MARINE MANAGEMENT SUPPORT:
CENTRAL WEST COAST

CENTRAL WEST COAST MARINE BIODIVERSITY AND CONSERVATION PROGRAMME. BASELINE WATER QUALITY MONITORING IN THE COASTAL WATERS OF THE CENTRAL WEST COAST FOCUSSING ON JURIEN BAY MARINE PARK: FIELD SURVEYS 2004

Field Programme Report: MMS/CWC/JBMP - 80/2004

A collaborative project between
CALM Marine Conservation Branch, CALM Moora District Office and Department of Environment

A project jointly funded by
the Natural Heritage Trust via the Northern Agricultural Catchment Council
and the Department of Conservation and Land Management

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SUMMARY

Prior to the gazettal on 26 August 2003 of Jurien Bay Marine Park (JBMP), the latest addition to the Statewide representative system of marine protected areas, the Department of Conservation and Land Management's (CALM's) Marine Conservation Branch (MCB) was successful in obtaining a Natural Heritage Trust grant via the Northern Catchment Council (NACC) to undertake a baseline water quality study.

The broad objective for the baseline water quality project is to establish a long-term dataset to detail the baseline levels of key water quality characteristics of the region.

To facilitate the broad objective, the project has been split into several major tasks:

1. undertake a review of existing water quality information;

2. undertake a risk assessment to identify current and potential threats, priority parameters to measure and information gaps; and

3. to undertake a marine monitoring programme to characterise the background water quality of the Central West Coast focussing on the Jurien Bay Marine Park.

Three water quality monitoring programmes are proposed:

1. a broadscale baseline water quality survey (biostimulants and physical parameters);

2. a potential impacts monitoring survey (biostimulants and physical parameters); and

3. a broadscale baseline toxicant survey.

Background information on three water quality monitoring programmes is outlined in this report, which includes:

- descriptions of the methods that will be utilised;
- site selection;
- sampling programme outline; and
- details applicable to the management of the project (e.g. resources, equipment, safety issues, communications); and
- data management.

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1 INTRODUCTION

1.1 BACKGROUND

Prior to the gazettal on 26 August 2003 of Jurien Bay Marine Park (JBMP), the latest addition to the Statewide representative system of marine protected areas, the Department of Conservation and Land Management's (CALM's) Marine Conservation Branch (MCB) was successful in obtaining a Natural Heritage Trust grant via the Northern Catchment Council (NACC) to undertake a baseline water quality study.

The coastal region of JBMP is a major centre for commercial crayfishing in the Central West Coast (CWC). The JBMP has also been identified as a hot spot of marine biodiversity of the CWC, as both temperate and tropical species are present (Barrett 2000; Barrett *et al*. 2002, Edgar *et al*. 2003).

With the gazettal of a marine park, the imminent improved accessibility from Perth (the new coast road is expected to be completed by 2006) and the associated increase in visitation, an increase in pressures that affect the values of the region is anticipated. Baseline water quality information will provide a reference from which to assess change in water quality in areas that are currently or potentially subjected to human-related pressures.

The indicative management plan for Jurien Bay Marine Park (Department of Conservation and Land Management, 2000), identified water quality as an ecological value of the Jurien Bay Marine Park. To ensure that the water quality of the park is not significantly impacted by the input of contaminants, establishment of baseline water quality monitoring programmes in relation to nutrient enrichment was recognised as a high priority key management strategy (H-KMS).

1.2 BROAD OBJECTIVES

The broad objective for the baseline water quality project is to establish a long-term dataset to detail the baseline levels of key water quality characteristics of the region.

To facilitate the broad objective, the project has been split into several major tasks:

1. undertake a review of existing water quality information;

2. undertake a risk assessment to identify current and potential threats, priority parameters to measure and information gaps; and

3. to undertake a marine monitoring programme to characterise the background water quality of the Central West Coast focussing on the Jurien Bay Marine Park.

2 REVIEW OF EXISTING WATER QUALITY INFORMATION

2.1 SCOPE OF WORKS

Prior to the development of a programme to characterise the baseline water quality in the Central West Coast, a review of existing water quality information for coastal waters between Dongara and Lancelin was undertaken by DAL Science & Engineering (DALSE 2004). The review included:

- a review of historical water quality data available for the region;
- a review of previous water quality monitoring programme designs used in the region;
- a review of water quality monitoring programmes currently underway in the region;
- the identification of gaps in the existing/historical data/monitoring programmes; and
- recommendations for a water quality monitoring programme for coastal waters between Dongara and Lancelin.

2.2 AVAILABLE DATA

As was expected, most of the monitoring programmes were designed to specifically address an impact or area of interest, with the exception of the Mola (2002) study, which included a broad capture of water quality information in nearshore and offshore (outside the reef chain) waters of the Jurien Bay region.

The results of this review demonstrate how little water quality monitoring has been undertaken in the Dongara–Lancelin region. In particular, most of the monitoring has been undertaken with specific purposes in mind, not including the capturing of background conditions within the region. Fortunately, custodians of the existing data are willing to contribute their information to CALM, enabling the Marine Conservation Branch to gain some familiarity with historical water quality in the Dongara to Lancelin region.

For further information see the DALSE (2004) report.

2.3 RECOMMENDATIONS FOR WATER QUALITY MONITORING

DALSE reviewed the existing data and concluded that there were large gaps in water quality information for the Dongara to Lancelin region (DALSE 2004). With that knowledge, DALSE (2004) proposed a monitoring programme design that will be considered when this project formulates its own monitoring programme design.

3 RISK ASSESSMENT

In the determination of the water sampling strategy and methods for the study, a risk assessment has been undertaken.

A review of potential threats to the water quality of the JBMP as identified in the draft indicative management plan (Department of Conservation and Land Management 2000) has highlighted that there are four sources of pollutant inputs:

(1) bio-stimulants (nutrients);

(2) toxicants (hydrocarbons, heavy metals, pesticides);

(3) pathogens; and,

(4) litter.

The major threats and their associated activities were reviewed and identified that bio-stimulants and toxicants were likely to be the main pollutant inputs relative to pathogens and litter (Table 3.1).

Table 3.1. Major pollutant inputs to the waters of JBMP

ACTIVITIES	BIO-STIMULANTS	TOXICANTS	PATHOGENS	LITTER
Sullage from vessels	Yes		Yes	
Septic tanks-groundwater flows	Yes	Possible	Yes	
Agriculture catchment runoff (Hill R)	Yes	Yes - Pesticides		
Aquaculture feeding	Yes			
Rock lobster processing outfalls	Yes			
Urban stormwater runoff	Yes	Yes	Yes	Yes
Boating activity		Yes - Hydrocarbons		Yes
Antifouling		Yes		
Oilspills from shipping		Possible		

3.1 BIO-STIMULANTS

A review of the major current and potential sources of bio-stimulants into the marine environment (Table 3.2) has highlighted that:

- ground water flux into the nearshore waters are the major current source of nutrients. Nutrients are introduced into the ground water, primarily from septic sewerage tanks in the major town sites and subsequently, the nutrient enriched groundwater enters the coastal waters;
- even though aquaculture feeding and stormwater are currently ranked as minor sources of bio-stimulants, they are likely in the future, to be the major inputs; and
- most sources are likely to increase in the future with the increase in development along the coastal strip adjacent to the marine park.

Table 3.2. Sources of bio-stimulants, relative ranking and future pressure

ACTIVITIES	RELATIVE RANKING	PROBABILITY OF INCREASED PRESSURE	SOURCES	COMMENTS
Septic tanks/ groundwater flows	H	M	Green Head, Jurien, Cervantes, North Head, Grey and Wedge	◆ Less than 10% of Green Head's, 30% of Jurien's and <20% Cervantes' resident populations have infiltration wastewater treatment. ◆ Further development is planned for the existing towns as well as Grey, Wedge and North Head. ◆ Slight increases in nutrient concentrations in nearshore waters is likely in the short term
Agriculture catchment runoff (Hill R)	M	L	Hill River	◆ Hill River is the sole source. ◆ Increase threat unlikely
Aquaculture feeding	L	H	Jurien boat harbour Proposed aquaculture	◆ The pro-artemia research facility has an intake and discharge in the harbour. ◆ Further aquaculture development is highly likely. ◆ Increase in nutrient input likely.
Sullage from vessels	L	M	Cray boats Charter vessel Private vessels	◆ Currently, only a minor concern possibly with a peak in the Jurien Marina during autumn. ◆ Future increase in inputs likely with the likely increase in boating.
Rock lobster processing outfalls	L	M	Green Head	◆ One current source that maintains a monitoring program. May be able to source collected data to understand possible impacts.
Urban stormwater runoff	L	H	Green Head, Jurien, Cervantes, North Head, Grey and Wedge	◆ Not a huge source of nutrients as a result of small urban catchments. ◆ With further development in existing towns and proposed nodal development at Grey, Wedge and North Head, increase in nutrient inputs into nearshore waters is likely.

Recommendations for survey design

- Ground water flux and urban storm water inputs from the current town sites and future nodal development locations, and aquaculture feeding are likely to be major sources of bio-stimulants. Therefore, it is recommended that nutrients, in the form of total inorganic nitrogen (TIN), Free reactive phosphate (FRP) and chlorophyll-a are measured at the existing town sites and the proposed nodal settlement sites, in the water quality monitoring programme.
- Appropriate reference sites should be sampled in the potential impacts monitoring programme.

3.2 TOXICANTS

The existing and potential sources of toxicants in various forms such as pesticides and hydrocarbons have been identified and are presented in Table 3.3. This risk assessment highlighted that:

- the input of hydrocarbons will increase with the likely increases in boating activities in the JBMP;
- the hydrocarbons and pesticides inputs through urban stormwater runoff will increase as development of existing towns and the proposed coastal nodes progress; and
- future toxicant inputs are likely to increase with the increases in boating activities in the JBMP.

Recommendations for survey design

- A survey to characterise background toxicant (hydrocarbons, heavy metals, pesticides) levels should be undertaken.
- CALM should seek further funding in collaboration with the Department of Environment (DoE) to undertake a baseline sediment quality survey in the Central West Coast.
- Liaise with the DoE to ensure that all new development proposals have conditions that include monitoring any contaminant inputs.
- CALM should encourage Department of Planning and Infrastructure (DPI) to undertake monitoring of toxicants in the Jurien marina and the Cervantes anchorage area.

3.3 PATHOGENS

The input of pathogens into the waters of JBMP is currently low, however it is likely to increase with further development of existing towns and the proposed development of tourism nodes (Table 3.4). The risk assessment highlighted sullage from vessels as potentially the most likely source of increased pathogen input.

Table 3.3. Sources of toxicants, relative ranking and future pressure

ACTIVITIES	RELATIVE RANKING	PROBABILITY OF INCREASED PRESSURE	Sources	COMMENTS
Hydrocarbons from boating activities	M	H	Commercial vessels Recreational vessels Fuelling at Jurien harbour Other fuelling activities	◆ There will be future increases in hydrocarbon pollution with increases in boating activity
Pesticides from agricultural catchment runoff	M	L	Hill River	◆ Only when there is high seasonal river flow which breaks the river mouth bar. ◆ No expected increases in loads to the nearshore marine waters.
Hull antifouling	L	L	Commercial vessels Recreational vessels	◆ Possible elevated heavy metal concentrations focussed around Jurien Marina and at Jurien, Green Head, Grey and Wedge anchorages. ◆ There may be increased concentrations with increases in commercial boating activities.
Urban stormwater runoff	L	M	Green Head, Jurien, Cervantes, North Head, Grey and Wedge	◆ Currently little threat from urban runoff. ◆ Possible increase in toxicant pollutants with future development in existing town sites and at proposed nodal development at Grey, Wedge and North Head.
Oil spills from shipping	L	L	Offshore shipping	◆ No increase in threats from offshore shipping foreseen at present

Table 3.4. Sources of pathogens, relative ranking and future pressure

ACTIVITIES	RELATIVE RANKING	PROBABILITY OF INCREASED PRESSURE	SOURCES	COMMENTS
Septic tanks-groundwater flows	L	L	Green Head, Jurien, Cervantes, North Head, Grey and Wedge	◆ Currently a low threat. ◆ Unlikely to increase as wastewater treatment infrastructure is established or increased.
Sullage from vessels	L	M	Commercial vessels Recreational vessels	◆ Increases in pathogen concentrations in the Jurien marina and major anchorage areas are likely to occur as boating activity increases.
Urban stormwater runoff	L	L	Green Head, Jurien, Cervantes, North Head, Grey and Wedge	◆ Currently a low threat and not expected to increase

Recommendations for survey design

- Encourage the DPI to monitor for pathogens in the Jurien Marina and at other major mooring areas.
- Liaise with the DoE to ensure that all new development proposals have conditions that include monitoring any contaminant inputs.
- Collaborate with other stakeholders (Community, DoE, DPI) to seek further funding to undertake a baseline pathogen survey.

4 PARAMETERS TO BE MEASURED

The number of physical and chemical parameters that will measured is limited by funding and resource constraints. The following sections present the selected parameters with comments relating to the reasons for their selection.

4.1 PHYSICAL PARAMETERS

4.1.1 Light attenuation

Light attenuation coefficients (LAC) are used by the DoE as triggers for management responses in the Cockburn Sound Environmental Protection Policy. Therefore, LAC will be measured to maintain consistency with DoE methodology (Environmental Protection Authority 2002a; 2002b) allowing for future comparative analysis.

4.1.2 Salinity, temperature and dissolved oxygen

Salinity, temperature and dissolved oxygen will be measured. Profiles of these parameters will assist in explaining any anomalies found in the chemical parameters as a result of density and dissolved oxygen stratification.

4.1.3 Total suspended solids and loss on ignition (TSS/LOI)

TSS/LOI will be measured to determine levels of suspended particulates and the organic fraction of suspended particulates.

4.1.4 Chlorophyll-a

The relationship between chlorophyll-a and the levels of bio-stimulants dissolved in the water column have been identified in various studies by the DoE. The Cockburn Sound EPP specifies the use of chlorophyll-a as a trigger for management response. Chlorophyll-a is used as a surrogate for nitrogen enrichment (Environmental Protection Authority 2002a; 2002b).

4.2 BIO-STIMULANTS

4.2.1 Total inorganic nitrates (ammonia/nitrates/nitrites)

Dissolved inorganic nitrogen, in the form of ammonia (NH_3) and nitrate/nitrite (NO_2/NO_3) will be measured to determine the concentration of bio-available nitrogen in the water column (ie. the amount of nutrient readily available for plant growth).

4.2.2 Dissolve inorganic phosphate (or free reactive phosphate)

Dissolved inorganic phosphorus in the form of free reactive phosphorus (FRP) will be measured to determine the concentration of bio-available fractions of phosphorus in the water column (ie. the amount of nutrient readily available for plant growth).

4.3 TOXICANTS

Hydrocarbon (total petroleum hydrocarbons, poly-aromatic hydrocarbons, benzene, toluene & phenol), pesticides (organochlorine, organophosphorus & triazine) and heavy metals (cadmium, chromium, copper, lead, mercury & zinc) will be surveyed. Background levels of toxicants in the JBMP are expected to be below normal detection limits. A survey will be undertaken in collaboration with the DEP and CSIRO.

4.4 PATHOGENS

Pathogens will not be sampled in this programme, however it is recommended that the Department liaise with the Department for Planning and Infrastructure and the WA Health Department to undertake future monitoring for pathogens in the JBMP.

5 METHODS

Three water quality monitoring programmes will be undertaken:

1. a broadscale baseline water quality survey (biostimulants and physical parameters);
2. a potential impacts monitoring survey (biostimulants and physical parameters); and
3. a broadscale baseline toxicant survey.

5.1 BROADSCALE BASELINE WATER QUALITY SURVEY

5.1.1 Specific objectives

The objectives of the broadscale background water quality survey are to characterise the natural (i.e. background) and the spatial and temporal variability of water quality indicators (TIN, FRP, Chlor-a, LAC) in the coastal waters of the CWC focussing on JBMP. To achieve this, data will be collected to address the following specific objectives regarding the spatial and temporal variation in key chemical/biological and physical parameters:

Objective 1. Determine offshore/onshore (west to east) variation in the background conditions for selected water quality parameters for the central west coast;

Objective 2. Determine the long-shore (north to south) variation in the background conditions for selected water quality parameters for the central west coast;

Objective 3. Determine the seasonal variation in the background conditions for selected water quality parameters for the central west coast;

Objective 4. Determine the monthly variation in the background conditions for selected water quality parameters for the central west coast; and

Objective 5. Determine the weekly variation in the background conditions for selected water quality parameters for the central west coast.

5.1.2 Site selection

In selecting the sampling sites a number of assumptions were made:

- Inside the barrier reef line has different WQ to the waters outside (i.e. inshore versus offshore);
- WQ close to the shoreline (nearshore) varies from WQ in areas inside the barrier reef line and greater than 1 km offshore (lagoonal), as there may be terrestrial sources of nutrients (i.e. groundwater flux, coastal legumes);
- Water depth influences the mixing regime; and
- WQ in protected nearshore waters differs to the WQ in nearshore waters exposed to swell energy.

Subsequent to the above assumptions, State Waters off the Central West Coast hereby defined as those waters within three nautical miles from the Australian Baseline, have been nominally split into five major locations that are identified by depth, distance offshore and exposure:

1. nearshore sheltered (<5 m depth, <500 m offshore);
2. nearshore exposed (<5 m depth, <500 m offshore);
3. shallow lagoonal (<10 m depth, inshore of barrier reef);
4. deep lagoonal (>10 m depth, inshore of barrier reef); and
5. offshore (>20 m depth, offshore of barrier reef).

Surveys will be conducted along three cross shelf transects. There will be five sites along each respective transect (one at each of the above locations) and each site will comprise of four replicate sampling points (Figure 1):

- Fisherman Islands (Tables 5.1.1);
- Hill River (Table 5.1.2);
- Nambung Bay (Table 5.1.3).

These transects have been selected to provide a long shore comparison of the water quality in the Central West Coast.

After the initial survey, data will be reviewed to determine if further modification of the above sampling regime is necessary.

Table 5.1.1. Proposed Fisherman Islands transect site locations

SITE NUMBER	REGION	DEPTH (M)	LATITUDE (DD)	LONGITUDE (DD)
F1.1	Nearshore sheltered	5	-30.17972	114.99705
F1.2	Nearshore sheltered	5	-30.17978	114.99394
F1.3	Nearshore sheltered	5	-30.17691	114.99394
F1.4	Nearshore sheltered	5	-30.17685	114.99705
F2.1	Nearshore exposed	3	-30.13476	114.99717
F2.2	Nearshore exposed	3	-30.13476	114.99400
F2.3	Nearshore exposed	3	-30.13189	114.99400
F2.4	Nearshore exposed	3	-30.13189	114.99711
F3.1	Shallow lagoonal	4	-30.13372	114.96248
F3.2	Shallow lagoonal	4	-30.13366	114.95930
F3.3	Shallow lagoonal	4	-30.13085	114.95930
F3.4	Shallow lagoonal	4	-30.13085	114.96248
F4.1	Deep lagoonal	9	-30.16567	114.99143
F4.2	Deep lagoonal	9	-30.16567	114.98826
F4.3	Deep lagoonal	9	-30.16274	114.98819
F4.4	Deep lagoonal	9	-30.16280	114.99137
F5.1	Deep offshore	30	-30.13171	114.91386
F5.2	Deep offshore	30	-30.13171	114.91069
F5.3	Deep offshore	30	-30.12878	114.91069
F5.4	Deep offshore	30	-30.12878	114.91380

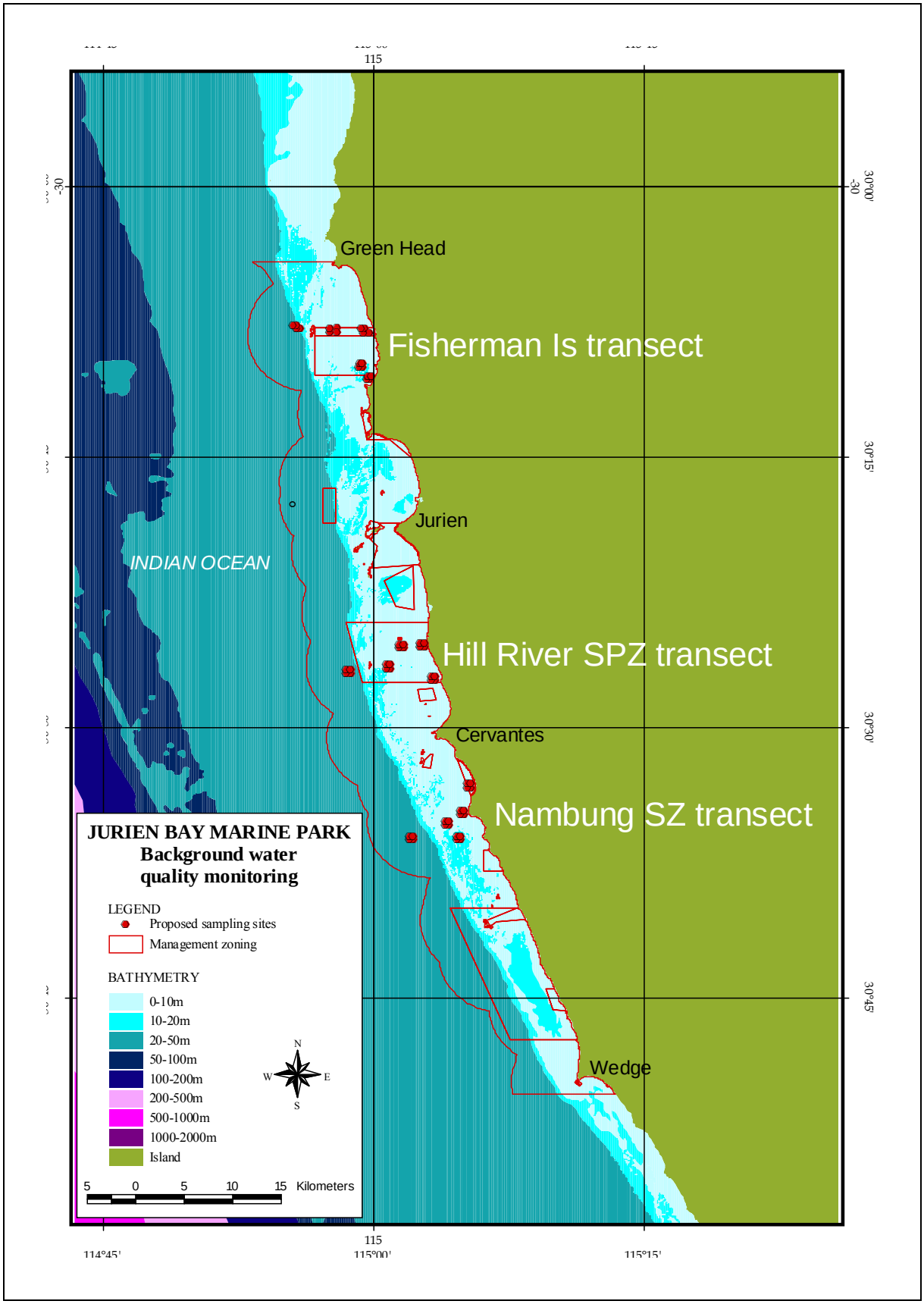

Figure 1. Proposed sites for the broadscale baseline water quality survey

Table 5.1.2. Proposed Hill River transect site locations

SITE NUMBER	REGION	DEPTH (M)	LATITUDE (DD)	LONGITUDE (DD)
H1.1	Nearshore sheltered	2.5	-30.45500	115.06039
H1.2	Nearshore sheltered	2.5	-30.45500	115.05715
H1.3	Nearshore sheltered	2.5	-30.45213	115.05721
H1.4	Nearshore sheltered	2.5	-30.45206	115.06033
H2.1	Nearshore exposed	2.5	-30.42214	115.04732
H2.2	Nearshore exposed	2.5	-30.42207	115.04414
H2.3	Nearshore exposed	2.5	-30.41920	115.04408
H2.4	Nearshore exposed	2.5	-30.41920	115.04726
H3.1	Shallow lagoonal	6	-30.42543	115.02991
H3.2	Shallow lagoonal	6	-30.42543	115.02667
H3.3	Shallow lagoonal	6	-30.42256	115.02673
H3.4	Shallow lagoonal	6	-30.42250	115.02991
H4.1	Deep lagoonal	9	-30.44357	115.01647
H4.2	Deep lagoonal	9	-30.44357	115.01336
H4.3	Deep lagoonal	9	-30.44076	115.01336
H4.4	Deep lagoonal	9	-30.44070	115.01653
H5.1	Deep offshore	28	-30.45194	114.97922
H5.2	Deep offshore	28	-30.45194	114.97598
H5.3	Deep offshore	28	-30.44907	114.97604
H5.4	Deep offshore	28	-30.44901	114.97922

Table 5.1.3. Proposed Nambung Bay transect site locations

SITE NUMBER	REGION	DEPTH (M)	LATITUDE (DD)	LONGITUDE (DD)
N1.1	Nearshore sheltered	3	-30.55382	115.09129
N1.2	Nearshore sheltered	3	-30.55376	115.08812
N1.3	Nearshore sheltered	3	-30.55089	115.08812
N1.4	Nearshore sheltered	3	-30.55089	115.09123
N2.1	Nearshore exposed	3	-30.57471	115.08177
N2.2	Nearshore exposed	3	-30.57471	115.07859
N2.3	Nearshore exposed	3	-30.57190	115.07865
N2.4	Nearshore exposed	3	-30.57184	115.08177
N3.1	Shallow lagoonal	6	-30.58772	115.07181
N3.2	Shallow lagoonal	6	-30.58778	115.06870
N3.3	Shallow lagoonal	6	-30.58491	115.06870
N3.4	Shallow lagoonal	6	-30.58491	115.07187
N4.1	Deep lagoonal	12	-30.60146	115.08122
N4.2	Deep lagoonal	12	-30.60140	115.07798
N4.3	Deep lagoonal	12	-30.59859	115.07804
N4.4	Deep lagoonal	12	-30.59859	115.08122
N5.1	Deep offshore	28	-30.60305	115.03736
N5.2	Deep offshore	28	-30.60299	115.03413
N5.3	Deep offshore	28	-30.60012	115.03419
N5.4	Deep offshore	28	-30.60012	115.03730

5.1.3 Programme outline

The broadscale background water quality survey programme has two components, seasonal and monthly. This is outlined in Table 5.1.4 and is as follows:

- The seasonal survey will be undertaken in summer, autumn, winter & spring.
- Each seasonal survey will comprise three transects (Fisherman Islands, Hill River and Nambung Bay) of five sites with four replicates at each site.
- The monthly surveys will comprise only the Hill River transect.
- At each site, samples will be integrated (top and bottom samples mixed), unless salinity and temperature profiles indicate stratification in which case respective top (1.0 m below surface) and bottom (1.0 m above substrate) samples will be taken.
- At sites <3 m depth, only a middle depth sample will be taken.
- Chlorophyll-a samples will be filtered through a 1.2 µm GFC filter and the volume of water filtered is to be recorded. Each GFC filter paper is to be wrapped in another GFC filter paper and placed into an appropriately labelled seed envelope.
- Water will be filtered through a 0.45 µm cellulose nitrate filter and from this filtered water a 10 mL tube sample taken for NH_3, NO_2/NO_3 & FRP analyses.
- TSS/LOI samples will be filtered through a pre-weighed 1.2 µm GFC filter paper and the volume of water filtered is to be recorded. GFC filter paper is to be wrapped in another GFC filter paper and placed into an appropriately labelled seed envelope.
- Filtered 10 mL tube samples will be collected as spares.
- All nutrient samples will be kept on ice at all times and frozen as soon as possible after collection, for transport to Perth for analysis at MFRL.
- At sites >7 m depth, light irradiance will be recorded at 1 m and 5 m using a LICOR 2π light meter. Data will be recorded on field data sheets. These measurements will be used to calculate LAC.
- A YSI6600 SDL recorder will be used to obtain salinity, temperature and dissolved oxygen profiles at each site. Data will be downloaded after each day of fieldwork.
- A 125 mL bottle of unfiltered water will be collected for future phytoplankton community studies. Each sample will have 2 mL of lugols solution added. It is not necessary to keep these samples on ice.

- Anticipated total number of samples taken in the field per seasonal trip are:
  - Chlorophyll-a (<0.1 µg.L^{-1}) 84
  - NH_3 (<3 µg N.L^{-1}) 84
  - NO_2/NO_3 (<2 µg N.L^{-1}) 84
  - FRP (<2 µg P.L^{-1}) 84
  - TSS 84
  - Filtered spare 84
  - Phytoplankton 84
  - LAC 15
  - Temp/salinity/DO 15

- Anticipated total number of samples taken in the field per monthly trip are:
  - Chlorophyll-a (<0.1 µg.L^{-1}) 28
  - NH_3 (<3 µg N.L^{-1}) 28
  - NO_2/NO_3 (<2 µg N.L^{-1}) 28
  - FRP (<2 µg P.L^{-1}) 28
  - TSS 28
  - Filtered spare 28
  - Phytoplankton 28
  - LAC 5
  - Temp/salinity/DO 5

5.1.4 Field staff

The members of the field team for the broadscale baseline water quality survey will comprise of staff from MCB, Moora District Office (CALM Jurien) and DoE, a Marine and Freshwater Research Laboratory (MFRL) consultant and a community member:

- Kevin Bancroft Survey Leader MCB
- Kevin Crane Support CALM Jurien
- Lee Butcher Support CALM Jurien
- Kate Fitzpatrick Support MCB
- Tim Daly Skipper DoE
- Yvette Pedretti QAQC MFRL
- Community member Support Volunteer

5.1.5 Survey vessel

The survey vessel for the broadscale baseline water quality survey will be the DoE research vessel "*Ziola*".

Table 5.1.4. Broadscale water quality sampling regime

MORPHOLOGICAL REGION	NUMBER OF REPLICATES PER REGION ANTICIPATED SAMPLING REGIME *	FISHERMAN ISLANDS TRANSECT	HILL RIVER TRANSECT	NAMBUNG BAY TRANSECT	PARAMETERS SAMPLED
Nearshore embayment	4 I	summer, autumn, winter, spring	Monthly (x12)	summer, autumn, winter, spring	NH_3, NO_2/NO_3, FRP, TSS, Chlor-a, LAC, Salinity, Temp, DO, Phytoplankton
Nearshore exposed	4 I	summer, autumn, winter, spring	Monthly (x12)	summer, autumn, winter, spring	NH_3, NO_2/NO_3, FRP, TSS, Chlor-a, LAC, Salinity, Temp, DO, Phytoplankton
Shallow lagoonal	4 I	summer, autumn, winter, spring	Monthly (x12)	summer, autumn, winter, spring	NH_3, NO_2/NO_3, FRP, TSS, Chlor-a, LAC, Salinity, Temp, DO, Phytoplankton
Deep lagoonal	4 S, B	summer, autumn, winter, spring	Monthly (x12)	summer, autumn, winter, spring	NH_3, NO_2/NO_3, FRP, TSS, Chlor-a, LAC, Salinity, Temp, DO, Phytoplankton
Offshore	4 S, B	summer, autumn, winter, spring	Monthly (x12)	summer, autumn, winter, spring	NH_3, NO_2/NO_3, FRP, TSS, Chlor-a, LAC, Salinity, Temp, DO, Phytoplankton

* S = surface, B = Bottom, I = Integrated samples

5.2 POTENTIAL IMPACTS MONITORING SURVEY

5.2.1 Specific objectives

The objective of the potential impacts monitoring survey is to provide baseline water quality datasets in areas where proposed and existing development may have an impact on the water quality of the JBMP. To achieve this, data will be collected to address the following specific objectives regarding the spatial and temporal variation in key chemical/biological and physical parameters:

.

Objective 1. Determine the background conditions for selected water quality parameters in autumn at selected sites in the central west coast, adjacent to proposed coastal development and other sites of interest; and

Objective 2. Determine the appropriate spatial scale for ongoing monitoring of water quality for the central west coast.

5.2.2 Site selection

The sampling sites for the potential impact sites survey (Figure 2) will comprise three potential impact sites and two reference sites. Each site will have four replicates (Table 5.2.1).

The rationale for the selection of potential impact sites is as follows:

- The potential impact sites around Jurien (PI1, PI3, PI4) were selected as being representative of other potential impact sites throughout the JBMP region such as Green Head, Cervantes, Grey, Wedge; and,
- Jurien was identified as the major future development node in JBMP region.

The rationale for the selection of reference sites is as follows:

- Hill River transect site H2 is the closest broadscale baseline WQ survey site to Jurien. This site will provide a weekly scale comparison to monthly sampling to be undertaken for the broadscale baseline WQ dataset;
- all nearshore sites from the broadscale baseline WQ survey, F1, F2, H1, H2, N1 & N2 may be used as reference sites for comparison to potential impact sites; and,
- site PI 2 has been selected to monitor WQ in the Peurulus SPZ.

The rationale for the autumn timing of the survey is as follows:

- WQ in JBMP is similar to that of Perth metropolitan coastal waters;
- autumn was identified in the Southern Metropolitan Coastal Waters Study (DEP, 1996) as the best time to collect WQ data as it showed the least variation over the season;
- autumn is a period of elevated/detectable concentrations of pollutants.

The survey will be undertaken on a weekly basis to:

- provide the fine scale temporal variability of the WQ at the potential impact monitoring sites; and
- the resident time of water in the nearshore basins is a 7-10 day cycle (Nick D'Adamo, pers. comm. 2003).

After the initial survey, data will be reviewed to determine if further modification of the above sampling regime is necessary.

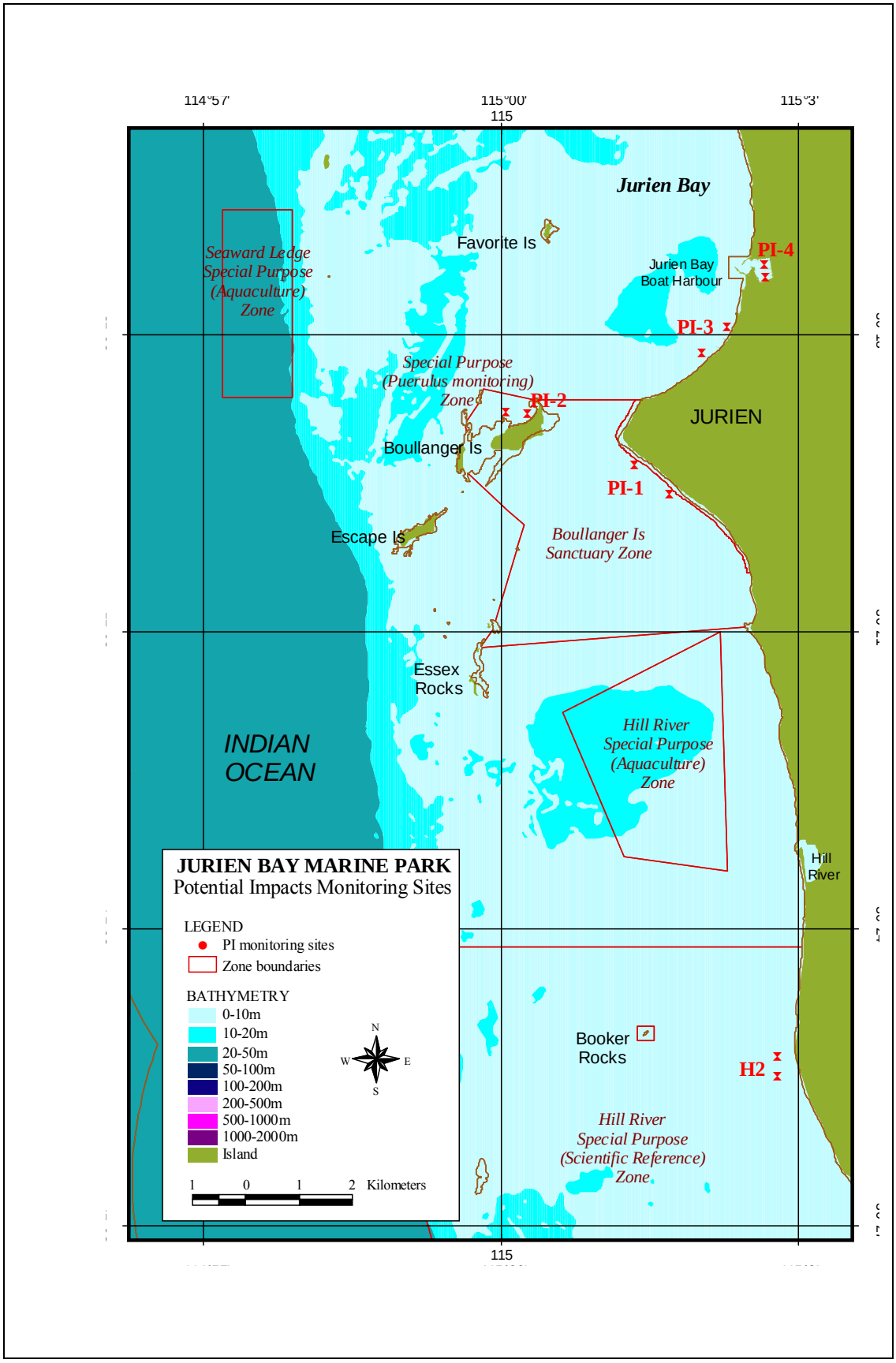

Figure 2. Proposed sites for the potential impacts monitoring survey

Table 5.2.1. Proposed potential impacts monitoring survey sites

SITE NUMBER	LOCATION	SITE TYPE	LATITUDE (DD)	LONGITUDE (DD)
H2.1	Hill River SPZ	Reference	-30.42500	115.04667
H2.2	Hill River SPZ	Reference	-30.42500	115.04333
H2.3	Hill River SPZ	Reference	-30.42167	115.04333
H2.4	Hill River SPZ	Reference	-30.42167	115.04667
PI1.1	Old Jetty	Potential impact	-30.32192	115.02252
PI1.2	Old Jetty	Potential impact	-30.32342	115.02378
PI1.3	Old Jetty	Potential impact	-30.32502	115.02622
PI1.4	Old Jetty	Potential impact	-30.32682	115.02842
PI2.1	Peurulus SPZ	Reference	-30.31325	115.00458
PI2.2	Peurulus SPZ	Reference	-30.31337	115.00285
PI2.3	Peurulus SPZ	Reference	-30.31315	115.00100
PI2.4	Peurulus SPZ	Reference	-30.31198	115.00298
PI3.1	Boullanger Is SPZ	Potential impact	-30.29857	115.03812
PI3.2	Boullanger Is SPZ	Potential impact	-30.30000	115.03668
PI3.3	Boullanger Is SPZ	Potential impact	-30.29938	115.03702
PI3.4	Boullanger Is SPZ	Potential impact	-30.30318	115.03392
PI4.1	Jurien Marina	Potential impact		
PI4.2	Jurien Marina	Potential impact	-30.28742	115.04487
PI4.3	Jurien Marina	Potential impact	-30.28928	115.04387
PI4.4	Jurien Marina	Potential impact	-30.29007	115.04567

5.2.3 Programme outline

The water impacts programme is outline in Table 5.2.2 and is further described below:

- Each respective weekly survey will be undertaken in one day.
- There will be a total of eight sampling occasions, approximately seven days apart, during autumn as a baseline to characterise WQ trends.
- Four replicate samples will be taken at each site.
- At each site, replicate samples will be integrated (top and bottom samples mixed).
- At sites <3 m depth, only a middle depth sample will be taken.
- Chlorophyll-a samples will be filtered through a 1.2 µm GFC filter and the volume of water filtered is to be recorded. Each GFC filter paper is to be wrapped in another GFC filter paper and placed into an appropriately labelled envelope.
- Water will be filtered through a 0.45 µm cellulose nitrate filter and from this filtered water a 10 mL tube sample will taken for NH_3, NO_2/NO_3 & FRP analyses.
- TSS/LOI samples will be filtered through a 1.2 µm GFC filter and the volume of water filtered is to be recorded. Each GFC filter paper is to be wrapped in another GFC filter paper and placed into an appropriately labelled seed envelope.

- At each replicate site, a filtered 10 mL tube sample will be collected as a spare.

- All nutrient samples will be kept on ice at all times and frozen as soon as possible after collection for transport to Perth for analysis.

- At all sites, light irradiance data will be collected at "in air", at 0.2 m increments for the first metre and 0.5 m increments thereafter. Data will be recorded on field data sheets. These data will be used to calculate LAC.

- A YSI6600 SDL recorder will be used to obtain salinity, temperature and dissolved oxygen parameter profiles at each location. Data will be downloaded after each day of fieldwork.

- A 125 mL bottle of unfiltered water will be collected for future phytoplankton community studies. Each sample will have 2 mL of lugols solution added. It is not necessary to keep these samples on ice.

- Anticipated total number of samples taken in the field per trip are:
  - Chlorophyll-a (<0.1 $\mu g.L^{-1}$) 20
  - NH_4 (<3 $\mu g\ N.L^{-1}$) 20
  - NO_2/NO_3 (<2 $\mu g\ N.L^{-1}$) 20
  - FRP (<2 $\mu g\ P.L^{-1}$) 20
  - TSS/LOI 20
  - Filtered spare 20
  - Phytoplankton 20
  - LAC 5
  - Salinity/temp 5

Table 5.2.2. Potential impact site sampling regime

SITE TYPE	SITE	NUMBER OF REPLICATES PER SITE	PARAMETERS	FREQUENCY
Potential impacts	• Old Jetty • Boullanger Is SPZ • Jurien Marina	4	DIN, FRP, TSS, Chlor-a, LAC, Salinity, Temp, Phytoplankton	weekly (x7)
Reference	• Puerulus SPZ • Hill R SPZ (H2)	4	DIN, FRP, TSS, Chlor-a, LAC, Salinity, Temp, Phytoplankton	weekly (x7)

5.2.4 Field staff

The members of the field team for the potential impacts monitoring survey will comprise of staff from the MCB and the Moora District Office, and a community member:

• Mr Kevin Bancroft	Support	MCB
• Mr Kevin Crane	Skipper/support	CALM Jurien
• Mr Lee Butcher	Skipper/support	CALM Jurien
• Ms Kate Fitzpatrick	Support	MCB
• Community member	Support	Volunteer

5.2.5 Survey vessel

The survey vessel for the potential impact sites survey will be the CALM vessel "*Carretta*".

5.3 TOXICANT SURVEY

A toxicant survey will be undertaken in collaboration with the DoE and CSIRO. Kevin McAlpine (DoE) has provided the following project outline.

5.3.1 Background

The Jurien Bay Marine Park incorporates a large section of the mid-west coast region of WA, an area that the Environmental Protection Authority (EPA) also considers a priority for establishing an environmental quality management framework for the marine environment. The EPA has already drafted a framework for implementing the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) in marine waters. This framework is to be applied to Cockburn Sound through an EPP (EPA, 2002) and will also be applied to the remainder of Perth metropolitan coastal waters, the North West Shelf region and the Mid-West Coast (MWC) region of WA in the near future. It is anticipated that the management framework will be incorporated into an environmental protection policy (EPP) for application to the MWC.

The management framework establishes the environmental values to be protected and the environmental quality objectives and environmental quality criteria (EQC) to be achieved if the environmental values are to be maintained. The EQC are based on the numerical guidelines and approaches recommended in ANZECC & ARMCANZ (2000). These recommended guidelines are threshold levels of contaminants in water and sediment beyond which there might be an adverse environmental impact in the marine environment. However, it is recognized that these values may need to be modified to establish site specific criteria in regions where natural background levels exceed the guidelines or where particularly sensitive organisms exist. For example, available data on copper levels in the waters of the Dampier Archipelago indicate that the national guideline might be naturally exceeded by an order of magnitude. This suggests that background levels need to be quantified and a new site-specific guideline derived.

Very little information exists on natural background concentrations of potentially toxic contaminants along the mid-west coast region of WA. Most monitoring programs focus around specific developments or activities, and all generally use analytical methods with practical quantification limits that are too high to resolve actual background concentrations for most contaminants.

It is therefore necessary to characterise natural background concentration for a range of chemical constituents of local concern to confirm the relevance of the recommended guidelines in ANZECC & ARMCANZ (2000). Characterising background concentrations of these constituents will also assist in establishing licensed discharge limits that ensure the EQC will be met in ambient waters.

5.3.2 Field staff

Members of the field team for the toxicant survey will involve staff from DoE, CSIRO, CALM and a community member:

• Dr Simon Apte	Sampling	CSIRO
• Mr Kevin McAlpine	Sampling	DoE
• Ms Kristel Wenziker	Support	DoE
• CALM District staff	Support	CALM
• DoE Regional staff	Support	DoE
• Community member	Support	CALM
• Mr Tim Daly	Skipper,	DoE

5.3.3 Survey vessel

The survey vessel will be the DoE research vessel "*Zoila*".

5.3.4 Objectives

The objectives of this proposed water quality survey are:

- to characterise the background concentration of a range of contaminants; and
- to determine the relevance of the national water quality guidelines to the mid-west coast of Western Australia. (*Note: this aspect of the program is not considered in any detail in the discussion below, but can be progressed once the results of the background survey are available*.)

5.3.5 The proposed program

The focus of the program will be on those toxic contaminants (mainly metals) considered to be of greatest threat to water quality in the region and will centre on the Jurien Bay Marine Park. For all metal analyses, except inorganic mercury, samples will be filtered though a 0.45µm GFC filter to estimate bio-available concentrations. Mercury analyses will be for total inorganic mercury.

Specialised sampling equipment is required to ensure that potential contamination is minimised when analysing down to the ultra-trace levels proposed. An acid washed teflon coated Niskin bottle is used to sample at the various depths required and a teflon rod sampler is also available for taking surface samples. Similar background water quality surveys using this equipment have been conducted recently on inshore marine waters of the Perth metropolitan region and the North West Shelf. Contaminant concentrations were found to be naturally very low (approaching oceanic levels) and relatively evenly distributed throughout the water column. Mercury was the only exception, but only showed small differences between surface and bottom concentrations. The DoE conducted the surveys, in collaboration with staff from the CSIRO Centre for Advanced Analytical Chemistry.

5.3.6 Toxicant parameters

The DoE has selected two analytical laboratories:

- CSIRO Centre for Advanced Analytical Chemistry, Sydney; and
- Australian Government Analytical Laboratories (AGAL).

Table 5.3.1 contains the parameters that will be measured, detection limits and the costs of analysis.

Table 5.3.1. Parameters to be measured in the toxicant survey of JBMP.

PARAMETER	DETECTION LIMIT QUOTED (µG/L)	QUOTE PER ANALYSIS (EX GST)
CSIRO Centre for Advanced Analytical Chemistry, Sydney		
Cadmium	0.005	$60
Chromium	0.1	$100
Copper	0.1	$60
Lead	0.1	$60
Mercury	0.0002	$150
Zinc	0.1	$60
Bottle preparation (Hg)		$10
Bottle preparation (other metals)		$10
Sample filtration		$20
Australian Government Analytical Laboratories (AGAL)		
Total petroleum hydrocarbons	25 – 100	
PAHs	0.1	
Other organics (eg. benzene, toluene, phenol)	0.1 - 1	$196.80
Organochlorine pesticides	0.001 – 0.01	$127.65
Organophosphorus/triazine pesticides	0.01	$73.65

5.3.7 Sample sites

The sites proposed for sampling are listed in Table 5.3.2. Sites are located in nearshore reference sites, offshore reference sites and nearshore sites that are possibly impacted. A guide to the sampling is presented in Table 5.3.3.

Table 5.3.2. Sample sites for the toxicant survey (undertaken by the DoE)

SITE NO.	LOCATION	SITE CATEGORY	LONGITUDE (dd E)	LATITUDE (dd S)
Site 1	Fisherman Islands SPZ	Reference nearshore	115.00064	-30.15808
Site 2	Fisherman Islands	Reference offshore	114.91249	-30.13016
Site 3	Jurien Bay	Monitoring nearshore	115.03353	-30.29939
Site 4	Hill River	Monitoring nearshore	115.04581	-30.37712
Site 5	Cavanagh Reef SZ	Reference nearshore	115.10303	-30.62408
Site 6	Green Islands SPZ	Reference offshore	115.07720	-30.67701

Table 5.3.3. Site sampling guide

SITE	LOCATION	SITE CATEGORY	ANALYTE		
			MERCURY	FILTERED METALS	ORGANICS
1	Fisherman Islands SPZ	Reference nearshore	S B	S	S B
2	Fisherman Islands	Reference offshore	S	S	S
3	Jurien Bay	Monitoring nearshore	S B	S	S B
			S	S	
4	Hill River	Monitoring nearshore	S	S	S B
5	Cavanagh Reef SZ	Reference nearshore	S	S	S
14	Green Islands SPZ		S B	S	S
		Reference offshore			

S = Surface B = Bottom

5.3.8 Program outline

- The monitoring program will be undertaken over a two day period.
- Each site will be sampled at the surface (1.0m below the surface) for total mercury, filtered metals and organic contaminant analysis using either the CSIRO stick sampler or the DEP Teflon-coated Niskin bottle.
- Bottom samples (1.0m above substrate) for total mercury analysis will be taken at sites 1, 3 and 6 using the Teflon-coated Niskin bottle.
- Bottom samples (1.0m above substrate) for organic contaminant analysis will be taken at sites 1, 3 and 4 using the Teflon-coated Niskin bottle.
- All samples are to be kept on ice at all times.
- Samples will not be preserved or filtered in the field, but sent immediately to the appropriate laboratory for sample preparation, treatment and analysis.
- Filter pore size for laboratory filtering will be 0.45μm.
- Duplicate samples will be taken for the metal analyses at site 3.
- Two field blanks shall be taken on the first day, and one on the second day, for analysis.
- The total number of samples to be taken in the field (including blanks) are:
    - Mercury – 13
    - Filtered Metals – 10
    - Organics - 9

5.3.9 Proposed timetable for the toxicant survey

The sampling program is planned to be undertaken over a three day period from 3 to 5 February 2004, inclusive.

Samples will each day be couriered immediately to the respective laboratory for processing and analysis.

Analytical results should be available within 6 weeks of the laboratories receiving the samples. The ultra-trace metal analyses by the CSIRO laboratory will take the longest to complete.

Sampling program report and data provided to CALM for incorporation into database June 2004.

5.4 REPORTING

A data report will be delivered at the completion of the baseline water quality survey of the JBMP. This report includes all data collected on each of the surveys and summary analyses.

6 PROPOSED TIMETABLE

The proposed timing of the broadscale baseline, potential impacts monitoring and toxicant surveys are listed in Table 6.1 (NB. These dates may vary under special circumstances).

Table 6.1. Proposed timetable for the broadscale baseline, monitoring and toxicant water quality surveys

SURVEY TYPE	PROPOSED DATES
Toxicant survey	3-5 February 2004
Broadscale baseline water quality (Summer)	9-13 February 2004
Broadscale baseline water quality (March)	22-24 March 2004
Potential impacts monitoring	24-25 March 2004
Potential impacts monitoring	30-31 March 2004
Potential impacts monitoring	6-7 April 2004
Potential impacts monitoring	13-14 April 2004
Potential impacts monitoring	20-21 April 2004
Broadscale baseline water quality (Autumn)	17-21 April 2004
Potential impacts monitoring	27-28 April 2004
Potential impacts monitoring	4-5 May 2004
Potential impacts monitoring	11-12 May 2004
Broadscale baseline water quality (May)	24-26 May 2004
Broadscale baseline water quality (June)	22-24 June 2004
Broadscale baseline water quality (Winter)	26-30 July 2004
Broadscale baseline water quality (August)	24-26 August 2004
Broadscale baseline water quality (September)	21-23 September 2004
Broadscale baseline water quality (Spring)	25-29 October 2004
Broadscale baseline water quality (November)	22-24 November 2004
Broadscale baseline water quality (December)	21-23 December 2004
Broadscale baseline water quality (January)	18-20 January2004

7 PROJECT MANAGEMENT

7.1 SURVEY TEAM CONTACTS

7.1.1 Marine Conservation Branch personnel

Kevin Bancroft	Project Leader Marine Ecologist	Ph (w): Ph (h): Fax: Mob:	(08) 9336 0102 (08) 9448 8192 (08) 9430 5408 0417 401 200
Kate Fitzgerald	Team member Marine Conservation Officer	Ph (w): Fax: Ph (h): Mob:	(08) 9336 117 (08) 9430 5408 (08) 9383 1919 0408 877 101

7.1.2 Moora District personnel

Kevin Crane	Vessel Master Marine Park Coordinator	Ph (w): Fax: Ph (h): Mob:	(08) 9652 1911 (08) 9652 1922 (08) 9652 1039 0429 600 740
Lee Butcher	Team member Marine Conservation Officer	Ph (w): Fax: Ph (h):	(08) 9652 1911 (08) 9652 1922 (08) 9652 1013

7.1.3 Department of Environment personnel

Tim Daly	Vessel Master Marine Operations Officer	Ph (w): Ph (h): Mob:	(08) 9222 7034 (08) 9948 3009 0408 893 259

7.2 SAFETY

7.2.1 General

Field operations shall be carried out in accordance with departmental procedures and protocols. Overall responsibility for field procedures during this field trip and the personal safety of all team members rests with the Project Leader.

7.2.2 Boating

All boating operations shall be carried out in accordance with Department of Planning and Infrastructure regulations and also conform to the Department of Conservation and Land Management's draft procedure for safe marine operations, "*Draft procedure guideline statement safe marine operations in CALM"* (Department of Conservation and Land Management, in prep.).

Alterations to the itinerary based on safety aspects related to weather conditions and sea-state are the responsibility of the Vessel Master in consultation with the Project Leader.

Prior to departure each day the Project Leader will log on with the Moora District office, detailing the proposed activities for the day. Upon return the Project Leader will log off with the Moora District

office. An intermediate contact will be made with the Moora District at approximately 1200 hrs every day.

7.3 COMMUNICATIONS AND EMERGENCY CONTACTS

7.3.1 General

The survey team will have the following communications equipment:

- a hand-held Department of Conservation and Land Management VHF radio will be carried on board the field vessel;
- the vehicle is equipped with a CALM VHF radio; and
- mobile phones but coverage may be intermittent in some locations.

The method of communication with the survey team is as follows:

- Before 0700 hrs ring mobile (0417 401 200).
- Between 0700 hrs and 1200 hrs contact the Moora District office and leave a message.
- The survey team will contact the Moora District office at approximately 1200 hrs everyday.
- After 1200 hrs leave a message at the accommodation or mobile.

7.3.2 CALM offices

Marine Conservation Branch, Fremantle:
Ph: (08) 9336 0100
Fax: (08) 9430 5408

Moora District, Jurien Bay:
Ph: (08) 9652 1911
Fax: (08) 9652 1922
Department VHF channel 66

Cervantes Office:
Ph: (08) 9652 7043
Fax: (08) 9652 7340

7.3.3 Volunteer Marine Rescue

Jurien Bay Volunteer Marine Rescue
Ph: 9652 1950
VHF channel 16
VHF 27.91 megahertz

7.3.4 Other emergency contacts

Silver Chain Bush Nursing Post, Jurien Bay – (08) 9652 1050
Department of Fisheries, Jurien Bay – (08) 9652 1048
Department for Planning and Infrastructure, Jurien Bay – (08) 9652 1323
Police, Jurien Bay – (08) 9652 1097

7.4 ACCOMMODATION

Name: Top Spot Accommodation
Ph: (08) 9652 1290
Mobile: 0407 521 290

7.5 BUDGET

Table 7.1. provides the estimate of overall costs involved in undertaking all surveys (background baseline, potential impacts and toxicant) for the baseline water quality marine monitoring programme for the Central West Coast.

Table 7.1. Overall costs for surveys undertaken in the Central West Coast water quality programme

DESCRIPTION	FREQUENCY OF SURVEYS	NHT COSTS	DEP COSTS	MCB COSTS	MOORA DISTRICT COSTS	TOTAL COSTS
Broadscale surveys	12 surveys	64,000	16,000	26,800	7500	$114,300
Potential impacts monitoring survey	8 surveys	30,000	0	8,500	4000	$42,500
Toxicant survey	1 survey	22,186	14,621	1,121	0	$37,928
Totals	**21 surveys**	**$116,186**	**$30,621**	**$36,421**	**$11,500**	**$194,728**

7.6 EQUIPMENT

7.6.1 Marine Conservation Branch

Digital imagery

- Olympus digital camera
- Camera housing

Information

- Marine Charts
- Laptop computer and accessories
- High density discs

Water quality equipment

- Water filter tower
- Vacuum pump
- Salinity/Temp/DO meter
- Bilge pump & hose
- 4 x 20 L buckets
- 4 x 2 L graduated measures
- disposables (filters etc.)

Other
- Sunscreen
- Eskies x2
- Freezerpaks
- Water bottle

Data recording
- Salinity/temperature/dissolved O_2 data sheets
- Pencils
- Erasers

7.6.2 Moora District

Boating
- '*Carretta*' and trailer
- Boating safety gear

Safety
- Comprehensive first aid kit
- Emergency response flow-sheet
- Emergency contact flow chart
- Patient information log
- Log sheets for accidents

Position fixing
- 1 x Garmin hand held GPS
- Batteries

Communications
- Hand held VHF radio

8 DATA MANAGEMENT

8.1 FIELD PROGRAMME REPORT

Hard copies of this Field Programme Report will be held at five locations:

1. Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St., Fremantle, Western Australia, 6160. Ph (08) 9432 5100 Fax (08) 9430 5408.

2. Woodvale Library, Science and Information Division, Department of Conservation and Land Management, Ocean Reef Rd., Woodvale, Western Australia, 6026. Ph (08) 9405 5100 Fax (08) 9306 1641.

3. Archived with CD ROM, Woodvale Library, Science and Information Division, Department of Conservation and Land Management, Ocean Reef Rd., Woodvale, Western Australia, 6026. Ph (08) 9405 5100 Fax (08) 9306 1641.

4. Moora District, Department of Conservation and Land Management, Lot 124 Bashford St., Jurien Bay, Western Australia, 6516. Ph (08) 9652 1911 Fax (08) 9652 1922.

5. Midwest Region, Department of Conservation and Land Management, PO Box 72, Geraldton, Western Australia, 6531. Ph (08) 9921 5955 Fax (08) 9921 5713.

Digital copies of this field programme report will be held at the following:

1. The Marine Conservation Branch server:
   Shareddata on 'Calm-frem-1'
   [T:\144-Marine Conservation Branch\Shared Data\Current_MCB_reports\MMS\mms_8004]

2. The Marine Conservation Branch server full backup DAT tape:
   Shareddata on 'Calm-frem-1'
   [T:\144-Marine Conservation Branch\Shared Data\Current_MCB_reports\MMS\mms_8004]

3. CD ROM held at Marine Conservation Branch and Woodvale Library: CD-ROM [mms_8004]

8.2 DATA

Collected raw data will be:

1. Housed in the MCB Marine Information System
   [V:\MIS\Data]; and

2. written into a data report and copies will be held at the same locations as the field programme report .

8.3 DIGITAL IMAGES

All digital imagery opportunistically collected during these surveys will be entered into the MCB image library located at the Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry Street, Fremantle, Western Australia.

9 REPORT DISTRIBUTION LIST

Copies of this report will be distributed to:

- Dr Chris Simpson, Manger, Marine Conservation Branch, CALM;
- Mr Kelly Gillen, Manager, Midwest Region, CALM;
- Mr Keith Hockey, Manager, Moora District, CALM;
- Dr Ray Masini, Manager Marine Impacts Branch, DoE; and
- all survey team members.

10 PUBLICITY/EDUCATION

10.1 PUBLIC RELATIONS OPPORTUNITIES

An article will be presented in the MCB newsletter, *Marine Conservation Matters.*

A media statement will be released prior field trips.

10.2 EDUCATION OPPORTUNITIES

It is intended that for each survey, a community volunteer is to be involved as one of the team.

11 REFERENCES

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Chua, J. (2002). Oceanographic modelling of Jurien Bay, Western Australia. Honours, University of Western Australia, Perth, Western Australia. 100p.

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