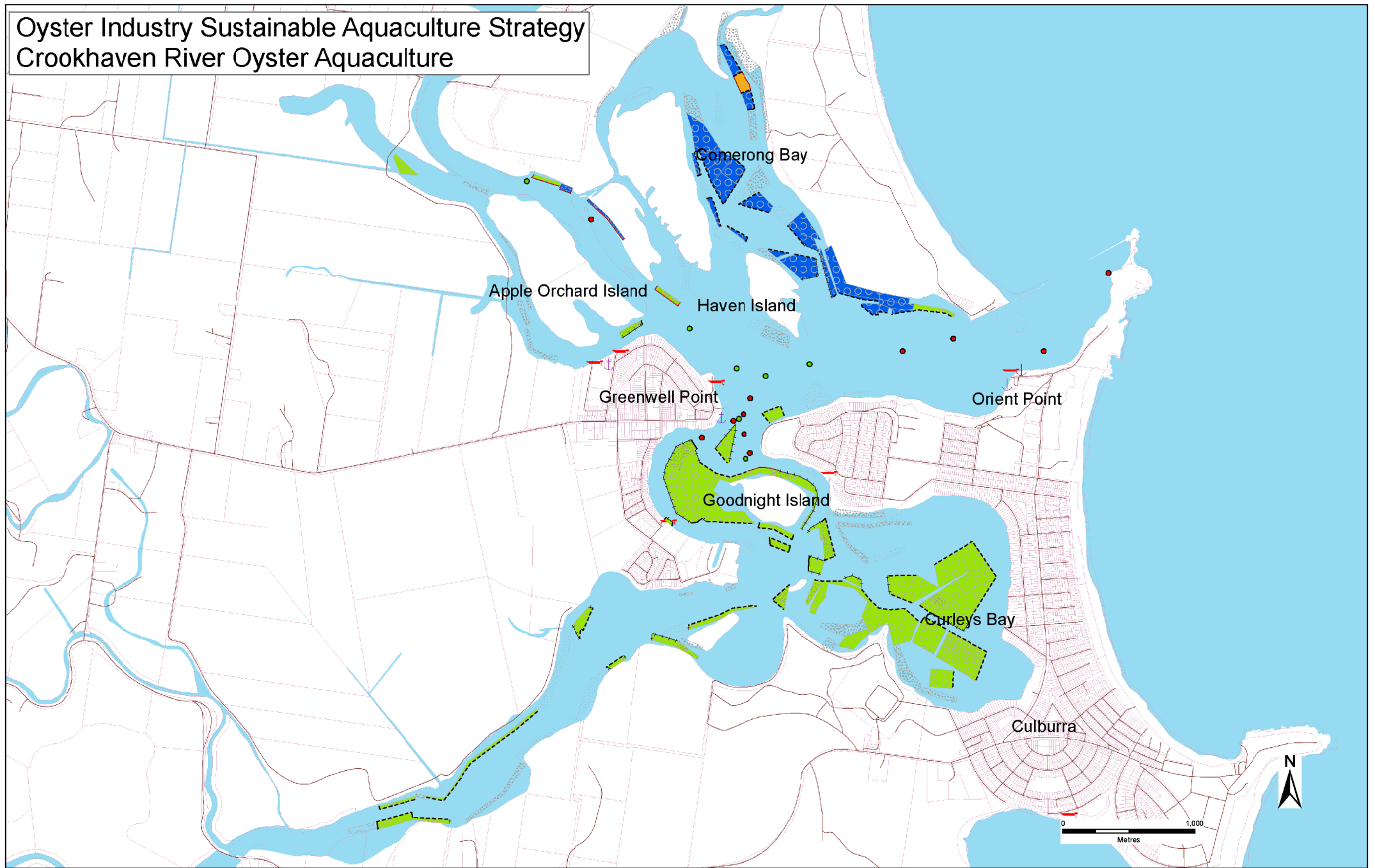


Martens & Associates Pty Ltd ABN 85 070 240 890		Environment Water Wastewater Geotechnical Civil Management	
Drawn:	MLK	Crookhaven River: Shoalhaven City Council Monitoring Locations	FIGURE 3
Approved:	AN		
Date:	23.08.2013		Job No: P1203365
Scale:	NA		

6 Attachment B – OISAS Crookhaven River Oyster Aquaculture

Oyster Industry Sustainable Aquaculture Strategy

Crookhaven River Oyster Aquaculture



Legend

- Priority oyster aquaculture areas
 - Current oyster aquaculture leases to be phased out
 - Current leased area in National Park Estate
 - Leases within Marine Park Boundaries
 - Current lease area within Merimbula Airport Jurisdiction
- Minimum Lease Marker post intervals**
- 10 metre intervals
 - 25 metre intervals
 - 50 metre intervals
 - Special navigation and marking condition
 - All other boundaries 100 metre intervals

- Former leases
- Current leases
- Cadastral boundaries (shorelines are indicative only)
- Roads

- Launching ramp
- Marina or boatshed
- Public wharf
- Port marker
- Starboard marker



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

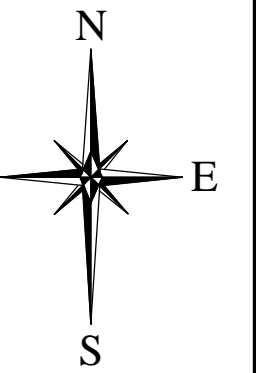
August 2006

Source: Data from the Department of Lands, NSW DPI, DPWS, and NSW Marine, with data from the Department of Primary Industries (DPI) and the Department of Primary Industries (DPI) and the Department of Primary Industries (DPI).

The State of New South Wales, the Department of Primary Industries, its employees, officers, agents or servants are not responsible for the result of any advice taken on the basis of the information contained in this map, or for any error, omission or inaccuracy that may appear on this map.

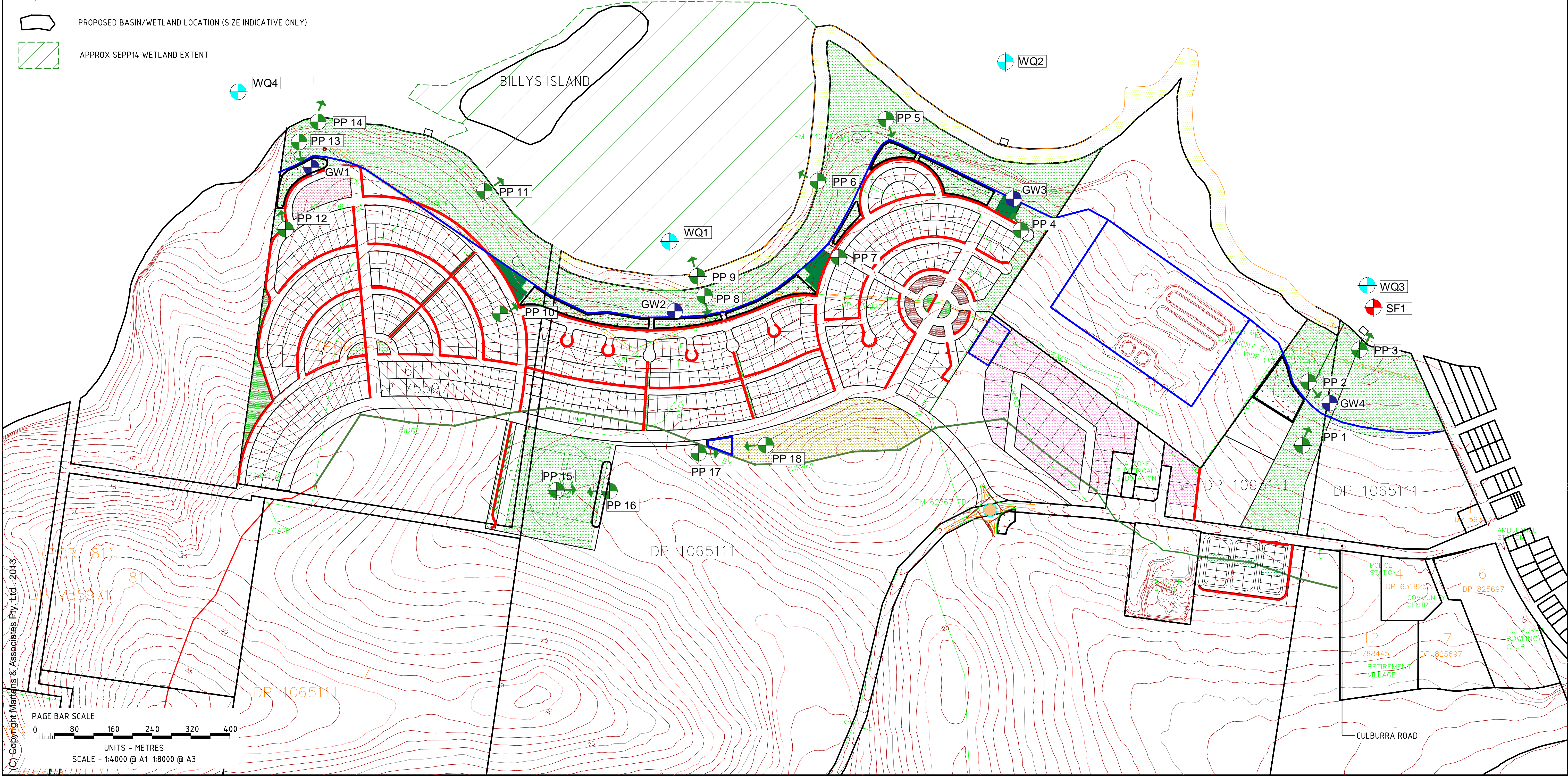
Prepared by SLS (senior), Aquaculture Management Branch, Division of Agriculture & Fisheries, NSW DPI.

7 Attachment C – Water Quality Monitoring Plan



CROOKHAVEN ESTUARY

- 7(a) ZONE BOUNDARY
- GW1 GROUNDWATER MONITORING LOCATION
- WQ1 WATER QUALITY MONITORING LOCATION
- SF1 SHELLFISH MONITORING LOCATION
- PP1 PHOTO POINT LOCATION
- PROPOSED BASIN/WETLAND LOCATION (SIZE INDICATIVE ONLY)
- APPROX SEPP14 WETLAND EXTENT



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CLIENT/ PROJECT		TITLE		DESIGNED:	DATUM:	SHEET	REV.	DESCRIPTION	DATE	ISSUED
REALITY REALIZATIONS		WATER QUALITY MONITORING PLAN MIXED USE SUBDIVISION - WEST CULBURRA, NSW		MLK	mAHD		1	FINAL	09.10.2013	AN
				DRAWN:	HORIZONTAL RATIO:					
				MLK	14000 @ A1 18000 @ A3					
THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY All measurements in mm unless otherwise specified.		PROJECT MANAGER: ANDREW NORRIS		DRAWING NUMBER: P1203365JD01V07	REVIEWED:	VERTICAL RATIO:	PAPER SIZE:			
					AN	14000 @ A1 18000 @ A3	A1 / A3			

8 Attachment D - Sediment and Erosion Control Plan

9 Attachment E – Sediment Detention Basin Sizing

1. Erosion Hazard and Sediment Basins

Site Name: NA

Site Location: West Culburra Mixed Use Subdivision

Precinct/Stage: NA

Other Details: NA

Site area	Sub-catchment or Name of Structure						Notes
	A	B	C	D			
Total catchment area (ha)	28.1	25.7	12.1	18.6			
Disturbed catchment area (ha)	27	24.5	10.1	15			

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	F	F	F	F			From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)	45	45	45	45			Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)	19	19	19	19			
% clay (fraction finer than 0.002 mm)	25	25	25	25			
Dispersion percentage	27.0	27.0	27.0	27.0			E.g. enter 10 for dispersion of 10%
% of whole soil dispersible	9.315	9.315	9.315	9.315			See Section 6.3.3(e). Auto-calculated
Soil Texture Group	F	F	F	F			Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5			See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	85	85	85	85			
x-day, y-percentile rainfall event (mm)	42.1	42.1	42.1	42.1			
Rainfall R-factor (if known)	3300	3300	3300	3300			Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							

RUSLE Factors

Rainfall erosivity (R -factor)	3300	3300	3300	3300			Auto-filled from above
Soil erodibility (K -factor)	0.042	0.042	0.042	0.042			RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	300	300	300	300			
Slope gradient (%)	5.5	5.7	3.7	3			
Length/gradient (LS -factor)	2.89	3.04	1.65	1.22			
Erosion control practice (P -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (C -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2			Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.58	0.58	0.58	0.58			See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	521	548	297	220			
Soil Loss Class	5	5	3	2			See Table 4.2, page 4-13
Soil loss (m ³ /ha/yr)	401	422	228	169			Conversion to cubic metres
Sediment basin storage (soil) volume (m ³)	1804	1721	384	422			See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m ³)	6861	6275	2955	4542			See Sections 6.3.4(i) for calculations
Sediment basin total volume (m ³)	8665	7996	3339	4964			

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).