Perth Long Term Ocean Outlet Monitoring (PLOOM) Program

2017 Summer Water Quality Surveys

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Quality Assurance

BMT Oceanica Pty Ltd has prepared this report in accordance with our Health Safety Environment Quality Management System, certified to OHSAS 18001, AS/NZS 4801, ISO 14004 and ISO 9001: 2008.

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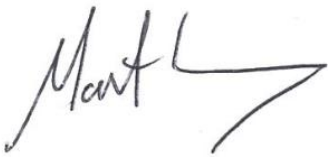

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1. Introduction

1.1 Background

Water Corporation operates major wastewater treatment plants (WWTPs) at Beenyup, Subiaco and Woodman Point (Figure 1.1). The WWTPs treat domestic wastewater and employ an activated sludge treatment process with high nitrogen removal capacity producing and discharging advanced secondary treated wastewater. Treated wastewater from each plant is discharged to the sea through ocean outlets at Ocean Reef, Swanbourne and Sepia Depression, respectively (Figure 1.1 and Table 1.1).

The Discharge from the Beenyup and Subiaco WWTPs consists almost entirely of domestic secondary treated wastewater. A small volume of primary treated wastewater (~10% of the final flow) and wastewater from industry (the Jervoise Bay Groundwater Recovery Scheme and the Kwinana Wastewater Reclamation Plant) (5% of final discharge) is added to the wastewater from Woodman Point WWTP prior to discharge.

Table 1.1 Ocean outlet characteristics

Wastewater source	Outlet location	Depth	Distance offshore	Diffuser length
Beenyup WWTP	Ocean Reef	~10 m (outlet A)	1.6 km	195 m
		~10 m (outlet B)	1.8 km	195 m
Subiaco WWTP	Swanbourne	~11 m	1.1 km	91 m
Woodman Point WWTP Point Peron WWTP Industry	Sepia Depression	~20 m	4.2 km	324 m

Licence conditions for the operation of the WWTPs at Ocean Reef and Sepia Depression require an annual summer water quality survey. An additional survey (although not formally required) is completed at Swanbourne to maintain a consistent approach.

The purpose of the annual summer water quality surveys is to:

- provide data on water quality in the vicinity of the outlets
- assess the performance of each outlet by determining the dilution and dispersion characteristics of the treated wastewater
- examine the extent of influence of the plumes
- allow for the ongoing assessment of the environmental impact of the wastewater discharge in relation to the marine water quality and beneficial uses of the area
- allow for the ongoing assessment of the level of public health risk associated with ocean disposal of treated wastewater.

This report presents the results of the 2016/2017 summer water quality surveys at Ocean Reef (7 February 2017), Swanbourne (24 January 2017) and Sepia Depression (28 February 2017).

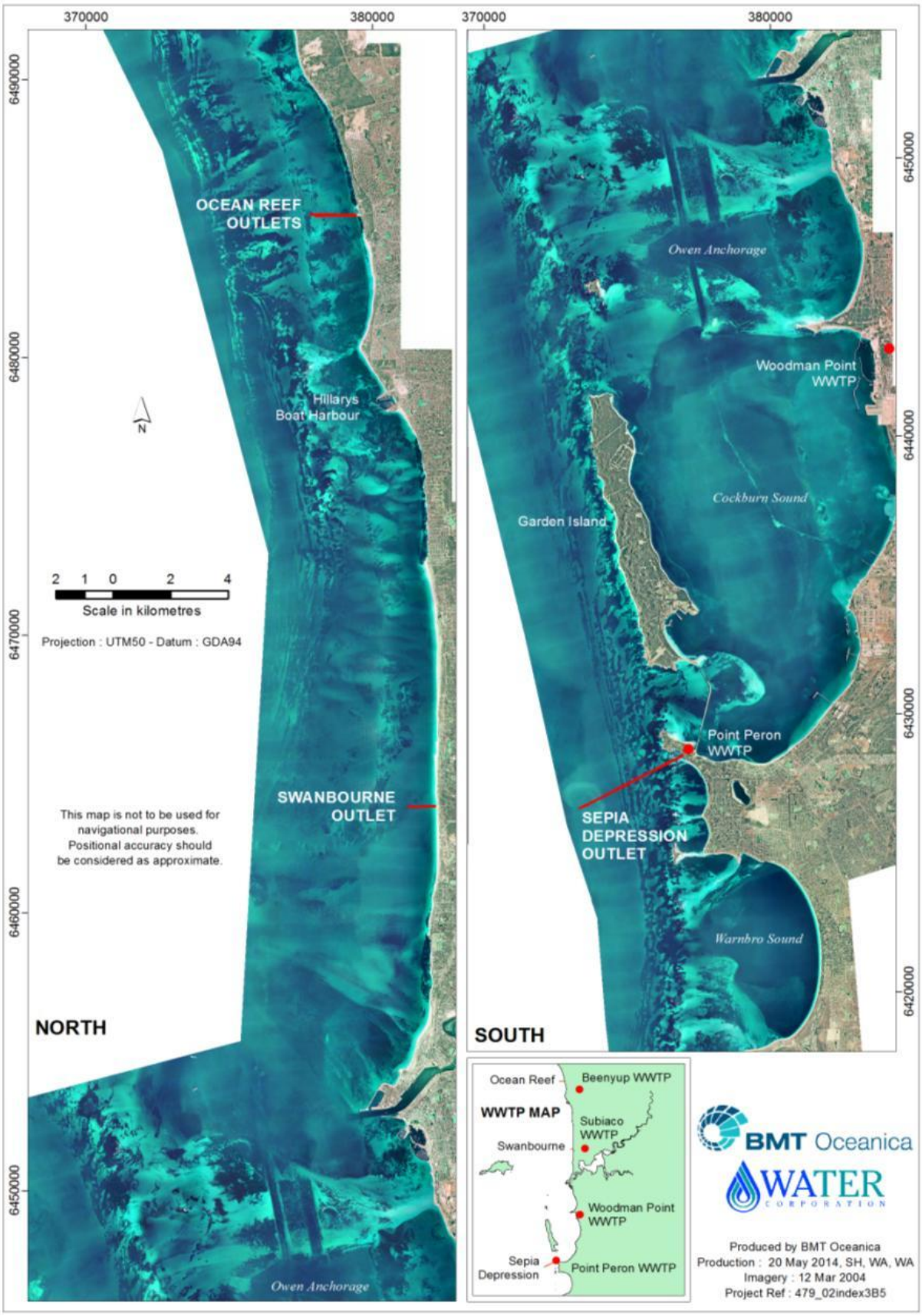


Figure 1.1 Treated wastewater ocean outlet locations, Perth

1.2 Water quality criteria

In 2000, the Environmental Protection Authority (EPA) established an Environmental Quality Management Framework (EQMF) for Perth's coastal waters (EPA (2000). First implemented practically in Cockburn Sound, the Framework was applied informally elsewhere until 2015 when it was formally applied to all the state's coastal waters (EPA 2015a). The summer surveys predate the EPA's Environmental Quality Management Framework and while there is some overlap, the design of the program is not consistent with the framework and the results cannot be evaluated against the EQMF criteria. The results are therefore generally compared to the ANZECC & ARMCANZ (2000) criteria.

1.2.1 Physical and chemical stressors

ANZECC & ARMCANZ (2000) default marine guidelines

Physical and chemical stressors are evaluated against the ANZECC & ARMCANZ (2000) default trigger values for physical and chemical stressors, specifically those pertaining to 'inshore marine waters' (Table 1.2). The default trigger guidelines are conservative low-risk guidelines and an exceedance should be regarded as an 'early warning' of a potential problem rather than evidence of an issue.

Table 1.2 Summary of default water quality guidelines (trigger values) applicable to south-west Australian coastal waters

Parameter	Inshore marine waters trigger value[1]
Total ammonia nitrogen (µg/L)	5
Ortho-phosphate (µg/L)	5
Nitrate+nitrite (µg/L)	5
Total phosphorus (µg/L)	20
Total nitrogen (µg/L)	230
Chlorophyll-a (µg/L)	0.7

Notes:
1. From ANZECC & ARMCANZ (2000)

Comparison with background/reference sites

Previous surveys suggest 'background' ortho-phosphate concentrations are naturally higher than the ANZECC & ARMCANZ (2000) default guidelines. Low-risk trigger values based on the local reference condition can provide more locally relevant guidelines for naturally occurring stressors (ANZECC & ARMCANZ 2000). Trigger values for physical and chemical stressors in slightly-to-moderately disturbed ecosystems are based on the 80th and/or 20th percentile values[1] from appropriate background or reference data. 'Background concentrations' were collated from the surface and bottom concentrations measured at sampling sites located upstream of the outlet at the time of each summer water quality over the last 18 years (1999–2017)[2] (Table 1.3).

[1] *A percentile is a value on a scale of one hundred that indicates the percent of a distribution that is equal to or below it. For example, the 80th percentile is greater than or equal to 80% of all values – conversely, 80% of all values are less than or equal to the 80th percentile.*

[2] *These years were selected on the basis that the same laboratory (Marine and Freshwater Research Laboratory) has been responsible for undertaking water quality analysis over this period, thereby minimising the potential for between-laboratory differences within the dataset (see DALSE 2004).*

Table 1.3 Median and 80th percentile values for the nutrients and chlorophyll a at reference sites near each ocean outlet

	Total ammonium nitrogen (µg/L)	Ortho-phosphate (µg/L)	Nitrate+ nitrite (µg/L)	Total phosphorus (µg/L)	Total nitrogen (µg/L)	Chlorophyll -a (µg/L)
Ocean Reef – surface waters						
median	<3	7	8	16	106	0.3
80th percentile	4	8	11	34	138	0.5
Ocean Reef – bottom Waters						
median	<3	6	8	16	110	0.3
80th percentile	3	8	11	33	130	0.5
Swanbourne – surface waters						
median	<3	4	<2	13	110	0.3
80th percentile	4	8	3	33	140	0.5
Swanbourne – bottom waters						
median	<3	4	<2	14	116	0.3
80th percentile	3	6	3	33	150	0.5
Sepia Depression – surface waters						
median	<3	4	3	14	110	0.4
80th percentile	6	6	4	31	137	0.5
Sepia Depression – bottom waters						
median	<3	3	2	13	100	0.4
80th percentile	4	5	4	31	147	0.7

Note:
1. Values in this table are rounded.

Applying the criteria

The median concentration of samples collected within 250 m of the diffuser was compared to the relevant guideline values (ANZECC & ARMCANZ 2000) default and locally derived). This distance nominally represents the region encapsulating the initial stages of treated wastewater mixing, as indicated by historical initial dilution modelling. For comparison, the median concentration of samples greater than 250 m from the diffuser were also calculated and compared to the guidelines. Concentrations at individual sites can also be compared to the default guidelines and the 80th percentile of reference values but for contextual purposes only.

1.2.2 Recreational contact

The ANZECC & ARMCANZ (2000) water quality guidelines for primary and secondary contact recreation in marine waters (Table 1.4) are exceeded if the median of the impact sites exceeds the guideline. The median concentrations of *Enterococci* spp. were calculated for sites located within 250 m of the diffuser and greater than 250 m from the diffuser.

Table 1.4 Guidelines for primary and secondary contact recreation in marine waters

Type of recreation contact	Guidelines from ANZECC & ARMCANZ (2000)
Primary contact recreation	35 MPN/100 mL
Secondary contact recreation	230 MPN/100 mL

Notes:
1. The guidelines are for median values
2. MPN = Most Probable Number

1.2.3 Seafood for human consumption

The Department of Health (DoH) discourages the public from taking wild shellfish, recommending that only shellfish harvested commercially and under strict monitoring programs are consumed. Regardless, the EPA (2015b) has published Environmental Quality Criteria (Table 1.5) that serve as a measure of the potential threat to human health for those who wish to collect and consume wild shellfish. The criteria are primarily concerned with the highest risk consumption of raw shellfish (filter feeding bivalve molluscs, e.g. oysters, mussels, clams, pipis, scallops, cockles and razor clams) rather than other forms of seafood (e.g. fin fish, abalone and crayfish).

Table 1.5 Environmental Quality Criteria for the maintenance of seafood safe for human consumption

Thermotolerant coliforms	Environmental Quality Criteria from EPA (2015b)
EQG[1]	14 CFU/100 mL
EQS[2]	70 CFU/100 mL

Notes:
1. The EQG is based on median values with no more than 10% of the samples exceeding 21 CFU/100 mL
2. The EQS is based on median values with no more than 10% of the samples exceeding 85 CFU/100 mL
3. CFU = Colony Forming Units

2. Methods

2.1 Physics

2.1.1 Wind, wave and tides

Wind conditions (wind speed and direction) at Ocean Reef[3], Swanbourne[4] and Sepia Depression[5] immediately prior to and for the duration of each summer water quality survey were provided by the Bureau of Meteorology. Significant wave height and wave period were obtained from the Department of Transport (DoT) wave rider buoy south-west of Rottnest Island[6]. Water surface elevations were obtained from the DoT gauge in the Fremantle Fishing Boat Harbour.

2.1.2 Currents

At the commencement of each survey, a drogue was released over the centre of the operational outlet diffuser (Outlet B for Ocean Reef). The location of the drogue was recorded at intervals throughout the survey using an on-board global positioning system (GPS). Drogue tracking provided an estimate of mean surface current speed and direction for the initial dilution modelling and determined which sampling grid was used at each outlet (DAL 2001).

2.1.3 Dilution

Initial dilution modelling

VPLUMES is an initial dilution model developed by the United States Environmental Protection Agency. Initial dilution occurs from the point of discharge to a point of maximum rise or fall (e.g. reaching the surface of the water body) of the plume.

These numerical models are designed to model the near-field[7] behaviour of plumes. These models capture simple features of the surrounding environment such as depth at point of discharge, net current and wind speed. However, because the models do not take into account broader scale bathymetry and hydrodynamics, they generally do not accurately predict the far-field behaviour (after the plume has reached the surface or is fully mixed in the water column). Three-dimensional baroclinic or barotropic hydrodynamic models are required to better estimate far-field behaviour.

The UM3 initial dilution model, which is part of the Visual Plumes (VPLUMES) suite of dilution models (Frick et al. 2001), was applied to the discharges from each outlet under ambient conditions and treated wastewater flows at the time of the surveys.

Model set-up

Model set-up parameters were selected to represent the outlet diffuser, flows and ambient conditions at Ocean Reef, Swanbourne and Sepia Depression, respectively, at the time of the surveys (Table 2.1).

[3] *Bureau of Meteorology Site Number 009214.*

[4] *Bureau of Meteorology Site Number 009215.*

[5] *Bureau of Meteorology Site Number 009256 (Garden Island).*

[6] *Attenuation of the wave energy, due to refraction and diffraction processes around the offshore reefs, results in lower wave height near the outlets relative to that observed offshore.*

[7] *The region where the plume first jets into the surrounding waters and then rises and mixes with the surrounding waters*

Table 2.1 Initial dilution model set-up parameters for ocean outlets at Ocean Reef, Swanbourne and Sepia Depression

Diffuser characteristics	Ocean Reef (outlet A) 7/02/2017	Ocean Reef (outlet B) 7/02/2017	Swanbourne 24/01/2017	Sepia Depression 28/02/2017
Port diameter (m)	0.125	0.16	0.17	0.135
Port elevation (m)	0.76	0.84	1	0.75
Number of open ports	50	48	20	68
Port spacing (m)[1]	4	4	5	4.65
Port orientation	Alternating horizontal	Alternating horizontal	Tee discharge horizontal, aligned N-S	Alternating horizontal
Water depth (m)	11.8	11.8	9.9	19.6
Ambient conditions at the time of sampling				
Temperature (°C)[2]	22.72	22.72	22.2	22.28
Salinity[2]	36.34	36.34	36.71	36.03
Surface current (m/s)(based on drogue movement)	0.15	0.15	0.082	0.15
Discharge characteristics				
Flow (ML/day)	62.5	62.5	57.9	154.31
Temperature (°C)[3]	27.2	27.2	28.6	26.8
Salinity	0.06	0.06	0.58	0.06

Notes:
1. In the case of alternate ports, modelling assumes they are on one side of the diffuser and 'port spacing' is the distance between each port irrelevant of the actual position on either side of the diffuser. For T-shaped risers, it is assumed that all ports are on the one side of the diffuser with the spacing equal to half of the spacing between the risers.
2. Ambient conditions have been taken from sites 64 for Ocean Reef and Sepia depression and site 63 for Swanbourne.
3. Treated wastewater temperature not collected, monthly average ambient air temperature used instead

Vertical velocity profiles were derived from mean surface currents assuming a linear decrease in current speeds from the surface to the seabed[8] of ~1.2% per metre at Ocean Reef/Swanbourne and ~3.8% per metre depth at Sepia Depression (Pattiaratchi et al. 1995).

2.2 Wastewater sampling

Flow-proportionate composite samples of treated wastewater were collected from each of the WWTPs over the 24-hour period prior to and during the annual summer water quality survey at each outlet and the characteristics of the treated wastewater samples determined.

2.3 Ocean sampling

2.3.1 Sampling locations

Water samples were collected from 35 offshore sites at each outlet (34 at Sepia Depression) within a rectangular sampling grid appropriate for the prevailing flow conditions on the day of the survey (Appendix B; DAL 2001). The sampling grid was chosen after 4–6 drogue readings to determine the predominant flow direction. The actual position of each sampling site was recorded using an on-board GPS.

In addition to the offshore sampling, nine shoreline sites located along the coast adjacent to each ocean outlet were also sampled.

[8] *Two sets of ambient conditions are set in the model, one at the surface (0 m) and one at ~1 m above the seabed. The current speed is set to linearly decrease to zero from this depth to the seabed.*

2.3.2 Water samples

Offshore samples were collected from the surface (1 m depth) and the bottom (~2 m above the seafloor) at each site using electric bilge pumps. At each site, the pumps were operated for ~30 s to flush the delivery hose prior to collecting the sample. The following samples were collected into sample rinsed (with the exception of pre-sterilised sample bottles used for the microbiological analysis) containers:

- two 125 mL unfiltered samples for total phosphorus and total nitrogen analysis
- two 10 mL filtered samples (onsite through a 45 µm filter) for ortho-phosphate, ammonia and nitrate+nitrite analysis
- one 10 mL sample for fluorometric chlorophyll-a analysis
- one 250 mL sample for thermotolerant coliforms and faecal streptococci analysis.

During each survey, three replicate samples for nutrients were obtained from surface waters at a single offshore site in the sampling grid to identify small-scale spatial variability and variability associated with laboratory analyses.

Shoreline samples were collected in waist-deep water by directly filling the sample containers.

All the samples were placed on ice and in the dark and returned to the laboratory.

2.3.3 Water column structure

A multi-parameter water quality sensor was lowered through the water column at seven or eight of the offshore sites at each of the outlets to provide information on the physical structure of the water column, i.e. vertical profiles of temperature, salinity and dissolved oxygen. Sites were arranged along a north–south transect through the middle of each sampling grid, with additional sites around the diffuser.

2.3.4 Laboratory analysis

The nutrient and primary production analyses were undertaken using the analytical methods identified in Table 2.2. For the purposes of calculating statistics and data presentation, nutrient, chlorophyll a and microbial concentrations below the reporting limit were assumed to be half the reporting limit (e.g. <3 µg/L becomes 1.5 µg/L).

Table 2.2 Analytical methods and reporting limits

Parameter	Analytical method	Reporting limit	Unit
Nutrient			
Total phosphorus	Lachat automated flow injection analyser (Valderrama 1981)	5[1]	µg P/L
Ortho-phosphate	Lachat automated flow injection analyser (Johnson & Petty 1982)	2[1]	µg P/L
Total nitrogen	Lachat automated flow injection analyser (Valderrama 1981)	50[1]	µg N/L
Total ammonia nitrogen	Lachat automated flow injection analyser (Switala 1993)	3[1]	µg N/L
Nitrate+nitrite	Lachat automated flow injection analyser (Johnson & Petty 1983)	2[1]	µg N/L
Primary production			
Chlorophyll-a	Fluorometric	0.1[2]	µg/L
Chlorophyll-a	Acetone extraction	0.1[1]	µg/L
Phaeophytin	Acetone extraction	0.1[1]	µg/L
Microbiological indicators			
Thermotolerant coliforms	Membrane filtration	Dilution	CFU/1

Parameter	Analytical method	Reporting limit	Unit
		dependent[3]	00 mL
Faecal streptococci (as *Enterococci* spp.)	Enterolert Defined Substrate Technology	Dilution dependent[3]	MPN/100 mL

Notes:
1. The reporting limit is calculated as the constituent concentration that produces a signal ten standard deviations above the reagent water blank.
2. Instrument reporting limit.
3. The lower assay limit for thermotolerant coliforms and faecal streptococci are dependent on the dilution of the original sample.

3. Swanbourne

3.1 The survey

The annual summer water quality survey at Swanbourne was completed on 24 January 2017.

3.2 Discharge

A 24-hour composite sample of treated wastewater was collected from the Subiaco WWTP on 24 January 2017 (prior to and during the ocean survey) (Table 3.1). At the time of the survey there were 20 ports open on the outlet.

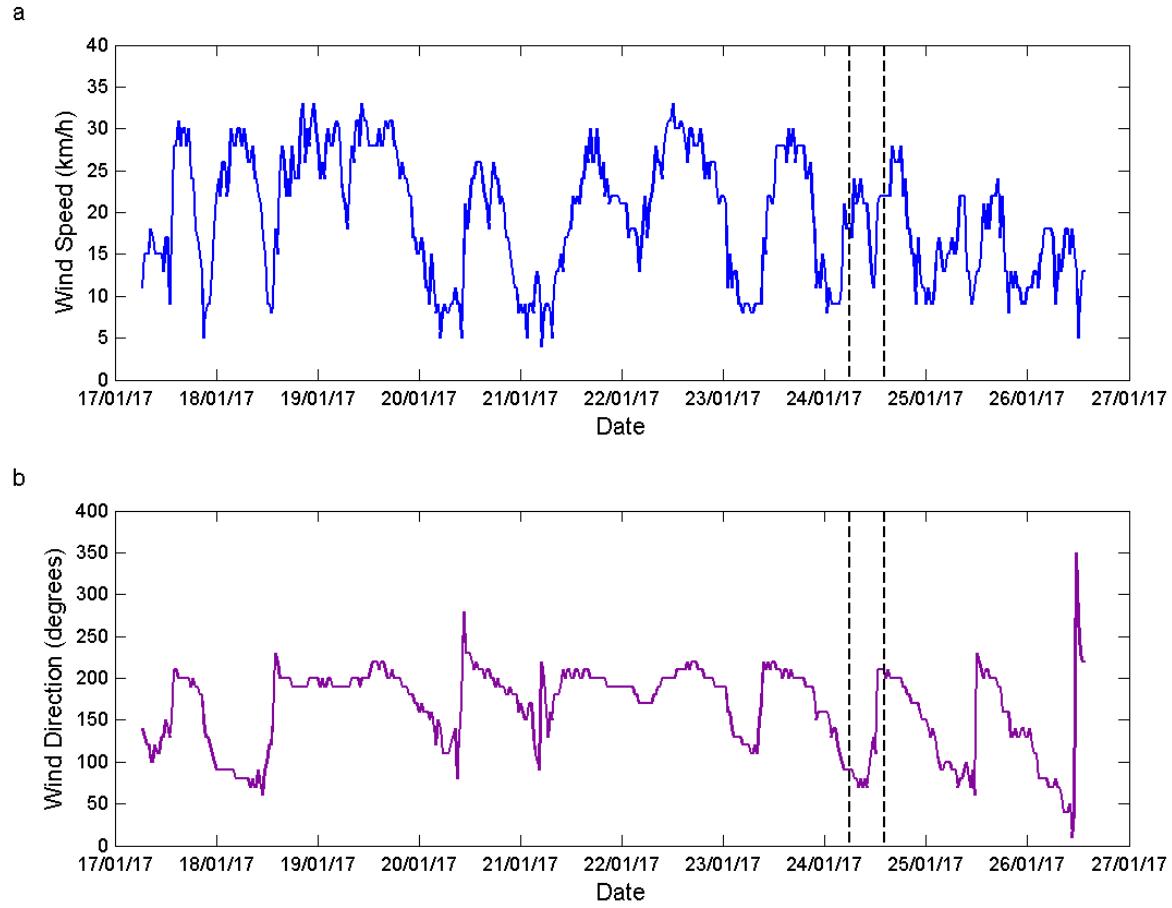
Table 3.1 Subiaco treated wastewater characteristics on 24 January 2017

Parameter	Concentration
Total phosphorus	6.9 mg/L
Total nitrogen	11 mg/L
Total ammonia nitrogen	0.13 mg/L
Nitrate+nitrite	4.5 mg/L
Thermotolerant coliforms	47 000 CFU/100 mL
Enterococci spp.	1 900 MPN/100 mL
Total suspended solids	11 mg/L
Biological oxygen demand	6 mg/L
Total flow	57.9 ML/d

3.3 Environmental characteristics

3.3.1 Wind

For 24 hours prior to the survey, the winds at Swanbourne increased from light easterlies and southerlies (averaging 8.7 km/h) to moderate (averaging 25.0 km/h) and then gentle (averaging 11.7 km/h) southerlies. The gentle breeze shifted to the east in the 3 hours prior to the commencement of sampling. During sampling, the gentle to moderate winds shifted from the east for the first half of the sampling towards the south at the end of sampling (averaging 19.3 km/h) (Figure 3.1).



Note:
1. Dashed lines (- -) show approximate timing of the summer water quality survey.
2. a = wind speed
3. b = wind direction

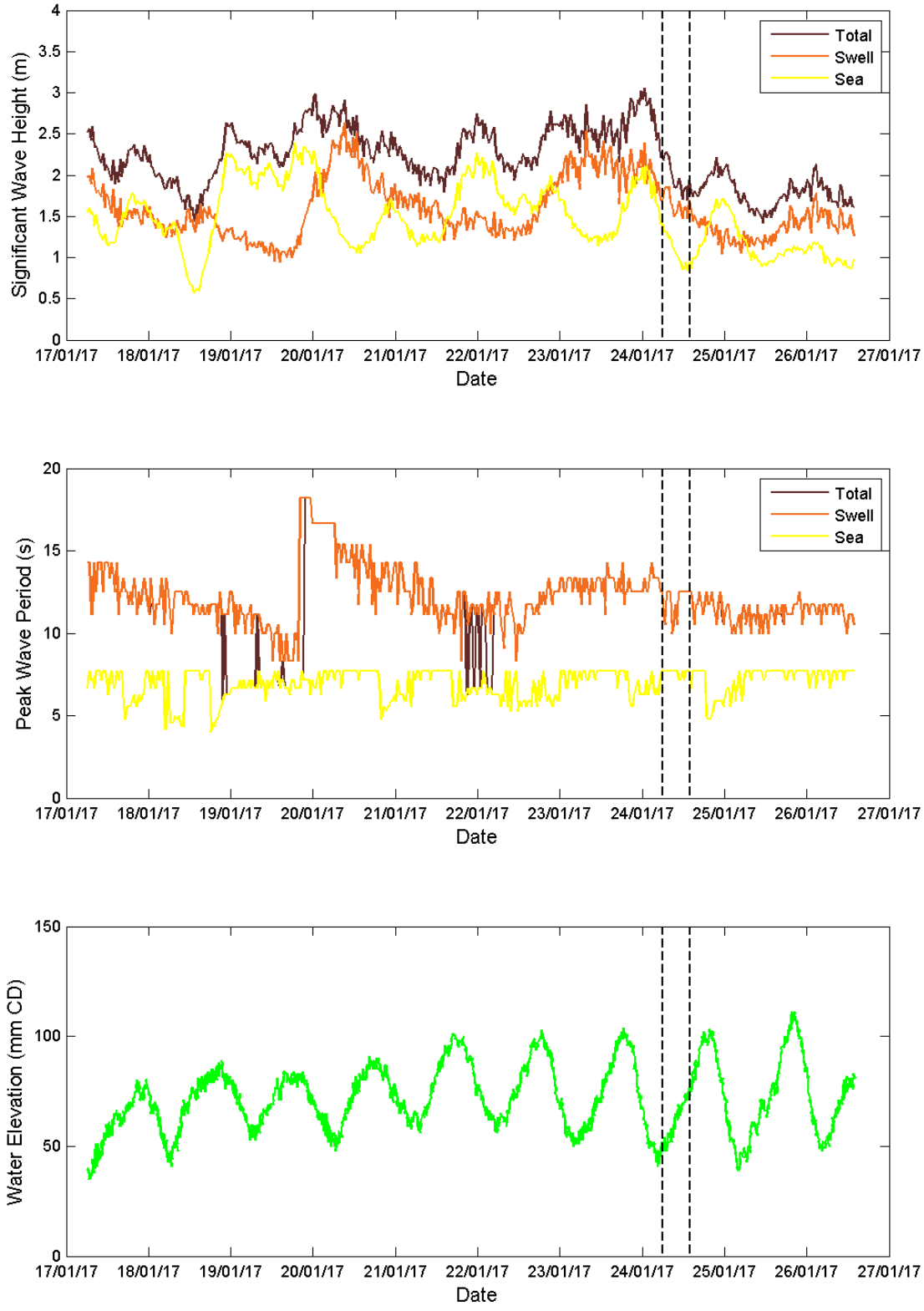
Figure 3.1 Wind speed and direction at Swanbourne

3.3.2 Waves and tide

For 24 hours prior to the survey, the average significant wave height[9] offshore from Rottnest Island was 2.6 m, with an average peak wave period[10] of 12.9 s (Figure 3.2). During the survey the average offshore significant wave height was 2.0 m and the average peak wave period of 11.8 s. The survey was completed during a rising tide (Figure 3.2)

[9] *The significant wave height (in metres) is defined as the average height of the highest one-third of waves recorded (source: http//www.dpi.wa.gov.au/)*

[10] *The wave period (in seconds) is the time between consecutive wave crests. The peak wave period is the wave period of those waves that are producing the most energy in a wave record*



Note:

1. Dashed lines (- -) show approximate timing of the survey.

Figure 3.2 Significant wave heights (offshore Rottnest Island), peak wave periods (offshore Rottnest Island) and water level elevation (Fremantle Fishing Boat Harbour)

3.3.3 Currents

The surface drogue, released at the centre of the diffuser at the beginning of the survey, drifted in a west north westerly direction for the duration of its passage. The average velocity of the drogue over the route was 0.08 m/s. At the time of the survey and based on drogue movements, it is expected that discharged treated wastewater would be travelling in a west north westerly direction and offshore of the diffuser (Figure 3.3).

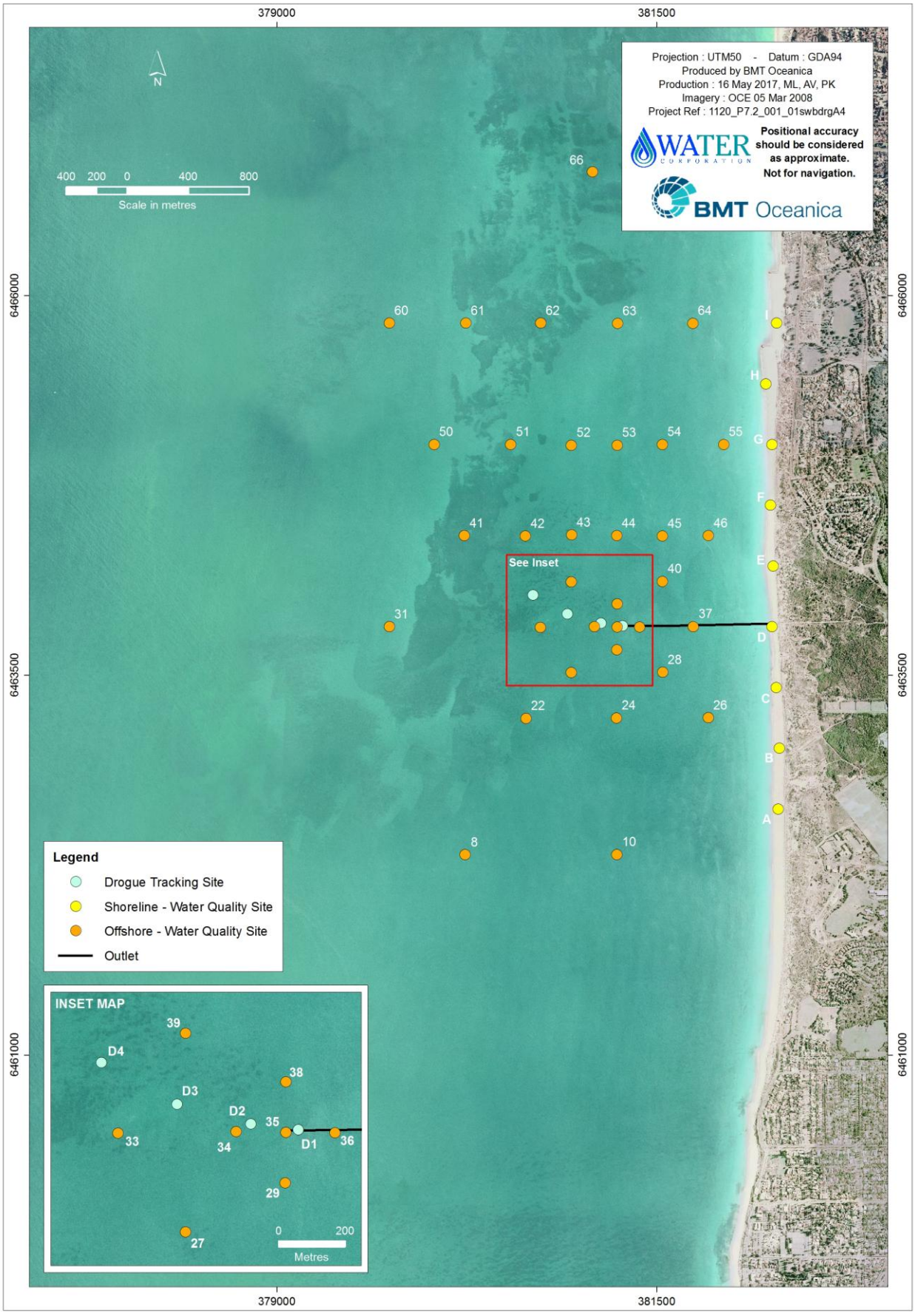
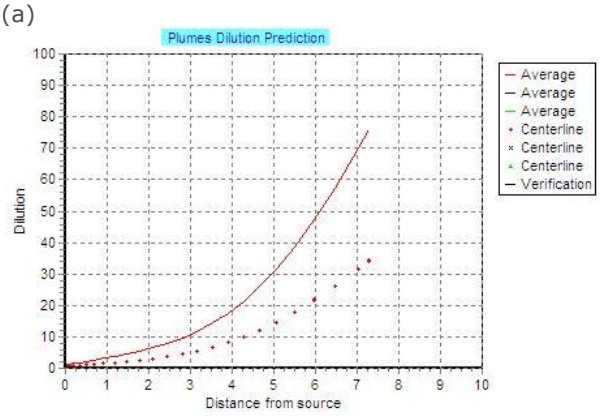


Figure 3.3 Swanbourne drogue tracking locations, 24 January 2017

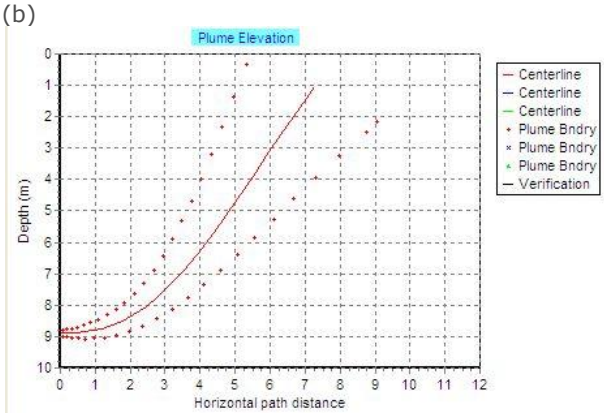
3.3.4 Initial dilution

For conditions at the time of the Swanbourne survey, the modelling predicted average initial dilution of 1:76 and centreline dilutions of 1:35 (Figure 3.4a). The plume was predicted to first reach the surface within ~7 m (horizontal distance) from the discharge point (see the ambient boundary[11] of the plume in Figure 3.4b). The full model output is included in Appendix C.

(a)



(b)



Notes:
1. a = predicted average and centreline dilution
2. b = predicted plume elevation

Figure 3.4 Predicted average and centreline dilutions and predicted plume elevation trajectory at Swanbourne

3.4 Water column structure

Water temperature from 8 sites profiled ranged from 21.75 and 22.22°C, salinity ranged from 36.59 to 36.78 and dissolved oxygen varied from 5.71 to 7.38 mg/L (equivalent to 80.6–104.1% saturation) (Figure 3.5 and Figure 3.6). There was no thermocline evident at most of the sites and salinity was typically constant with depth, with the exception of sites 53 and 63 where there was some warming near the surface and site 36 where a layer of lower salinity water was evident at the surface, possibly indicating the presence of the treated wastewater plume (Figure 3.5 and Figure 3.6). Dissolved oxygen was depleted at the surface of site 29 which was near to but up wind of the diffuser. It is not clear whether the observed localised depletion was due to the treated wastewater plume, technical issues with the probe or any other process occurring at the site (Figure 3.5 and Figure 3.6). Notwithstanding, dissolved oxygen at site 29 remained above 80% saturation and did not represent a risk to the marine environment.

[11] *The ambient boundary corresponds to the plume boundary at which concentrations are estimated to be equal to ambient conditions.*

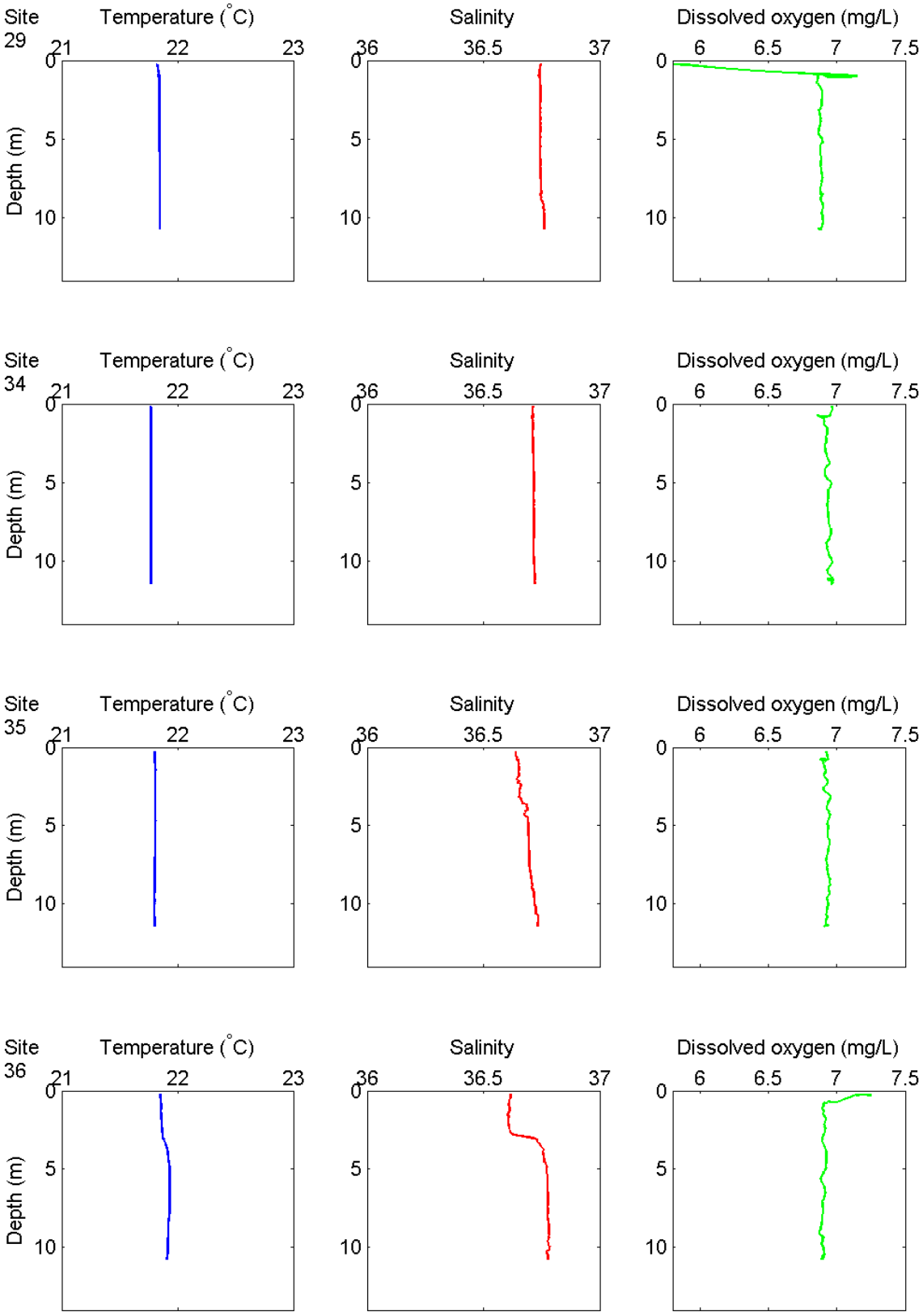


Figure 3.5 Temperature, salinity and dissolved oxygen vertical profiles at Swanbourne

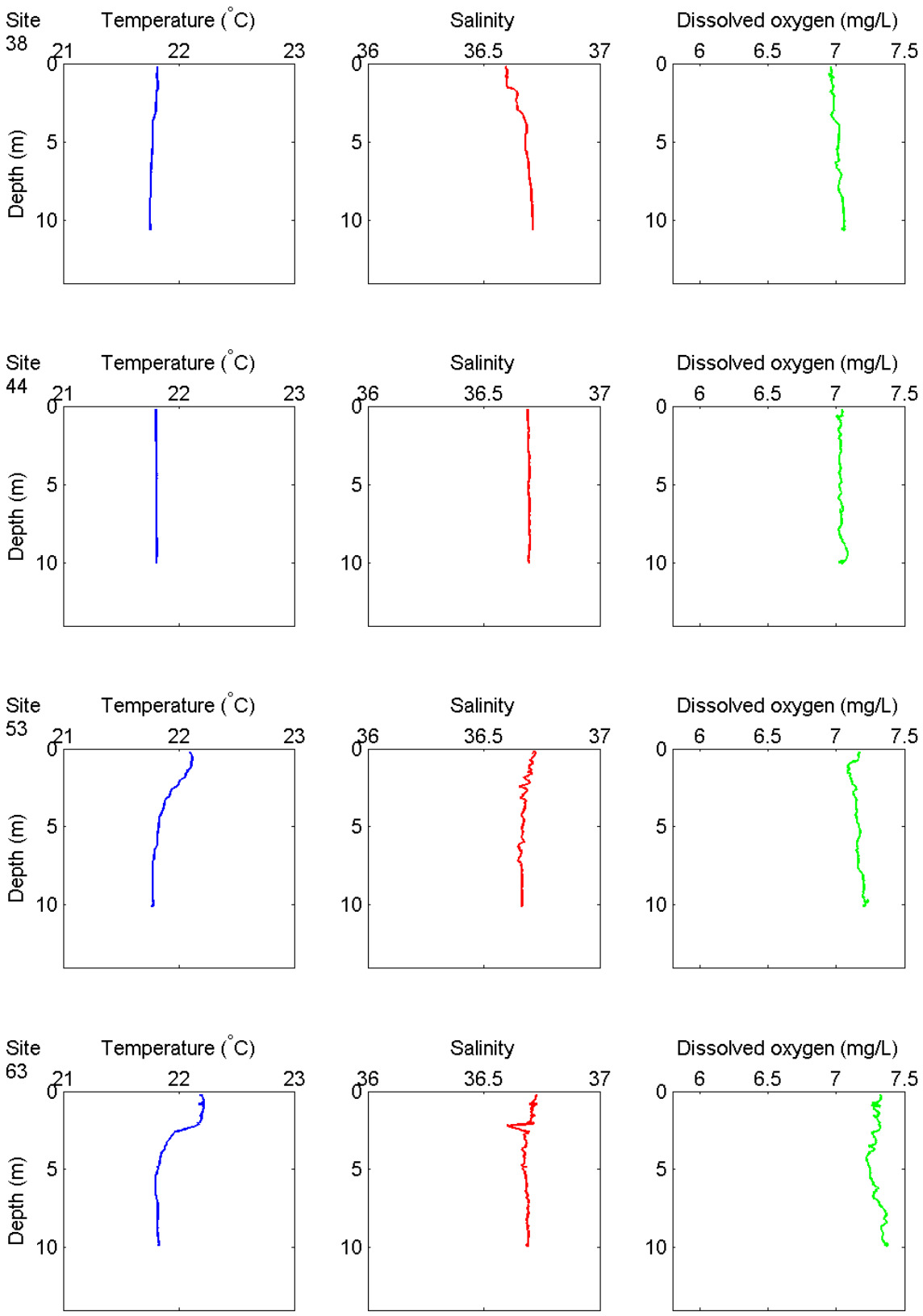


Figure 3.6 Temperature, salinity and dissolved oxygen vertical profiles at Swanbourne

Water temperature was generally uniform with increasing distance downstream of the diffuser with the exception of a warm layer extending north beyond about 800 m from the diffuser (Figure 3.7a). There appeared to be a small area of low salinity (and density) water at the surface immediately down current of the diffuser that was mixed away and absent from sites further from the diffuser (44-63) (Figure 3.7b and Figure 3.7c).

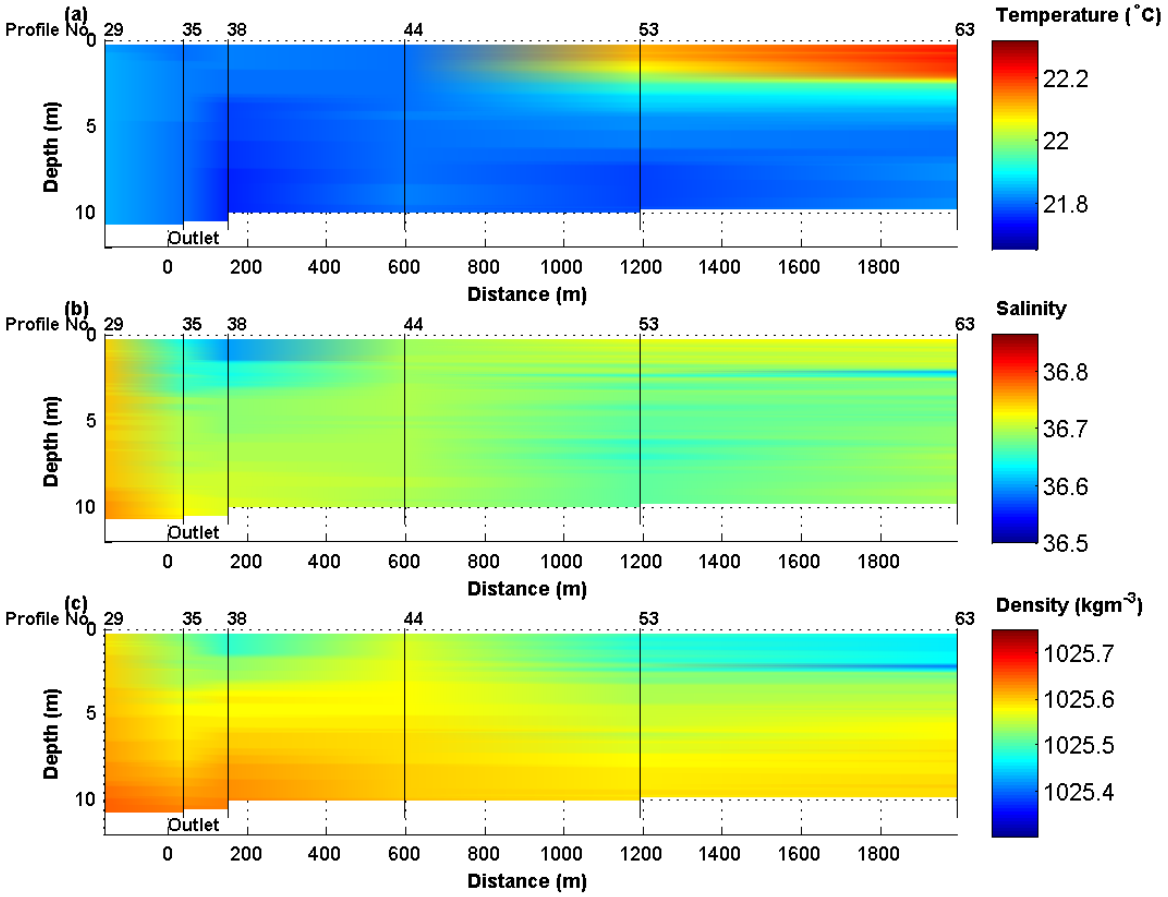


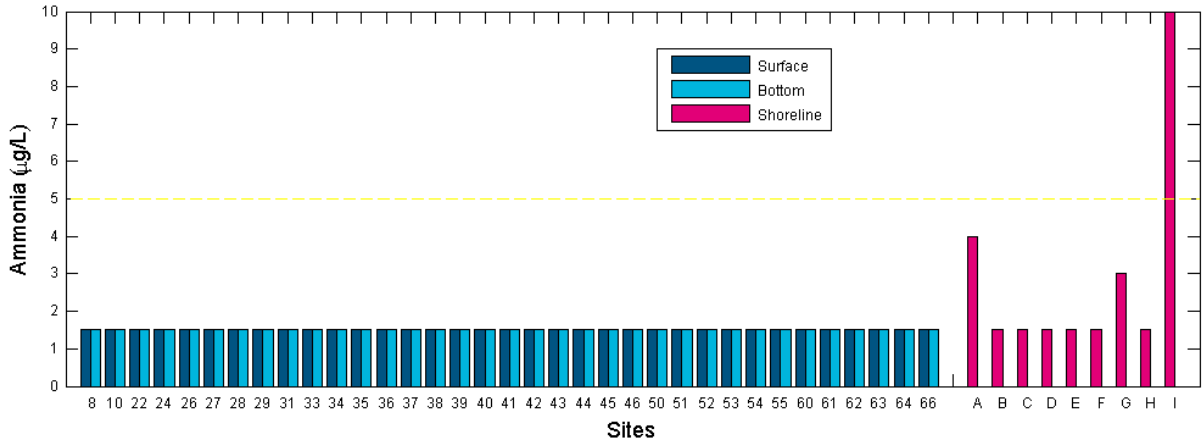
Figure 3.7 Temperature (a), salinity (b) and density (c) transect at Swanbourne

3.5 Nutrients

Total Ammonia Nitrogen ($HN_4^+ + NH_3$)

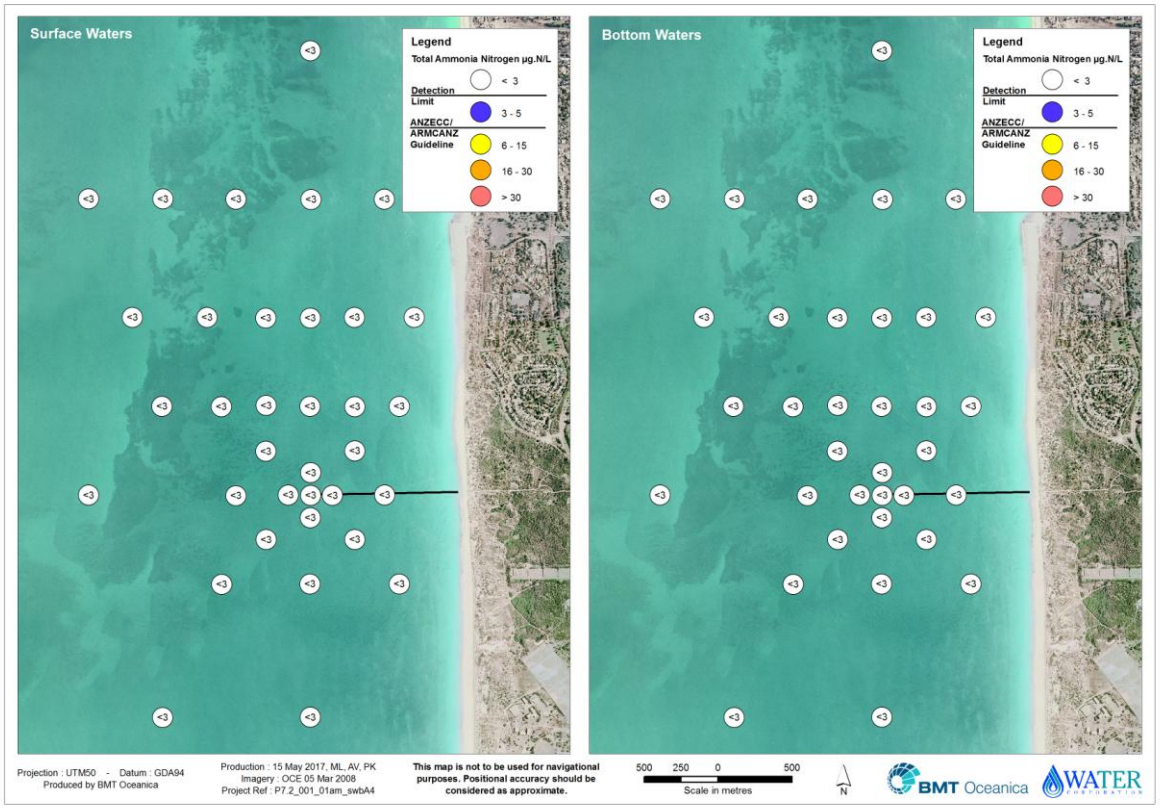
All offshore surface and bottom ammonia concentrations around the Swanbourne diffuser were at the limit of reporting (3 µg/L) (Figure 3.8 and Figure 3.9). Median concentrations (surface and bottom, both within and outside 250 m of the diffuser) were therefore also below the ANZECC & ARMCANZ (2000) default guideline and 80th percentile of reference concentrations (Table 3.3).

Ammonia concentrations at one shoreline location exceeded the ANZECC & ARMCANZ (2000) default guideline (Figure 3.8 and Figure 3.9). Pockets of elevated ammonia concentrations at this distance from the diffuser are likely from terrestrial sources rather than the influence of the outlet. Nevertheless, median shoreline concentrations still met the ANZECC & ARMCANZ (2000) default guideline (Table 3.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 3.8 Total ammonia nitrogen concentrations at Swanbourne



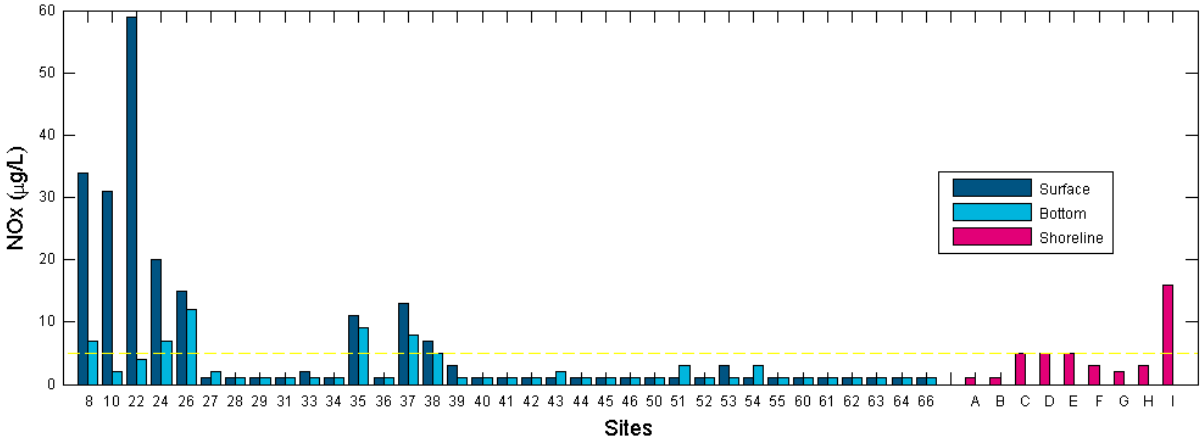
Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.9 Spatial distribution of total ammonia nitrogen at Swanbourne

Nitrate+nitrite (NO_2^-+NO_3^-)

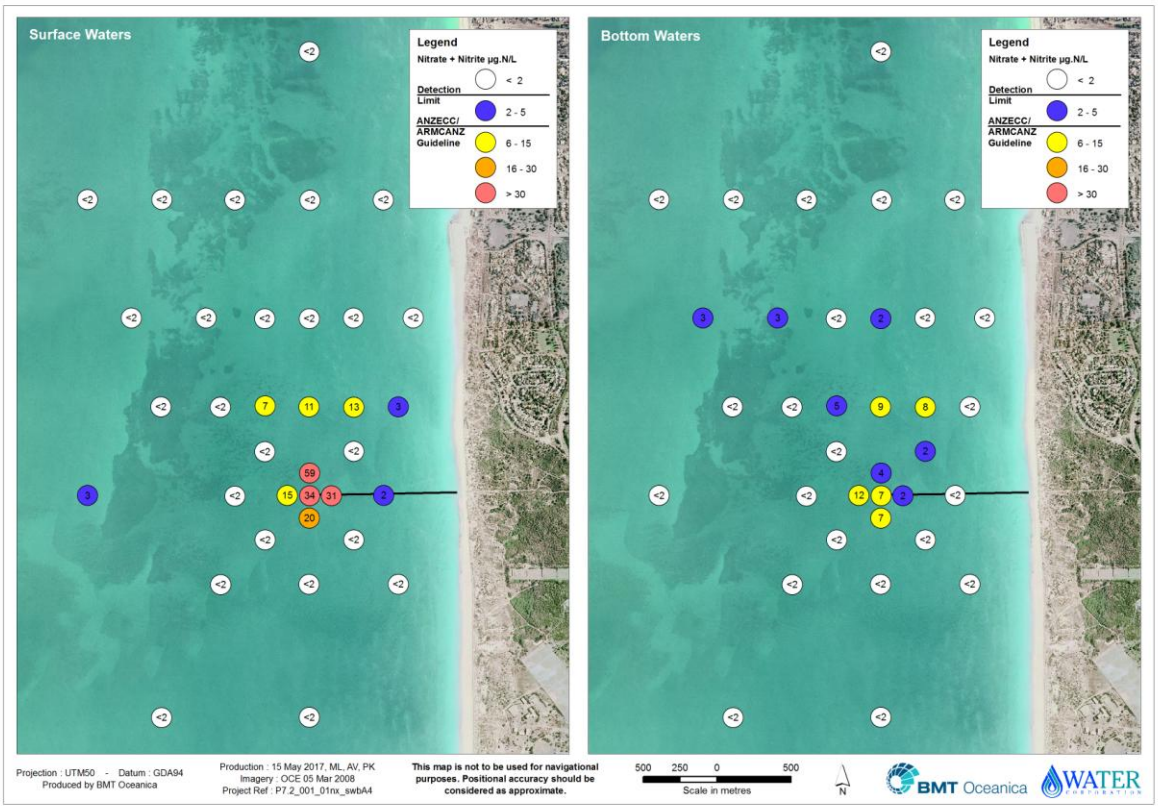
Offshore, 8 (23%) surface and 5 (14%) of bottom sample concentrations exceeded the ANZECC & ARMCANZ (2000) guideline, while 8 (23%) surface and 7 (20%) bottom sample concentrations exceeded the 80th percentile of reference site concentrations (Figure 3.10 and Figure 3.11). The median concentration of nitrate + nitrite at the

surface and bottom within 250 m of the outlet exceeded the ANZECC & ARMCANZ (2000) guideline (Table 3.3). The median concentration of samples >250 m from the diffuser was below the ANZECC & ARMCANZ (2000) guideline (Table 3.3). One (11%) shoreline sample exceeded the ANZECC & ARMCANZ (2000) guideline but the median nitrate + nitrite concentration from the shoreline stations was below the ANZECC & ARMCANZ (2000) guideline (Table 3.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 3.10 Total nitrate+nitrite concentrations at Swanbourne

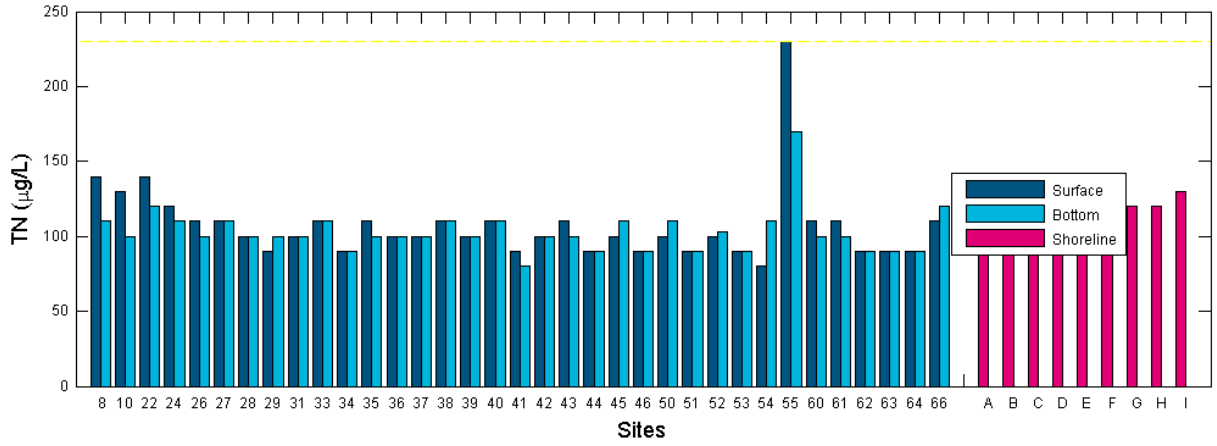


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.11 Spatial distribution of nitrate+nitrite at Swanbourne

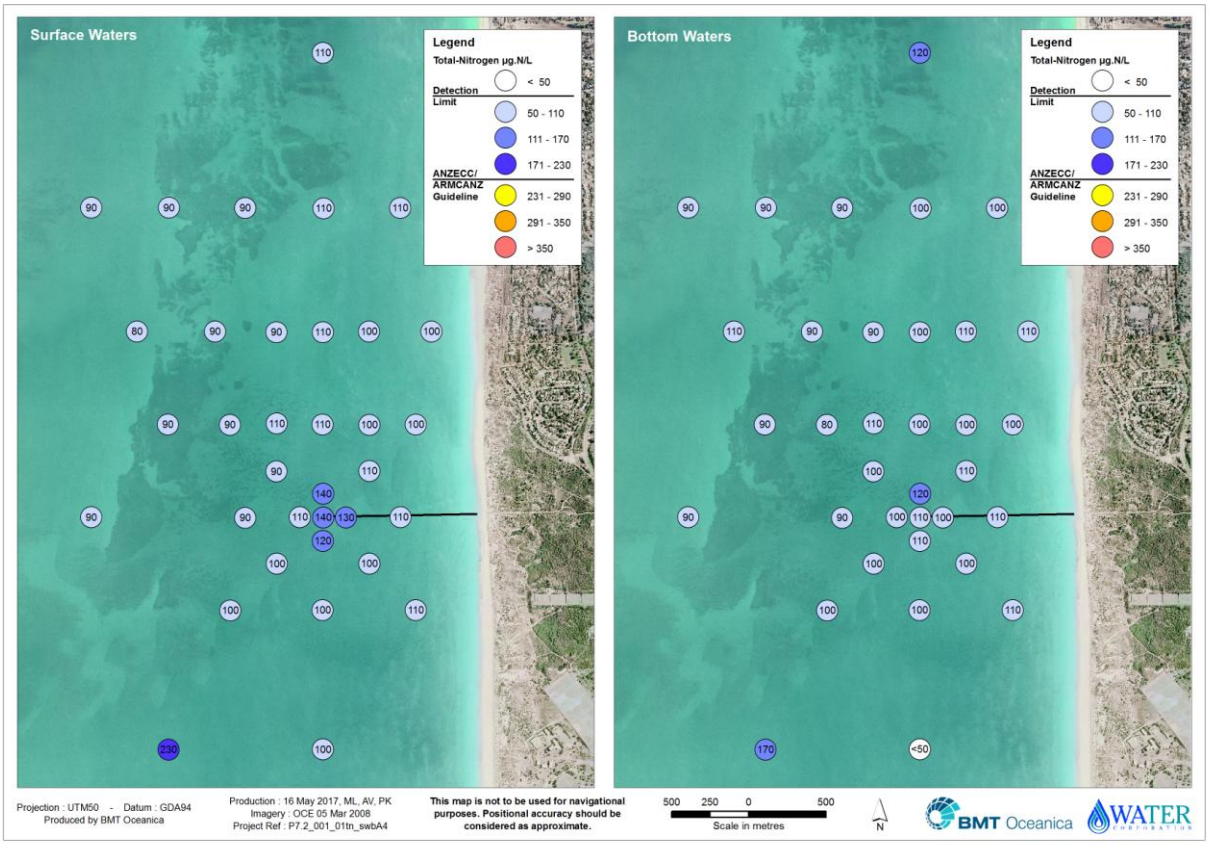
Total nitrogen

Total nitrogen concentrations at all offshore and shoreline sites were lower than or equal to the ANZECC & ARMCANZ (2000) guideline value (Figure 3.12 and Figure 3.13). One (3%) surface and one (3%) bottom sample exceeded the 80th percentile of reference site concentrations (Figure 3.12 and Figure 3.13). Median surface and bottom concentrations within and outside 250 m of the outlet were below the 80th percentile of reference site concentrations (Table 3.3). Total nitrogen concentrations were below the ANZECC & ARMCANZ (2000) guideline value at each shoreline site (Figure 3.12 and Figure 3.13).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline.

Figure 3.12 Total nitrogen concentrations at Swanbourne

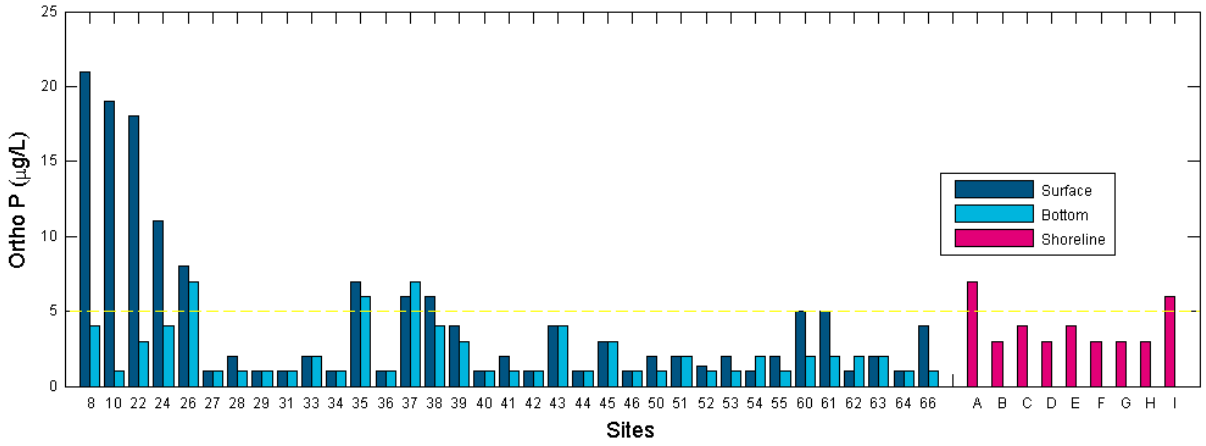


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.13 Spatial distribution of total nitrogen at Swanbourne

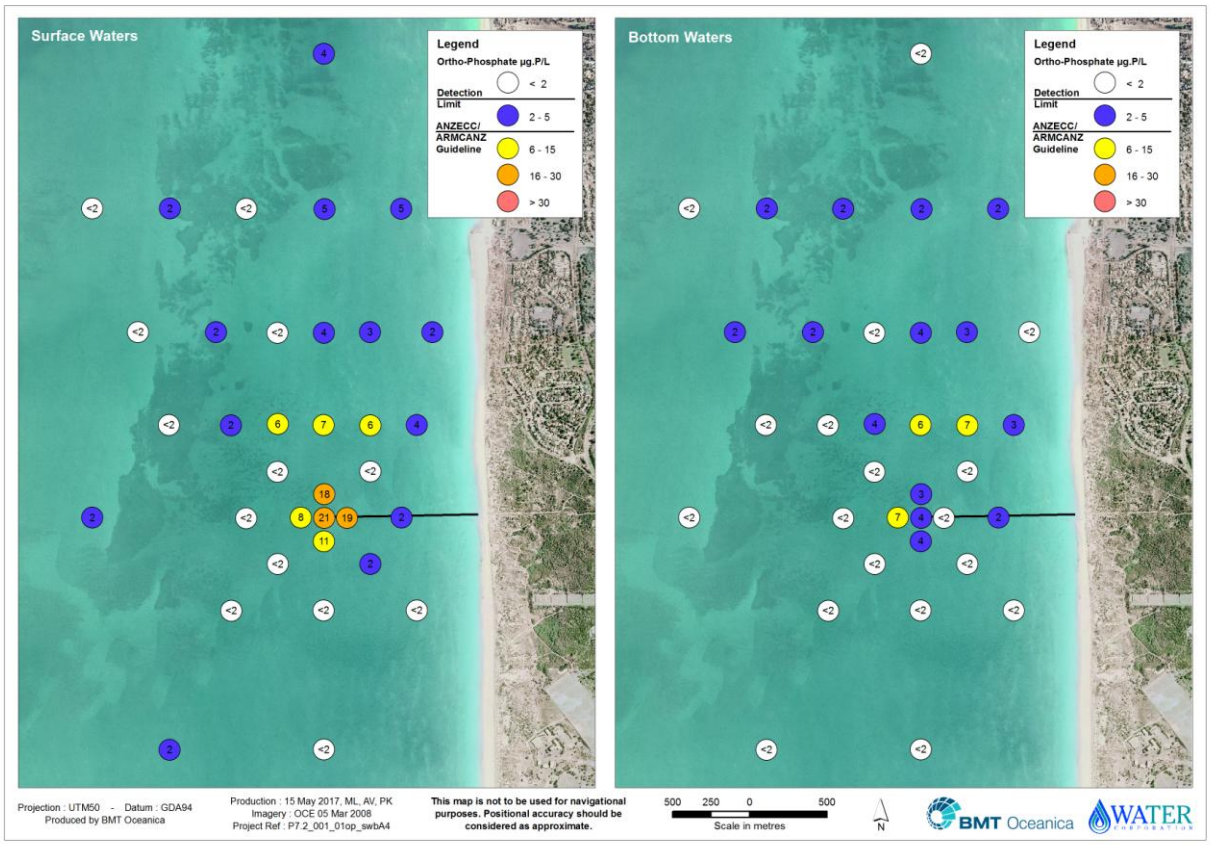
Orthophosphate

Offshore, 8 (23%) of surface and 3 (9%) of bottom sample concentrations exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 3.14 and Figure 3.15). The ANZECC & ARMCANZ (2000) guideline is lower than the 80th percentile of background but 4 (11%) of surface and 2 (6%) of bottom samples exceeded the 80th percentile of reference concentrations (Figure 3.14 and Figure 3.15). Median concentrations of orthophosphate at the surface and near the bottom were higher than both guidelines <250 m from the outlet but below both guidelines >250 m from the outlet (Table 3.3). Two of the 8 shoreline sites exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 3.14 and Figure 3.15).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 3.14 Ortho-phosphate concentrations at Swanbourne



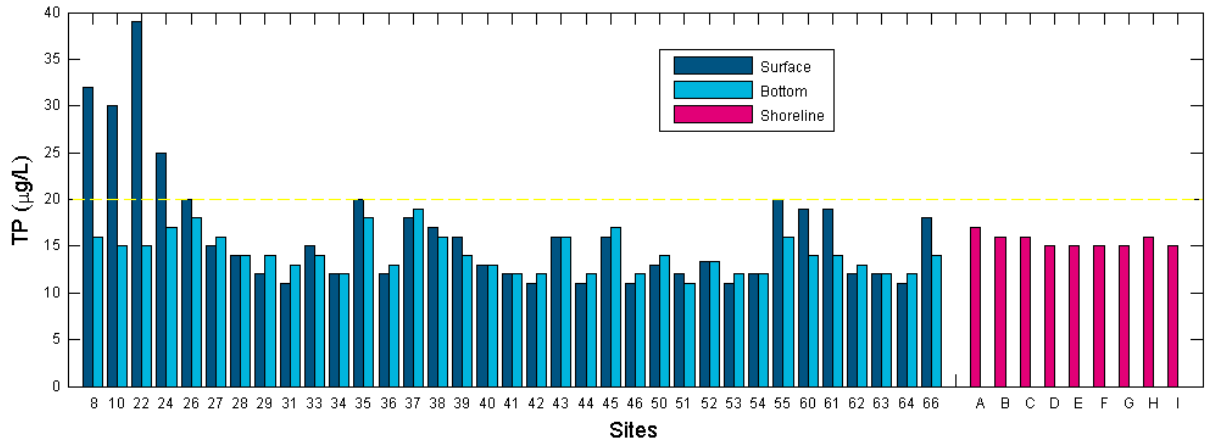
Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.15 Spatial distribution of ortho-phosphate at Swanbourne

Total Phosphorus (TP)

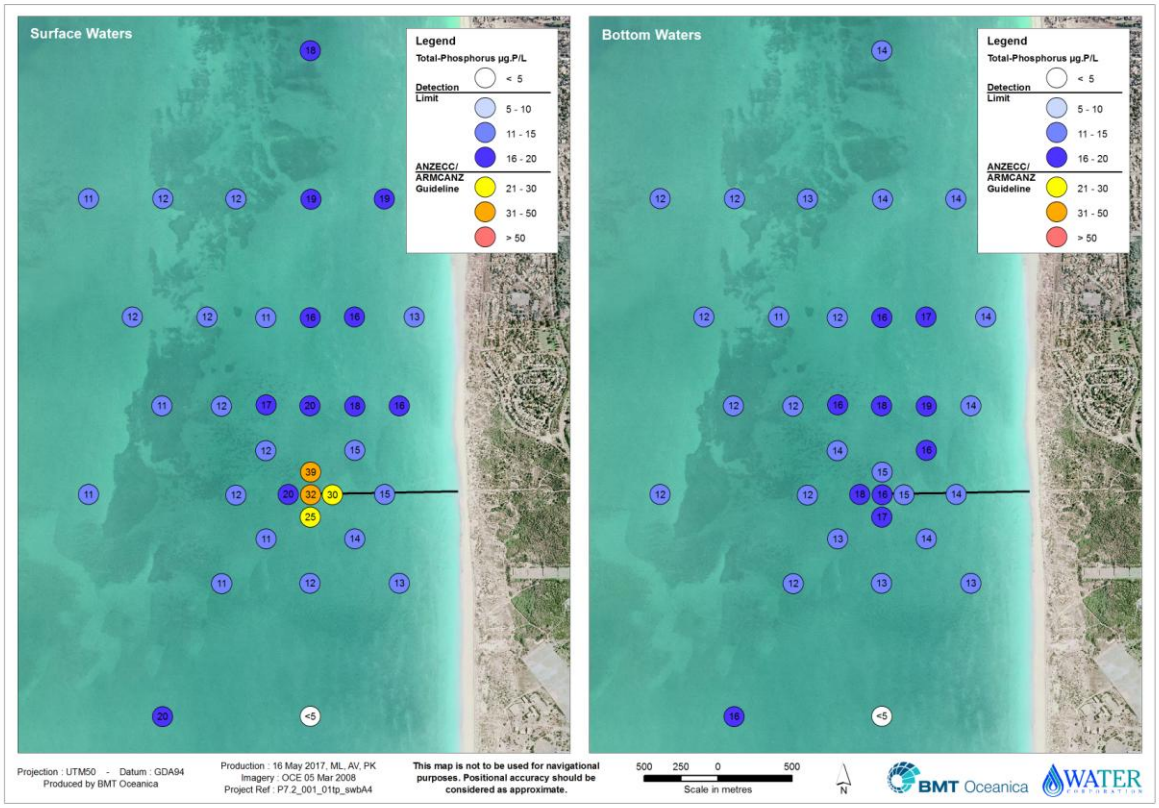
4 (11%) surface samples and no bottom samples exceeded the ANZECC & ARMCANZ (2000) guideline, while 1 (3%) surface and no bottom samples exceeded the 80th percentile of reference concentrations (Figure 3.16 and Figure 3.17). Shoreline concentrations did not exceed the ANZECC & ARMCANZ (2000) guideline (Figure 3.16

and Figure 3.17). Only the median concentrations at the surface inside 250 m exceeded the ANZECC & ARMCANZ (2000) guideline. Median concentrations did not exceed the 80th percentile of reference concentrations (Table 3.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 3.16 Total phosphorus concentrations at Swanbourne

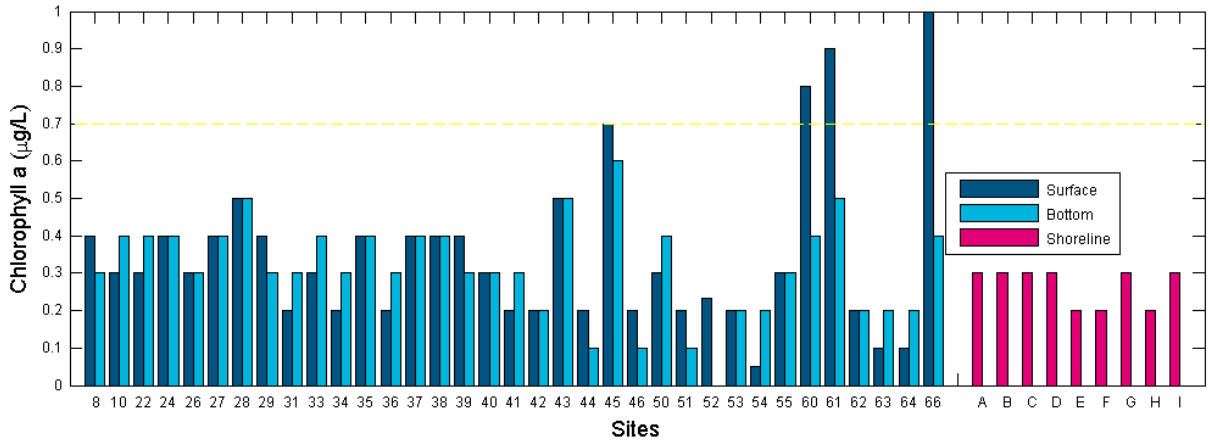


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.17 Total phosphorus concentrations at Swanbourne

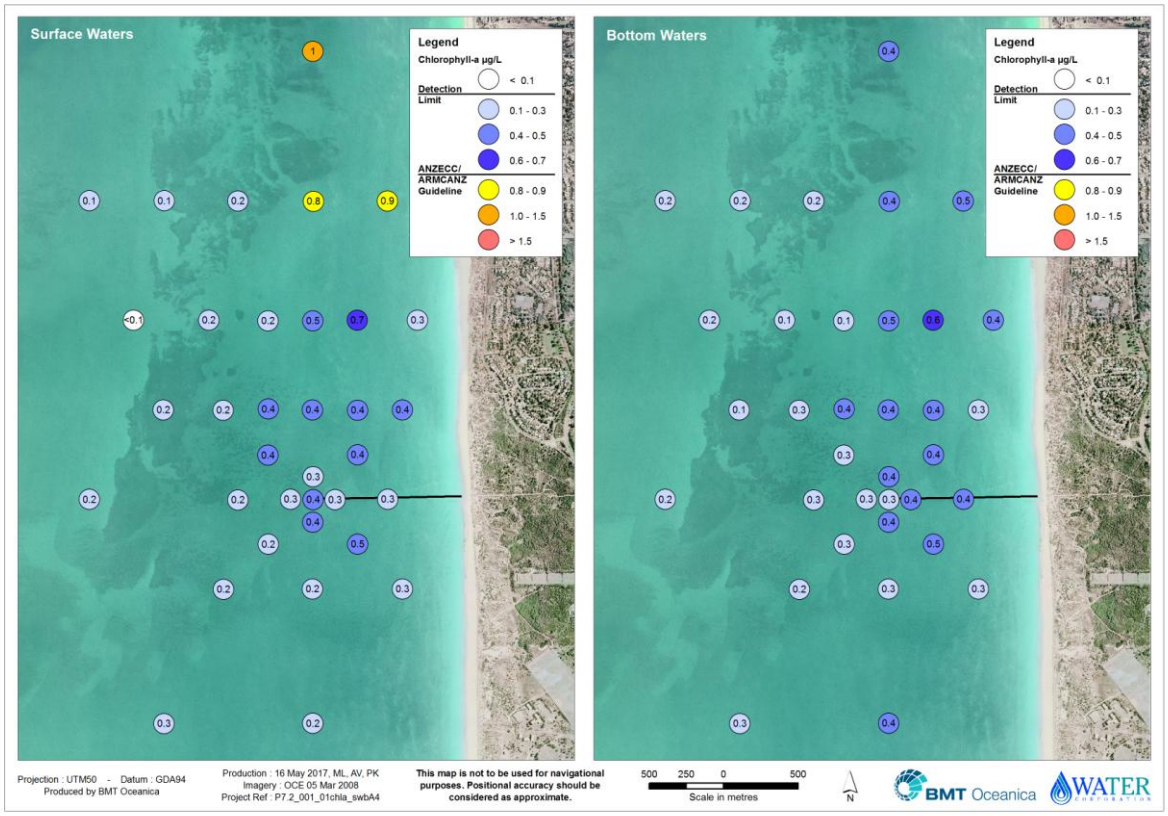
3.6 Chlorophyll

Three surface samples (9%) all located a significant distance down current of the diffuser exceeded the ANZECC & ARMCANZ (2000) guideline for chlorophyll. 4 (11%) surface samples exceeded the 80th percentile of reference site concentrations for chlorophyll (Figure 3.18 and Figure 3.19). No individual shoreline samples exceeded the ANZECC & ARMCANZ (2000) guideline for chlorophyll (Figure 3.18 and Table 3.3). Median concentrations inside and outside 250 m of the diffuser were below the ANZECC & ARMCANZ (2000) guideline for chlorophyll and 80th percentile of reference site concentrations (Table 3.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline.

Figure 3.18 Chlorophyll-a concentrations at Swanbourne

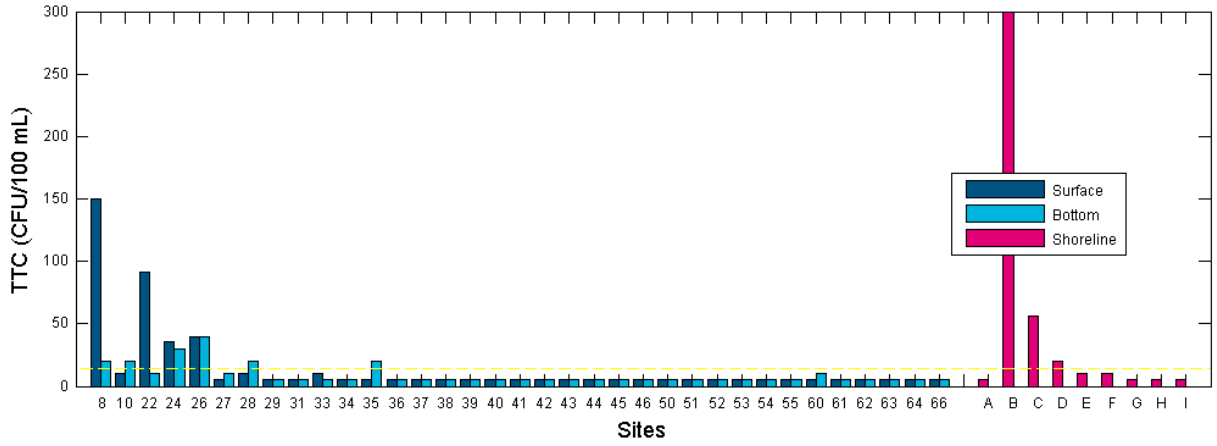


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.19 Spatial distribution of chlorophyll-a concentrations at Swanbourne

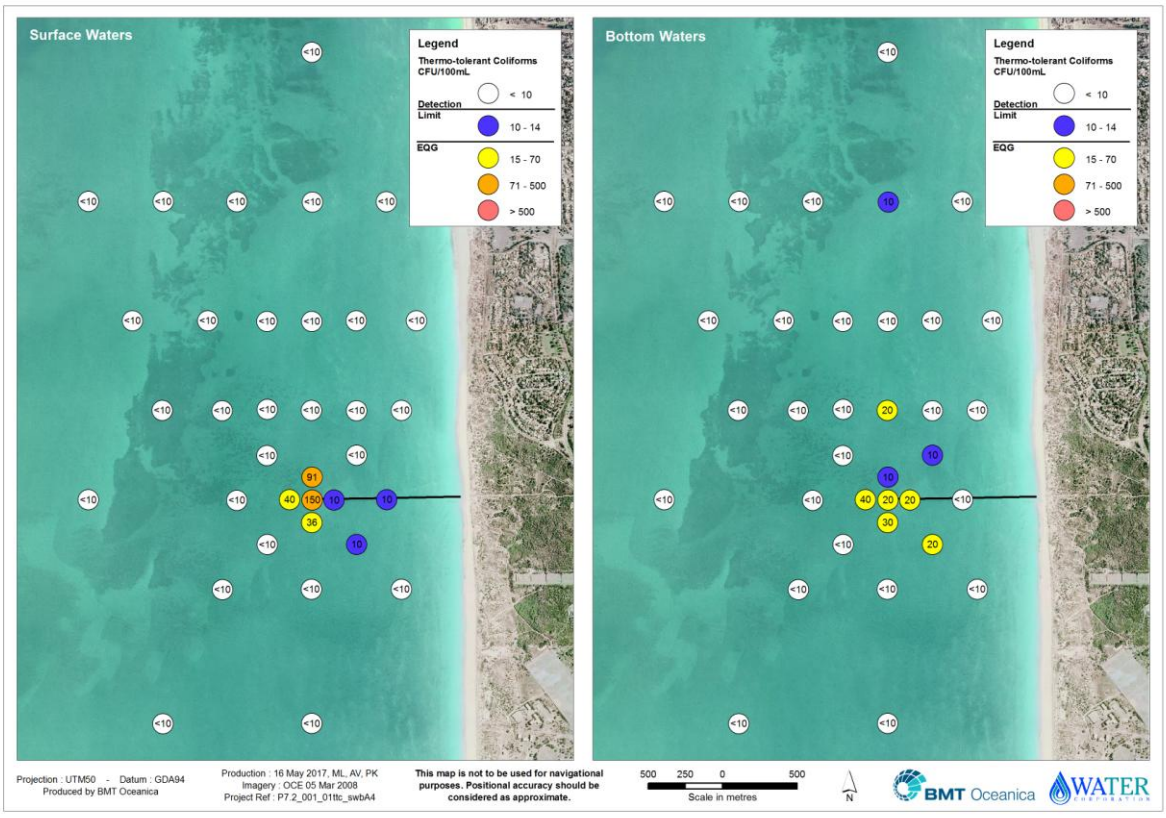
3.7 Microbial community

Four (11%) surface and 6 (17%) bottom TTC concentrations exceed the EPA (2015b) EQG trigger (Figure 3.20 and Figure 3.21). The median surface and the bottom concentrations from sites <250 m from the diffuser both exceeded the EPA (2015b) EQG trigger (Table 3.3). Beyond 250 m, surface and bottom median concentrations were equivalent to the limit of detection and the EQG trigger was met (Table 3.3). A total of 3 (33%) shoreline stations exceeded the EPA (2015b) EQG trigger (Figure 3.20). These sites are well removed from the influence of the plume and these elevated concentrations reflect terrestrial inputs. Nevertheless, the median concentrations of shoreline TTC concentrations were below the EQG trigger (Table 3.3).



Note:
1. Dashed line indicates EQG (EPA 2015b) guideline

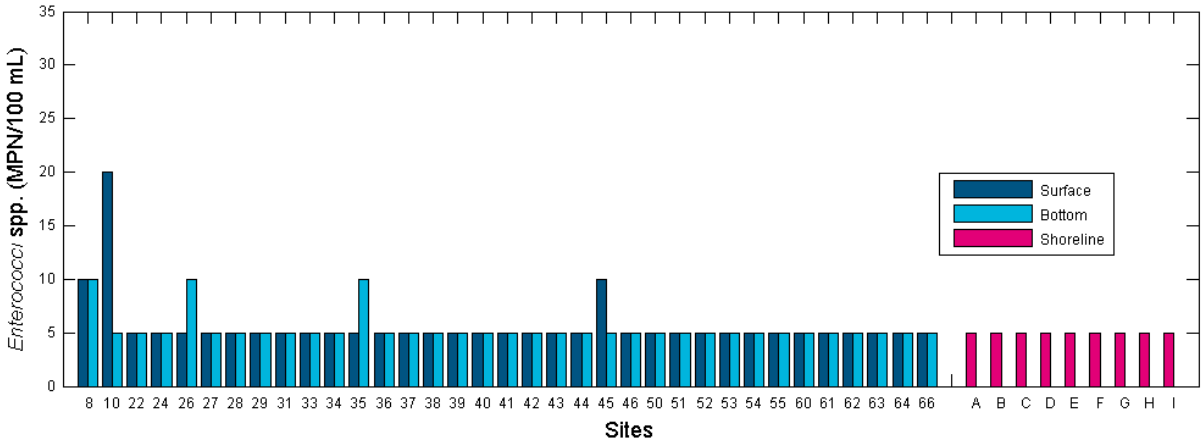
Figure 3.20 Thermotolerant coliform concentrations at Swanbourne



Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or EQG.

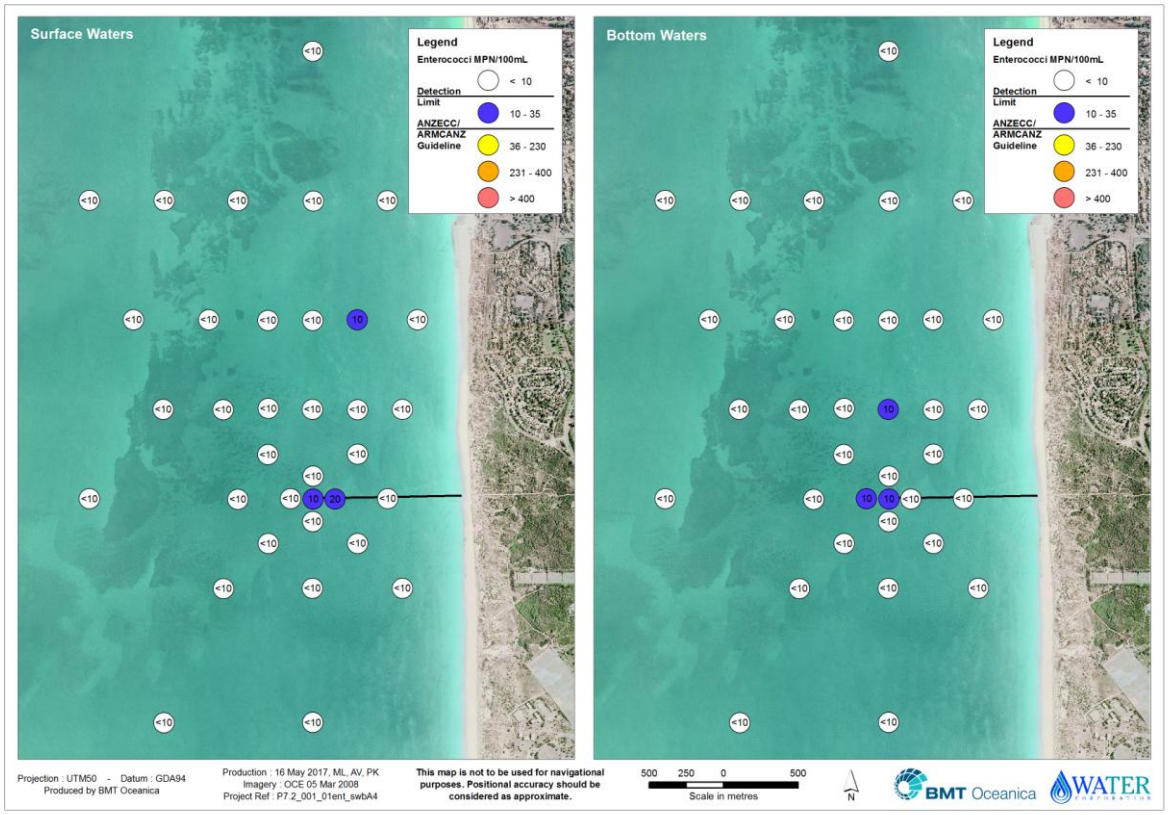
Figure 3.21 Spatial distribution of thermotolerant coliform concentrations at Swanbourne

The highest *Enterococci* spp. concentrations were at the surface and bottom sites nearest the diffuser (Figure 3.22 and Figure 3.23). Nevertheless, *Enterococci* spp concentrations at all sites and the overall median concentrations were all below the ANZECC & ARMCANZ (2000) trigger (Table 3.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 3.22 *Enterococci* spp. concentrations at surface Swanbourne



Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 3.23 Spatial distribution of *Enterococci* spp. at Swanbourne

3.8 Summary

The summer water quality surveys were not specifically designed for comparison with the ANZECC & ARMCANZ (2000) guidelines or with 80th percentile of reference values but comparisons were made for sites located <250 m and >250 m from the diffuser as an indicator rather than a means of assessing 'compliance.

Despite elevated concentrations at some individual sites outside the immediate zone of influence of the outlet, the guidelines for demonstrating ecosystem protection and public health criteria were met (Table 3.2).

During the survey, the treated wastewater plume was initially buoyant (as indicated by the lower salinity and slightly higher concentrations of nutrients and microbiological indicators in surface waters than in bottom waters) and was advecting in a west north westerly direction. Surface nutrients were typically elevated within 250 m of the diffuser but median concentrations were diluted to below the guidelines beyond 250 m (Table 3.2). There was no indication that the wastewater nutrients were stimulating detectable increases in phytoplankton (chlorophyll) within or outside the 250 m area around the diffuser (Table 3.2).

Median *Enterococci* spp. concentrations were below the guideline for recreation contact in surface and bottom waters within and outside 250 m of the diffuser (Table 3.2). Thermotolerant coliform (TTC) concentrations were below the maintenance of seafood safe for human consumption, respectively and in surface and bottom waters >250 m from the diffuser (Table 3.2. Shoreline monitoring found no indication of contamination of adjacent beaches (Table 3.2). Results suggest that these waters are maintained for recreation and seafood quality.

Table 3.2 Summary Swanbourne

Parameter	Inside the mixing zone (sites <250 m from diffuser)		Outside the mixing zone (sites >250 m from diffuser)		Shoreline
	Surface	Bottom	Surface	Bottom	
ANZECC & ARMCANZ (2000) guideline values					
Total ammonia nitrogen					
Ortho-phosphate					
Nitrate+nitrite					
Total phosphorus					
Total nitrogen					
Chlorophyll-a					
Enterococci spp.[3]					
80th percentile of reference values					
Total ammonia nitrogen					
Ortho-phosphate					
Nitrate+nitrite					
Total phosphorus					
Total nitrogen					
Chlorophyll-a					
Environmental Quality Guideline (EPA 2015b)					
Thermotolerant coliforms[4]					

Notes:

1. Green = median values ≤ ANZECC & ARMCANZ (2000) guideline values , ≤80th percentile reference values or ≤ EQG.
2. Red = Median values > ANZECC & ARMCANZ (2000) guideline values , >80th percentile reference values or > EQG
3. For the maintenance of seafood safe for human consumption
4. For primary contact recreation

Table 3.3 Summary statistics for Swanbourne

Parameter	depth	lowest		highest		Median		number (%) below the guideline		number (%) below 80th percentile of reference	
		Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Ammonia (NH4)	All	1.5	1.5	1.5	1.5	1.5	1.5	35 (100)	35 (100)	35 (100)	35 (100)
	Inside 250 m	1.5	1.5	1.5	1.5	1.5	1.5	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	1.5	1.5	1.5	1.5	1.5	1.5	30 (100)	30 (100)	30 (100)	30 (100)
	Shoreline	1.5	NA	10	NA	1.5	NA	8 (89)	NA	NA	NA
Nitrate + nitrite	All	1	1	59	12	1	1	27 (77)	30 (86)	27 (77)	28 (80)
	Inside 250 m	15	2	59	12	31	7	0 (0)	2 (40)		1 (20)
	Outside 250 m	1	1	13	9	1	1	27 (90)	28 (93)	27 (90)	27 (90)
	Shoreline	1	NA	16	NA	3	NA	8 (89)	NA	NA	NA
Total nitrogen	All	80	80	230	170	100	100	35 (100)	35 (100)	34 (97)	34 (97)
	Inside 250 m	110	100	140	120	130	110	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	80	80	230	170	100	100	30 (100)	30 (100)	29 (97)	29 (97)
	Shoreline	120	NA	140	NA	130	NA	9 (100)	NA	NA	NA
Ortho-phosphate	All	1	1	21	7	2	1	27 (77)	32 (91)	31 (89)	33 (94)
	Inside 250 m	8	1	21	7	18	4	0 (0)	4 (80)	1 (20)	4 (80)
	Outside 250 m	1	1	7	7	2	1	27 (90)	28 (93)	30 (100)	29 (97)
	Shoreline	3	NA	7	NA	3	NA	7 (78)	NA	NA	NA
Total phosphorus	All	11	11	39	19	14	14	31 (89)	35 (100)	34 (97)	35 (100)
	Inside 250 m	20	15	39	18	30	16	1 (20)	5 (100)	4 (80)	5 (100)
	Outside 250 m	11	11	20	19	13	14	30 (100)	30 (100)	30 (100)	30 (100)
	Shoreline	15		17	NA	15	NA	9 (100)	NA	NA	NA
Chlorophyll a	All	0.05	0.1	1	0.6	0.3	0.3	32 (91)	35 (100)	31 (89)	34 (97)
	Inside 250 m	0.3	0.3	0.4	0.4	0.3	0.4	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	0.05	0.1	1	0.6	0.3	0.3	27 (90)	30 (100)	26 (87)	29 (97)
	Shoreline	0.2	NA	0.3	NA	0.3	NA	9 (100)	NA	NA	NA
Thermotolerant coliforms	All	5	5	150	40	5	5	31 (89)	29 (83)	NA	NA
	Inside 250 m	10	10	150	40	40	20	1 (20)	1 (20)	NA	NA
	Outside 250 m	5	5	10	20	5	5	30 (100)	28 (93)	NA	NA
	Shoreline	5	NA	300	NA	10	NA	6 (67)	NA	NA	NA
Enterococci spp.	All	5	5	20	10	5	5	35 (100)	35 (100)	NA	NA
	Inside 250 m	5	5	20	10	5	5	5 (100)	5 (100)	NA	NA
	Outside 250 m	5	5	10	10	5	5	30 (100)	30 (100)	NA	NA
	Shoreline	5	NA	5	NA	5	NA	9 (100)	NA	NA	NA

Notes:
1. NA = Comparison not applicable

4. Ocean Reef

4.1 The survey

The annual summer water quality survey at Ocean Reef was completed on 7 February 2017.

4.2 Discharge

A discrete sample of treated wastewater was collected from the Beenyup WWTP on 7 February 2017 (during the ocean survey) (Table 4.1). At the time of the survey there were 50 ports open on Outlet A and 48 ports on Outlet B. Discharge was evenly split between the outlets.

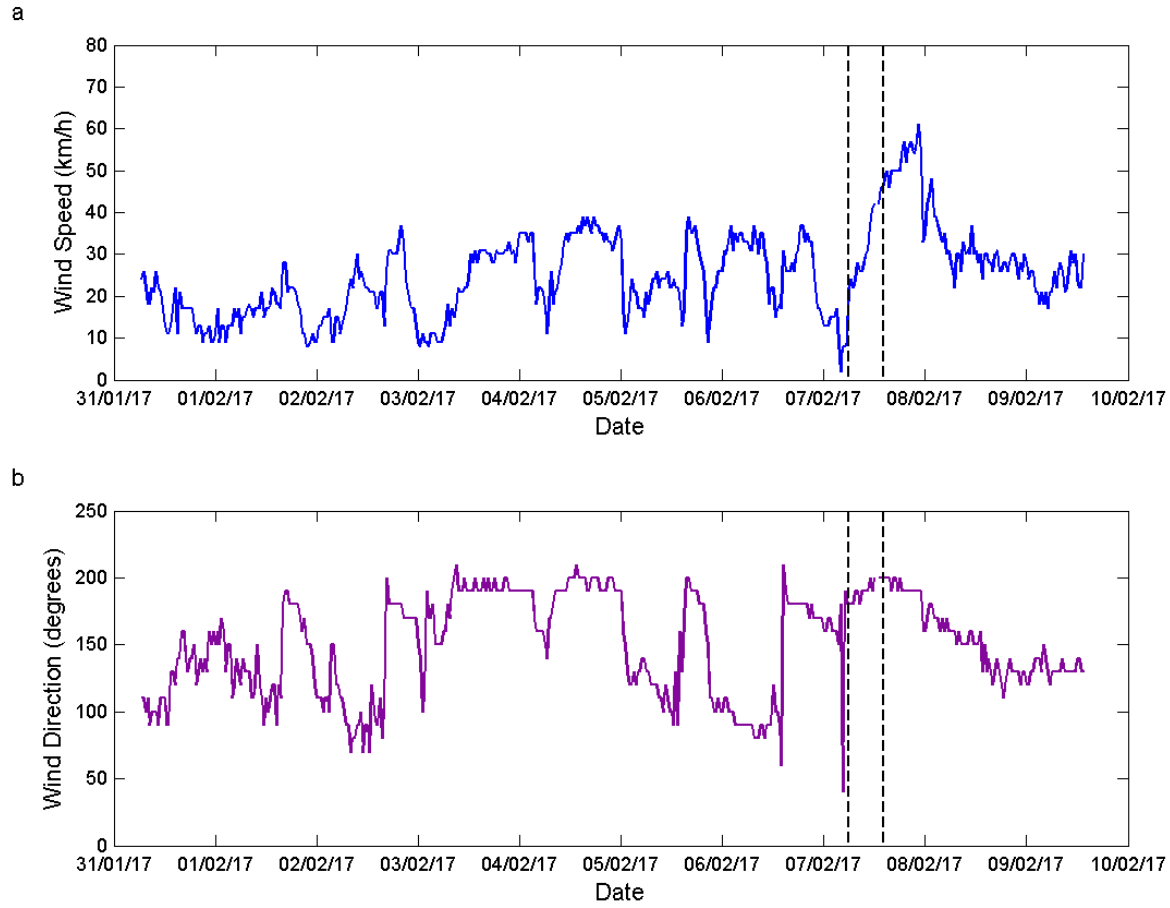
Table 4.1 Beenyup treated wastewater characteristics on 7 February 2017

Parameter	Concentration
Total phosphorus	8.7 mg/L
Total nitrogen	21 mg/L
Total ammonia nitrogen	0.12 mg/L
Nitrate+nitrite	21 mg/L
Thermotolerant coliforms	25 000 CFU/100 mL
Enterococci spp.	1300 MPN/100 mL
Total suspended solids	21 mg/L
Biological oxygen demand	7 mg/L
Total flow (combined outlet A and B)	125 ML/d

4.3 Environmental characteristics

4.3.1 Wind

For 24 hours prior to the survey, the winds at Ocean Reef were mostly fresh (averaging 32.2 km/h) to gentle easterlies (averaging 18.4 km/h), before shifting to fresh southerlies (average 30.7 km/h) that gradually abated (to ~9 km/h) over the 8 hour period prior to the commencement of sampling. An increase in the strength of the southerlies to ~24 km/h coincided with the commencement of sampling and built throughout the day culminating in a strong winds 40-46 km/h in the early afternoon (Figure 4.1).



Note:
1. a = wind speed
2. b = wind direction
3. Dashed lines (- -) show approximate timing of the summer water quality survey.

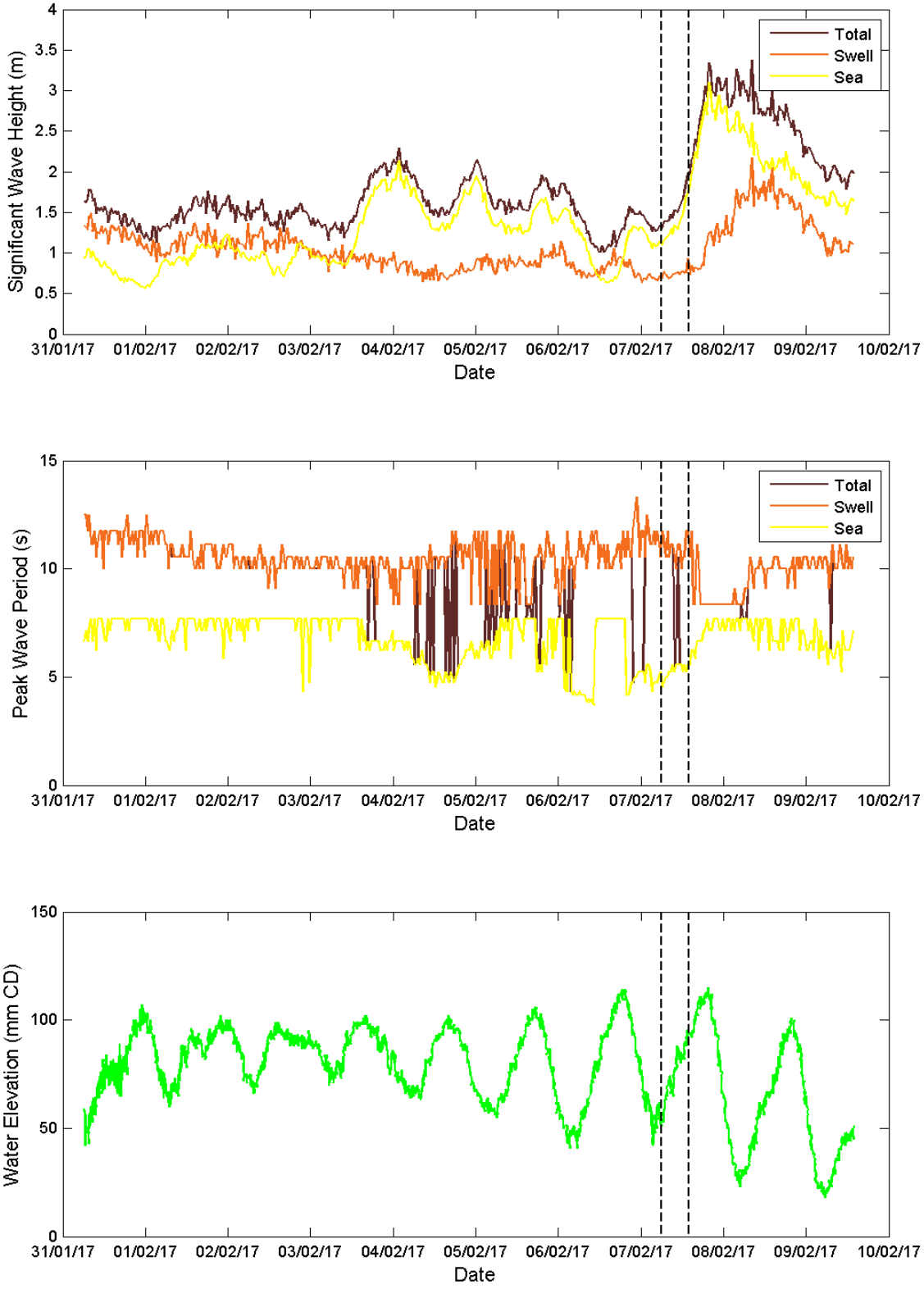
Figure 4.1 Wind speed and wind direction at Ocean Reef

4.3.2 Waves and tide

For 24 hours prior to the survey, the average significant wave height[12] offshore from Rottnest Island was 1.3 m, with an average peak wave period[13] of 10.1 s (Figure 4.2). During the survey the average offshore significant wave height was 1.5 m with an average peak wave period of 8.3 s. The survey was completed during a rising tide (Figure 4.2).

[12] *The significant wave height (in metres) is defined as the average height of the highest one-third of waves recorded (source: http//www.dpi.wa.gov.au/)*

[13] *The wave period (in seconds) is the time between consecutive wave crests. The peak wave period is the wave period of those waves that are producing the most energy in a wave record*



Note:
1. Dashed lines (- -) show approximate timing of the survey

Figure 4.2 Significant wave heights (offshore Rottnest Island), peak wave periods (offshore Rottnest Island) and water level elevation (Fremantle Fishing Boat Harbour)

4.3.3 Currents

The surface drogue, released at the centre of the diffuser at the beginning of the survey, drifted in a northerly direction for duration of its passage. The average velocity of the drogue over the route was 0.15 m/s. At the time of the survey and based on drogue movements, it is expected that discharged treated wastewater would have travelled in a northerly direction and offshore of the diffuser (Figure 4.3).

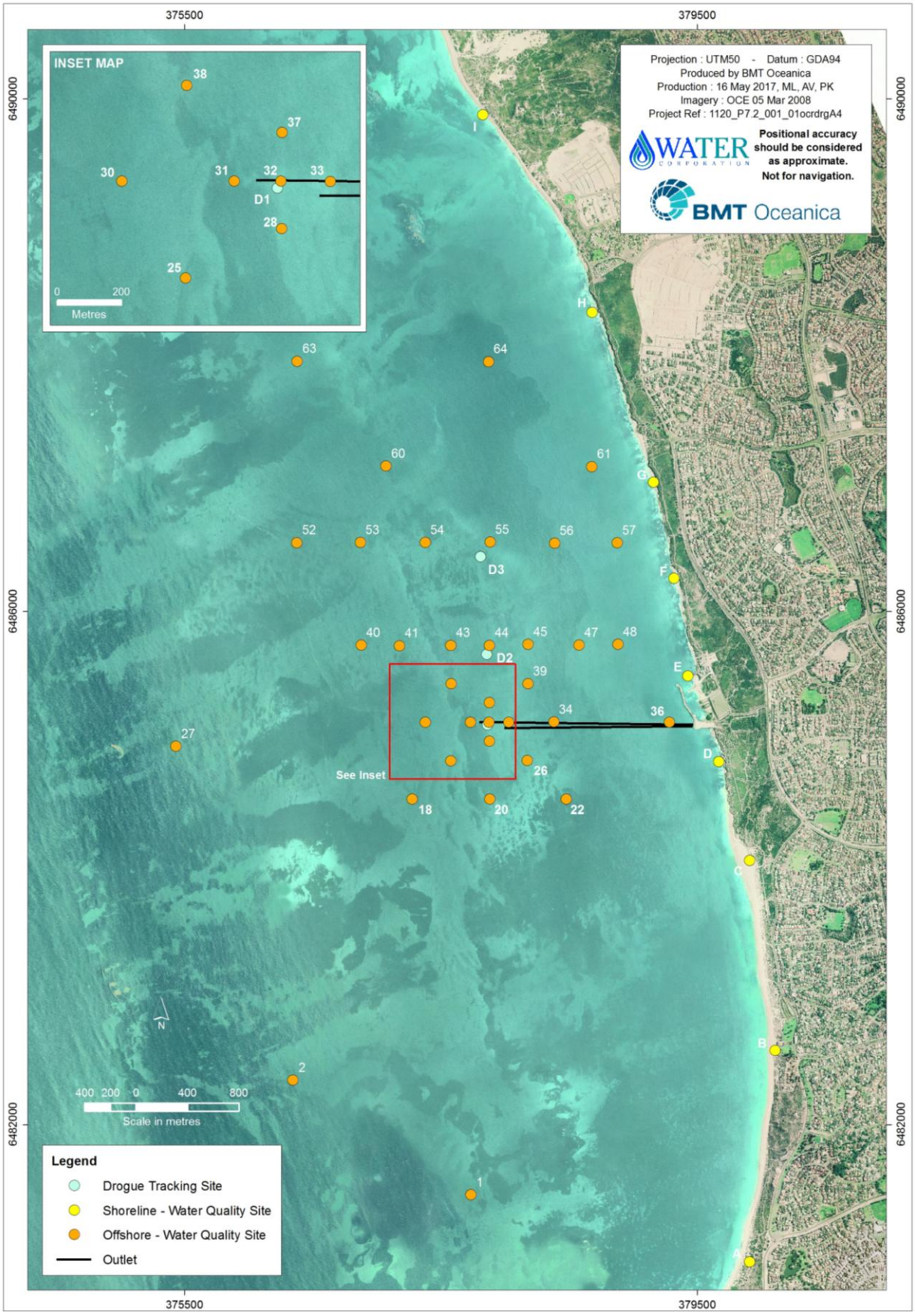
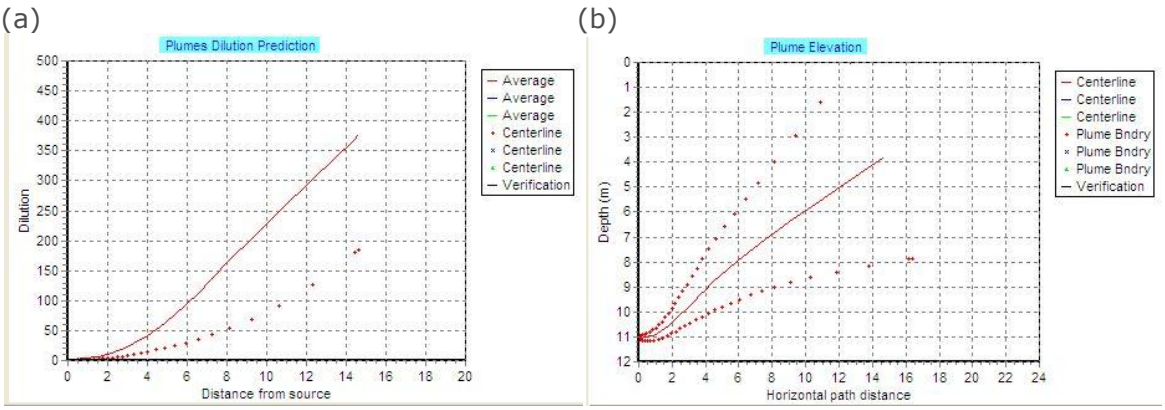


Figure 4.3 Ocean Reef drogue tracking locations, 7 February 2017

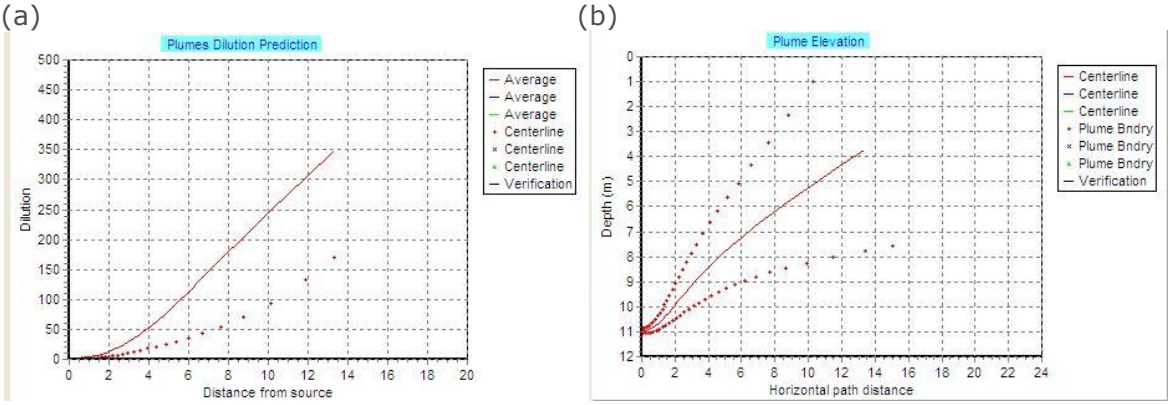
4.3.4 Initial dilution

For ambient conditions at the time of the Ocean Reef survey, the modelling predicted average initial dilutions of 1:377 for Outlet A and 1:348 for Outlet B with centreline dilutions of 1:185 for Outlet A and 1:171 for Outlet B (Figure 4.4a and Figure 4.5a). The plume was predicted to first reach the surface within ~13-15 m (horizontal distance) from the discharge point (see the ambient boundary[14] of the plume in Figure 4.4b and Figure 4.5b). The full model output is included in Appendix C.



Notes:
1. a = predicted average and centreline dilution
2. b = predicted plume elevation

Figure 4.4 Predicted average and centreline dilutions and predicted plume elevation trajectory for Outlet A at Ocean Reef



Notes:
1. a = predicted average and centreline dilution
2. b = predicted plume elevation

Figure 4.5 Predicted average and centreline dilutions and predicted plume elevation trajectory for Outlet B at Ocean Reef

4.4 Water column structure

Water temperature from 8 sites profiled ranged from 22.63°C to 22.87°C, salinity ranged from 36.12 to 36.44 and dissolved oxygen varied from 6.70 mg/L to 7.27 mg/L (equivalent to 95.8–104% saturation) (Figure 4.6 and Figure 4.7). There were no thermoclines evident at any site (Figure 4.6 and Figure 4.7). Salinity was slightly reduced at the surface relative to deeper waters at three sites (32, 33 and 37) near the diffuser (Figure 4.6 and Figure 4.7). Dissolved oxygen was not depleted by the treated wastewater plume or any other process at any site (Figure 4.6 and Figure 4.7).

[14] *The ambient boundary corresponds to the plume boundary at which concentrations are estimated to be equal to ambient conditions.*

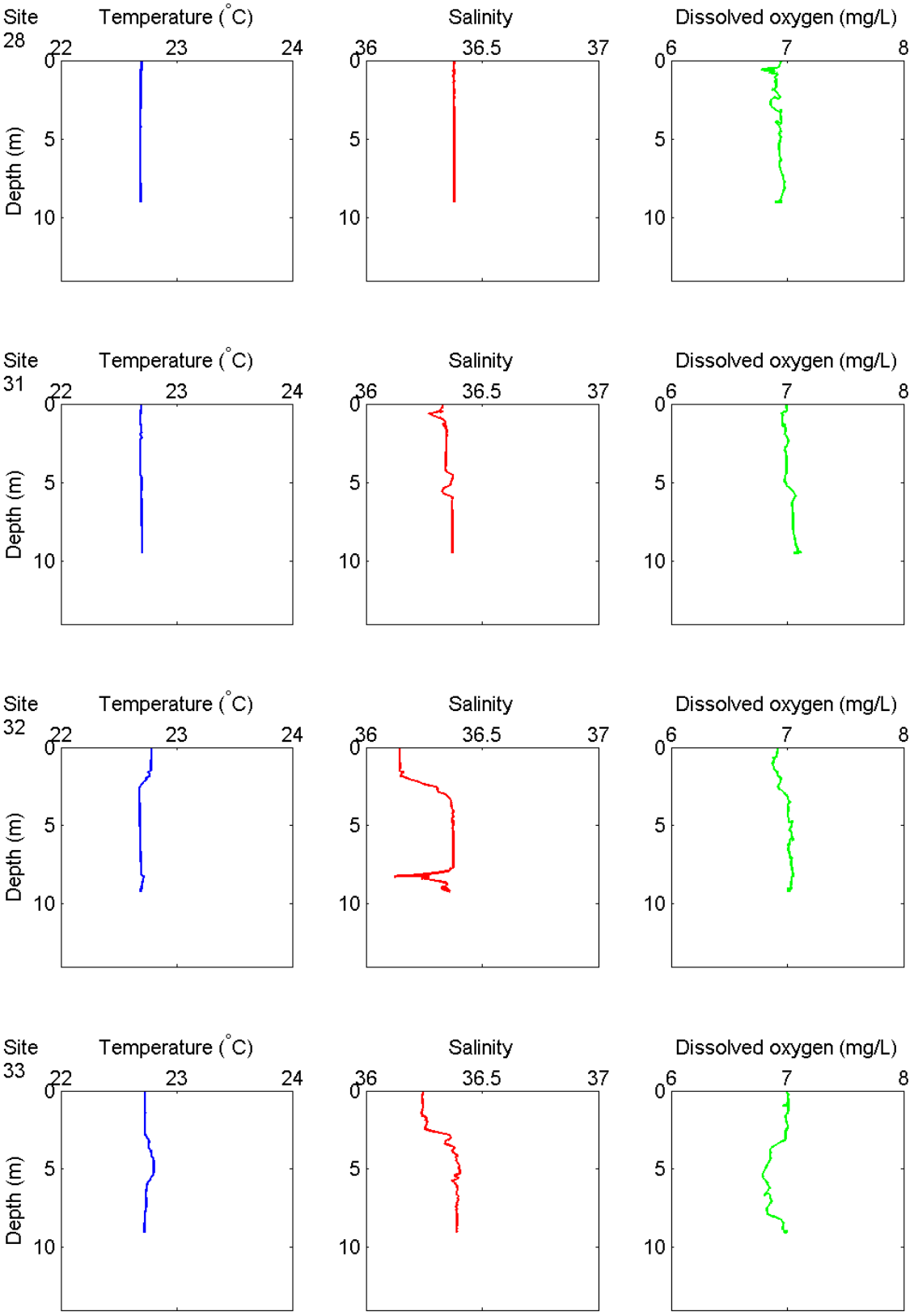


Figure 4.6 Temperature, salinity and dissolved oxygen vertical profiles at Ocean Reef

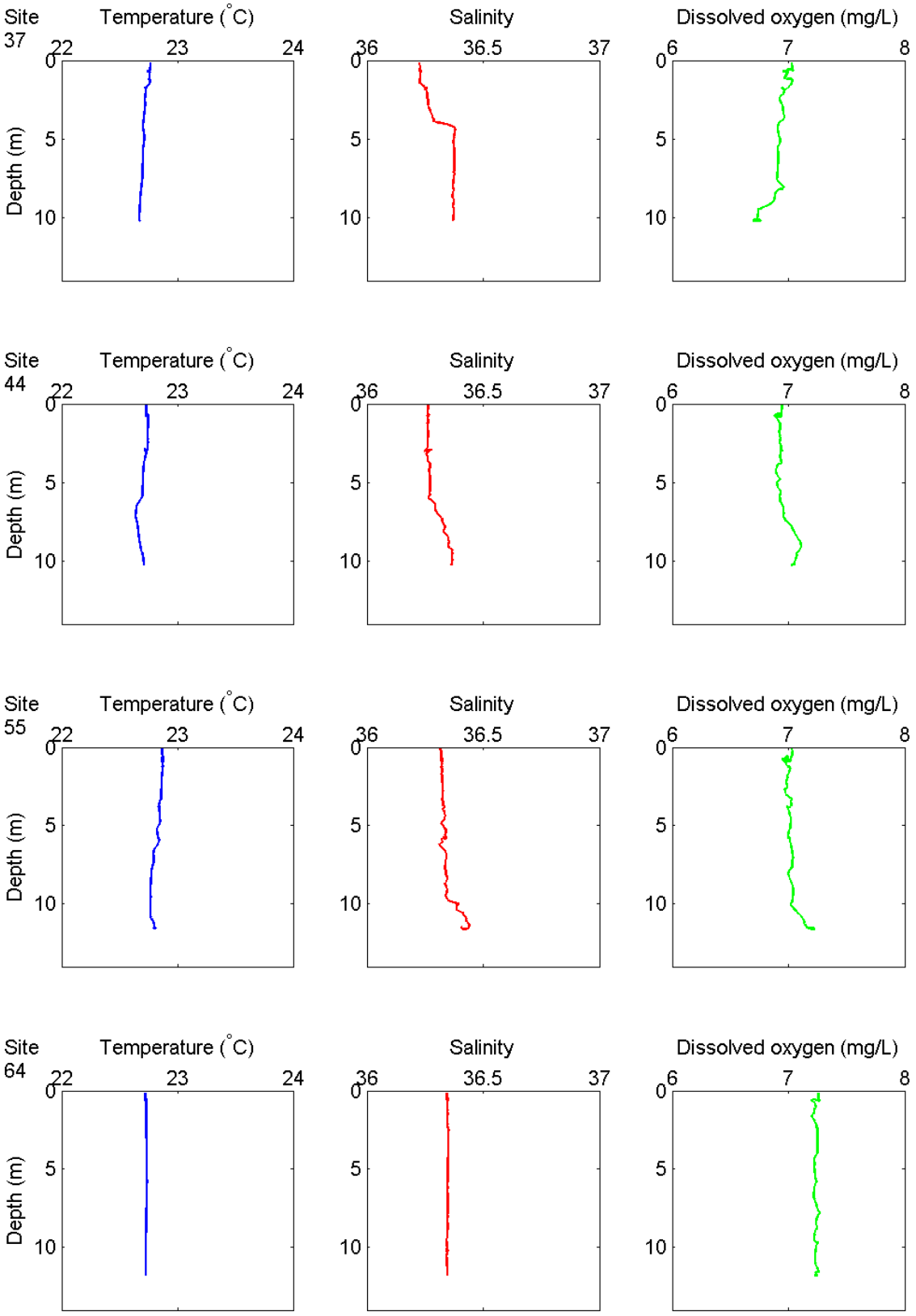


Figure 4.7 Temperature, salinity and dissolved oxygen vertical profiles at Ocean Reef

There was a salinity gradient between the surface (lower salinity) and deeper (higher salinity) waters immediately above the outlet that presumably reflects the influence of the treated wastewater (Figure 4.8b). The salinity gradient is not evident at station 28 and 37 up and down current of the diffuser, respectively (Figure 4.8b). Down current of the diffuser, the water column is well mixed and the size of the variations in salinity, temperature and density are small (Figure 4.8).

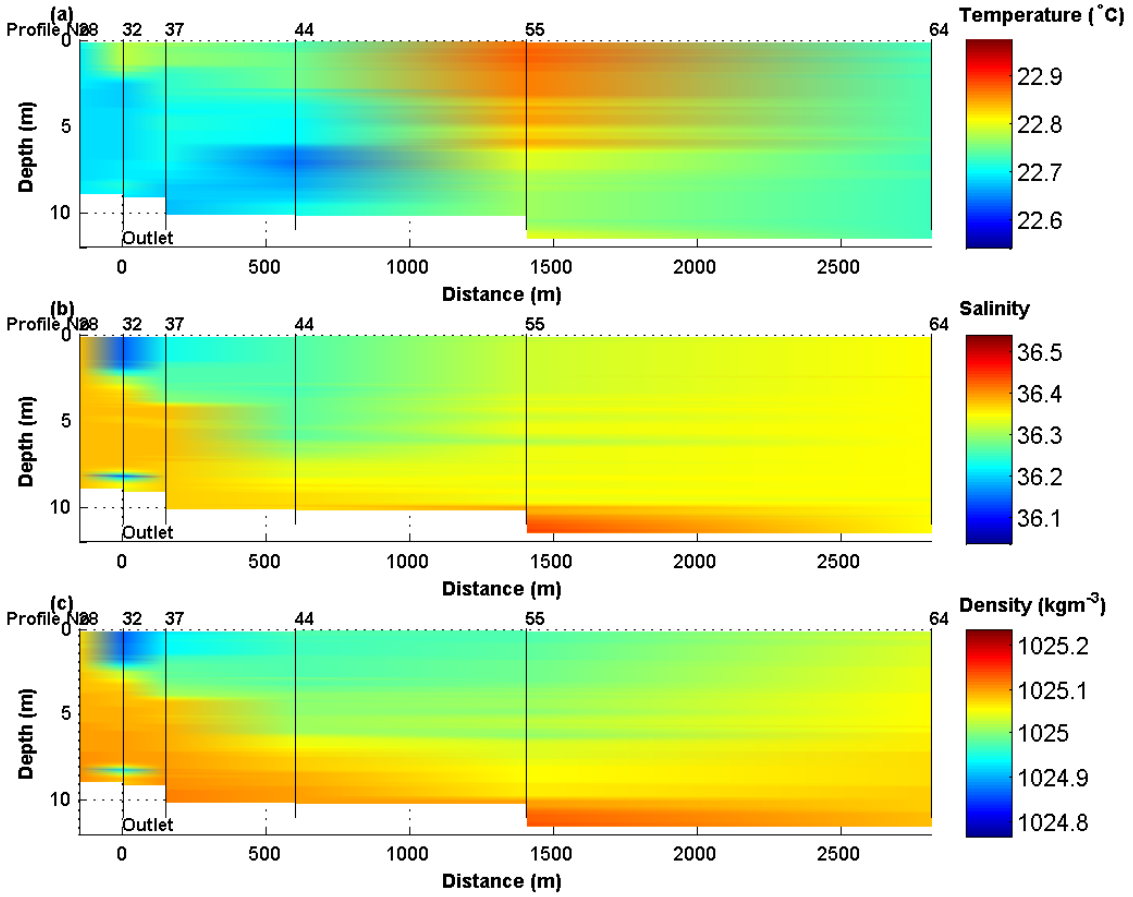
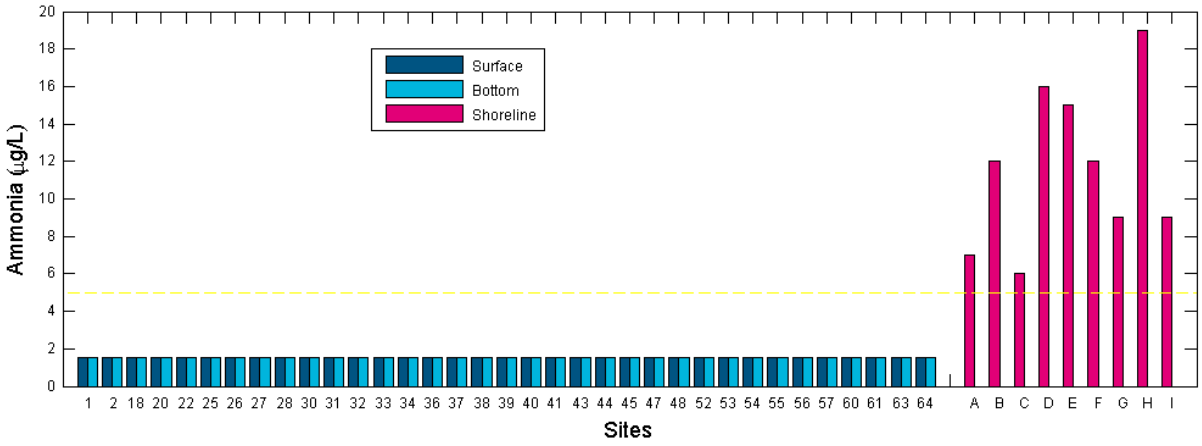


Figure 4.8 Temperature (a), salinity (b) and density (c) transect at Ocean Reef

4.5 Nutrients

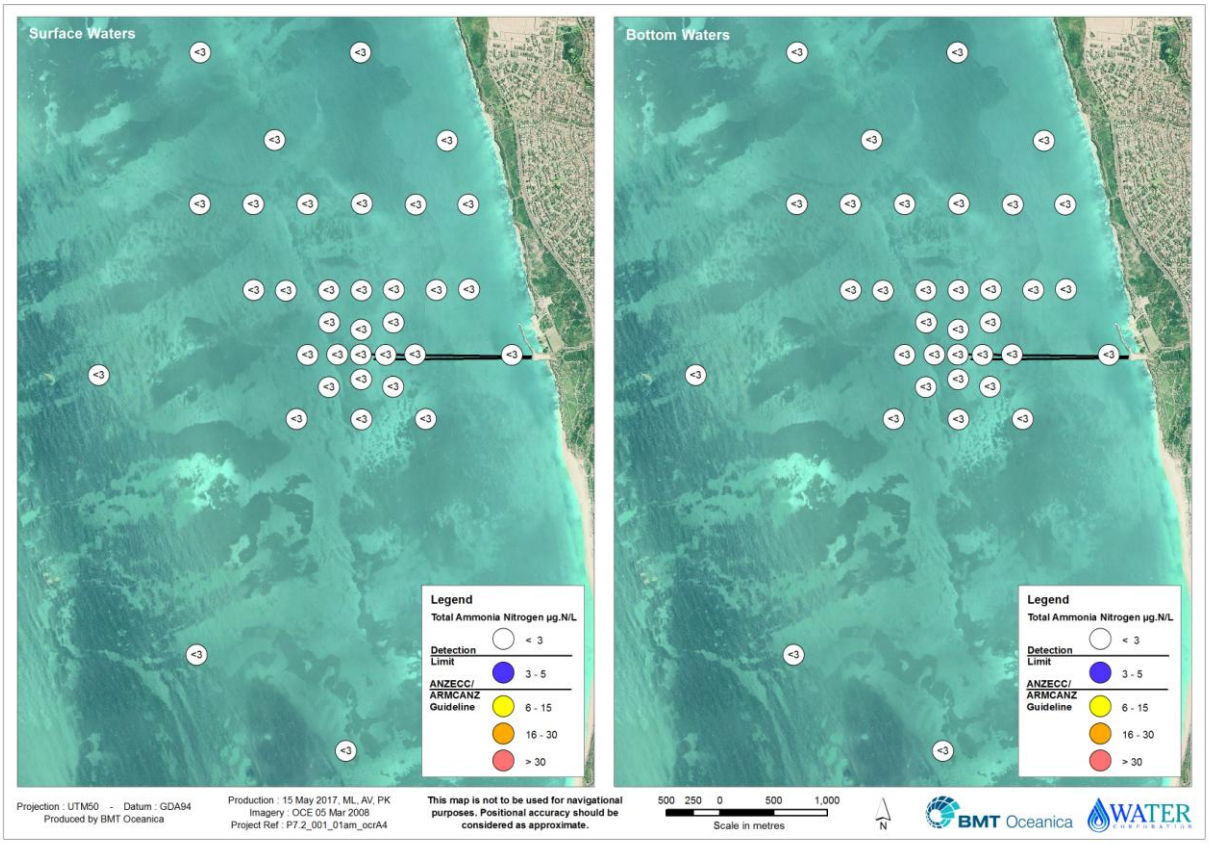
Total Ammonia Nitrogen (HN_4^+ + NH_3)

No surface or bottom samples exceeded the ANZECC & ARMCANZ (2000) guideline and the 80th percentile of reference concentrations for total ammonia nitrogen (Figure 4.9 and Figure 4.10). Each of the 9 (100%) shoreline sites exceeded the ANZECC & ARMCANZ (2000) trigger (Figure 4.9). Median ammonia concentration at the surface and bottom within and outside 250 m of the diffuser were below the ANZECC & ARMCANZ (2000) guideline but median ammonia concentrations at the shoreline exceeded the guideline (Table 4.3). Elevated ammonia at the shoreline sites in the absence of detectable concentrations near to the diffuser suggest that the ammonia at these sites comes from terrestrial sources.



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 4.9 Total ammonia nitrogen concentrations at Ocean Reef



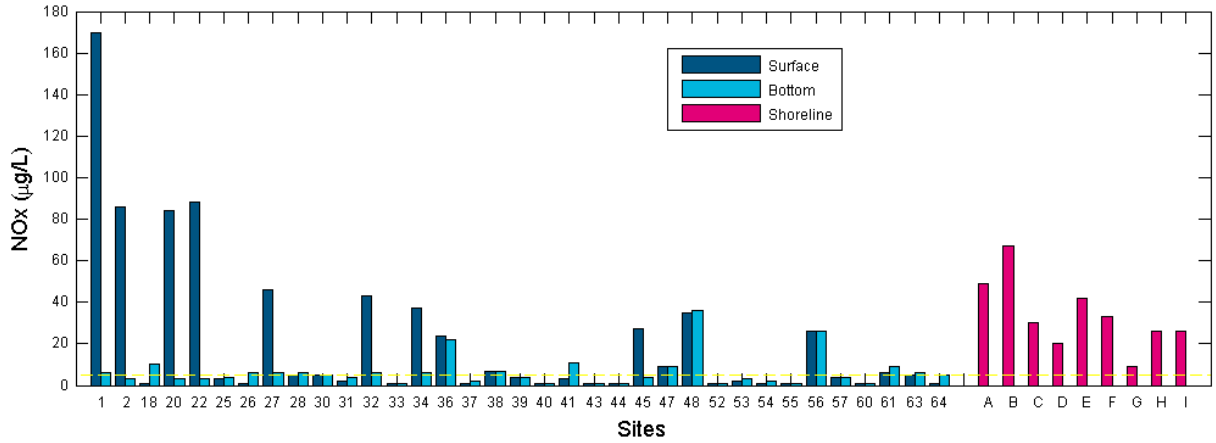
Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.10 Spatial distribution of total ammonia nitrogen at Ocean Reef

Nitrate+nitrite (NO_2^-+NO_3^-)

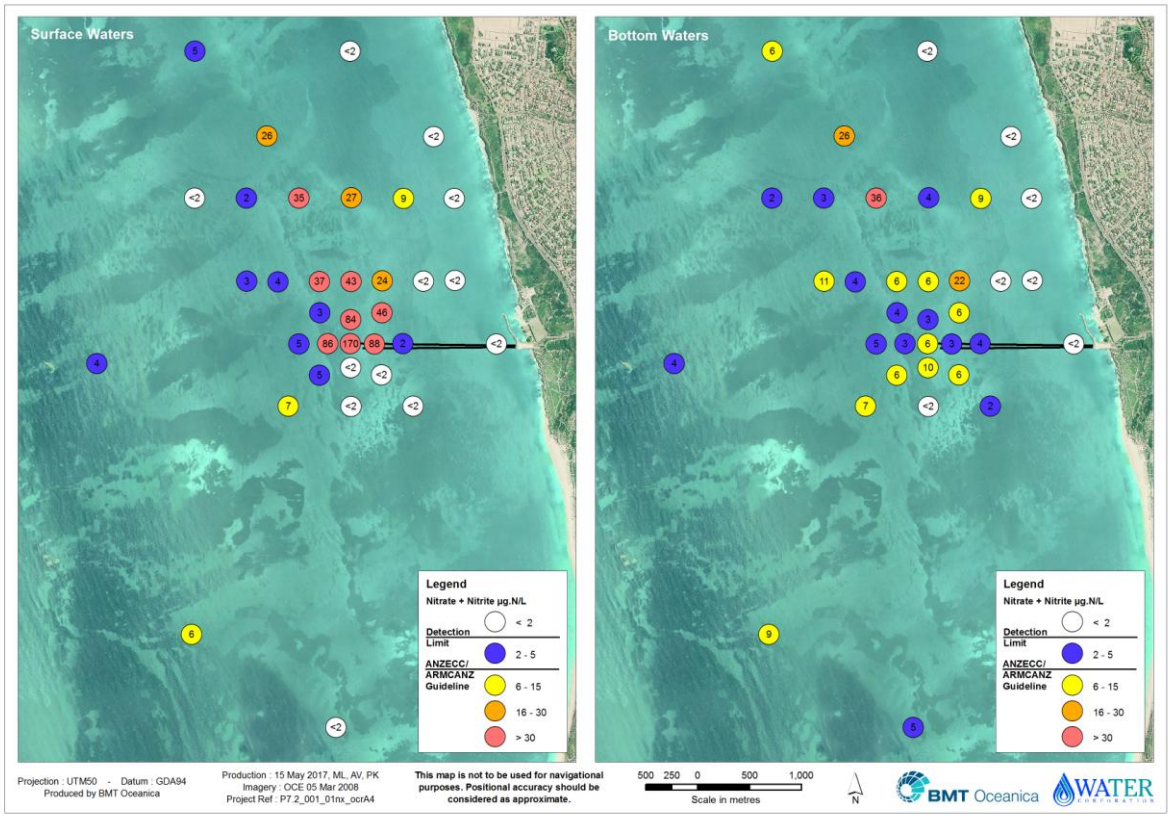
Background nitrate + nitrite concentrations in Perth's coastal waters are naturally high and often exceed the ANZECC & ARMCANZ (2000) guideline trigger value. Consequently

14 (40%) of surface and 14 (43%) of bottom sites exceeded the ANZECC & ARMCANZ (2000) guideline trigger value (Figure 4.11 and Figure 4.12) whereas only 11 (31%) surface and 3 (9%) bottom samples exceeded the 80th percentile of reference values (Figure 4.11 and Figure 4.12). Median concentrations at the surface inside 250 m of the diffuser exceeded the ANZECC & ARMCANZ (2000) guideline and the 80th percentile of reference data (Table 4.3). All (100%) shoreline samples exceeded the ANZECC & ARMCAZ (2000) guideline (Figure 4.11). Median concentrations at the shoreline exceeded both triggers but these sites are far from the identifiable effect of the outlet and likely elevated by terrestrial sources (Table 4.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 4.11 Total nitrate+nitrite concentrations at Ocean Reef

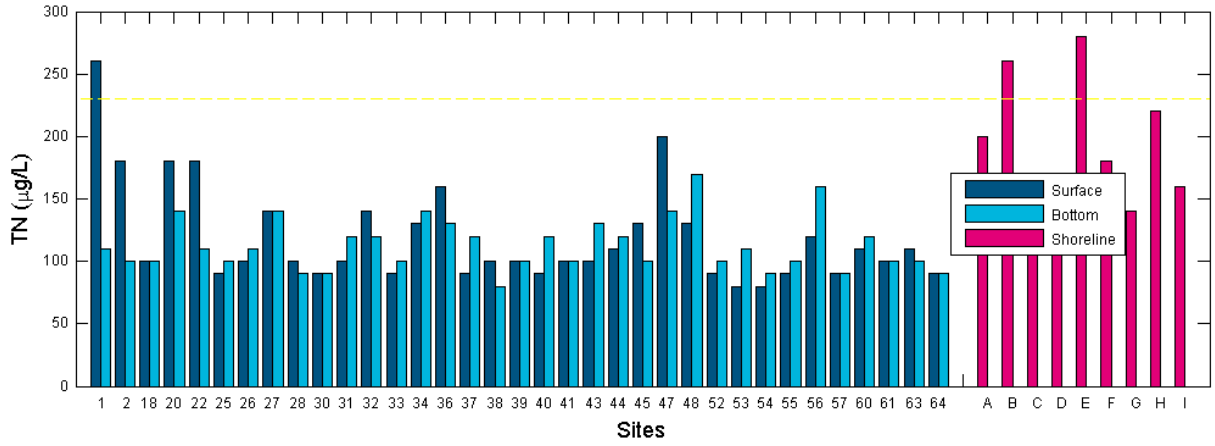


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.12 Spatial distribution of nitrate+nitrite at Ocean Reef

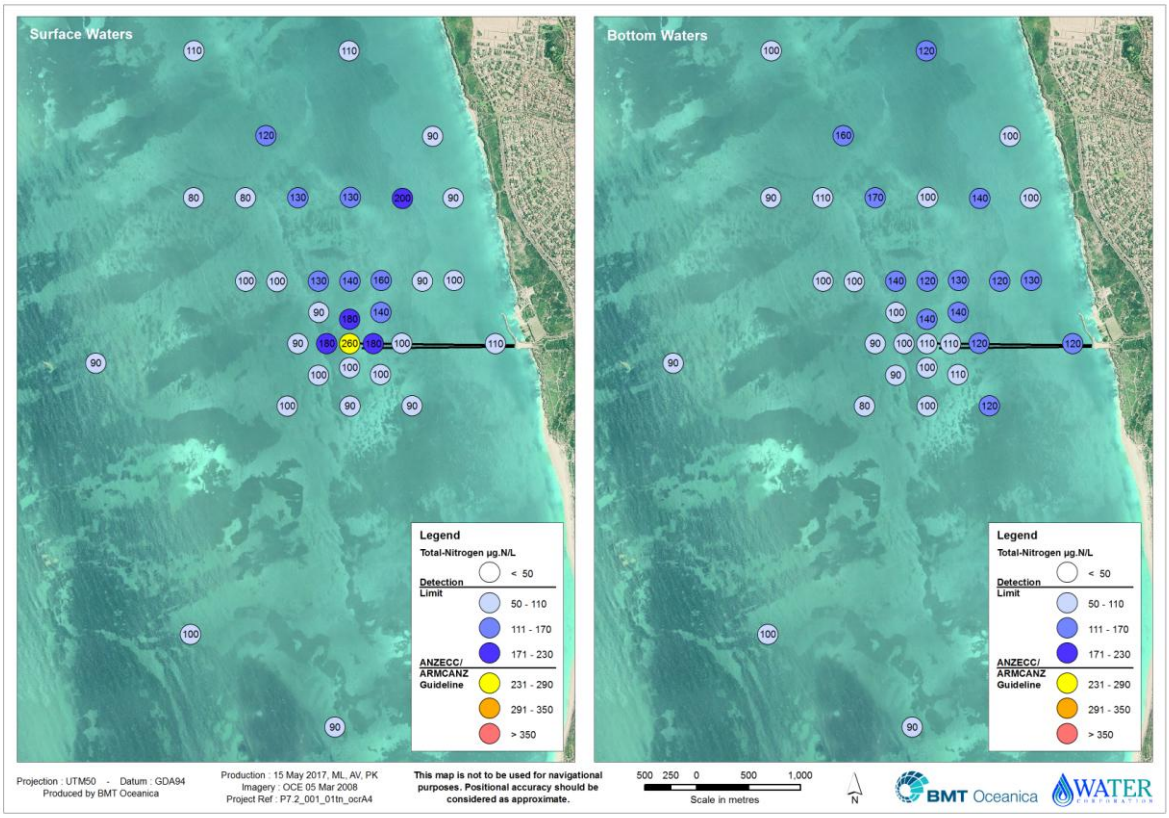
Total nitrogen

Total nitrogen concentrations exceeded the ANZECC & ARMCANZ (2000) guideline at only one (3%) offshore and two (22%) shoreline sites (Figure 4.13 and Figure 4.14). By comparison, 8 (23%) surface and 18 (51%) bottom samples exceeded the 80th percentile of reference site concentrations (Figure 4.13 and Figure 4.14). No median concentrations (surface, bottom, inside and outside 250 m) exceeded the ANZECC & ARMCANZ (2000) guideline (Table 4.3). Median concentrations at the surface inside 250 m and at the shoreline exceed the 80th percentile of reference concentrations (Table 4.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 4.13 Total nitrogen concentrations at Ocean Reef



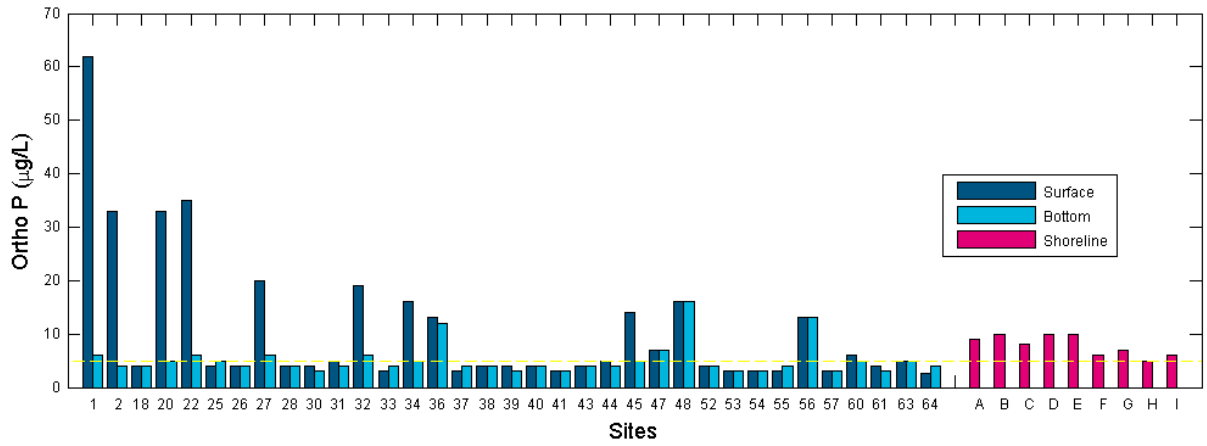
Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.14 Spatial distribution of total nitrogen at Ocean Reef

Orthophosphate

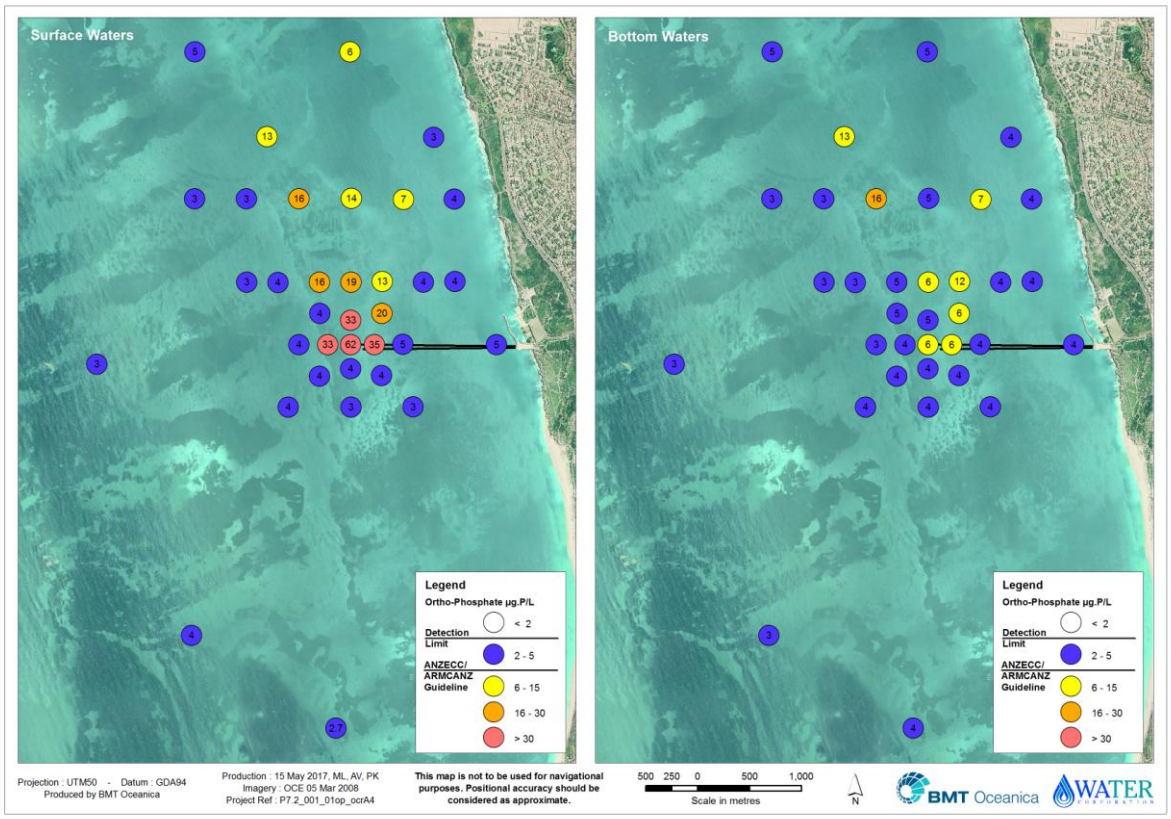
13 (37%) surface samples and 8 (23%) bottom samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 4.15 and Figure 4.16). By comparison, 11 (31%) samples at the surface and 3 (9%) samples at the bottom exceeded the 80th percentile of reference site concentrations (Figure 4.15 and Figure 4.16). Eight (89%) of the

shoreline samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 4.15). As a result, median surface concentrations <250 m and at the shore line exceeded the ANZECC & ARMCANZ (2000) and the 80th percentile of reference site concentrations (Table 4.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 4.15 Ortho-phosphate concentrations at Ocean Reef

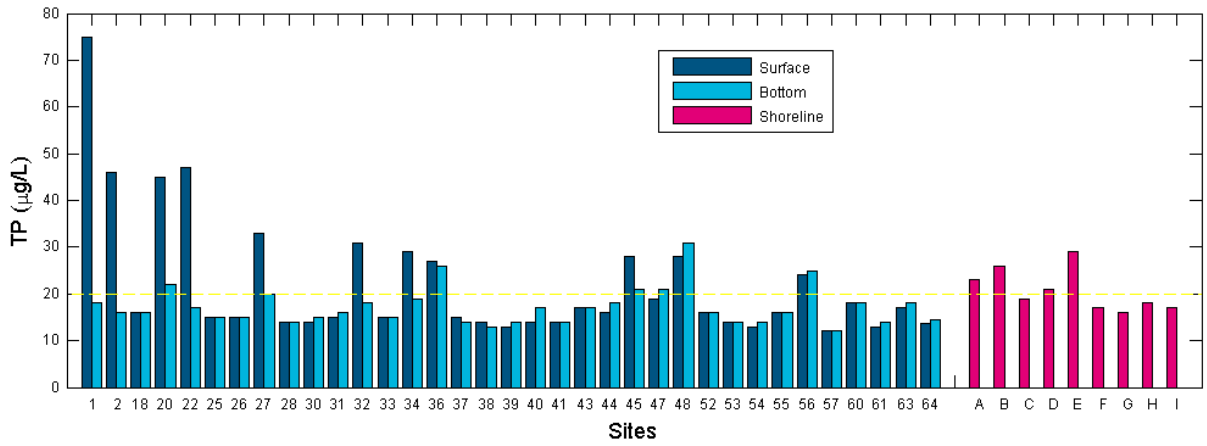


Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.16 Spatial distribution of ortho-phosphate at Ocean Reef

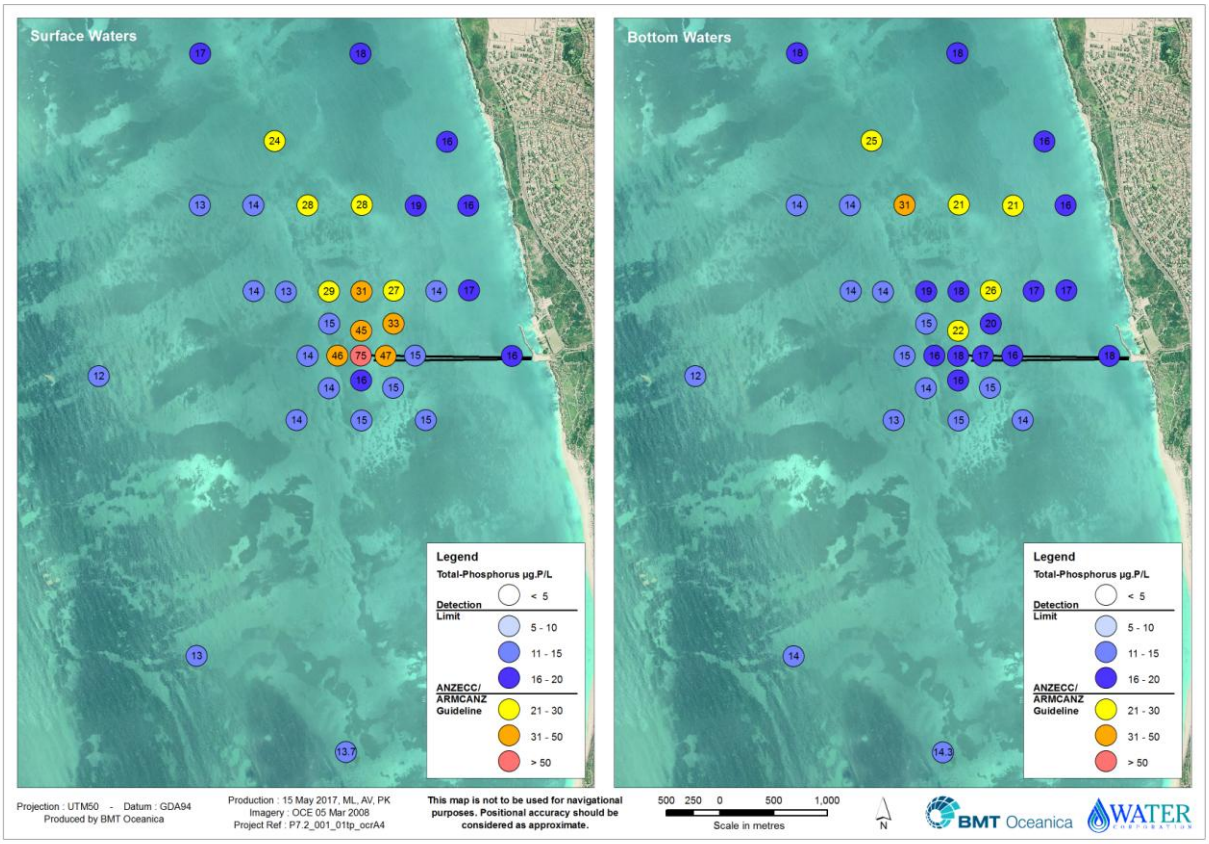
Total Phosphorus (TP)

Eleven (31%) surface and 6 (17%) bottom samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 4.17 and Figure 4.18). The 80th percentile was exceeded by 4 (11%) and 0 surface and bottom samples, respectively (Figure 4.17 and Figure 4.18). Four (44%) of the shoreline samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 4.17). Only median concentrations at the surface <250 m from the diffuser exceeded the ANZECC & ARMCANZ (2000) guideline and 80th percentile of reference site data (Table 4.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 4.17 Total phosphorus concentrations at Ocean Reef

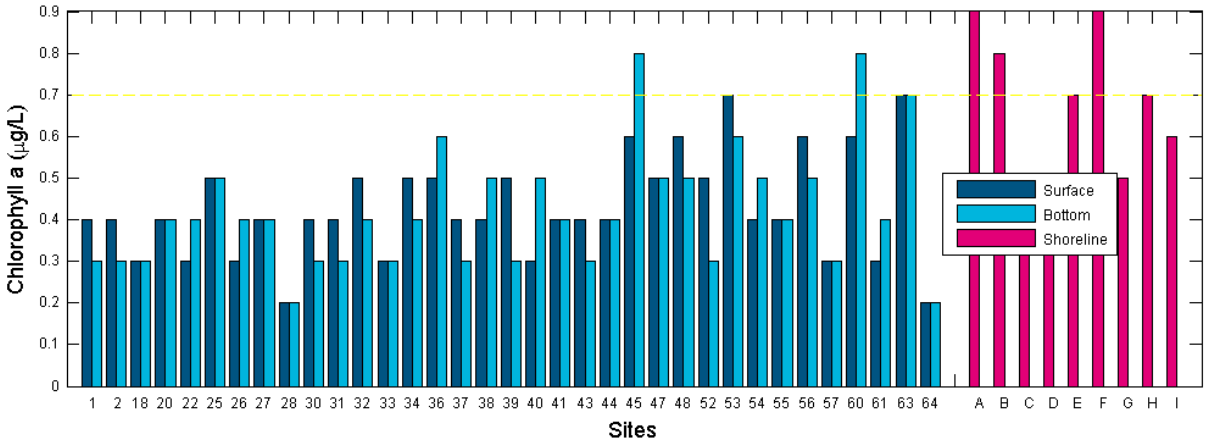


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.18 Total phosphorus concentrations at Ocean Reef

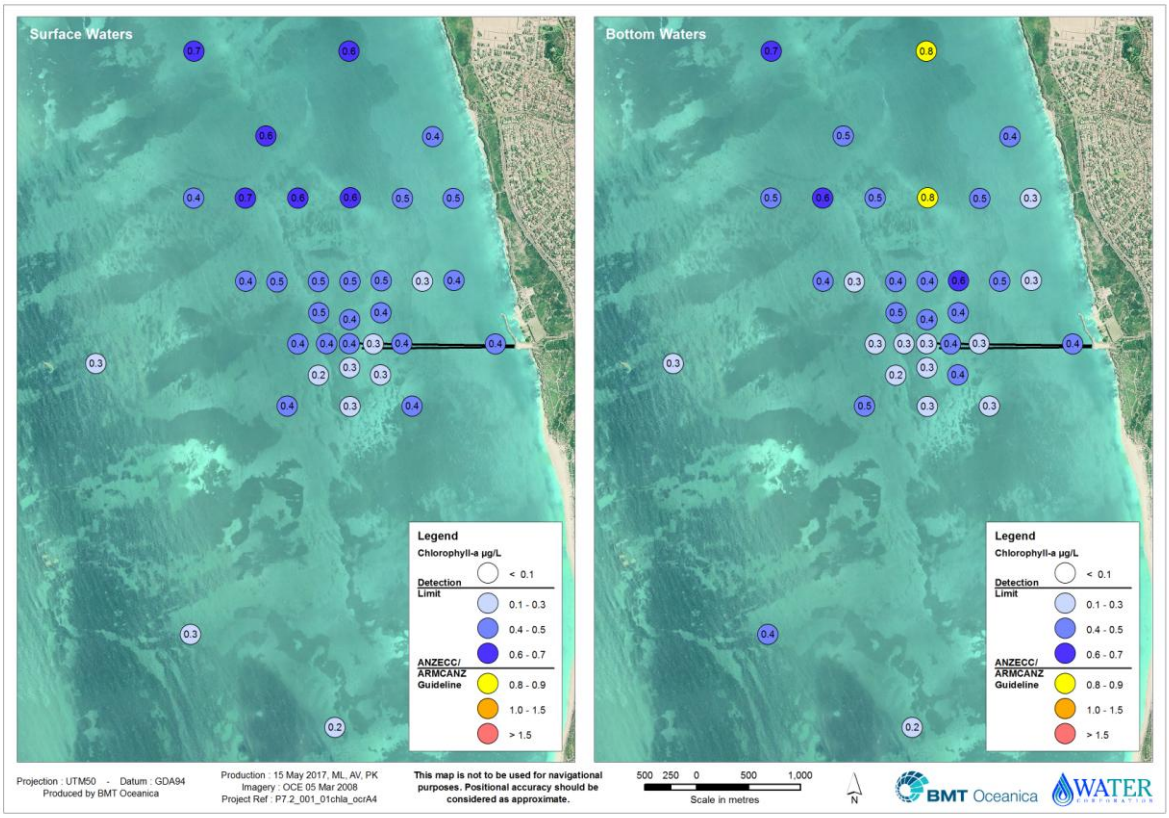
4.6 Chlorophyll

No surface samples and 2 (6%) of the shoreline samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 4.19 and Figure 4.20). Shoreline sites included some very high concentrations (up to 6 µg/L) (Figure 4.19). The long-term 80th percentile concentration at the reference sites is lower than the ANZECC & ARMCANZ (2000) guideline and was exceeded at 14 (40%) surface sites and 5 (14%) bottom sites (Table 4.3). Only shoreline median concentrations exceeded the ANZECC & ARMCANZ (2000) guideline but median concentrations at the surface and bottom within 250 m exceeded the 80th percentile of reference site concentrations as well as the shoreline sites (Table 4.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline.

Figure 4.19 Chlorophyll-a concentrations at Ocean Reef

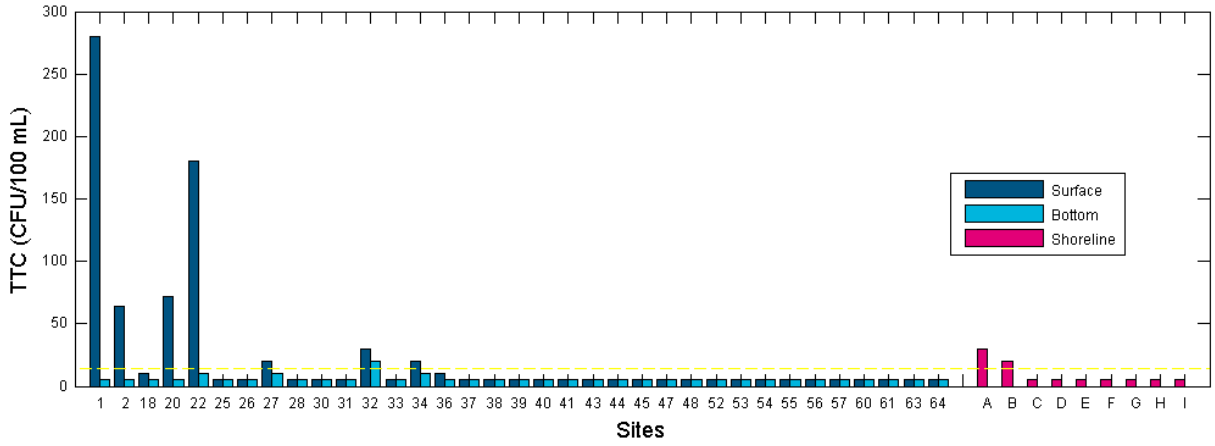


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.20 Spatial distribution of chlorophyll-a concentrations at Ocean Reef

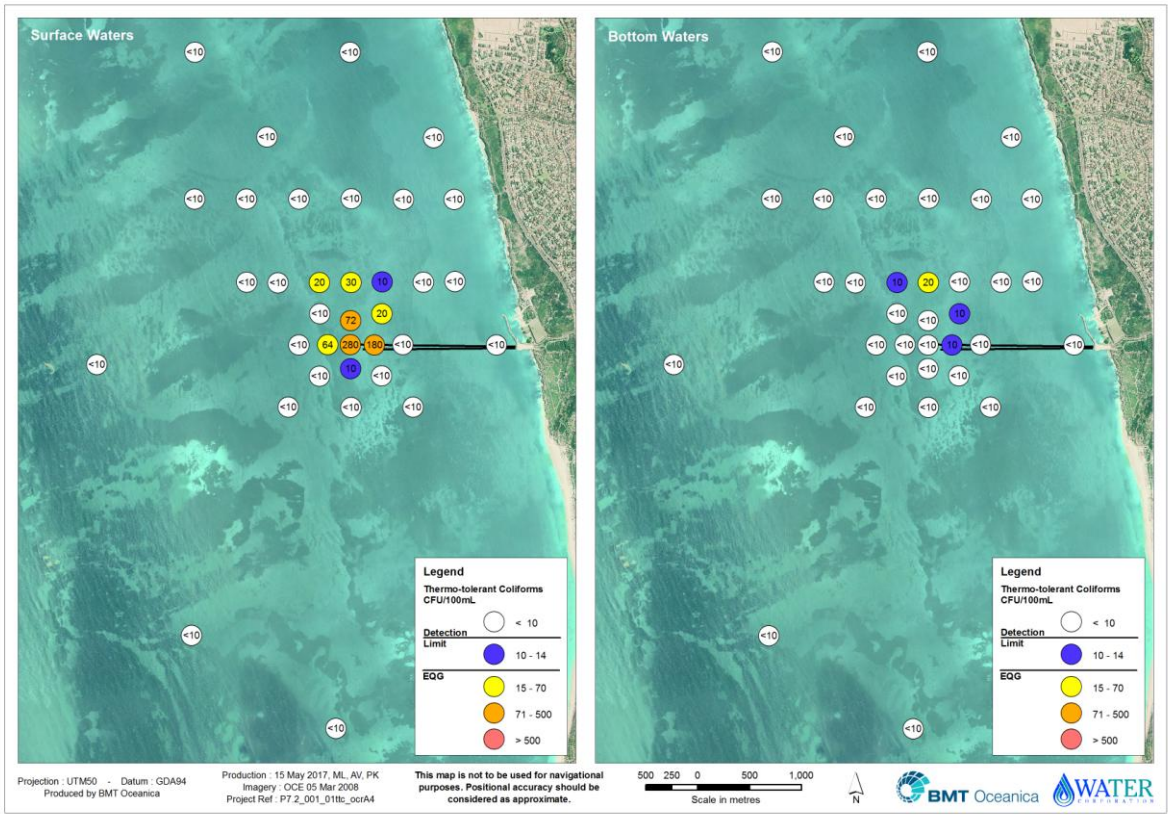
4.7 Microbial community

Surface TTC concentrations were elevated around the diffuser (Figure 4.21 and Figure 4.22). Seven surface samples (20%) exceed the EPA (2015b) EQG trigger (Figure 4.21). Median concentrations exceeded the EPA (2015b) EQG trigger at the surface within 250 m of the diffuser (Table 4.2).



Note:
1. Dashed line indicates EQG (EPA 2015b) guideline

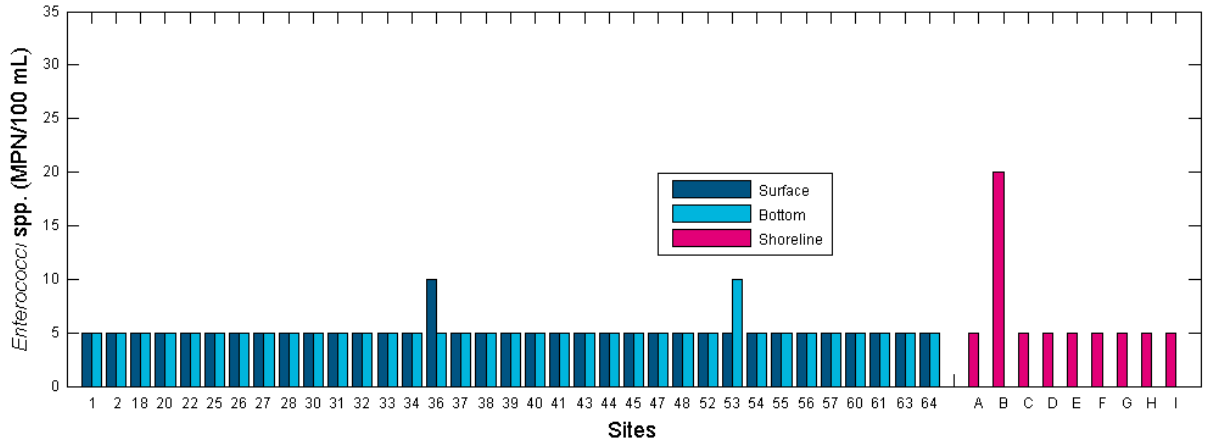
Figure 4.21 Thermotolerant coliform concentrations at Ocean Reef



Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or EQG.

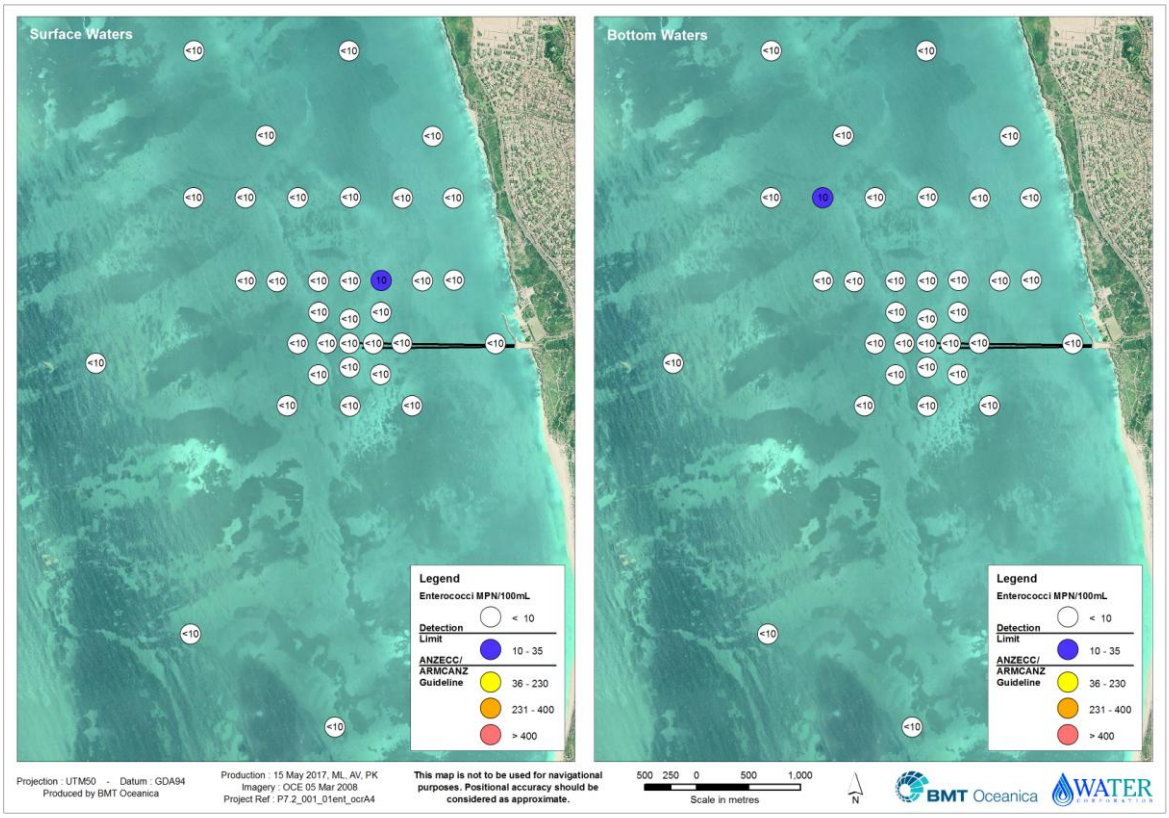
Figure 4.22 Spatial distribution of thermotolerant coliform concentrations at Ocean Reef

Enterococci spp. concentrations did not exceeded the ANZECC & ARMCANZ (2000) guideline in any sample (Figure 4.23 and Figure 4.24). Median concentrations were therefore all below the ANZECC & ARMCANZ (2000) guideline (Table 4.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 4.23 *Enterococci* spp. concentrations at Ocean Reef



Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 4.24 Spatial distribution of *Enterococci* spp. at Ocean Reef

4.8 Summary

The summer water quality surveys were not designed for comparison with the ANZECC & ARMCANZ (2000) guidelines or with 80th percentile of reference values but comparisons were made for sites located <250 m and >250 m from the diffuser as an indicator rather

than a means of assessing compliance. Despite elevated concentrations at some individual sites outside the immediate zone of influence of the outlet, the guidelines for demonstrating ecosystem protection and public health criteria were met (Table 4.2).

During the survey, the treated wastewater plume was initially buoyant (as indicated by the lower salinity and slightly higher concentrations of nutrients and microbiological indicators in surface waters than in bottom waters) and was advecting in a northerly direction. Surface nutrients were elevated above the 80th percentile of reference site concentrations within 250 m of the diffuser. Median concentrations were diluted to below the 80th percentile of reference site concentrations beyond 250 m (Table 4.2). There was potentially a general increase in chlorophyll a with distance away from the diffuser, but only 2 samples exceeded the guideline and there was no indication that the wastewater nutrients were increasing chlorophyll outside the 250 m area around the diffuser (Table 4.2).

Median *Enterococci* spp. concentrations were below the guidelines for recreation contact in surface and bottom samples collected within and outside 250 m from the diffuser (Table 4.2). Thermotolerant coliform (TTC) concentrations exceeeded the guideline for the maintenance of seafood safe for human consumption at the surface near the diffuser but surface and bottom waters >250 m from the diffuser were maintained for seafood quality. Shoreline monitoring found no indication of contamination of adjacent beaches by the wastewater plume (Table 4.2)

Table 4.2 Summary Ocean Reef

Parameter	Inside the mixing zone (sites <250 m from diffuser)		Outside the mixing zone (sites >250 m from diffuser)		Shoreline
	Surface	Bottom	Surface	Bottom	
ANZECC & ARMCANZ (2000) guideline values					
Total ammonia nitrogen					
Ortho-phosphate					
Nitrate+nitrite					
Total phosphorus					
Total nitrogen					
Chlorophyll-a					
Enterococci spp.[3]					
80th percentile of reference values					
Total ammonia nitrogen					
Ortho-phosphate					
Nitrate+nitrite					
Total phosphorus					
Total nitrogen					
Chlorophyll-a					
Environmental Quality Guideline (EPA 2015b)					
Thermotolerant coliforms[4]					

Notes:

1. Green = median values ≤ ANZECC & ARMCANZ (2000) guideline values , ≤80th percentile reference values or ≤ EQG.
2. Red = Median values > ANZECC & ARMCANZ (2000) guideline values , >80th percentile reference values or > EQG
3. For the maintenance of seafood safe for human consumption
4. For primary contact recreation

Table 4.3 Summary statistics for Ocean Reef

Parameter	depth	lowest		highest		Median		number (%) below the guideline		number (%) below 80th percentile of reference	
		Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Ammonia (NH4)	All	1.5	1.5	1.5	1.5	1.5	1.5	35 (100)	35 (100)	35 (100)	35 (100)
	Inside 250 m	1.5	1.5	1.5	1.5	1.5	1.5	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	1.5	1.5	1.5	1.5	1.5	1.5	30 (100)	30 (100)	30 (100)	30 (100)
	Shoreline	6	NA	19	NA	12	NA	0 (0)	NA	NA	NA
Nitrate + nitrite	All	1	1	170	36	4	4	21 (60)	20 (57)	24 (69)	32 (91)
	Inside 250 m	1	3	170	10	86	3	1 (20)	3 (60)		5 (100)
	Outside 250 m	1	1	46	36	3.5	4.5	20 (67)	17 (57)	23 (77)	27 (90)
	Shoreline	9	NA	67	NA	30	NA	0 (0)	NA	NA	NA
Total nitrogen	All	80	80	260	170	100	110	34 (97)	35 (100)	27 (77)	17 (49)
	Inside 250 m	100	100	260	140	180	110	4 (80)	5 (100)	1 (20)	2 (40)
	Outside 250 m	80	80	200	170	100	105	30 (100)	30 (100)	26 (87)	15 (50)
	Shoreline	140	NA	280	NA	180	NA	7 (78)	NA	NA	NA
Ortho-phosphate	All	3	3	62	16	4	4	22 (63)	27 (77)	24 (69)	32 (91)
	Inside 250 m	4	4	62	6	33	5	1 (20)	3 (60)	1 (20)	5 (100)
	Outside 250 m	3	3	20	16	4	4	21 (70)	24 (80)	23 (77)	27 (90)
	Shoreline	5	NA	10	NA	8	NA	1 (11)	NA	NA	NA
Total phosphorus (TP)	All	12	12	75	31	16	16	24 (69)	29 (83)	31 (89)	35 (100)
	Inside 250 m	16	16	75	22	46	17	1 (20)	4 (80)	1 (20)	5 (100)
	Outside 250 m	12	12	33	31	15	16	23 (77)	25 (83)	30 (100)	30 (100)
	Shoreline	16	NA	29	NA	19	NA	5 (56)	NA	NA	NA
Chlorophyll a	All	0.2	0.2	0.7	0.8	0.4	0.4	35 (100)	33 (94)	29 (83)	30 (86)
	Inside 250 m	0.3	0.3	0.4	0.4	0.4	0.3	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	0.2	0.2	0.7	0.8	0.4	0.4	30 (100)	28 (93)	24 (80)	25 (83)
	Shoreline	0.4	NA	0.9	NA	0.7	NA	6 (67)	NA	NA	NA
Thermotolerant coliforms	All	5	5	280	20	5	5	28 (80)	34 (97)	NA	NA
	Inside 250 m	10	5	280	10	72	5	1 (20)	5 (100)	NA	NA
	Outside 250 m	5	5	30	20	5	5	27 (90)	29 (97)	NA	NA
	Shoreline	5	NA	30	NA	5	NA	7 (78)	NA	NA	NA
Enterococci spp.	All	5	5	10	10	5	5	35 (100)	35 (100)	NA	NA
	Inside 250 m	5	5	5	5	5	5	5 (100)	5 (100)	NA	NA
	Outside 250 m	5	5	10	10	5	5	30 (100)	30 (100)	NA	NA
	Shoreline	5	NA	20	NA	5	NA	9 (100)	NA	NA	NA

Notes:
1. NA = Comparison not applicable

5. Sepia Depression

5.1 The survey

The annual summer water quality survey at Sepia Depression was completed on 28 February 2017.

5.2 Discharge

A 24- hour composited sample of treated wastewater was collected from sampling point D on the Sepia depression Ocean Outlet Landline (SDOOL) on 28 February 2017 (prior to and during the ocean survey) (Table 3.1). At the time of the survey there were 68 ports open on the Outlet.

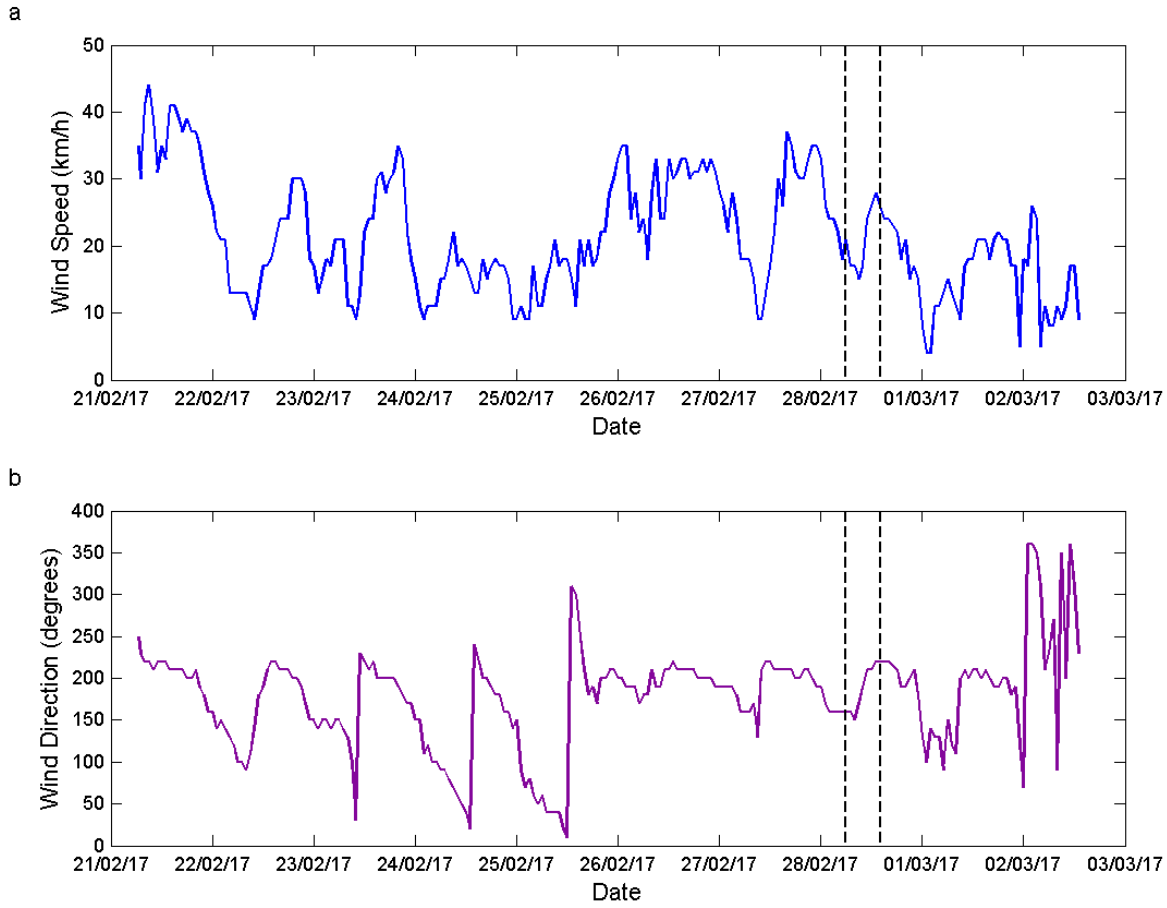
Table 5.1 SDOOL treated wastewater characteristics on 28 February 2017

Parameter	Concentration
Total phosphorus	5.9 mg/L
Total nitrogen	20 mg/L
Total ammonia nitrogen	0.59 mg/L
Nitrate+nitrite	3 mg/L
Thermotolerant coliforms	>1 000 000 CFU/100 mL
Enterococci spp.	>24 000 MPN/100 mL
Total suspended solids	66 mg/L
Biological oxygen demand	28 mg/L
Total flow	154.3 ML/d

5.3 Environmental characteristics

5.3.1 Wind

For 24 hours prior to the survey, the wind at Sepia Depression was typically southerly increasing to between 30 and 37 km/h) for the period between14 and 8 h before the survey and then gradually decreasing to 18 km/h. Wind remained southerly but the speed gradually increased to ~28 km/h over the course of the sampling event (Figure 5.1).



Note:
1. a = wind speed
2. b = wind direction
3. Dashed lines (- -) show approximate timing of the summer water quality survey.

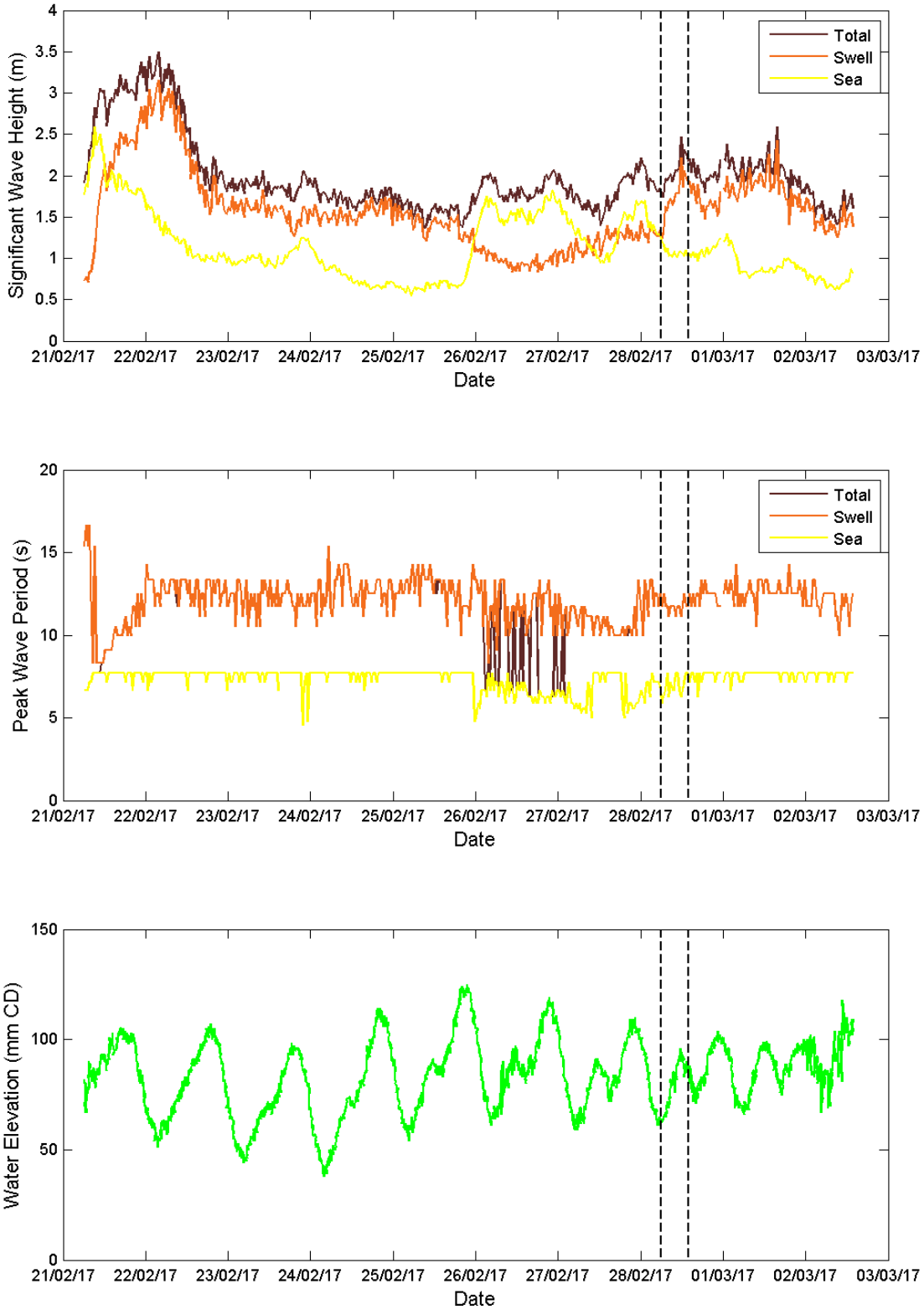
Figure 5.1 Wind speed and wind direction at Sepia Depression

5.3.2 Waves and tide

For 24 hours prior to the survey, the average significant wave height[15] offshore from Rottnest Island was 1.8 m, with an average peak wave period[16] of 11.1 s (Figure 5.2). During the survey the average offshore significant wave height was 2.1 m with an average peak wave period of 11.7 s. The survey was completed during a rising and turn of the tide (Figure 5.2).

[15] *The significant wave height (in metres) is defined as the average height of the highest one-third of waves recorded (source: http//www.dpi.wa.gov.au/)*

[16] *The wave period (in seconds) is the time between consecutive wave crests. The peak wave period is the wave period of those waves that are producing the most energy in a wave record*



Note:
1. Dashed lines (- -) show approximate timing of the survey

Figure 5.2 Significant wave heights (offshore Rottnest Island), peak wave periods (offshore Rottnest Island) and water level elevation (Fremantle Fishing Boat Harbour)

5.3.3 Currents

The surface drogue released at the centre of the diffuser at the beginning of the survey drifted in a northerly direction for the duration of its passage. The average velocity of the drogue over the route was 0.15 m/s. At the time of the survey and based on drogue movements, it is expected that discharged treated wastewater would have travelled in a north north westerly direction away from the diffuser (Figure 5.3).

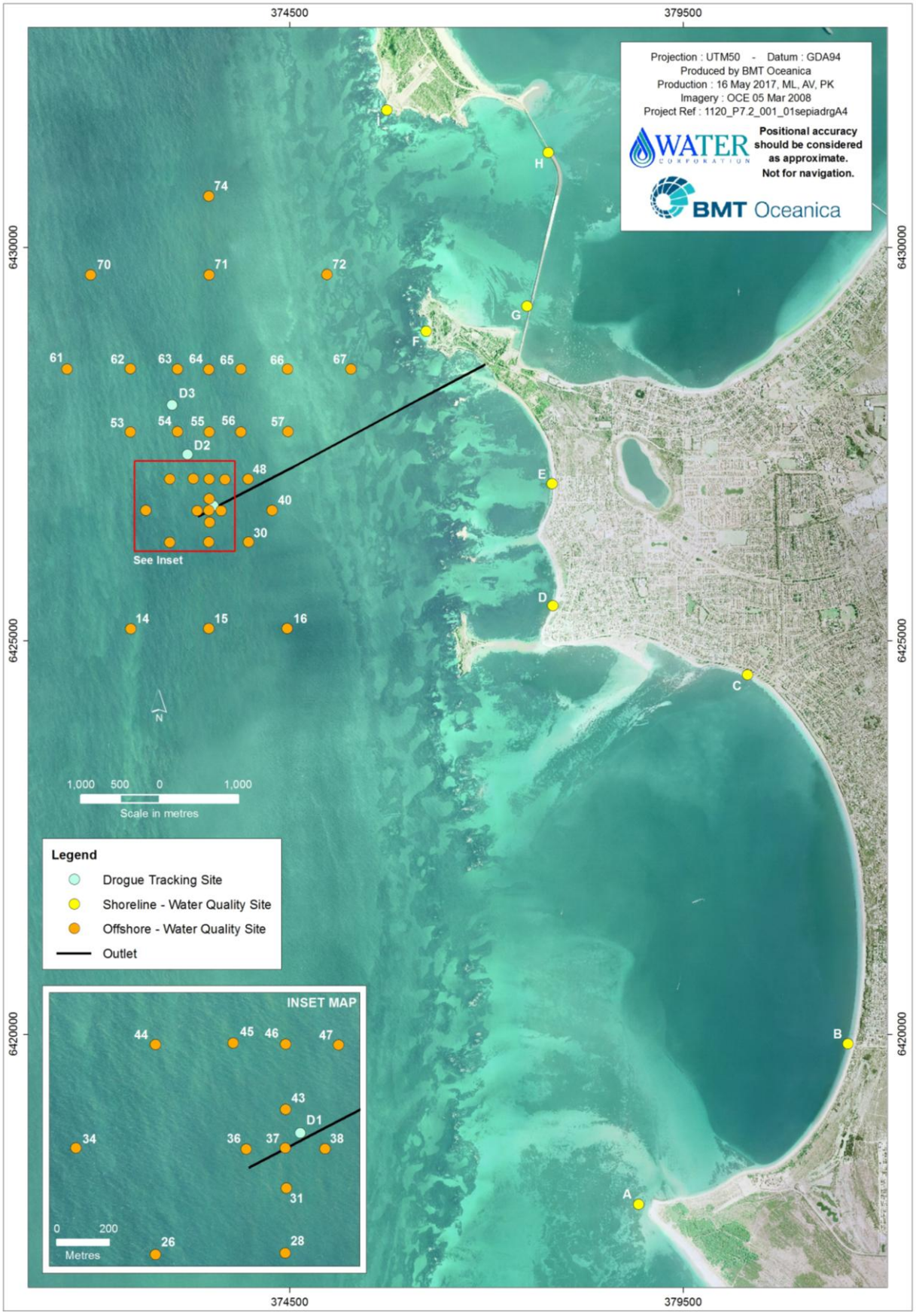
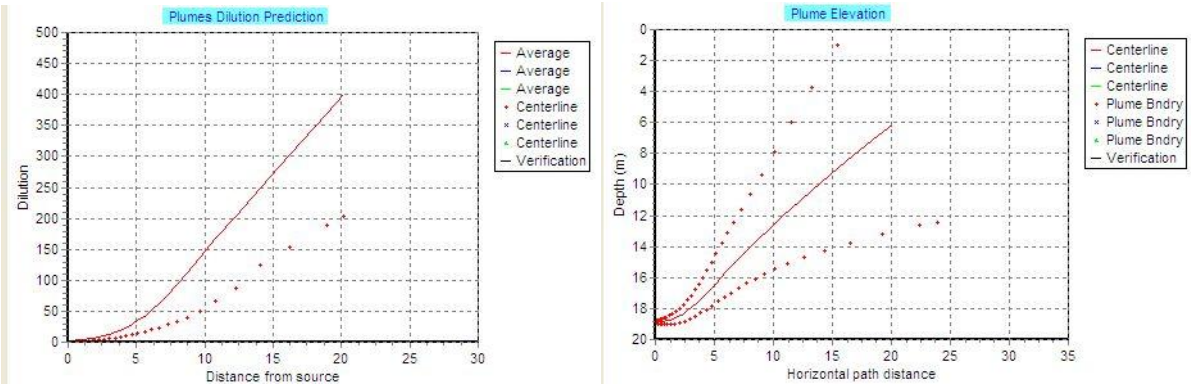


Figure 5.3 Sepia Depression drogue tracking locations, 28 February 2017

5.3.4 Initial dilution

For ambient conditions at the time of the Sepia Depression survey, the modelling predicted an average initial dilution of 1:400 and a centreline dilution of 1:203 (Figure 5.4a). The plume was predicted to first reach the surface within ~20 m (horizontal distance) of the discharge point (see the ambient boundary[17] of the plume in Figure 5.4b). The full model output is included in Appendix C.



Notes:
1. a = predicted average and centreline dilution
2. b = predicted plume elevation

Figure 5.4 Predicted average and centreline dilutions and predicted plume elevation trajectory for Sepia Depression

5.4 Water column structure

Water temperatures at the profiled sites (8 in total) ranged from 22.06°C to 22.33°C, salinity ranged from 34.33 to 36.09 and dissolved oxygen varied from 6.75 mg/L to 7.08 mg/L (equivalent to 95.4–100% saturation) (Figure 5.5 and Figure 5.6). Thermoclines were typically absent and salinity was typically constant with depth. However, at the site directly inshore of the diffuser (site 37) there was a layer of slightly elevated temperature, reduced salinity and dissolved oxygen relative to the rest of the water column near the bottom (Figure 5.5 and Figure 5.6). Dissolved oxygen was not depleted by the treated wastewater plume or any other process at any site (Figure 5.5 and Figure 5.6).

[17] *The ambient boundary corresponds to the plume boundary at which concentrations are estimated to be equal to ambient conditions.*

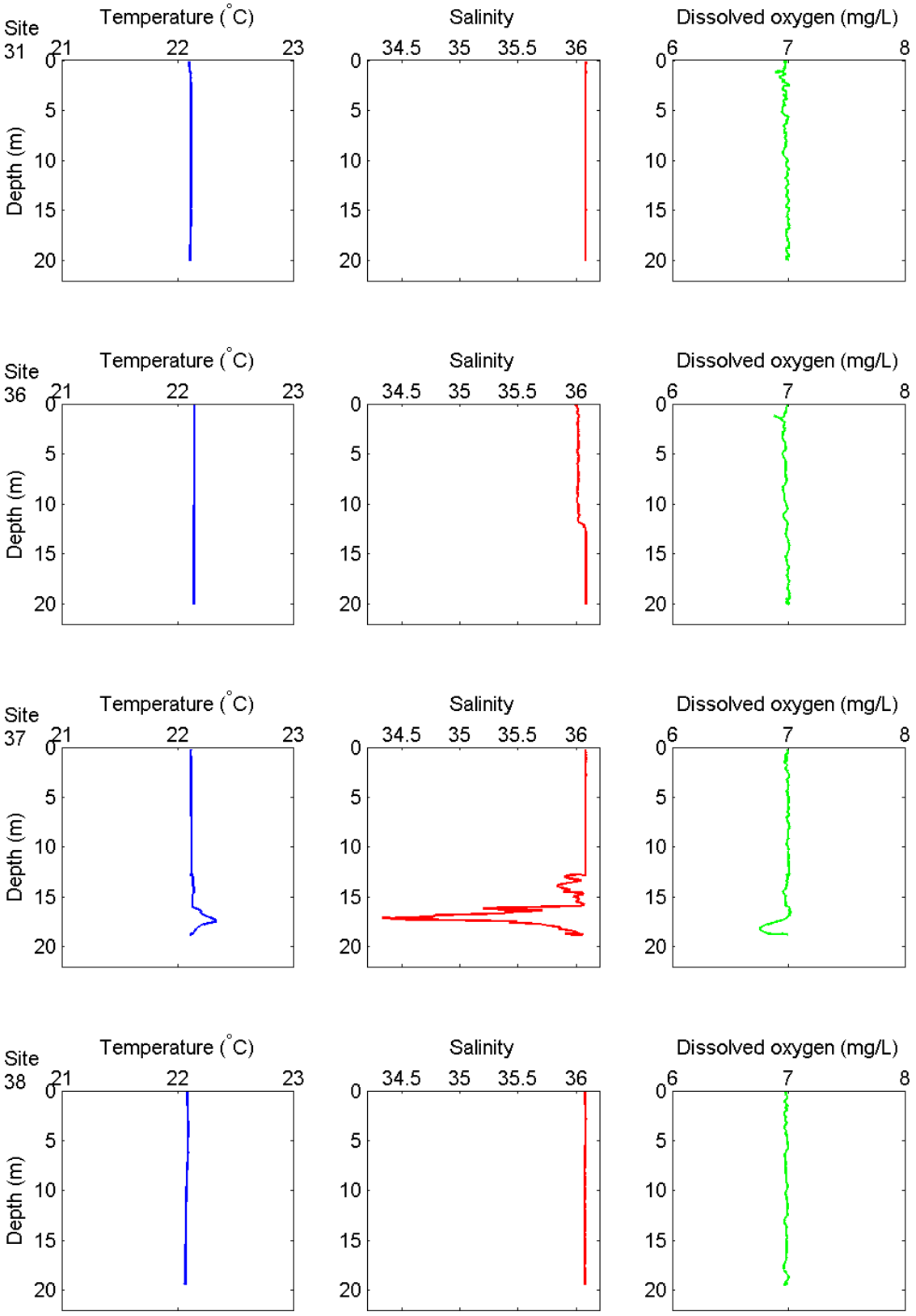


Figure 5.5 Temperature, salinity and dissolved oxygen vertical profiles at Sepia Depression

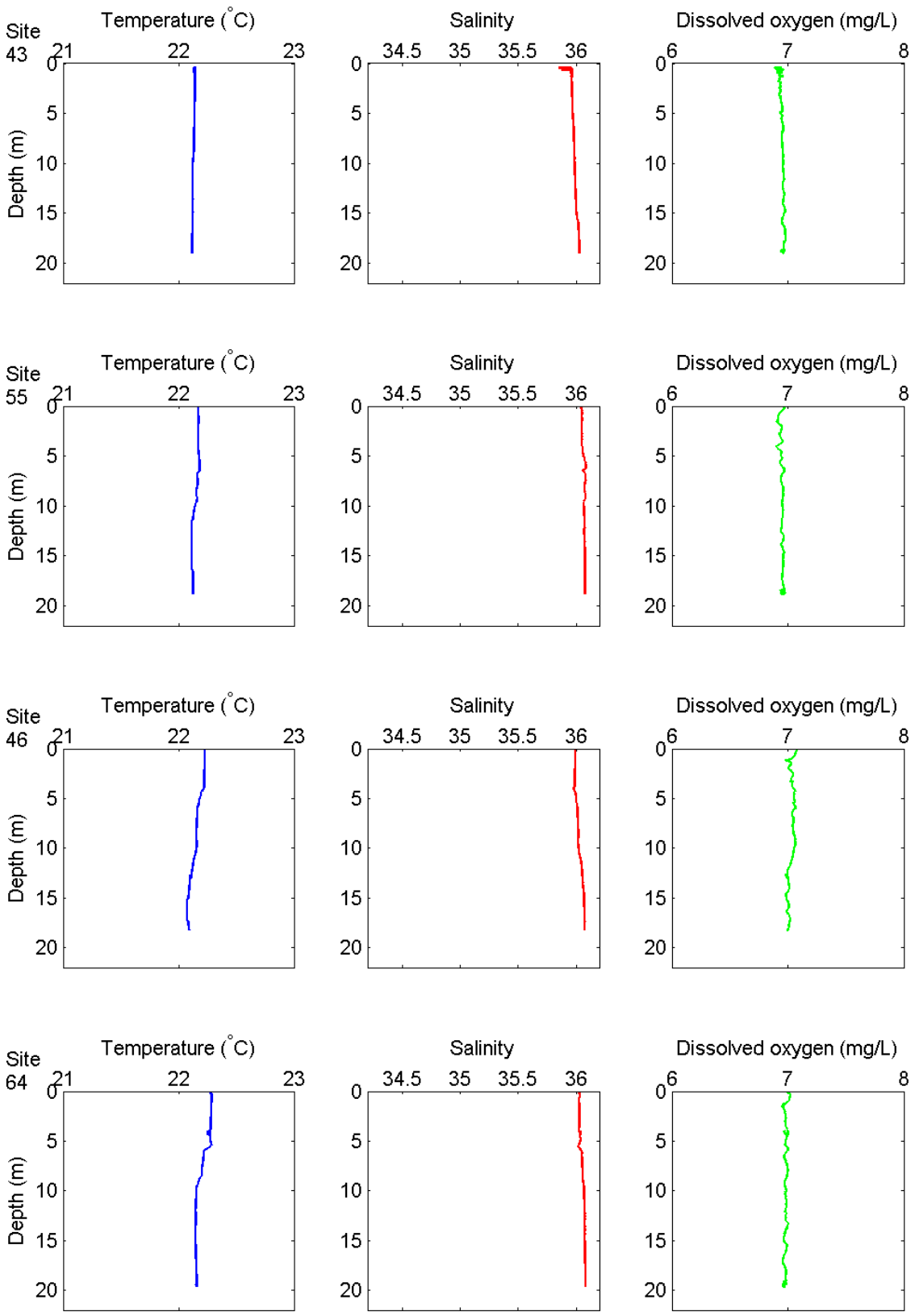


Figure 5.6 Temperature, salinity and dissolved oxygen vertical profiles at Sepia Depression

The wastewater stream is evident at the outlet (site 43) as a plume of low salinity/density water extending from the surface to bottom (Figure 5.7). The discharge forms a buoyant layer that overlies more saline water as it is advected further from the outlet (Figure 5.7).

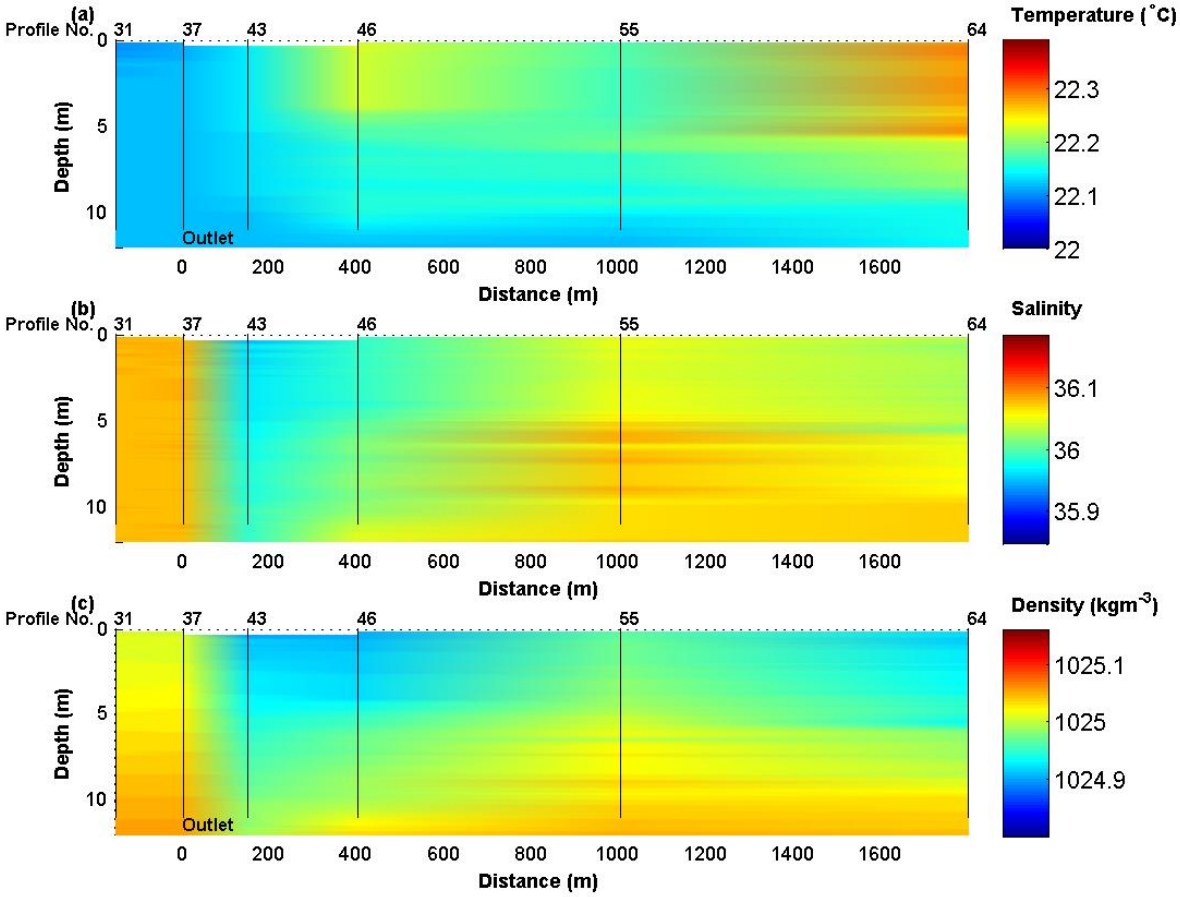
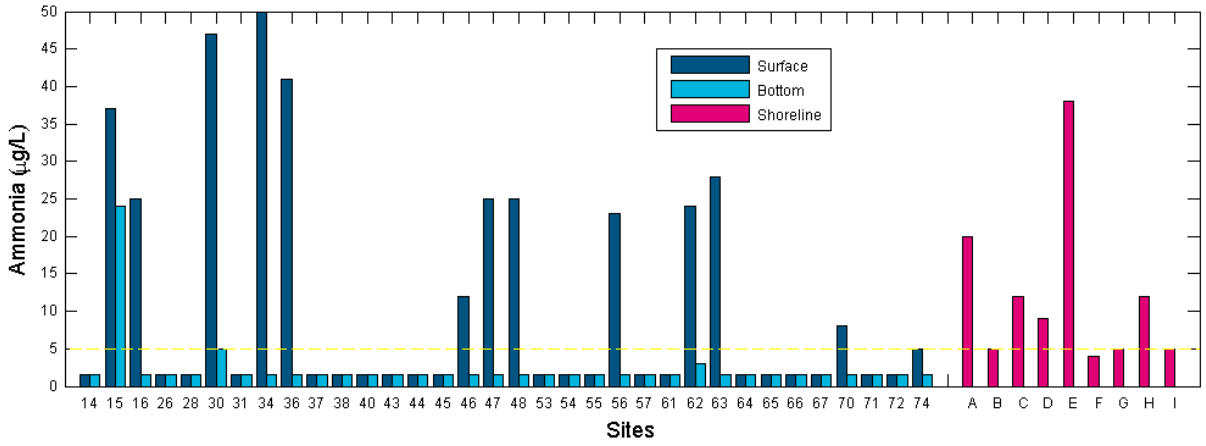


Figure 5.7 Temperature (a), salinity (b) and density (c) transect at Sepia Depression

5.5 Nutrients

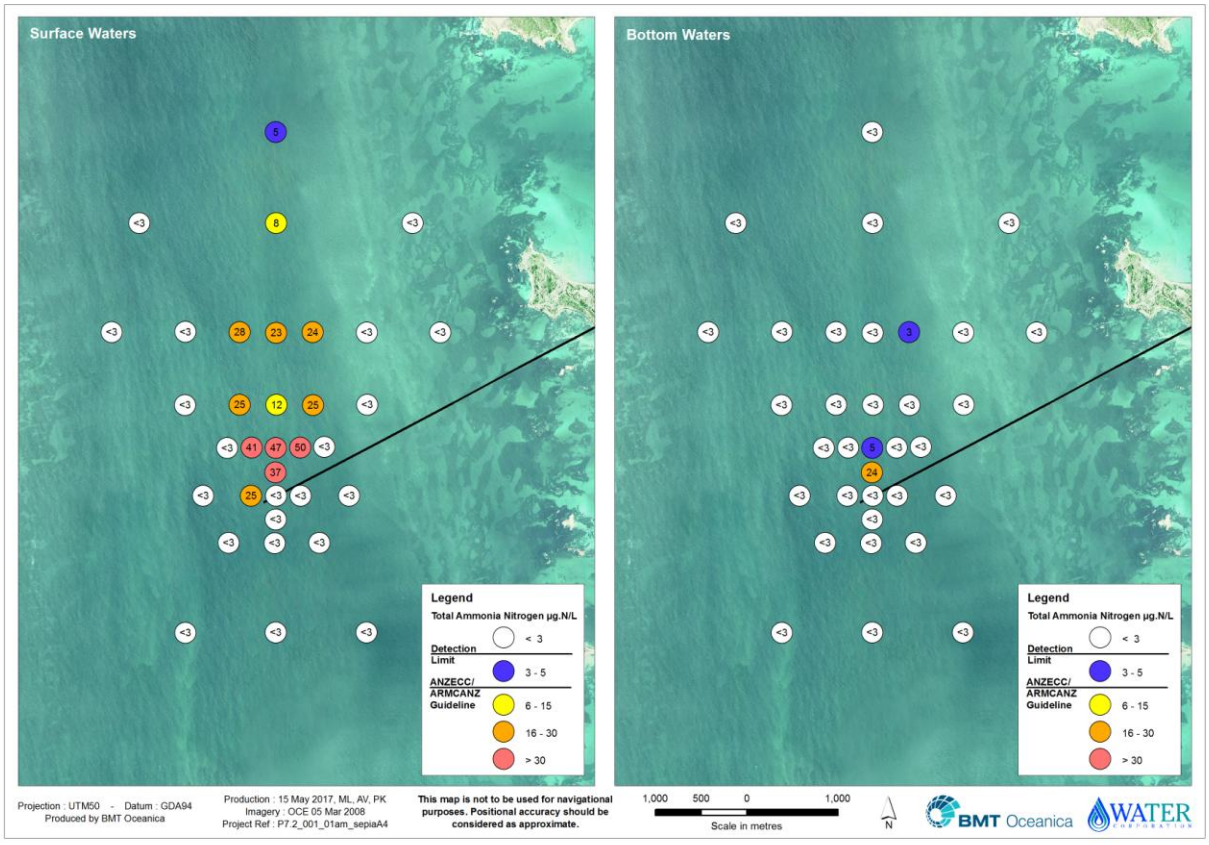
Total Ammonia Nitrogen (HN_4^+ + NH_3)

Twelve (35%) surface samples exceeded the ANZECC & ARMCANZ (2000) guideline for ammonia and the 80th percentile of reference site concentrations (Figure 5.8 and Figure 5.9). One (3%) bottom water sample exceeded the ANZECC & ARMCANZ (2000) guideline and 2 (6%) exceeded the 80th percentile of reference site concentrations (Figure 5.8 and Figure 5.9). The highest concentrations were evident at the surface and north of the outlet (the direction of the prevailing current at the time (Figure 5.9). There is general reduction in concentration with increasing distance from the outlet (Figure 5.9). Median concentrations at the surface and bottom, both inside and beyond a distance of 250 m from the diffuser were all lower than the ANZECC & ARMCANZ (2000) and 80th percentile of reference site concentrations (Table 5.3). Five (56%) of the shoreline samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 5.8). Consequently, the median shoreline concentration also exceeded the ANZECC & ARMCANZ (2000) guideline but this result is unlikely related to the passage of the plume (Table 5.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 5.8 Total ammonia nitrogen concentrations at Sepia Depression



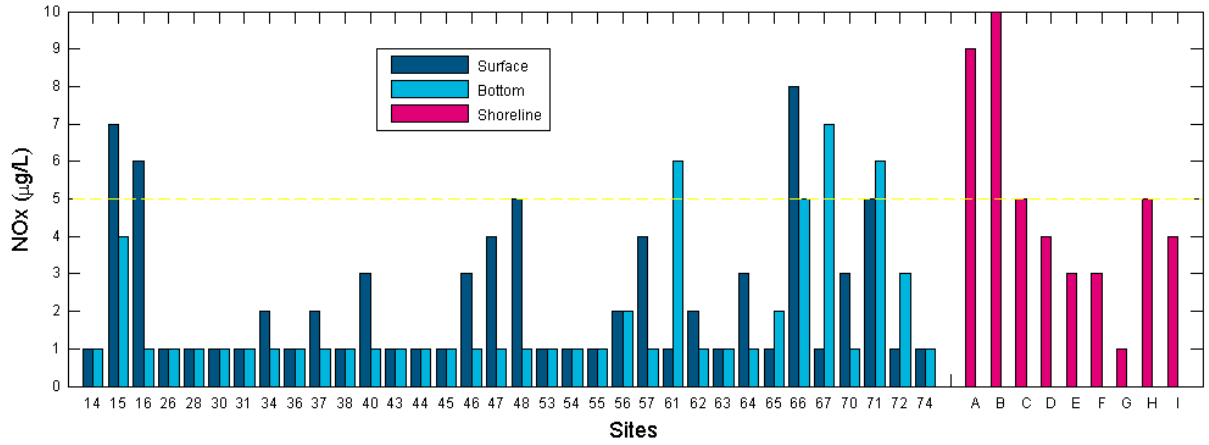
Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.9 Spatial distribution of total ammonia nitrogen at Sepia Depression

Nitrate+nitrite (NO_2^-+NO_3^-)

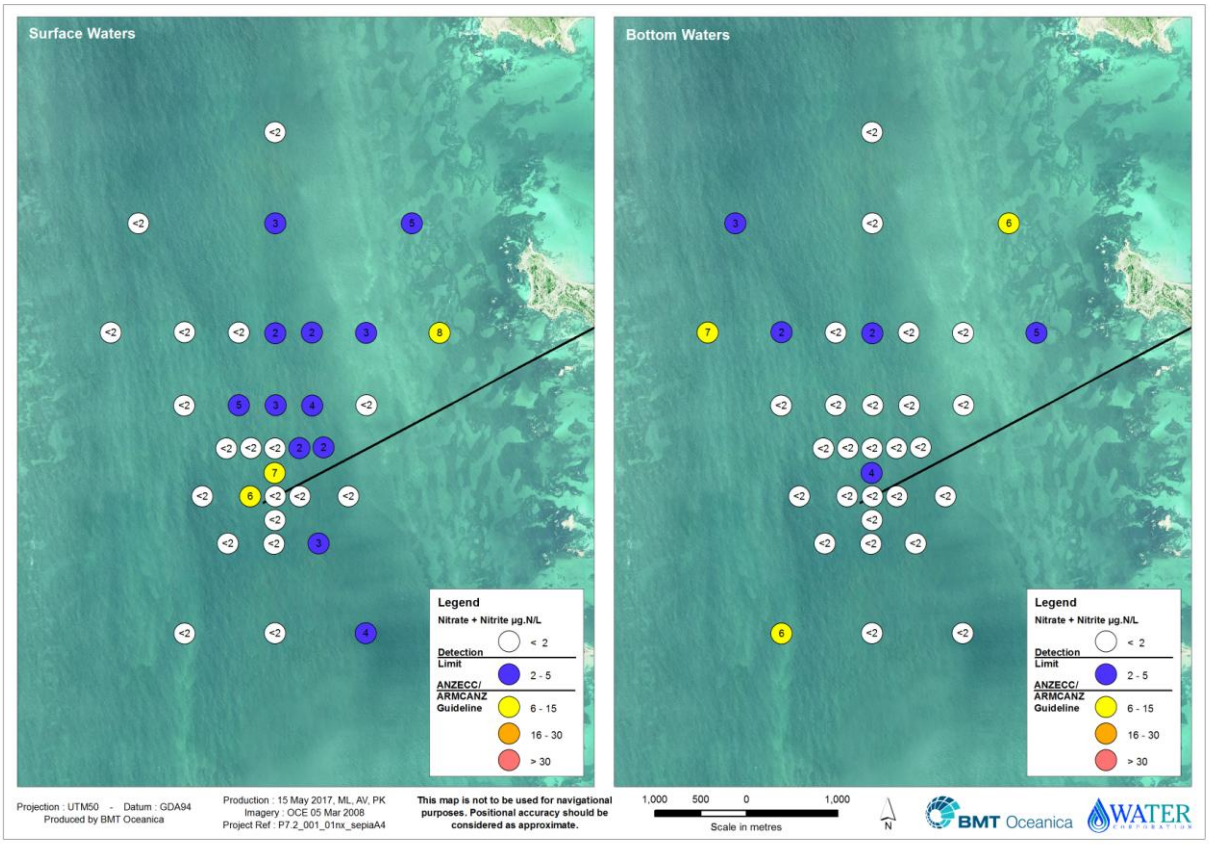
Three (9%) surface and 3 (9%) bottom samples exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 5.10Figure 5.11). Five surface (15%) and 4 (12%) bottom samples exceeded the 80th percentile of reference site concentrations (Figure 5.10 and Figure 5.11). Concentrations at 2 (22%) shoreline sites exceeded the ANZECC &

ARMCANZ (2000) guidelines (Figure 5.10). All median concentrations (i.e. combinations of surface and bottom, both within and outside 250 m from the diffuser as well as at the shoreline) were below the ANZECC & ARMCANZ (2000) guideline and 80th percentile of reference site concentrations (Table 5.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 5.10 Nitrate+nitrite concentrations at Sepia Depression

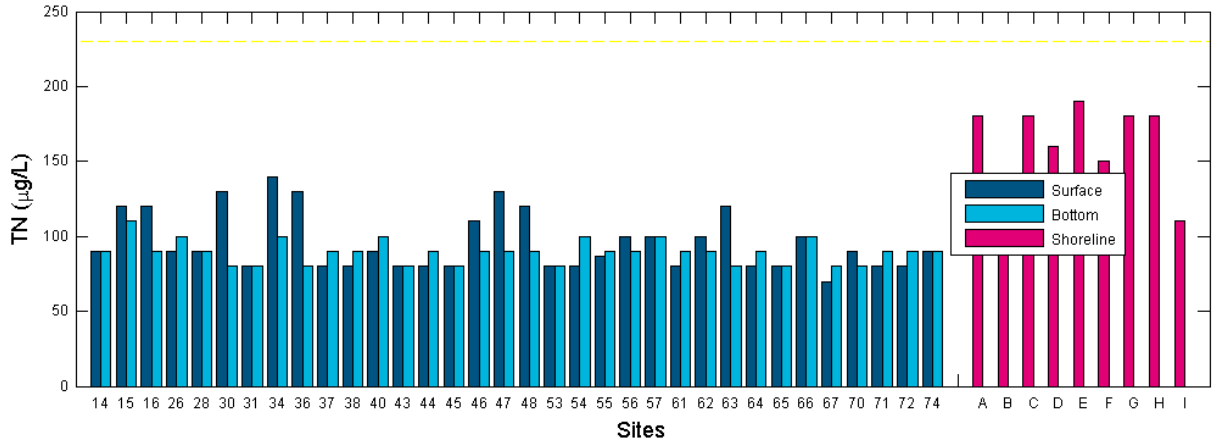


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.11 Spatial distribution of nitrate+nitrite at Sepia Depression

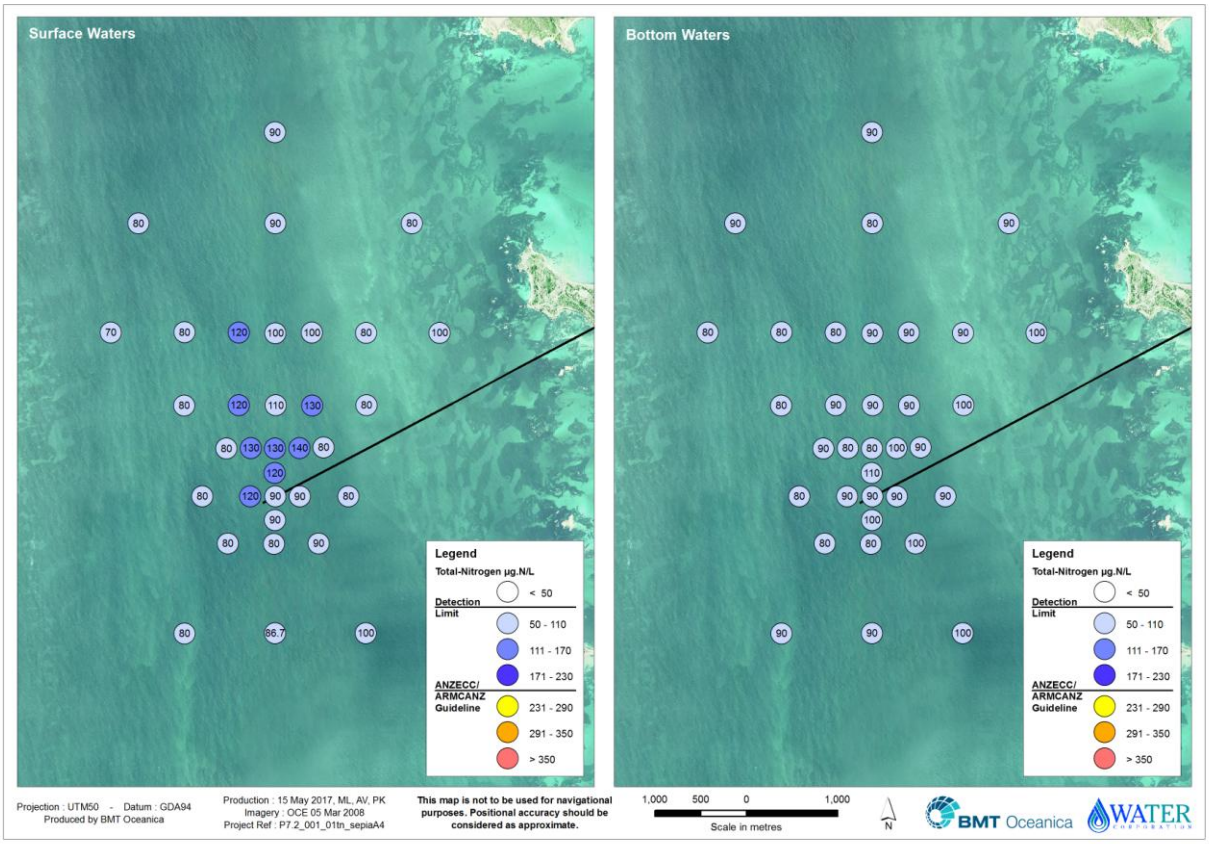
Total nitrogen

No surface or bottom sample concentrations exceeded the ANZECC & ARMCANZ (2000) total nitrogen guideline (Figure 5.12 and Figure 5.13). One (3%) surface sample exceeded the 80th percentile of reference site data (Figure 5.12 and Figure 5.13). No shoreline sites exceeded the ANZECC & ARMCANZ (2000) trigger (Figure 5.12). Median surface and bottom sample concentrations, inside and outside 250 m from the diffuser were below the ANZECC & ARMCANZ (2000) guideline and 80th percentile of reference site concentrations (Table 5.3). Median shoreline concentrations were below the ANZECC & ARMCANZ (2000) total nitrogen trigger (Table 5.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 5.12 Total nitrogen concentrations at Sepia Depression

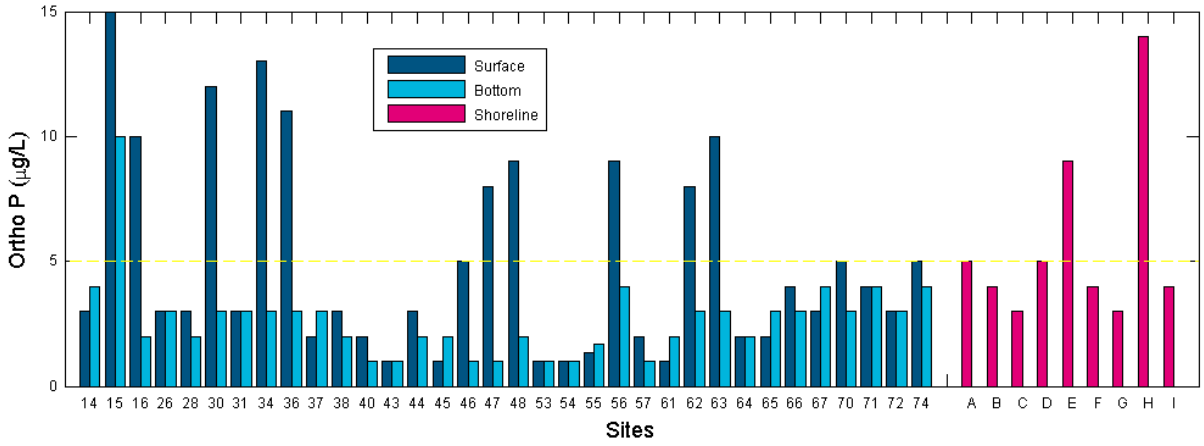


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.13 Spatial distribution of total nitrogen at Sepia Depression

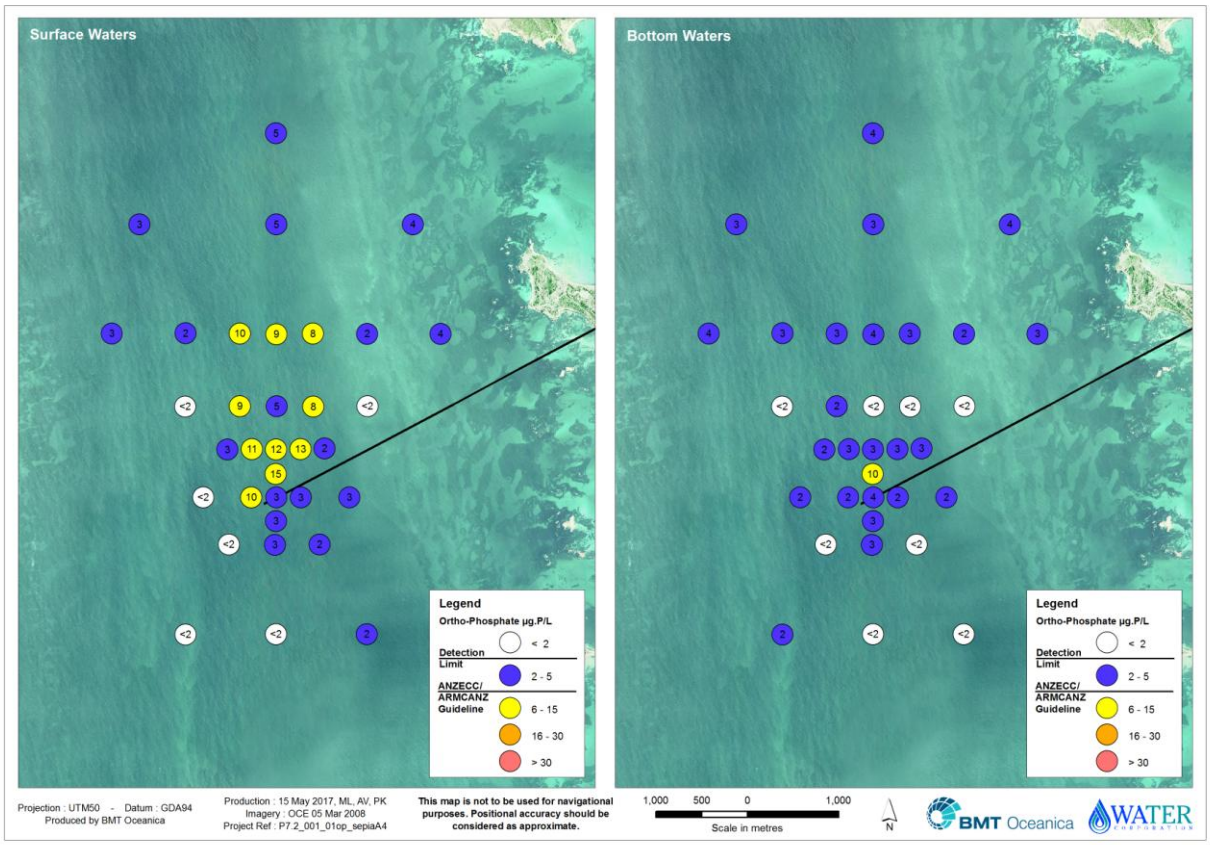
Orthophosphate

Concentrations of orthophosphate in 10 (29%) surface and 1 (3%) bottom samples exceeded the ANZECC & ARMCANZ (2000) guideline and the 80th percentile of reference site concentrations (Figure 5.14 and Figure 5.15). Elevated surface concentrations extended to the north of the diffuser (in the direction of the prevailing current (Figure 5.15). Concentrations of orthophosphate in 2 of the 9 (22%) shoreline sites exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 5.14). Median concentrations of surface and bottom samples both within and outside 250 m from the diffuser as well as at the shoreline sites were below the ANZECC & ARMCANZ (2000) guideline and the 80th percentile of reference site concentrations (Table 5.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 5.14 Ortho-phosphate concentrations at Sepia Depression



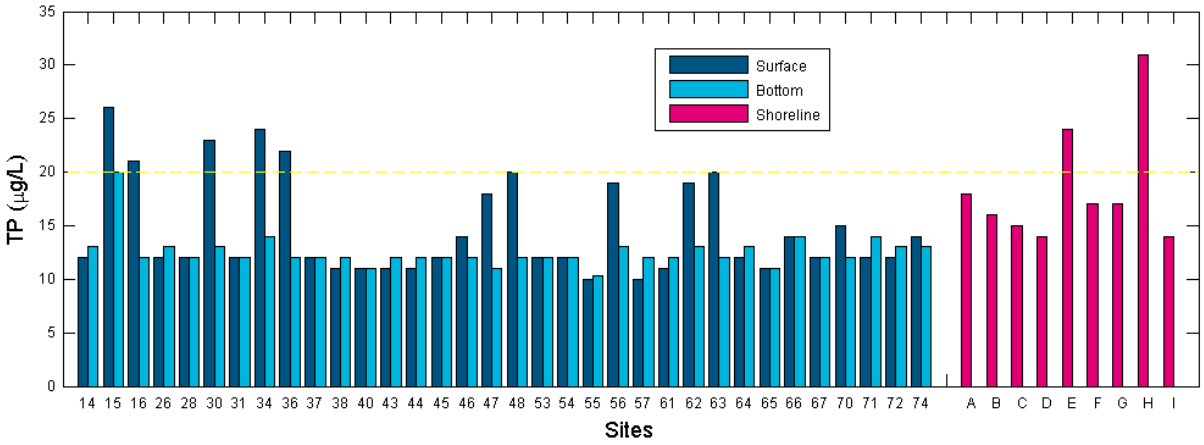
Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.15 Spatial distribution of ortho-phosphate at Sepia Depression

Total Phosphorus (TP)

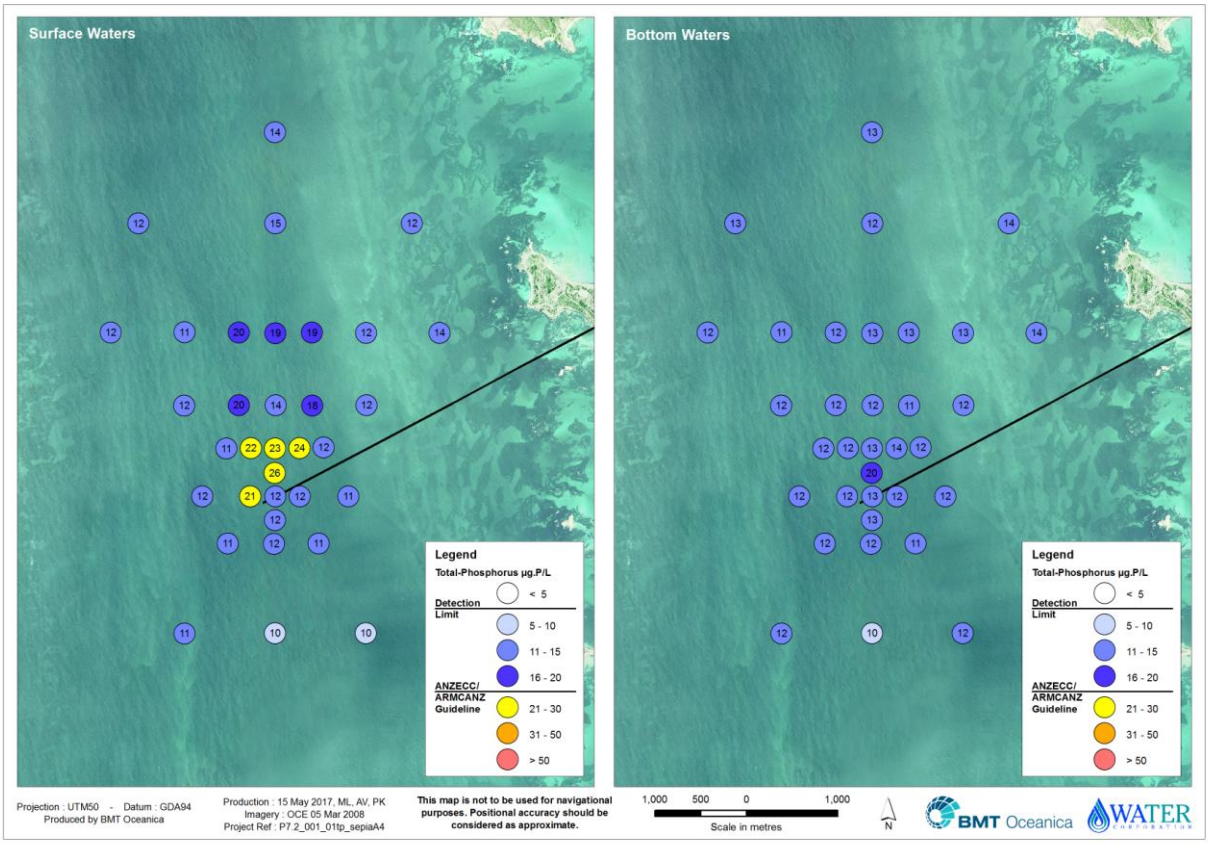
Total phosphorus concentrations exceeded the ANZECC & ARMCANZ (2000) guideline in 5 (15%) surface samples (Figure 5.16 and Figure 5.17). Concentrations did not exceed the 80th percentile of reference site concentrations in any sample (Figure 5.16 and

Figure 5.17). A total of 2 (22%) shoreline sample concentrations exceeded the ANZECC & ARMCANZ (2000) guideline (Figure 5.16 and Figure 5.17). Median concentrations of surface and bottom samples < 250 m and >250 m from the diffuser and at the shoreline sites were below the ANZECC & ARMCANZ (2000) guideline and 80th percentile of reference site concentrations (Table 5.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline

Figure 5.16 Total phosphorus concentrations at Sepia Depression

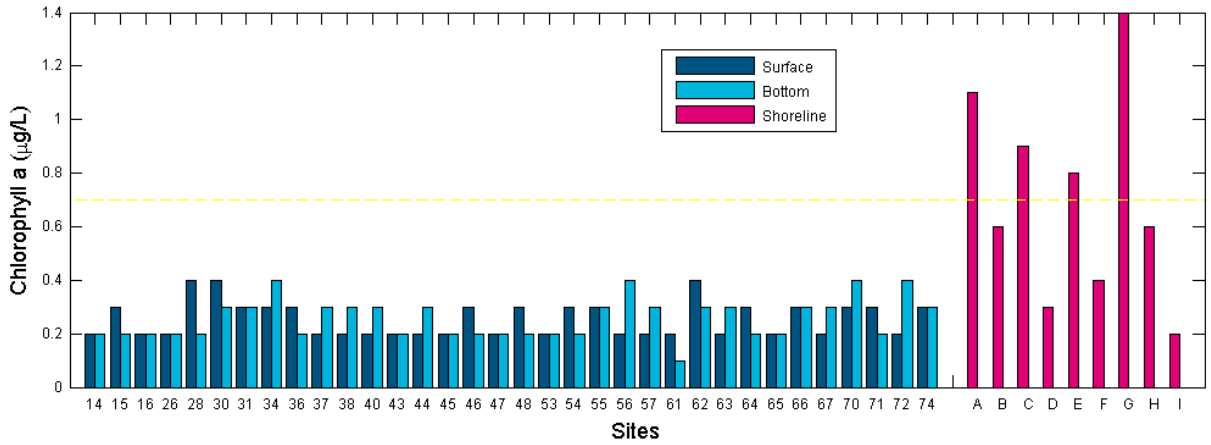


Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.17 Total phosphorus concentrations at Sepia Depression

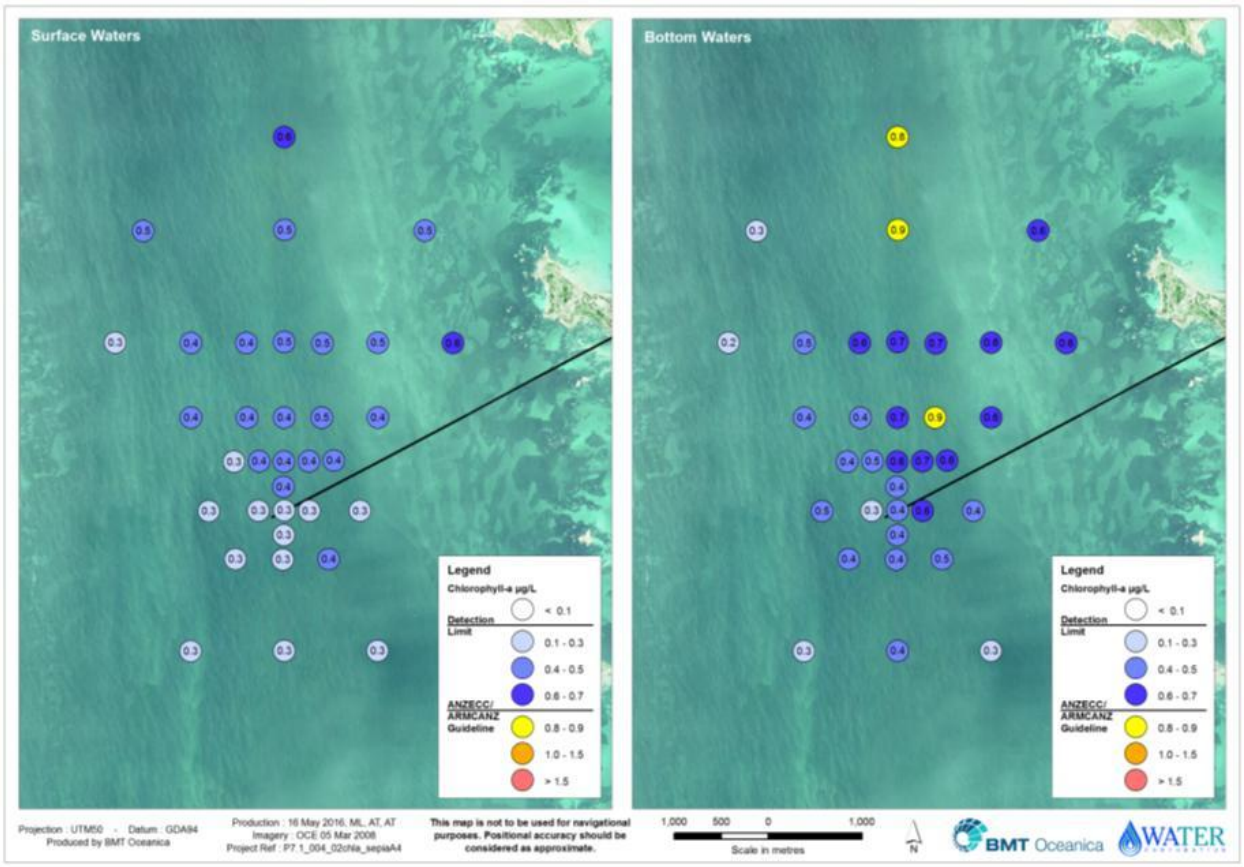
5.6 Chlorophyll

Chlorophyll *a* concentrations did not exceed either the ANZECC & ARMCANZ (2000) guideline or the 80th percentile of reference site concentrations in any surface or bottom samples (Figure 5.18 and Figure 5.19). Chlorophyll concentrations at 4 (44%) of the shoreline sites exceeded the ANZECC & ARMCANZ (2000) guidelines (Figure 5.18 and Figure 5.19). Median concentrations of surface and bottom samples inside and outside 250 m from the diffuser and at the shoreline sites were below the ANZECC & ARMCANZ (2000) guideline and 80th percentile of reference site concentrations (Table 5.3).



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline.

Figure 5.18 Chlorophyll-a concentrations at Sepia Depression



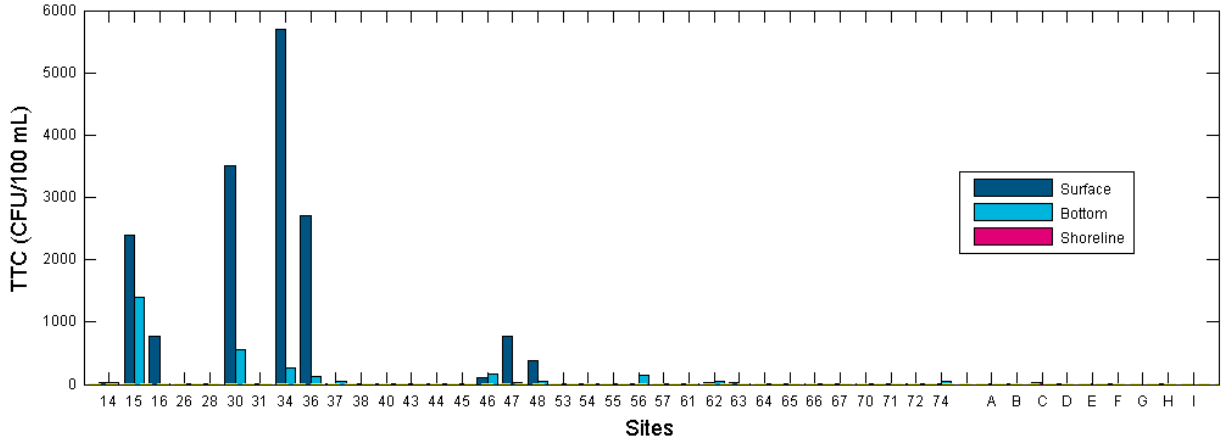
Notes:
1. Site locations have been exaggerated for visual clarity.
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.19 Spatial distribution of chlorophyll-a concentrations at Sepia Depression

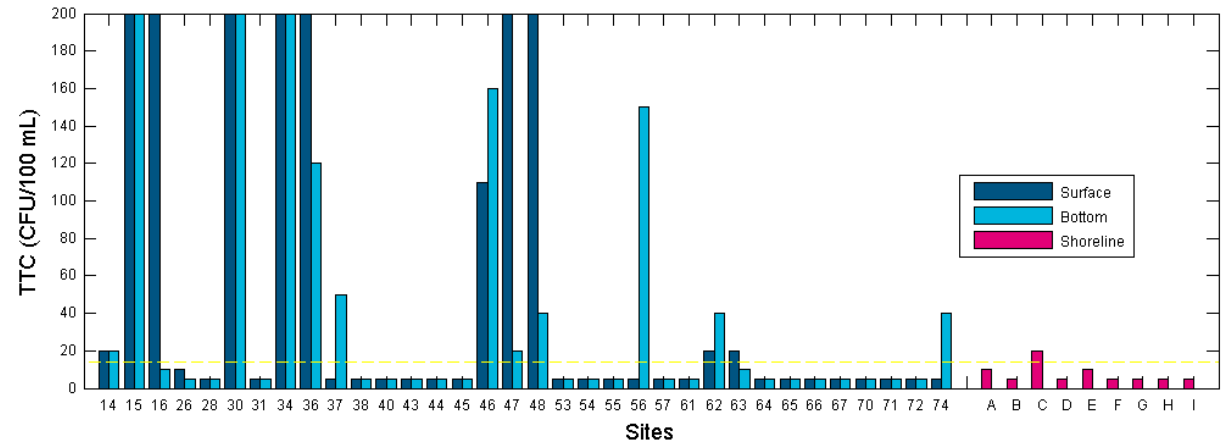
5.7 Microbial community

Surface and bottom TTC concentrations were elevated near the diffuser and 11 (32%) surface and 12 (35%) bottom samples exceeded the EPA (2015b) EQG trigger (Figure 5.20 and Figure 5.21). Surface concentrations remained elevated (although decreasing with distance) in samples collected in a northerly direction from the diffuser (the direction of the prevailing current) (Figure 5.21). Median concentrations at the surface <250 m from the diffuser exceeded the EPA (2015b) EQG trigger. Median TTC concentrations at the bottom and >250 m from the diffuser were below the EPA (2015b) EQG trigger. TTC concentrations at 1 (11%) shoreline site exceeded the EPA (2015b) EQG trigger, but overall median concentrations were below the guideline (Figure 5.20 and Table 5.3).

a

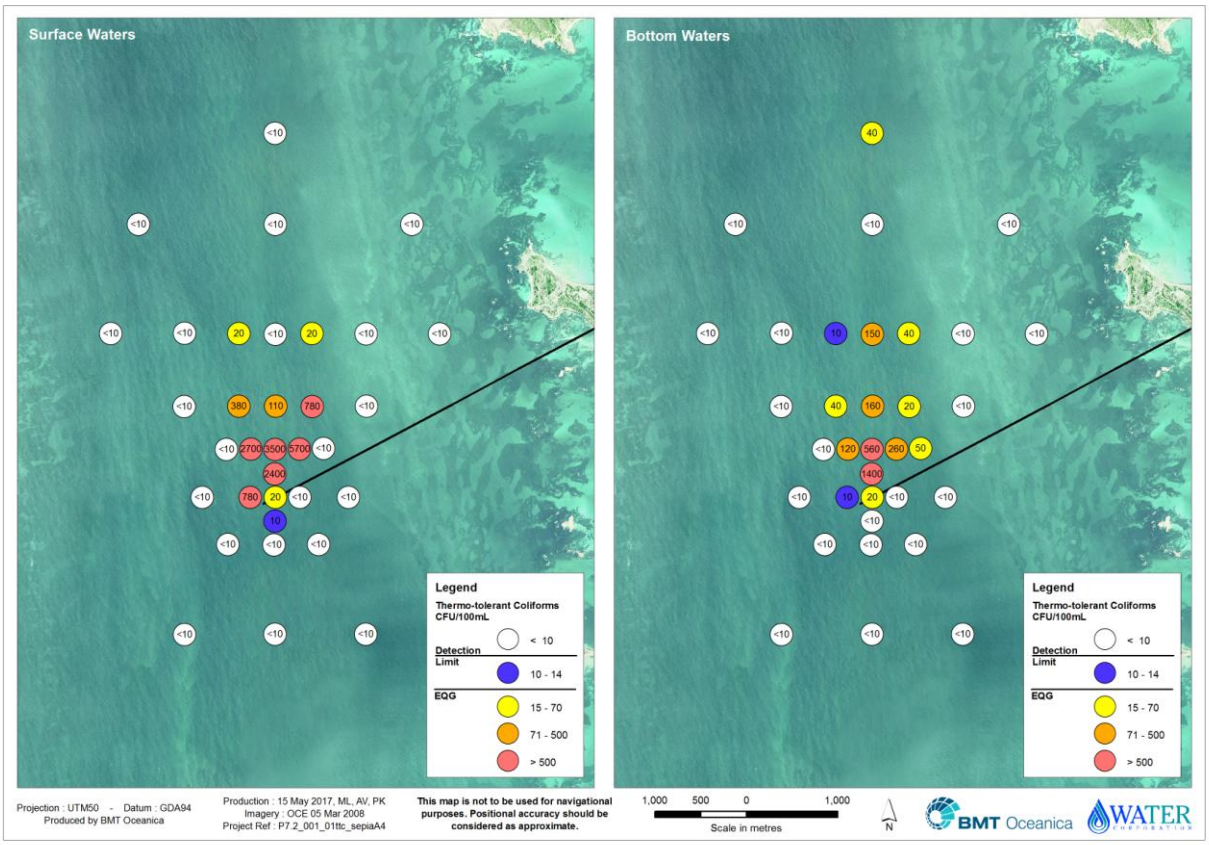


b



Note:
1. Dashed line indicates EQG (EPA 2015b) guideline
2. a) Full scale and b) rescaled to show detail at low concentration

Figure 5.20 Thermotolerant coliform concentrations at Sepia Depression

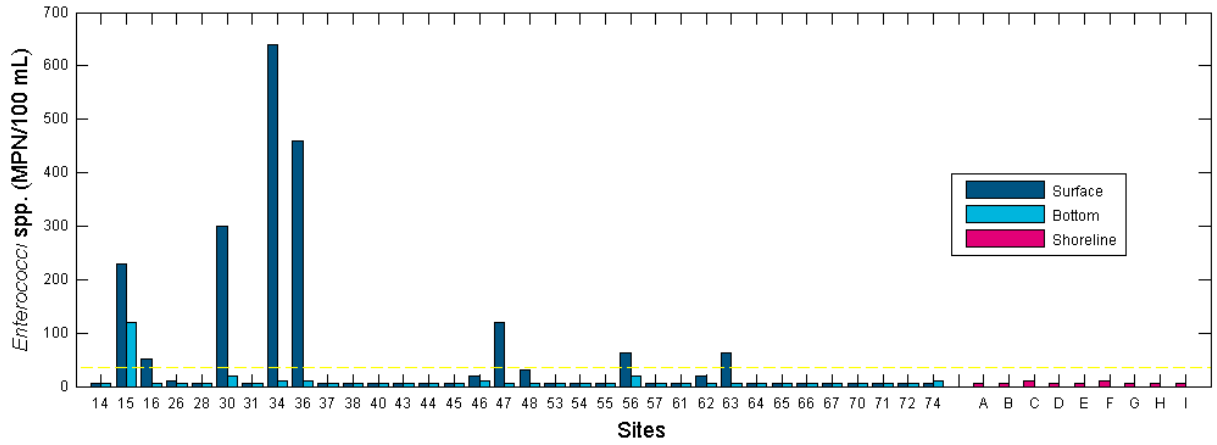


Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or EQG.

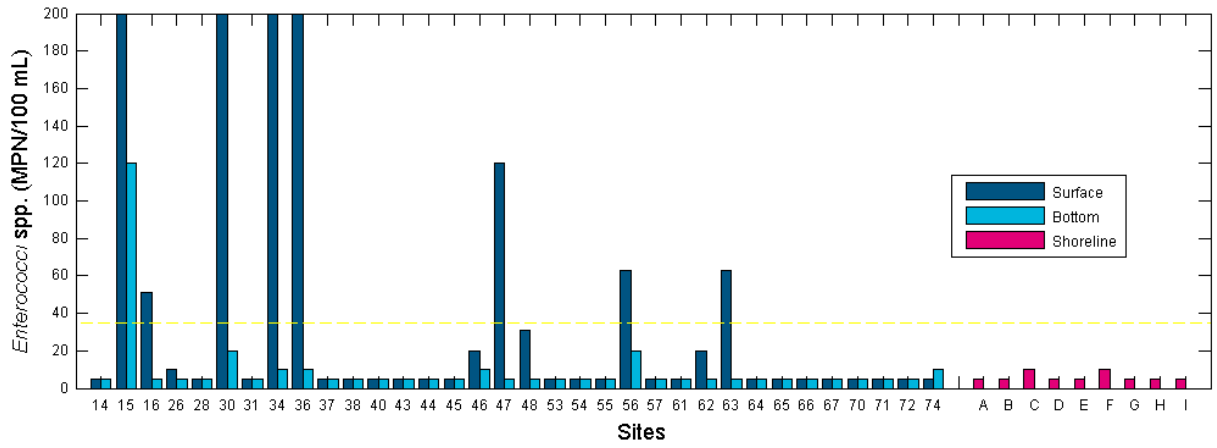
Figure 5.21 Spatial distribution of thermotolerant coliform concentrations at Sepia Depression

Surface and bottom *Enterococci* spp. concentrations were elevated near the diffuser and remained elevated (although decreasing with distance) in samples collected in the direction of the prevailing current (a northerly direction) (Figure 5.22 and Figure 5.23). Eight (24%) surface samples and 1 (3%) bottom sample exceeded the ANZECC & ARMCANZ (2000) trigger. However, median concentrations at the surface and bottom, both less than and greater than 250 m met the ANZECC & ARMCANZ (2000) trigger (Table 5.3). Concentrations did not exceed the ANZECC & ARMCANZ (2000) guideline at any of the shoreline sites (Figure 5.22).

a

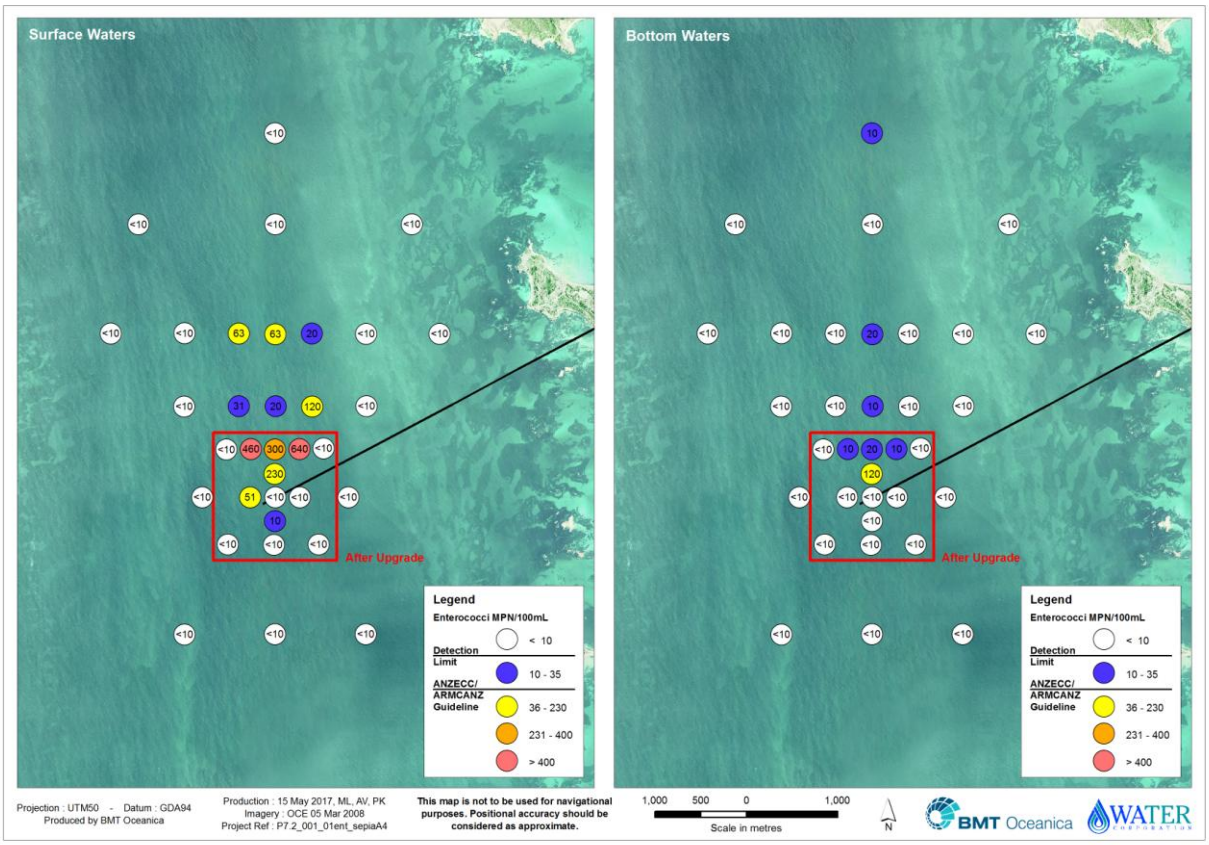


b



Note:
1. Dashed line indicates ANZECC & ARMCANZ (2000) guideline
2. a) Full scale and b) rescaled to show detail at low concentration

Figure 5.22 *Enterococci* spp. concentrations at Sepia Depression



Notes:
1. Site locations have been exaggerated for visual clarity
2. Breaks in the legend (solid lines) indicate concentrations above or below the detection limit or ANZECC & ARMCANZ (2000) guideline.

Figure 5.23 Spatial distribution of *Enterococci* spp. at Sepia Depression

5.8 Summary

The summer water quality surveys were not designed for comparison with the ANZECC & ARMCANZ (2000) guidelines or with 80th percentile of reference values but comparisons were made for sites located <250 m and >250 m from the diffuser as an indicator rather than a means of assessing compliance. Despite elevated concentrations at some individual sites outside the immediate zone of influence of the outlet, the guidelines for demonstrating ecosystem protection and public health criteria were met (Table 5.2).

During the survey, the treated wastewater plume was initially buoyant (as indicated by the lower salinity and higher concentrations of nutrients and microbiological indicators in surface waters than in bottom waters) and was advecting in a north-north westerly direction. Median concentrations of nutrients and chlorophyll a were typically below the guidelines both within and beyond 250 m from the outlet (Table 5.2) some elevated nutrients at the shoreline appear to be unrelated to the outlet (Table 5.2).

Median thermotolerant coliform (TTC) concentrations were below the maintenance of seafood safe for human consumption guideline in surface and bottom waters >250 m from the diffuser (Table 5.2) suggesting that these waters are maintained for seafood quality. Guidelines relating to recreation contact were met both within and outside 250 m of the diffuser (Table 5.2).

Table 5.2 Summary Sepia Depression

Parameter	Inside the mixing zone (sites <250 m from diffuser)		Outside the mixing zone (sites >250 m from diffuser)		Shoreline
	Surface	Bottom	Surface	Bottom	
ANZECC & ARMCANZ (2000) guideline values					
Total ammonia nitrogen					
Ortho-phosphate					
Nitrate+nitrite					
Total phosphorus					
Total nitrogen					
Chlorophyll-a					
Enterococci spp.[3]					
80th percentile of reference values					
Total ammonia nitrogen					
Ortho-phosphate					
Nitrate+nitrite					
Total phosphorus					
Total nitrogen					
Chlorophyll-a					
Environmental Quality Guideline (EPA 2015b)					
Thermotolerant coliforms[4]					

Notes:

1. Green = median values ≤ ANZECC & ARMCANZ (2000) guideline values , ≤80th percentile reference values or ≤ EQG.
2. Red = Median values > ANZECC & ARMCANZ (2000) guideline values , >80th percentile reference values or > EQG
3. For the maintenance of seafood safe for human consumption
4. For primary contact recreation

Table 5.3 Summary statistics for Sepia Depression

Parameter	depth	lowest		highest		Median		number (%) below the guideline		number (%) below 80th percentile of reference	
		Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Ammonia (NH4)	All	1.5	1.5	50	24	1.5	1.5	22 (65)	33 (97)	22 (65)	32 (94)
	Inside 250 m	1.5	1.5	37	24	1.5	1.5	3 (60)	4 (80)	3 (60)	4 (80)
	Outside 250 m	1.5	1.5	50	5	1.5	1.5	19 (66)	29 (100)	19 (66)	28 (97)
	Shoreline	4	NA	38	NA	9	NA	4 (44)	NA	NA	NA
Nitrate + nitrite	All	1	1	8	7	1	1	31 (91)	31 (91)	29 (85)	30 (88)
	Inside 250 m	1	1	7	4	1	1	3 (60)	5 (100)		5 (100)
	Outside 250 m	1	1	8	7	1	1	28 (97)	26 (90)	26 (90)	25 (86)
	Shoreline	1	NA	10	NA	4	NA	7 (78)	NA	NA	NA
Total nitrogen	All	70	80	140	110	90	90	34 (100)	34 (100)	33 (97)	34 (100)
	Inside 250 m	90	90	120	110	90	90	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	70	80	140	100	87	90	29 (100)	29 (100)	28 (97)	29 (100)
	Shoreline	110	NA	190	NA	180	NA	9 (100)	NA	NA	NA
Ortho-phosphate	All	1	1	15	10	3	3	24 (71)	33 (97)	24 (71)	33 (97)
	Inside 250 m	3	2	15	10	3	3	3 (60)	4 (80)	3 (60)	4 (80)
	Outside 250 m	1	1	13	4	3	3	21 (72)	29 (100)	21 (72)	29 (100)
	Shoreline	3	NA	14	NA	4	NA	7 (78)	NA	NA	NA
Total phosphorus (TP)	All	10	10	26	20	12	12	29 (85)	34 (100)	34 (100)	34 (100)
	Inside 250 m	12	12	26	20	12	13	3 (60)	5 (100)	5 (100)	5 (100)
	Outside 250 m	10	10	24	14	12	12	26 (90)	29 (100)	29 (100)	29 (100)
	Shoreline	14	NA	31	NA	17	NA	7 (78)	NA	NA	NA
Chlorophyll a	All	0.2	0.1	0.4	0.4	0.2	0.25	34 (100)	34 (100)	34 (100)	34 (100)
	Inside 250 m	0.2	0.2	0.4	0.2	0.2	0.2	5 (100)	5 (100)	5 (100)	5 (100)
	Outside 250 m	0.2	0.1	0.4	0.4	0.2	0.3	29 (100)	29 (100)	29 (100)	29 (100)
	Shoreline	0.2	NA	1.4	NA	0.6	NA	5 (56)	NA	NA	NA
Thermotolerant coliforms	All	5	5	5700	1400	5	5	23 (68)	22 (65)	NA	NA
	Inside 250 m	5	5	2400	1400	20	10	2 (40)	3 (60)	NA	NA
	Outside 250 m	5	5	5700	560	5	5	21 (72)	19 (66)	NA	NA
	Shoreline	5	NA	20	NA	5	NA	8 (89)	NA	NA	NA
Enterococci spp.	All	5	5	640	120	5	5	26 (76)	33 (97)	NA	NA
	Inside 250 m	5	5	230	120	10	5	3 (60)	4 (80)	NA	NA
	Outside 250 m	5	5	640	20	5	5	23 (79)	29 (100)	NA	NA
	Shoreline	5	NA	10	NA	5	NA	9 (100)	NA	NA	NA

Notes:
1. NA = Comparison not applicable

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Appendix A – Wastewater Treatment Plant Licences

Government of Western Australia
Department of Environment Regulation

Licence

Environmental Protection Act 1986, Part V

Licensee: Water Corporation

Licence: L7882/1992/14

Registered office: 629 Newcastle Street
LEEDERVILLE WA 6007

Premises address: Beenyup Wastewater Treatment Plant
Part of Lot 8278 on Plan 30778
Ocean Reef Road
CRAIGIE WA 6025
Bound by the following points, as depicted in Schedule 1

Point	Easting	Northing
1	383932.04m	6482700.62m
2	384010.53m	6482748.00m
3	384116.46m	6482755.52m
4	384146.54m	6482763.18m
5	384149.93m	6482701.61m
6	384170.03m	6482702.20m
7	384165.22m	6482733.01m
8	384339.70m	6482741.06m
9	384342.89m	6482684.45m
10	384383.60m	6482687.31m
11	384389.41m	6482600.98m
12	384434.98m	6482603.54m
13	384438.54m	6482549.71m
14	384443.75m	6482546.68m
15	384455.28m	6482376.99m
16	384450.62m	6482373.23m
17	384455.06m	6482312.90m
18	384532.63m	6482318.61m
19	384531.53m	6482335.27m
20	384595.84m	6482339.99m
21	384594.88m	6482315.55m
22	384599.70m	6482261.03m
23	383932.87m	6482216.62m
24	383931.33m	6482228.03m
25	383938.24m	6482276.32m
26	383961.56m	6482314.51m
27	383967.98m	6482420.53m
28	383965.59m	6482452.45m
29	383960.15m	6482454.02m

30	383956.19m	6482508.51m
31	383933.16m	6482518.59m
32	383930.96m	6482570.84m
33	383937.71m	6482613.83m
34	384264.48m	6482738.17m
35	384260.60m	6482813.19m
36	384359.81m	6482819.61m
37	384363.69m	6482743.28m

Issue Date: Friday, 30 September 2011

Commencement date: Tuesday, 1 November 2011

Expiry date: Friday, 31 October 2031

Prescribed Premises Category
Schedule 1 of the *Environmental Protection Regulations 1987*

Category number	Category description	Category production or design capacity	Approved Premises production or design capacity
54	Sewage facility premises – (a) on which sewage is treated (excluding septic tanks); or (b) from which treated sewage is discharged onto land or into waters.	100 cubic metres or more per day	135,000 cubic meters per day
61	Liquid waste facility: premises on which liquid waste produced on others premises (other than sewage waste) is stored, reprocessed, treated or irrigated.	100 tonnes or more per year	50,000 tonnes per annual period

Conditions
This Licence is subject to the conditions set out in the attached pages.

Date signed: 24 March 2016
…..
Alan Kietzmann
MANAGER LICENSING, WASTE INDUSTRIES
Officer delegated under section 20
of the *Environmental Protection Act 1986*

Contents

Introduction

This Introduction is not part of the Licence conditions.

DER's industry licensing role
The Department of Environment Regulation (DER) is a government department for the state of Western Australia in the portfolio of the Minister for Environment. DER's purpose is to advise on and implement strategies for a healthy environment for the benefit of all current and future Western Australians.

DER has responsibilities under Part V of the *Environmental Protection Act 1986* (the Act) for the licensing of prescribed premises. Through this process regulates to prevent, control and abate pollution and environmental harm to conserve and protect the environment. DER also monitors and audits compliance with works approvals and licence conditions, takes enforcement action as appropriate and develops and implement licensing and industry regulation policy.

Licence requirements
This licence is issued under Part V of the Act. Conditions contained within the licence relate to the prevention, reduction or control of emissions and discharges to the environment and to the monitoring and reporting of them.

Where other statutory instruments impose obligations on the Premises/Licensee the intention is not to replicate them in the licence conditions. You should therefore ensure that you are aware of all your statutory obligations under the Act and any other statutory instrument. Legislation can be accessed through the State Law Publisher website using the following link: http://www.slp.wa.gov.au/legislation/statutes.nsf/default.html

For your Premises relevant statutory instruments include but are not limited to obligations under the:

- *Environmental Protection (Unauthorised Discharges) Regulations 2004* – these Regulations make it an offence to discharge certain materials such as contaminated stormwater into the environment other than in the circumstances set out in the Regulations.

- *Environmental Protection (Controlled Waste) Regulations 2004* – these Regulations place obligations on you if you produce, accept, transport or dispose of controlled waste.

- *Environmental Protection (Noise) Regulations 1997* – these Regulations require noise emissions from the Premises to comply with the assigned noise levels set out in the Regulations.

You must comply with your licence. Non-compliance with your licence is an offence and strict penalties exist for those who do not comply.

Licence holders are also reminded of the requirements of section 53 of the Act which places restrictions on making certain changes to prescribed premises unless the changes are in accordance with a works approval, licence, closure notice or environmental protection notice.

Other Guidelines which you should be aware of include:

- *Western Australian Guidelines for Biosolids Management*, Department of Environment and Conservation, December 2012 (as amended from time to time).

Licence Fees
If you have a licence that is issued for more than one year, you are required to pay an annual licence fee prior to the anniversary date of issue of your licence. Non payment of annual licence fees will result in your licence ceasing to have effect meaning that it will no longer be valid and you will need to apply for a new licence for your Premises.

Ministerial conditions
If your Premises has been assessed under Part IV of the Act you may have had conditions imposed by the Minister for Environment. You are required to comply with any conditions imposed by the Minister.

Premises description and Licence summary
Beenyup WWTP is located on part of Lot 8278 on Plan 30778 Ocean Reef Road, Craigie, Western Australia. The plant has been operating at this premises since 1972. The Lot is bounded by the Mitchell Freeway to the east, Ocean Reef Road to the north, the residential suburb of Craigie to the west and Craigie Open Space, an area of regionally significant bushland, to the south. Water Corporation's Advanced Water Replenishment Plant is located on the same lot immediate north of the premises, and the rest of the Lot contains the Bush Forever site 303 as well as a hardstand area to the north occupied by Water Corporation's construction branch.

The geology of the site is generally made up of Bassendean sands over Tamala Limestone. A large stretch of the Quindalup dune system occurs along the western margin of the site. The Perth Groundwater Atlas indicates the historical maximum water table level at the site is at 4.0m AHD, corresponding to 17-19m below current ground level. A dissipation test at the site indicated that the water table was present at 18.1m below ground level (3.6m AHD) (Worley Parsons, 2007); therefore, interference of plant structural and civil elements by groundwater is not expected.

Sewage enters the plant via pipelines. After screening, the wastewater flows into circular grit removal tanks, aerated to allow the inorganic material to settle and the organic material to pass through very slowly to large rectangular primary sedimentation tanks allowing about 50 per cent of the suspended solids to settle out as sludge. Sludge is collected by scraper mechanism and pumped to the solids handling area for thickening and digestion. The treated wastewater leaving the primary tanks called primary treated wastewater passes to secondary treatment tanks. Secondary treatment is achieved in aeration tanks by the activated sludge process. Following aeration, the treated wastewater passes slowly through circular clarifiers in which the activated sludge settles leaving a high quality secondary effluent. The settled sludge containing micro-organisms is rapidly removed using scrapers and is returned to the aeration tanks.

Solids removed from the primary sedimentation tanks and excess solids produced by the activated sludge process are thickened and fed to the anaerobic digesters. Following digestion, the sludge is mechanically dewatered to produce a biosolid suitable for use as a soil conditioner.

Secondary treated wastewater flows by gravity to the Indian Ocean in the vicinity of the Marmion Marine Park and is discharged into 10 metres of water via two outlets, one 1850 metres and the other one 1650 metres offshore, where it is rapidly diluted and dispersed. This is regulated by Ministerial Statement 382.

The main emission from the premises is odour. Odorous air is extracted from the inlet works, primary tanks, secondary treatment tanks and sludge storage facilities, sludge loading and unloading area, and passed through activated carbon, a biological and chemical scrubber vented to a 50 meter stack.

This Licence is the result of an amendment to adjust the premises boundary to the physical boundary of the treatment plant rather than the entire Lot 8278. The licence has also been converted to the new format for consistency with other Water Corporation licences. Changes have been made in relation to definitions and controlled waste codes. This amendment does result in any alteration of discharges, emissions or processes at the premises but does extend the expiry date of the instrument.

The premise is subject to Ministerial Statement 382 and this licence does not duplicate any conditions of this statement.

The licences and works approvals issued for the Premises since 01/10/1994 are:

Instrument log		
Instrument	**Issued**	**Description**
W1243/1991/1	01/10/1994	New works approval
W1867/1991/1	06/03/1997	New works approval
W2580/1991/1	03/11/1998	New works approval
L4727/1991/1	01/10/2000	New Licence
W3217/1991/1	31/01/2001	New works approval
L4727/1991/2	01/10/2001	Licence renewal
L4727/1991/3	01/10/2002	Licence renewal
W3761/1991/1	24/02/2003	New works approval
L7882/1991/8	20/10/2003	New Licence
L7882/1991/9	01/10/2004	Licence renewal
W4091/1991/1	04/01/2005	Licence renewal
W4090/1991/1	28/02/2005	New works approval
L7882/1991/10	01/11/2005	Licence renewal
L7882/1991/11	01/11/2006	Licence renewal
L7882/1991/12	01/11/2007	Licence renewal
L7882/1991/13	01/11/2008	Licence renewal
L7882/1991/14	01/11/2011	Licence renewal
W5809/2015/1	13/04/2015	New works approval
W5235/2012/1	14/09/2012	New works approval
L7882/1991/14	31/03/2016	Licence amendment to new format, updating premises boundary and extending expiry date.

Severance

It is the intent of these Licence conditions that they shall operate so that, if a condition or a part of a condition is beyond the power of this Licence to impose, or is otherwise *ultra vires* or invalid, that condition or part of a condition shall be severed and the remainder of these conditions shall nevertheless be valid to the extent that they are within the power of this Licence to impose and are not otherwise *ultra vires* or invalid.

END OF INTRODUCTION

Licence conditions

1 General

1.1 Interpretation

1.1.1 In the Licence, definitions from the *Environmental Protection Act 1986* apply unless the contrary intention appears.

1.1.2 For the purposes of this Licence, unless the contrary intention appears:

'Act' means the *Environmental Protection Act 1986;*

'annual period' means the inclusive period from 1 July until 30 June;

'AS/NZS 2031' means the Australian Standard AS/NZS 2031 *Selection of containers and preservation of water samples for microbiological analysis;*

'AS/NZS 5667.1' means the Australian Standard AS/NZS 5667.1 *Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples;*

'AS/NZS 5667.10' means the Australian Standard AS/NZS 5667.10 *Water Quality – Sampling – Guidance on sampling of waste waters;*

'averaging period' means the time over which a limit is measured or a monitoring result is obtained;

'CEO' means Chief Executive Officer of the Department of Environment Regulation;

'CEO' for the purpose of correspondence means;

Chief Executive Officer
Department Administering the Environmental Protection Act 1986
Locked Bag 33
CLOISTERS SQUARE WA 6850
Email: info@der.wa.gov.au;

'CEMS' means continuous emissions monitoring system;

'CEMS Code' means the current version of the Continuous Emission Monitoring System (CEMS) Code for Stationary Source Air Emissions, Department of Environment & Conservation, Government of Western Australia;

'cfu/100 mL' means colony forming units per 100 millilitres;

'controlled waste' has the definition in *Environmental Protection (Controlled Waste) Regulations 2004;*

'covers' means metallic or non-metallic covers used to cover the pre-treatment, primary treatment and secondary aeration areas of the treatment plant;

'hardstand' means a surface with a permeability of 10^{-9} metres/second or less;

'Leachate' means liquid released by or water that has percolated through waste and which contains some of its constituents;

'Licence' means this Licence numbered L7882/1992/14 and issued under the *Environmental Protection Act 1986;*

'Licensee' means the person or organisation named as Licensee on page 1 of the Licence;

'NATA' means the National Association of Testing Authorities, Australia;

'NATA accredited' means in relation to the analysis of a sample that the laboratory is NATA accredited for the specified analysis at the time of the analysis;

'Premises' means the area defined in the Premises Map in Schedule 1 and listed as the Premises address on page 1 of the Licence;

'**Process equipment**' means any wastewater or sludge containment infrastructure or wastewater treatment vessel;

'quarterly' means the four inclusive periods from 1 July to 30 September, 1 October to 31 December and 1 January to 31 March and 1 April to 30 June in the following year.

'Schedule 1' means Schedule 1 of this Licence unless otherwise stated;

'Schedule 2' means Schedule 2 of this Licence unless otherwise stated;

'six-monthly' means the two inclusive periods from 1 July to 30 December and 1 January to 30 June in the following year;

'spot sample' means a discrete sample representative at the time and place at which the sample is taken;

'STP, dry' means standard temperature and pressure (0^{o}C and 101.325 kilopascals); dry;

'Waste Code' means the Waste Code assigned to a type of controlled waste for purposes of waste tracking and reporting as specified in the Department of Environment Regulation "Controlled Waste Category List" (July 2014), as amended from time to time;

'wastewater treatment vessels' means any vessel or tank containment infrastructure associated with the treatment of wastewater and includes, but not limited to oxidation ditches and clarifiers; and

'usual working day' means 0800 – 1700 hours, Monday to Friday excluding public holidays in Western Australia.

1.1.3 Any reference to an Australian or other standard in the Licence means the relevant parts of the standard in force from time to time during the term of this Licence.

1.1.4 Any reference to a guideline or code of practice in the Licence means the version of that guideline or code of practice in force from time to time, and shall include any amendments or replacements to that guideline or code of practice made during the term of this Licence.

1.2 Premises operation

1.2.1 The Licensee shall only allow waste to be accepted on to the Premises if:
(a) it is of a type listed in Table 1.3.1; and
(b) the quantity accepted is below any limit listed in Table 1.2.1; and
(c) it meets any specification listed in Table 1.2.1

Table 1.2.1: Waste acceptance

Waste	Waste Code	Quantity Limit	Specification[1]
Putrescible and Organic wastes			
Sewage	N/A	135,000 m^3/day	Accepted through sewer inflow(s) only
Septage wastes	K210	50,000 t/annual period	From other Water Corporation assets tankered into the premises at the pre-treatment works of the sewage treatment plant. The waste shall be delivered to the plant via an enclosed pipeline.
Sewage waste from reticulated sewage system	K130		

1.2.2 The Licensee shall ensure that the wastes accepted onto the Premises are only subjected to the process(es) set out in Table 1.2.2 and in accordance with any process requirements described in that table.

Table 1.2.2: Waste processing

Waste type	Process	Process requirements
Sewage	Screening, grit removal, disinfection and filtration. And Physical, biological and chemical treatment. **Preliminary treatment** • Screening and Grit removal **Primary treatment** • Primary Sedimentation tanks **Secondary treatment** • Aeration tanks and secondary sedimentation tanks **Tertiary treatment and disinfection** • Filtration and chlorination	The licensee shall dispose of all collected grit and screenings from the pre-treatment area, and sludge and biosolids to a licenced or registered landfill.
Septage and sewage wastes		
Sewage sludge and Waste activated sludge	Sludge treatment and storage	

1.2.3 The Licensee shall ensure that material is only stored and/or treated within vessels or compounds provided with the infrastructure detailed in Table 1.2.3.

Table 1.2.3: Containment infrastructure		
Storage vessel or compound	**Material**	**Requirements**
Inlet/preliminary works: Mechanical Step Screens and Grit Removal Tanks	Screenings and Grit	Recovered screenings and grit to be stored in a sealed bin which is stored within a bunded hardstand area or a hardstand area that is graded to a collection drain which returns sludge leachate to the start of the treatment process.
Primary Sedimentation Tanks	Wastewater	Ensure that the covers on the primary and aeration tank areas of the plant are kept in place at all times except when removal is required for maintenance operations or during emergency situations.
Aeration Treatment		
Secondary Sedimentation Tanks		None specified
Sludge blending tanks	Sludge and leachate	Returns sludge leachate to the start of the treatment process.

1.2.4 The Licensee shall manage the wastewater treatment tanks such that:
(a) overtopping of the tanks does not occur; and
(b) stormwater runoff is prevented from entering the tanks; and
(c) vegetation and floating debris (emergent or otherwise) is prevented from growing or accumulating in the tanks.

2 Emissions

2.1 Point source emissions to air

2.1.1 The Licensee shall ensure that where waste is emitted to air from the emission points in Table 2.1.1 it is done so in accordance with the conditions of this Licence.

Table 2.1.1: Emission points to air		
Emission point reference	**Emission point height (m)**	**Source, including any abatement**
Scrubber stack 1	50	Stack via odour scrubbing systems
Scrubber stack 2	50	

2.1.2 The Licensee shall not cause or allow point source emissions to emissions to air greater than the limits listed in Table 2.1.2.

Table 2.1.2: Point source emission limits to air			
Emission point reference	**Parameter**	**Limit (including units)[1]**	**Averaging period**
Scrubber Stack 1	Hydrogen Sulphide	0.20 g/s at STP dry	N/A
Scrubber Stack 2		0.19g/s at STP dry	

2.1.3 The licensee shall maintain a log of all CEMS calibration curve correlations and make this log available on request.

2.2 Point source emissions to surface water

2.2.1 The Licensee shall ensure that where waste is emitted to surface water from the emission points in Table 2.2.1 it is done so in accordance with the conditions of this Licence.

Table 2.2.1: Emission points to surface water		
Emission point reference	**Description**	**Source including abatement**
Ocean Reef Ocean outlets	Discharge of treated wastewater via the Ocean Reef Outlets, one 1850 metres and one 1650 metres offshore.	Treated wastewater

3 Monitoring

3.1 General monitoring

3.1.1 The licensee shall ensure that:
(a) all water samples are collected and preserved in accordance with AS/NZS 5667.1;
(b) all wastewater samples are collected in accordance with AS/NZS 5667.10;
(c) all microbiological samples are collected in accordance with AS/NZS 2031;
(d) all laboratory samples are submitted to a laboratory with current NATA accreditation for the parameters to be measured unless indicated otherwise in relevant table.

3.1.2 The Licensee shall ensure that :
(a) monthly monitoring is undertaken at least 15 days apart;
(b) quarterly monitoring is undertaken at least 45 days apart; and
(c) six monthly monitoring is undertaken at least 5 months apart.

3.1 Monitoring of point source emissions to air

3.2.1 The Licensee shall undertake the monitoring in Table 3.2.1 according to the specifications in that table.

Table 3.2.1: Monitoring of emissions to air				
Emission point reference	**Parameter**	**Units[1]**	**Frequency[2]**	**Method**
Bio scrubbers and chemical scrubbers as depicted in Schedule 1	Hydrogen sulphide	ppb	Continuous	CEMS
	Hydrogen sulphide	mg/m^3 g/s	Quarterly	NATA accredited method for the measurement and analysis of hydrogen sulphide emissions from stationary sources
	Volumetric flow rate	m^3/s		Thermal mass flow meters calibrated against USEPA Method 2
	Stack exit temperature	degrees Celsius		None specified

Note 1: All units are referenced to STP dry
Note 2: Monitoring shall be undertaken to reflect normal operating conditions and any limits or conditions on inputs or production.

3.2.2 The Licensee shall ensure that sampling required under Condition 3.2.1 of the Licence is undertaken at sampling locations in compliance with the AS 4323.1 or relevant part of the CEMS Code.

3.2.3 The Licensee shall ensure that all non-continuous sampling and analysis undertaken pursuant to condition 3.2.1 for the parameters specified in Table 3.2.1 is undertaken by a holder of NATA accreditation for the relevant methods of sampling and analysis.

3.2.4 For any parameter in Table 3.2.1 requiring continuous monitoring, the Licensee shall ensure that the CEMS is regularly operated, maintained and calibrated in accordance with the CEMS Code.

3.3 Monitoring of point source emissions to surface water

3.3.1 The Licensee shall undertake the monitoring in Table 3.3.1 according to the specifications in that table.

Table 3.3.1: Monitoring of emissions to surface waters					
Emission point	**Monitoring point reference and location**	**Parameter**	**Units**	**Averaging period**	**Frequency**
Ocean Reef Outlet	Magflow to Ocean Outfall	Volumetric flow rate	L/s m^3/day	Monthly	Continuous
Ocean Reef Outlet	Effluent Discharge Pumping Station Sample point	pH[1]	-	Spot or composite sample	Monthly
		Total Nitrogen	mg/L		
		Total Phosphorus			
		E. Coli	cfu/100mL		Six-monthly
		Total Suspended Solids	mg/L		
		Total Dissolved Solids			
		Biochemical			

Table 3.3.1: Monitoring of emissions to surface waters					
Emission point	**Monitoring point reference and location**	**Parameter**	**Units**	**Averaging period**	**Frequency**
		Oxygen Demand			
		Oil and Grease			
		Arsenic			
		Cadmium			
		Copper			
		Chromium			
		Lead			
		Mercury			
		Nickel			
		Zinc			

Note 1: In-field non-NATA accredited analysis permitted.

3.4 Monitoring of inputs and outputs

3.4.1 The Licensee shall undertake the monitoring specified in Table 3.4.1 according to the specifications in that table.

Table 3.4.1: Monitoring of inputs and outputs					
Input/Output	**Monitoring point reference**	**Parameter**	**Units**	**Averaging period**	**Frequency**
Sewage - Inlet Flow	Inlet Channel Flow Meter (FT201)	Volumetric flow rate	L/s m^3/day	Monthly	Continuous
Septage and sewage wastes	None specified	Volume of Controlled waste (by category) received at the WWTP	m^3/day	Monthly	Continuous

4 Information

4.1 Records

4.1.1 All information and records required by the Licence shall:
- (a) be legible;
- (b) if amended, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval;
- (c) except for records listed in 4.1.1(d) be retained for at least 6 years from the date the records were made or until the expiry of the Licence or any subsequent licence; and
- (d) for those following records, be retained until the expiry of the Licence and any subsequent licence:
  - (i) off-site environmental effects; or
  - (ii) matters which affect the condition of the land or waters.

4.1.2 The Licensee shall complete an Annual Audit Compliance Report indicating the extent to which the Licensee has complied with the conditions of the Licence, and any previous licence issued under Part V of the Act for the Premises for the previous annual period.

4.1.3 The Licensee shall:

(a) implement a complaints management system that shall record the following information (if known or provided) about complaints received at the Premises concerning any environmental impact of the activities undertaken at the Premises:

(i) name and address of the complainants (if consented);
(ii) date and time of complaint;
(iii) date and time of alleged incident;
(iv) alleged source of the incident;
(v) general description of the alleged incident, including any environmental or health impacts reported by the complainant;
(vi) wind direction, wind speed and temperature at time of alleged incident;
(vii) likely source of the alleged incident; and
(viii) actions taken by licensee to address complaint, including the outcome of any investigation(s) and action(s) to verify any impacts.

(b) complete an annual analysis and review of complaints recorded under 4.1.3(a) to identify any common factors and root cause of complaints and proposals to address these.

4.2 Reporting

4.2.1 The Licensee shall submit to the CEO an Annual Environmental Report within 63 calendar days after the end of the annual period. The report shall contain the information listed in Table 4.2.1 in the format or form specified in that table.

Table 4.2.1: Annual Environmental Report

Condition or table (if relevant)	Parameter	Format or form[1]
-	Summary of any failure or malfunction of any pollution control equipment and any environmental incidents, that have occurred during the annual period and any action taken	None specified
Table 1.2.1	Summary of any treatment capacity exceedances and any action taken.	None specified
3.2.1	Monitoring of emissions to air	None specified
3.3.1	Monitoring of emissions to surface waters	None specified
	Contaminant loading (kg/day – monthly average) to water of parameters monitored in Table 3.3.1 (except pH and Escherichia coli)	None specified
	Methodology and calculations used to estimate the daily volumetric flow rate of treated wastewater discharged to Ocean Reef Outlet and results of those calculations.	
3.4.1	Monitoring of inputs and outputs	None specified
4.1.2	Compliance	AACR
4.1.3	Complaints summary	None specified
-	Summary of any changes to site boundaries, or sampling point location/name	None specified
-	The quantity of sewage sludge removed from the Premises	

Note 1: Forms are in Schedule 2

4.2.2 The Licensee shall ensure that the Annual Environmental Report also contains:
(a) any relevant process, production or operational data recorded under conditions of this licence; and
(b) an assessment of the information contained within the report against previous monitoring results and Licence limits

4.2.3 The Licensee shall submit the information in Table 4.2.2 to the CEO according to the specifications in that table.

Table 4.2.2: Non-annual reporting requirements

Condition or table (if relevant)	Parameter	Reporting period	Reporting date (after end of the reporting period)	Format or form
-	Copies of original monitoring reports submitted to the Licensee by third parties	Not Applicable	Within 14 days of the CEOs request	As received by the Licensee from third parties

4.3 Notification

4.3.1 The Licensee shall ensure that the parameters listed in Table 4.3.1 are notified to the CEO at the Contact Address and in accordance with the notification requirements of the table.

Table 4.3.1: Notification requirements

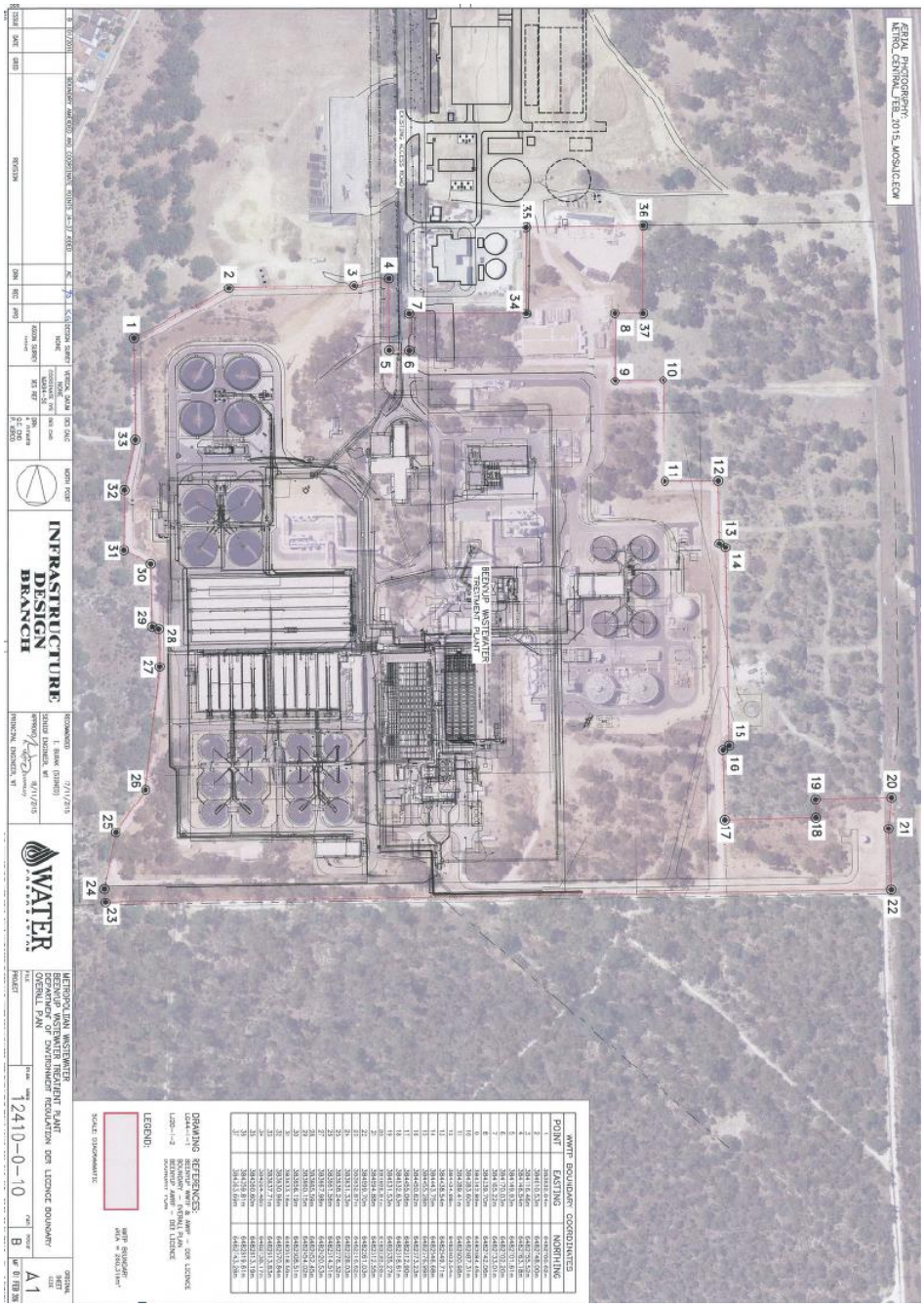
Condition or table (if relevant)	Parameter	Notification requirement[1]	Format or form[2]
-	Taking process equipment offline for maintenance works that may result in increase odour emissions.	No less than 72 hours in advance of works	None specified
-	Breach of any limit specified in the Licence	Part A: As soon as practicable but no later than 5pm of the next working day Part B: As soon as practicable	N1

Note 1: No notification requirement in the Licence shall negate the requirement to comply with s72 of the Act.
Note 2: Forms are in Schedule 2

Schedule 1: Maps

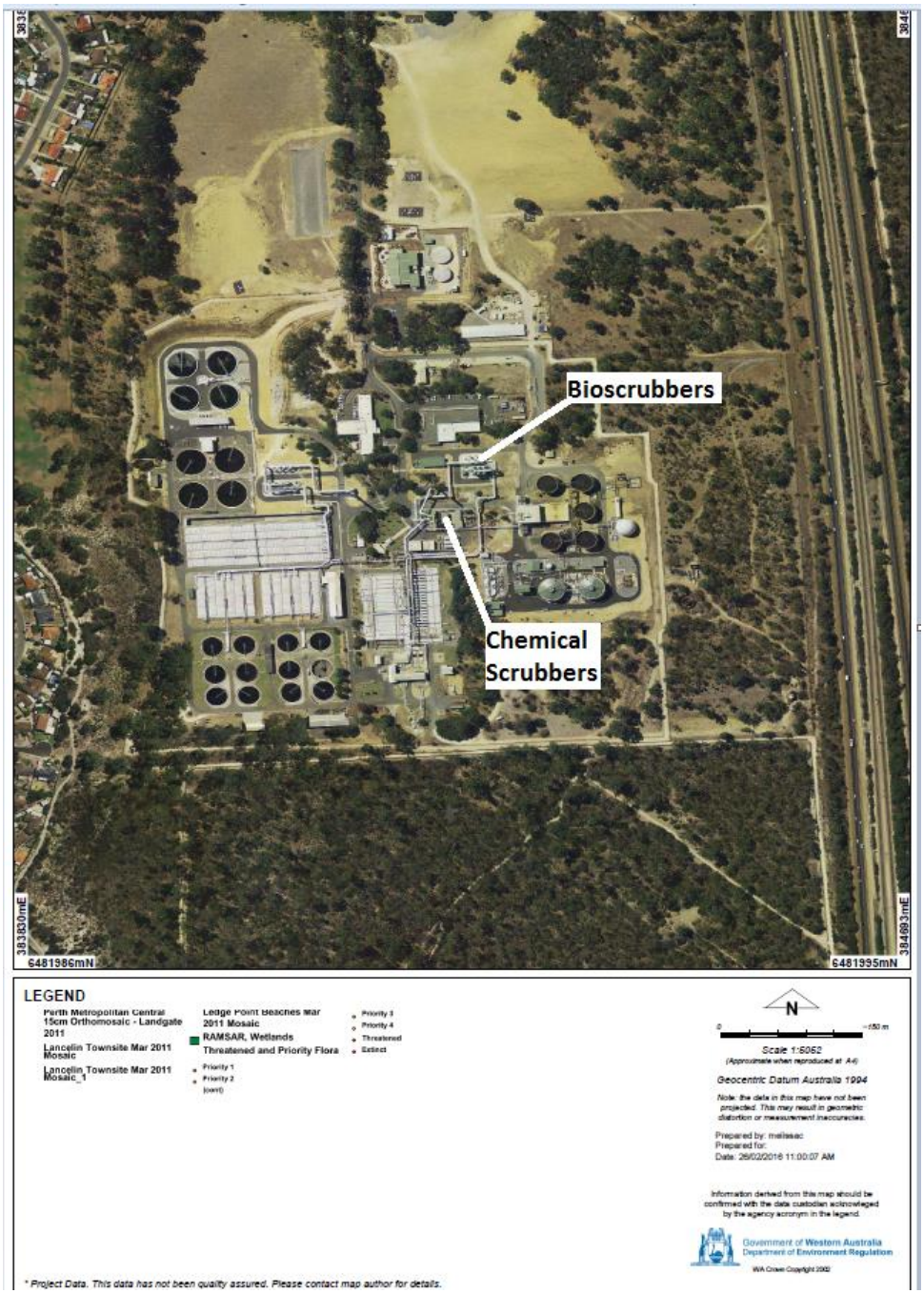
Premises map

The Premises is shown in the map below. The pink line depicts the Premises boundary.



Scrubber locations

The location of scrubbers described in Table 3.2.1 shown in the map below.



Outfall map

The location of the Ocean Reef Outlet as described in Table 3.3.1 is shown on the map below.

Schedule 2: Reporting & notification forms

These forms are provided for the proponent to report monitoring and other data required by the Licence. They can be requested in an electronic format.

ANNUAL AUDIT COMPLIANCE REPORT PROFORMA

SECTION A

LICENCE DETAILS

Licence Number:	Licence File Number:
Company Name: Trading as:	ABN:
Reporting period: _____ to _____	

STATEMENT OF COMPLIANCE WITH LICENCE CONDITIONS

1. Were all conditions of the Licence complied with within the reporting period? (please tick the appropriate box)

Yes ☐ Please proceed to Section C

No ☐ Please proceed to Section B

Each page must be initialled by the person(s) who signs Section C of this Annual Audit Compliance Report (AACR).

Initial:

SECTION B

DETAILS OF NON-COMPLIANCE WITH LICENCE CONDITION.

Please use a separate page for each licence condition that was not complied with.

a) Licence condition not complied with:	
b) Date(s) when the non compliance occurred, if applicable:	
c) Was this non compliance reported to DER?:	
☐ Yes ☐ Reported to DER verbally Date _____ ☐ Reported to DER in writing Date _____	☐ No
d) Has DER taken, or finalised any action in relation to the non compliance?:	
e) Summary of particulars of the non compliance, and what was the environmental impact:	
f) If relevant, the precise location where the non compliance occurred (attach map or diagram):	
g) Cause of non compliance:	
h) Action taken, or that will be taken to mitigate any adverse effects of the non compliance:	
i) Action taken or that will be taken to prevent recurrence of the non compliance:	

Each page must be initialled by the person(s) who signs Section C of this AACR

Initial:

SECTION C

SIGNATURE AND CERTIFICATION

This Annual Audit Compliance Report (AACR) may only be signed by a person(s) with legal authority to sign it. The ways in which the AACR must be signed and certified, and the people who may sign the statement, are set out below.

Please tick the box next to the category that describes how this AACR is being signed. If you are uncertain about who is entitled to sign or which category to tick, please contact the licensing officer for your premises.

If the licence holder is		The Annual Audit Compliance Report must be signed and certified:
An individual	□	by the individual licence holder, or
	□	by a person approved in writing by the Chief Executive Officer of the Department of Environment Regulation to sign on the licensee's behalf.
A firm or other unincorporated company	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A corporation	□	by affixing the common seal of the licensee in accordance with the *Corporations Act 2001*; or
	□	by two directors of the licensee; or
	□	by a director and a company secretary of the licensee, or
	□	if the licensee is a proprietary company that has a sole director who is also the sole company secretary – by that director, or
	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A public authority (other than a local government)	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
a local government	□	by the chief executive officer of the licensee; or
	□	by affixing the seal of the local government.

It is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give information on this form that to their knowledge is false or misleading in a material particular. There is a maximum penalty of $50,000 for an individual or body corporate.

I/We declare that the information in this annual audit compliance report is correct and not false or misleading in a material particular.

SIGNATURE: _____

NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

SIGNATURE: _____

NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

SEAL (if signing under seal)

Licence: L7882/1992/14 Licensee: Water Corporation
Form: N1 Date of breach:

Notification of detection of the breach of a limit.

These pages outline the information that the operator must provide.
Units of measurement used in information supplied under Part A and B requirements shall be appropriate to the circumstances of the emission. Where appropriate, a comparison should be made of actual emissions and authorised emission limits.

Part A

Licence Number	
Name of operator	Water Corporation
Location of Premises	
Time and date of the detection	

Notification requirements for the breach of a limit	
Emission point reference/ source	
Parameter(s)	
Limit	
Measured value	
Date and time of monitoring	
Measures taken, or intended to be taken, to stop the emission	

Part B

Any more accurate information on the matters for notification under Part A.	
Measures taken, or intended to be taken, to prevent a recurrence of the incident.	
Measures taken, or intended to be taken, to rectify, limit or prevent any pollution of the environment which has been or may be caused by the emission.	
The dates of any previous N1 notifications for the Premises in the preceding 24 months.	

Name	
Post	
Signature on behalf of Water Corporation	
Date	

Government of Western Australia
Department of Environment Regulation

Decision Document

Environmental Protection Act 1986, Part V

Proponent: Water Corporation

Licence: L7882/1992/14

Registered office: 629 Newcastle Street
LEEDERVILLE WA 6007

Premises address: Beenyup Wastewater Treatment Plant
Part Lot 8278 on Plan 30778, Ocean Reef Road
CRAIGIE WESTERN AUSTRALIA 6025
Bound by the following points

Point	Easting	Northing
1	383932.04m	6482700.62m
2	384010.53m	6482748.00m
3	384116.46m	6482755.52m
4	384146.54m	6482763.18m
5	384149.93m	6482701.61m
6	384170.03m	6482702.20m
7	384165.22m	6482733.01m
8	384339.70m	6482741.06m
9	384342.89m	6482684.45m
10	384383.60m	6482687.31m
11	384389.41m	6482600.98m
12	384434.98m	6482603.54m
13	384438.54m	6482549.71m
14	384443.75m	6482546.68m
15	384455.28m	6482376.99m
16	384450.62m	6482373.23m
17	384455.06m	6482312.90m
18	384532.63m	6482318.61m
19	384531.53m	6482335.27m
20	384595.84m	6482339.99m
21	384594.88m	6482315.55m
22	384599.70m	6482261.03m
23	383932.87m	6482216.62m
24	383931.33m	6482228.03m
25	383938.24m	6482276.32m
26	383961.56m	6482314.51m
27	383967.98m	6482420.53m
28	383965.59m	6482452.45m
29	383960.15m	6482454.02m

30	383956.19m	6482508.51m
31	383933.16m	6482518.59m
32	383930.96m	6482570.84m
33	383937.71m	6482613.83m
34	384264.48m	6482738.17m
35	384260.60m	6482813.19m
36	384359.81m	6482819.61m
37	384363.69m	6482743.28m

Issue date: Friday, 30 September 2011

Commencement date: Tuesday, 1 November 2011

Expiry date: Monday, 31 October 2031

Decision

Based on the assessment detailed in this document the Department of Environment Regulation (DER) CEO delegated officer, has decided to issue an amended licence. The delegated officer considers that in reaching this decision, it has taken into account all relevant considerations.

Decision Document prepared by: Melissa Chamberlain
Licensing Officer

Decision Document authorised by: Alan Kietzmann
Delegated Officer

Contents

1 Purpose of this Document

This decision document explains how DER CEO delegated officer has assessed and determined the application and provides a record of the decision-making process and how relevant factors have been taken into account. Stakeholders should note that this document is limited to the delegated officer's assessment and decision making under Part V of the *Environmental Protection Act 1986.* Other approvals may be required for the proposal, and it is the proponent's responsibility to ensure they have all relevant approvals for their Premises.

2 Administrative summary

Administrative details		
Application type	Works Approval ☐ New Licence ☐ Licence amendment ☒ Works Approval amendment ☐	
Activities that cause the premises to become prescribed premises	**Category number(s)**	**Assessed design capacity**
	54	135,000 cubic meters per day
	61	50,000 tonnes per year
Application verified Application fee paid	Date: N/A Date: N/A	
Works Approval has been complied with Compliance Certificate received	Yes☐ No☐ N/A☒ Yes☐ No☐ N/A☒	
Commercial-in-confidence claim	Yes☐ No☒	
Commercial-in-confidence claim outcome		
Is the proposal a Major Resource Project?	Yes☐ No☒	
Was the proposal referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986*?	Yes☐ No☒	Referral decision No: Managed under Part V ☐ Assessed under Part IV ☐

Is the proposal subject to Ministerial Conditions?	Yes☒ No☐	Ministerial statement No: 382 EPA Report No: 912
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the *Environmental Protection Act 1986*)?	Yes☐ No☒ Department of Water consulted Yes ☐ No ☒	
Is the Premises within an Environmental Protection Policy (EPP) Area Yes☐ No☒		
Is the Premises subject to any EPP requirements? Yes☐ No☒		

3 Executive summary of proposal and assessment

Beenyup WWTP is located on part of Lot 8278 on Plan 30778 Ocean Reef Road, Craigie, Western Australia. The plant has been operating at this premises since 1972. The Lot is bounded by the Mitchell Freeway to the east, Ocean Reef Road to the north, the residential suburb of Craigie to the west and Craigie Open Space, an area of regionally significant bushland, to the south. Water Corporation's Advanced Water Replensihment Plant is located on the same lot immediate north of the premises, and the rest of the Lot contains the Bush Forever site 303 as well as a hardstand area to the north occupied by Water Corporation's construction branch.

The geology of the site is generally made up of Bassendean sands over Tamala Limestone. A large stretch of the Quindalup dune system occurs along the western margin of the site. The Perth Groundwater Atlas indicates the historical maximum water table level at the site is at 4.0m AHD, corresponding to 17-19m below current ground level. A dissipation test at the site indicated that the water table was present at 18.1m below ground level (3.6m AHD) (Worley Parsons, 2007); therefore, interference of plant structural and civil elements by groundwater is not expected.

Sewage enters the plant via pipelines. After screening, the wastewater flows into circular grit removal tanks, aerated to allow the inorganic material to settle and the organic material to pass through very slowly to large rectangular primary sedimentation tanks allowing about 50 per cent of the suspended solids to settle out as sludge. Sludge is collected by scraper mechanism and pumped to the solids handling area for thickening and digestion. The treated wastewater leaving the primary tanks called primary treated wastewater passes to secondary treatment tanks. Secondary treatment is achieved in aeration tanks by the activated sludge process. Following aeration, the treated wastewater passes slowly through circular clarifiers in which the activated sludge settles leaving a high quality secondary effluent. The settled sludge containing micro-organisms is rapidly removed using scrapers and is returned to the aeration tanks.

Solids removed from the primary sedimentation tanks and excess solids produced by the activated sludge process are thickened and fed to the anaerobic digesters. Following digestion, the sludge is mechanically dewatered to produce a biosolid suitable for use as a soil conditioner.

Secondary treated wastewater flows by gravity to the Indian Ocean in the vicinity of the Marmion Marine Park and is discharged into 10 metres of water via two outlets, one 1850 metres and the other one 1650 metres offshore, where it is rapidly diluted and dispersed

The main emission from the premises is odour. Odourous air is extracted from the inlet works, primary tanks, secondary treatment tanks and sludge storage facilities, sludge loading and unloading area, and passed through biological scrubbers and chemical scrubbers vented to a 50 meter stack.

February 2016 Amendment
This Licence is the result of an amendment to adjust the premises boundary to the physical boundary of the treatment plant rather than the entire Lot 8278. The licence has also been converted to the new format for consistency with other Water Corporation licences. Changes have been made in relation to definitions and controlled waste codes. This amendment does result in any alteration of discharges, emissions or processes at the premises but does extend the expiry date of the instrument.

The premise is subject to Ministerial Statement 382 and this licence does not duplicate any conditions of this statement.

4 Decision table

All applications are assessed in line with the *Environmental Protection Act 1986*, the *Environmental Protection Regulations 1987* and DER's Operational Procedure on Assessing Emissions and Discharges from Prescribed Premises. Where other references have been used in making the decision they are detailed in the decision document.

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Premises operation	L1.2.1 L1.2.2 L1.2.3 L1.2.4	Condition 1.2.1 and Table 1.2.1 limits the waste types and quantities that can be accepted at the premises to those that have been assessed under the licence application as suitable given the infrastructure and control measures at the premises. Condition 1.2.2 and Table 1.2.2 limits the waste processing that can occur to those assessed under the licence application as suitable given the infrastructure and control measures at the premises, and relevant to the licence categories applied for. Condition 1.2.3 and Table 1.2.3 specify the containment infrastructure at the premises and any requirements of those infrastructure as the assessment has been undertaken and control measures proposed under the understanding that the specified infrastructure is in place to contain the specified materials. Condition 1.2.4 specifies that wastewater treatment tanks must be managed appropriately to avoid damage and ensure proper function to prevent potential spillage or malfunction of the treatment system.	L7882/1992/14
Point Source Emissions to Air and monitoring air emissions.	L2.1.1	<u>Emission Description</u> *Emission:* Odour from the acceptance and processing of biological wastes resulting in hydrogen sulphide and volatile organic compounds. *Impact:* Odour has the potential to interfere with the amenity of odour sensitive receptors. The nearest residents are located approximately 50 meters west of the premises.	L7882/1992/14

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		Controls: Waste is delivered to the premises via an enclosed pipeline. Odourous air is extracted from the inlet works, primary tanks, secondary treatment tanks and sludge storage facilities, sludge loading and unloading area, and passed through biological scrubbers and chemical scrubbers vented to a 50 meter stack. Risk Assessment Consequence: Minor Likelihood: Possible Risk Rating: Moderate Regulatory Controls Condition 1.2.3 and Table 1.2.3 specify the containment infrastructure that wastewater must be stored in, including the requirement that covers be kept on the primary and aeration tanks at all time except when removal is required for maintenance operations or during emergency situations. Condition 2.1.1 and Table 2.1.1 specify the emission points where air emissions can occur under the licence. Condition 2.1.2 and Table 2.1.2 specify that the air emissions at the emission points cannot exceed the limits of 0.20 g/s and 0.19 g/s at any time. Condition 2.1.3 requires the licensee to maintain a log of all CEMS calibration curve correlations and make this log available on request to allow DER to verify the data collected. Condition 3.2.1 and Table 3.2.1 requires the licensee to monitor for hydrogen sulphide continuously to determine compliance with licence limits, and also requires quarterly monitoring data on hydrogen sulphide (mg/m3 and g/s), volumetric flow rate and stack exit temperature to assess the nature of air emissions.	

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		Conditions 3.2.2 to 3.2.4 further specify how CEMS monitoring must occur to ensure that monitoring is done effectively and appropriately and the data can be relied upon. Condition 6 of the previous licence required the plant to achieve a hydrogen sulphide emission of less than 1.5 ppm at the stack outlet. Targets have been removed from the licence in accordance with DER regulatory policy as they are not enforceable unless linked to a specific managmenet activity. Hydrogen sulphide limits have been placed on the licence and the Licensee will need to implement appropriate management and monitoring strategies to ensure compliance with the condition. <u>Risk Assessment</u> Consequence: Minor Likelihood: Possible Risk Rating: Moderate	
Point source emissions to surface water and surface water monitoring		<u>Emission Description</u> *Emission:* Residual Nitrogen and Phosphorus contained within the treated wastewater. *Impact:* Excess nutrients may impact the receiving environment (Indian Ocean) causing eutrophication and/or may alter the water quality impacting sea life. *Controls:* The licensee is required by Ministerial Statement to limit the daily loading rate of Nitrogen and Phosphorus being discharged to the ocean and monitor these concentration loads. <u>Risk Assessment</u> Consequence: Minor Likelihood: Possible Risk Rating: Moderate <u>Regulatory Controls</u> Condition 2.2.1 and Table 2.2.1 specifies that treated wastewater may be discharged to the Ocean Reef Ocean outlet. The ocean discharge is regulated by Ministerial	L7882/1992/14

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		Statement 382. <u>Risk Assessment</u> Consequence: Minor Likelihood: Possible Risk Rating: Moderate	
Fugitive Emissions		Dust emissions are not expected from premises activities. Any fugitive dust emissions would be adequately managed under the general provisions of the *Environmental Protection Act 1986.*	*Environmental Protection Act 1986*
Odour		Odour emissions are risk assessed above in emissions to air. Any fugitive odour emissions not otherwise controlled by the licence conditions can be adequately managed under the general provisions of the *Environmental Protection Act 1986*	*Environmental Protection Act 1986*
Noise		Noise emissions are not expected from premises activities. The licensee is required to comply with the *Environmental Protection (Noise) Regulations 1997*	*Environmental Protection (Noise) Regulations 1997*
Monitoring of inputs and outputs	L3.4.1	Condition 3.4.1 and Table 3.4.1 requires the licensee to continually monitor the sewage inlet flow and the volume of septage and sewage waste tankered into the premises to monitor compliance with licence limits.	N/A
Information	L4.1.1	Condition 4.1.1 sets out the requirements for any records that are required under this licence, such as ensuring they are legible and retained for 6 years, which assists DER in regulating the conditions of this licence. Condition 4.1.2 requires the occupier to undertake an audit of their operations against the conditions of the licence and to report on this compliance in an Annual Audit Compliance Report (AACR). This condition assists DER in regulating the occupier's compliance with licence conditions and allows an opportunity for DER to recive the occupier's environmental performance. Condition 4.1.3 requires a complaints management system to be implemented where	N/A

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		the occupier can internally address any issues that arise from premises operations. DER will review these complaints as reported in the Annual Environmental Report (AER) and can consider the requirement for the reassessment of any regulatory controls to address the complaints. Condition 4.2.1 requires the licensee to submit an AER. The AER is required to include the AACR and a summary of the complaints required under condition 4.1.3. DER reviews all of the data procided in the AER to assess compliance with the licence conditions and to monitor the environmental impacts from the premises. Condition 4.2.2 requires the Annual Report to include any relevant process, production or operational data recorded under conditions of this licence to ensure all relevant data is provided in the annual report for DER to review, and requires an assessment of the information against previous monitoring results and licence limits to ensure the licensee has reviewed the data and provides DER with comparative information. Condition 4.2.3 specifies that the licensee must submit copies of original monitoring reports within 14 days of request by the CEO, in the event that the CEO wishes to review this data. Condition 4.3.1 requires the licensee to notify the CEO if there is a breach of any licence limit (i.e processing limits). The notifications required under this condition give DER appropriate notice of any environmental impacts at the premises so that DER can determine if any further action is required to address the incident.	
Licence Duration	N/A	As the licence has been reassessed as part of this amendment. Based on the risk profile, the expiry date has been extended to 2031 (15 years). Water Corporation have advised that there are no planning or lease agreements which expire within this period.	Department of Environment Regulation Guidance Statement, Licence Duration,

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
			November

5 Advertisement and consultation table

Date	Event	Comments received/Notes	How comments were taken into consideration
1/03/2016	Proponent sent a copy of draft instrument	Comment was received on 21 March 2016. Response identified errors in the descriptions of activities and controls (e.g. omission of activiated carbon in odour control, air emissions through stack after scrubbing, ocean outfall discharge distance was incorrect, and duplication of a condition) as well as clarification of flow rate measurement units.	Errors have been corrected and wording clarified to reflect operations and monitoring requirements.

6 Risk Assessment

Note: This matrix is taken from the DER Corporate Policy Statement No. 07 - Operational Risk Management

Table 1: Emissions Risk Matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	Moderate	High	High	Extreme	Extreme
Likely	Moderate	Moderate	High	High	Extreme
Possible	Low	Moderate	Moderate	High	Extreme
Unlikely	Low	Moderate	Moderate	Moderate	High
Rare	Low	Low	Moderate	Moderate	High

Government of Western Australia
Department of Environment Regulation

Licence

Environmental Protection Act 1986, Part V

Licensee: Water Corporation

Licence: L4201/1991/11

Registered office: 629 Newcastle Street
LEEDERVILLE WA 6007

Premises address: Woodman Point Wastewater Treatment Plant
Cockburn Road
MUNSTER WA 6166
Being Lot 9 on Diagram 31097 as depicted in Schedule 1.

Issue date: Thursday, 28 October 2010

Commencement date: Monday, 1 November 2010

Expiry date: Friday, 31 October 2031

Prescribed premises category
Schedule 1 of the *Environmental Protection Regulations 1987*

Category number	Category description	Category production or design capacity	Approved Premises production or design capacity
54	Sewage facility: premises – (a) On which sewage is treated (excluding septic tanks); or (b) From which treated sewage is discharged onto land or into waters.	100 cubic metres per more per day	180,000 cubic metres per day
61	Liquid waste facility: premises on which liquid waste produced on other premises (other than sewerage waste) is stored, reprocessed, treated or irrigated.	100 tonnes or more per year	50,000 tonnes per annual period

Conditions
This Licence is subject to the conditions set out in the attached pages.

Date signed: 12 July 2016
.....
Caron Goodbourn
A/ Manager Licensing (Waste Industries)
Officer delegated under section 20
of the *Environmental Protection Act 1986*

Contents

Introduction

This Introduction is not part of the Licence conditions.

DER's industry licensing role
The Department of Environment Regulation (DER) is a government department for the state of Western Australia in the portfolio of the Minister for Environment. DER's purpose is to advise on and implement strategies for a healthy environment for the benefit of all current and future Western Australians.

DER has responsibilities under Part V of the *Environmental Protection Act 1986* (the Act) for the licensing of prescribed premises. Through this process DER regulates to prevent, control and abate pollution and environmental harm to conserve and protect the environment. DER also monitors and audits compliance with works approvals and licence conditions, takes enforcement action as appropriate and develops and implements licensing and industry regulation policy.

Licence requirements
This Licence is issued under Part V of the Act. Conditions contained within the Licence relate to the prevention, reduction or control of emissions and discharges to the environment and to the monitoring and reporting of them.

Where other statutory instruments impose obligations on the Premises/Licensee the intention is not to replicate them in the licence conditions. You should therefore ensure that you are aware of all your statutory obligations under the Act and any other statutory instrument. Legislation can be accessed through the State Law Publisher website using the following link:
http://www.slp.wa.gov.au/legislation/statutes.nsf/default.html

For your Premises relevant statutory instruments include but are not limited to obligations under the:

- *Environmental Protection (Unauthorised Discharges) Regulations 2004* – these Regulations make it an offence to discharge certain materials such as contaminated stormwater into the environment other than in the circumstances set out in the Regulations.

- *Environmental Protection (Controlled Waste) Regulations 2004* - these Regulations place obligations on you if you produce, accept, transport or dispose of controlled waste.

- *Environmental Protection (Noise) Regulations 1997* – these Regulations require noise emissions from the Premises to comply with the assigned noise levels set out in the Regulations.

You must comply with your licence. Non-compliance with your licence is an offence and strict penalties exist for those who do not comply.

Licence holders are also reminded of the requirements of section 53 of the Act which places restrictions on making certain changes to prescribed premises unless the changes are in accordance with a works approval, licence, closure notice or environmental protection notice.

Other Guidelines which you should be aware of include:

- *Western Australian Guidelines for Biosolids Management*, Department of Environment and Conservation, December 2012 (as amended from time to time).

Licence fees
If you have a licence that is issued for more than one year, you are required to pay an annual licence fee prior to the anniversary date of issue of your licence. Non payment of annual licence fees will result in your licence ceasing to have effect meaning that it will no longer be valid and you will need to apply for a new licence for your Premises.

Ministerial conditions
If your Premises has been assessed under Part IV of the Act you may have had conditions imposed by the Minister for Environment. You are required to comply with any conditions imposed by the Minister.

Premises description and Licence summary
The Woodman Point Wastewater Treatment Plant (WWTP) is owned and operated by Water Corporation and is located approximately 25km south west of Perth. The premises is surrounded by 'Special Use' town planning scheme zoned areas to the east, south and west, and is adjacent to the 'Jervoise Bay Cove' to the west. The premises services the southern suburbs of Perth which has a nominal contributing population of approximately 700,000.

The WWTP consists of pre-treatment, primary treatment and secondary treatment, which includes a four quadrant sequencing batch reactor (SBR) and an anaerobic biosolids digestion process.

Treated wastewater is discharged to the Sepia Depression via a 23km Sepia Depression Ocean Outfall Landline (SDOOL) and ocean outfall via the Jervoise Bay Cove.

An Odour Control Facility (OCF) treats odours from the pre-treatment and primary treatment facility, the SBR bio-selectors and the biosolids handling area. The plant also has a Tanker Receiver Facility (TRF), which accepts third party waste. The TRF has a separate dedicated chemical odour scrubber to control odour. Dewatered biosolids is removed from the premises and disposed of to landfill, with the liquid fraction from the WWTP and TRF being discharged to the flow balancing dam.

The plant is designed to treat up to 160 ML influent per day, with the average daily inflow currently at 141ML/d, for the 2014/ 2015 reporting period. As the premises is nearing capacity, the Licensee has proposed an upgrade to the premises which will increase the design capacity to 180 ML/d, on completion of the works upgrade. This will require the current operation to be taken off line and operated through a temporary (150 ML/d) system until the works are completed. The proposed works will be constructed over a 2.5 year period consisting of three stages that will include construction of the following:

Stage one –
- Two new 9.75 m vortex grit tanks;
- Four new primary sedimentation tanks;
- Eight secondary sedimentation tanks (temporarily designed as aeration tanks, four with lift out diffused aeration grids and four operated as clarifiers);
- New recycled water pump station and filtration system.

Stage two –

- Conversion of the SBR to a Modified Ludzack-Ettinger (MLE) configuration (Treated wastewater from the primary sedimentation tanks will bypass the SBR to the temporary secondary sedimentation tanks for a period of nine months).

Stage three –

- Secondary sedimentation tanks retrofitted from temporary aeration tanks to fully functioning secondary sedimentation tanks;
- Mixed liquor transferred to MLE quadrants over 2-3 days and blended with imported seed biosolids.

A desk top assessment of groundwater bore (Site Id. 20022946) on the western boundary of the premises identifies depth to groundwater at approximately 10.4 mBGL, with TDS approximately 5,000 mg/L (saline). The groundwater forms part of the Murray River Basin and Bartram Road Catchment.

The closest sensitive residential receptor has been identified by the Licensee as approximately 0.5 km south of the premises. The premises operation includes an odour buffer of 750 m to the nearest land use.

The premises is subject to conditions within Ministerial Statement 665.

The main potential emissions during construction are expected to be odour issues from the change in operational process and dust emissions from site construction.

This Licence is a DER initiated amendment to undertake administrative changes from the previous amendment process carried out for the works upgrade at the premises. Comments from the draft review process were omitted and are now included through this amendment.

The licences and works approvals issued for the Premises, since 25/10/1998, are:

Instrument log		
Instrument	**Issued**	**Description**
W1013/1991/1	25/10/1993	Works approval
W1330/1991/1	19/12/1995	Works approval
W2710/1991/1	01/04/1999	Works approval
L4201/1991/4	19/09/2000	Licence re-issue
L4201/1991/5	01/07/2001	Licence re-issue
L4201/1991/6	01/07/2002	Licence re-issue
L4201/1991/7	14/01/2003	Licence re-issue
W3793/1991/1	28/04/2003	Works approval
L4201/1991/8	30/06/2003	Licence re-issue
L4201/1991/9	02/07/2004	Licence re-issue
L4201/1991/10	31/10/2005	Licence re-issue
W4319/1991/1	01/10/2007	Works approval
L4201/1991/11	28/10/2010	Licence re-issue
L4201/1991/11	19/11/2015	Licence amendment
L4201/1991/11	14/04/2016	Licence amendment for works upgrade for design capacity increase
L4201/1991/11	12/07/2016	Licence amendment for administrative changes on previous amendment process

Severance

It is the intent of these Licence conditions that they shall operate so that, if a condition or a part of a condition is beyond the power of this Licence to impose, or is otherwise *ultra vires* or invalid, that condition or part of a condition shall be severed and the remainder of these conditions shall nevertheless be valid to the extent that they are within the power of this Licence to impose and are not otherwise *ultra vires* or invalid.

END OF INTRODUCTION

Licence conditions

1 General

1.1 Interpretation

1.1.1 In the Licence, definitions from the *Environmental Protection Act 1986* apply unless the contrary intention appears.

1.1.2 For the purposes of this Licence, unless the contrary intention appears:

'Act' means the *Environmental Protection Act 1986;*

'annual period' means the inclusive period from 1 July until 30 June in the following year;

'AS/NZS 2031' means the Australian Standard AS/NZS 2031 *Selection of containers and preservation of water samples for microbiological analysis;*

'AS 4323.1' means the Australian Standard AS4323.1 *Stationary Source Emissions Method 1: Selection of sampling positions;*

'AS 4323.3' means the Australian Standard AS4323.3 *Stationary Source Emissions Part 3: Determination of odour concentration by dynamic olfactory*;

'AS/NZS 5667.1' means the Australian Standard AS/NZS 5667.1 *Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples;*

'AS/NZS 5667.9' means the Australian Standard AS/NZS 5667.9 *Water Quality – Sampling – Guidance on sampling from marine waters*;

'AS/NZS 5667.10' means the Australian Standard AS/NZS 5667.10 *Water Quality – Sampling – Guidance on sampling of waste waters;*

'averaging period' means the time over which a limit is measured or a monitoring result is obtained;

'CEO' means Chief Executive Officer of the Department of Environment Regulation;

'CEO' for the purpose of correspondence means;
Chief Executive Officer
Department Administering the Environmental Protection Act 1986
Locked Bag 33
CLOISTERS SQUARE WA 6850
Email: info@der.wa.gov.au

'controlled waste' has the definition in *Environmental Protection (Controlled Waste) Regulations 2004*;

'Chemical Scrubber Outlet' means after the chemical scrubber but prior to entering the Odour Control Facility Discharge Stack;

'engineered containment system' means any vessel or tank containment infrastructure associated with the treatment of wastewater;

'g/s' means grams per second;

'hardstand' means a surface with a permeability of 10^{-9} metres/second or less;

'Jervoise Bay Ocean Outlet', '**Sepia Depression Ocean Outlet (SDOOL)'** and **'Woodman Point Ocean Outlet'** mean the marine discharge points labelled and depicted in Schedule 1: Maps of the Licence;

'leachate' means liquid released by or water that has percolated through waste and which contains some of its constituents;

'Licence' means this Licence numbered L4201/1991/11 and issued under the Act;

'Licensee' means the person or organisation named as Licensee on page 1 of the Licence;

'Ministerial Statement 665' means "*Ministerial Statement 665 - Use of the Cape Peron Outlet Pipeline to Dispose of Industrial Wastewater to the Sepia Depression, Kwinana*" as amended from time to time;

'NATA' means the National Association of Testing Authorities, Australia;

'NATA accredited' means in relation to the analysis of a sample that the laboratory is NATA accredited for the specified analysis at the time of the analysis;

'normal operating conditions' means any operation of a particular process (including abatement equipment) excluding start-up, shut-down and upset conditions, in relation to stack sampling or monitoring;

'Odour Control Facility' and '**Odour Control Facility Discharge Stack'** means those structures labelled and depicted in Schedule 1;

'Odour Control Summary' means Woodman Point Wastewater Treatment Plant Upgrade – Odour Control Summary, identified as Appendix 1 within Woodman Point Wastewater Treatment Plant Licence Amendment – Supporting Document, November 2015. Version: 2 February 2016. Doc Id. PM#13945397-V4.)

'OU' means odour units;

'Premises' means the area defined in the Premises Map in Schedule 1 and listed as the Premises address on page 1 of the Licence;

'**process equipment**' means any wastewater or biosolids containment infrastructure or wastewater treatment vessel;

'quarterly' means the 4 inclusive periods from, 1 July to 30 September, 1 October to 31 December and in the following year, 1 January to 31 March and 1 April to 30 June;

'Schedule 1' means Schedule 1 of this Licence unless otherwise stated;

'Schedule 2' means Schedule 2 of this Licence unless otherwise stated;

'six monthly' means the 2 inclusive periods from 1 July to 31 December and 1 January to 30 June in the following year;

'spot sample' means a discrete sample representative at the time and place at which the sample is taken; and

'stack test' means a discrete set of samples taken over a representative period at normal operating conditions;

'STP' means standard temperature and pressure (0^{o}Celsius and 101.325 kilopascals respectively);

'Tanker Receival Facility" and **'Tanker Receival Facility Discharge Stack'** means those structures labelled and depicted in Schedule 1;

'usual working day' means 0800 – 1700 hours, Monday to Friday excluding public holidays in Western Australia.

'USEPA' means United States (of America) Environmental Protection Agency; and

'USEPA Method 2' means the USEPA Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube).

'Waste Code' means the Waste Code assigned to a type of controlled waste for purposes of waste tracking and reporting as specified in the Department of Environment Regulation "Controlled Waste Category List" (July 2014), as amended from time to time; and

'wastewater treatment vessels' means any vessel, pond or tank containment infrastructure associated with the storage and treatment of wastewater.

1.1.3 Any reference to an Australian or other standard in the Licence means the relevant parts of the the standard in force from time to time during the term of this Licence.

1.1.4 Any reference to a guideline or code of practice in the Licence means the version of that guideline or code of practice in force from time to time, and shall include any amendments or replacements to that guideline or code of practice made during the term of this Licence.

1.2 General conditions

1.2.1 The Licensee shall operate and maintain all pollution control (odour control facility, covers on process equipment) and monitoring equipment (continuous monitors) to the manufacturer's specification or any relevant and effective internal management system.

1.2.2 The Licensee shall immediately recover, or remove and dispose of spills of waste (as defined in Table 1.3.1) outside an engineered containment system.

1.2.3 Subject to the Conditions of this Licence, the Licensee must construct and operate the Works in accordance with the document listed in Table 1.2.1.

Table 1.2.1: Construction Requirements[1]

Document	Parts	Date of Document
Woodman Point Wastewater Treatment Plant Licence Amendment – Supporting Document, November 2015. Version: 2 February 2016. Doc Id. PM#13945397-V4.	All, including appendices and drawings	2 February 2016

Note 1: Where the details and commitments of the documents listed in condition 1.2.1 are inconsistent with any other condition of this Licence, the Conditions of this Licence shall prevail.

1.2.4 The Licensee must ensure that the proposed Works specified in Column 1 of Table 1.2.2 meets or exceeds the specifications in Column 2 of Table 1.2.2 for the infrastructure in each row of Table 1.2.2.

1.2.5 The Licensee must not depart from the specifications in Table 1.2.2 except:
(a) where such departure is minor in nature and does not materially change or affect the infrastructure; or
(b) where such departure improves the functionality of the infrastructure and does not increase risks to public health, public amenity or the environment;
and all other Conditions in this Licence are still satisfied.

Table 1.2.2: Works specifications	
Column 1 Infrastructure	Column 2 Specifications (design and construction)
Stage one	1. Installation of two new 9.75 m vortex grit tanks to replace pre-treatment (cross-flow) detritors; 2. Grit tanks to have trafficable FRP covers; 3. Grit tanks to include ability to have pumped grit removal and separate grit washer; 4. Foul air extraction to be included for the grit washing and classification systems; 5. Construction of four new primary sedimentation tanks (PST); 6. Construction of eight secondary sedimentation tanks (temporarily designed as aeration tanks, four with lift out diffused aeration grids and four operated as clarifiers); 7. SST to each include a pair of direct-piped Return Activated Biosolids (RAS) pumps; 8. New recycled water pump station and filtration system integrated into system with existing recycled water facility decommissioned; 9. New recycled water pump station to include a new junction chamber on the twin outlets to the treated water disposal pump station to allow dam bypass functionality; 10. Incorporation of a new solids-liquids separation system.
Stage two	1. Conversion of the SBR to a continuously aerated Modified Ludzack-Ettinger (MLE) configuration (Treated wastewater from the primary sedimentation tanks will bypass the SBR to the temporary secondary sedimentation tanks for a period of nine months); 2. Treated wastewater to be diverted to the SST from the PST during conversion of the SBR; 3. Decommissioning and removal of two mixed liquor recycle (MLR) pump stations, one WAS pump station, eight mechanical decanters and the existing fixed-to-floor system from each SBR basin; 4. Construction of baffle walls and MLR duct; 5. Height of the existing peripheral channel wall adjacent to basin 1 and 2 increased; 6. New mixed liquor discharge structure intergrated into channel; 7. Installation of three submersible mixers, five submersible MLR pumps and one submersible drain pump into each MLE basin.
Stage three	1. Eight secondary sedimentation tanks retrofitted from temporary aeration tanks to six fully functioning secondary sedimentation tanks; 2. Mixed liquor transferred to MLE quadrants over 2-3 days and blended with imported seed biosolids; 3. Imported seed biosolids to be obtained from Beenyup or Kwinana WWTP's.

1.2.6 If Condition 1.2.5 applies, then the Licensee must provide the CEO with a list of departures which are certified as complying with Condition 1.2.5 at the same time as the certifications under Condition 1.2.8.

1.2.7 The Licensee must submit a construction compliance document to the CEO, within one month, following the construction of each stage (Stages 1 to 3) of the Works at Woodman Point Wastewater Treatment Plant.

1.2.8 The Licensee must ensure the construction compliance document:

(a) is certified by a suitably qualified professional engineer or builder that each item of infrastructure specified in Condition 1.2.5, Table 1.2.2 has been constructed in accordance with the Conditions of the Licence with no material defects; and

(b) be signed by a person authorised to represent the Licensee and contain the printed name and position of that person within the company.

1.2.9 The Licensee must not operate the premises above 160 ML/day until the compliance documents for all stages of the works upgrade have been submitted and in accordance with Licence conditions 1.2.6-1.2.8.

1.3 Premises operation

1.3.1 The Licensee shall only accept waste on to the Premises if:
(a) it is of a type listed in Table 1.3.1;
(b) the quantity accepted is below any quantity limit listed in Table 1.3.1; and
(c) it meets any specification listed in Table 1.3.1.

Table 1.3.1: Waste acceptance

Waste	Waste Code	Quantity Limit	Specification[1]
Putrescible and Organic wastes			
Sewage waste	K130	180 ML/ day	• Accepted through sewer inflows; and/ or • Tankered into the premises and discharged via the WWTP pre-treatment works during emergency events or maintenance works.
Septage waste	K210	Combined total of 50,000 t/annual period	• Tankered into the premises and discharged via the Tanker Receival Facility.
Vegetable oils and derivatives and other wastes	K200		
Wool scouring wastes	K190		
Tannery wastes not containing chromium	K140		
Animal effluent and residues	K100		
Grease waste	K110		
Industrial Strength Wastewater			
Industrial wash water	L150		
Car and truck wash waters	L100		
Inorganic Chemicals			
Non toxic salts	D300		

Note 1: Additional requirements for the acceptance of controlled waste are set out in the *Environmental Protection (Controlled Waste) Regulations 2004*.

1.3.2 The Licensee shall ensure that where waste does not meet the waste acceptance criteria set out in conditions 1.3.1 it is removed from the Premises by the delivery vehicle or, where that is not possible, the Licensee shall contact the CEO to agree a course of action in relation to the waste.

1.3.3 The Licensee shall ensure that wastes accepted onto the Premises are only subjected to the process(es) set out in Table 1.3.2 and in accordance with any process limits described in that Table.

Table 1.3.2: Waste processing		
Waste type	**Process**	**Process requirements**
Sewage	Physical, chemical and biological treatment	1. Treatment of sewage waste shall be at or below the treatment capacity of 180 ML/day. 2. Sewage biosolids to be directed to ABD; 3. Dewatered biosolids to be removed via a controlled waste carrier to a licenced landfill. 4. Discharged to ocean outfall via SDOOL.
Liquid waste	Physical, chemical and biological treatment	1. Treatment of liquid waste received shall be at or below 50,000 tonnes per annual period; 2. Tested for pH and electrical conductivity prior to being processed at the premises. 3. Leachate from dewatering system to be returned back to the WWTP pre-treatment works.
Biosolids	Physical, biological treatment	1. Dewatered biosolids to be removed to for offsite disposal.

1.3.4 The Licensee shall ensure that waste material is only stored and/or treated within vessels or compounds provided with the infrastructure detailed in Table 1.3.3.

Table 1.3.3: Containment infrastructure		
Vessel or compound	**Material**	**Requirements**
Inlet works (Step Screen)	Grit and Screenings	• Screening wash which returns leachate to the start of the treatment process. • Screenings stored within an enclosed bin which is removed to landfill weekly.
Tanker receival facility	Wastewater	• Covered except during routine maintenance or emergency situations; • Chemical scrubbers; • Odour emission stack.
Primary sedimentation tanks	Wastewater	• Tanks constructed of concrete with splitter box.
Secondary sedimentation tanks	Wastewater	• Tanks constructed of concrete with splitter chamber.
Sequencing batch reactor (SBR)	Treated wastewater	• Constructed of concrete; • Biosolids directed via Dissolved Air Flotation Tank to ABD; • Liquid fraction directed to flow balancing dam.
Flow balancing dam	Treated wastewater	• 2 x 1.5 mm Plastic lined (polyethylene) layers with leak detection layer; • Discharge to ocean outfall via SDOOL.
Odour control facility	-	• Enclosed; • Odour scrubbing equipment; • Odour emission stack.
Anerobic biosolids disgester (ABD)	Sewage biosolids	• Enclosed; • Digested biosolids storage tank; • Dewatering centrifuge; • Biosolid hoppers.

1.3.5 The Licensee shall take the specified management action in the case of an event in Table 1.3.4.

Table 1.3.4: Management actions

Emission point	Event/ action reference	Event	Management action
Odour control facility and Tanker Receival Facility	EA1	Hydrogen sulphide emission levels above 1,500 ppb from the chemical scrubber outlets	a) Assess operation to determine any failure, malfunction or abnormal operation period; b) Implement corrective actions to reduce hydrogen sulphide emission levels; c) Restore normal operation of any failed equipment or replace the failed equipment; d) Notify DER CEO in writing, as per condition 5.3.1.

1.3.6 Following the cessation of emissions/operation under condition 1.3.5, the Licensee shall not restart operation of the process until:
(a) the problem has been rectified; and
(b) the Licensee has complied with condition 1.3.5.

1.3.7 The Licensee shall manage the wastewater treatment vessels such that:
(a) overtopping of the vessels does not occur; and
(b) stormwater runoff is prevented from entering the vessels; and
(c) the integrity of the containment infrastructure and facility operation is maintained; and
(d) vegetation and floating debris (emergent or otherwise) is prevented from growing or accumulating in the vessels.

1.3.8 The Licensee shall:
(a) implement security measures at the site to prevent as far as is practical unauthorised access to the site; and
(b) undertake regular inspections of all security measures and repair damage as soon as practicable; and
(c) ensure the entrance gates are closed and locked when the site is closed or unmanned.

1.3.9 The Licensee must develop an 'Odour Monitoring Strategy' within three months of commencing construction that will:
(a) specify an odour field criteria that can be compared against the odour field assessment results;
(b) undertake a risk assessment of exceedences and the proposed management measures to be employed.

1.3.10 The Licensee must:
(a) undertake an odour verification of the monitoring and modelling programme (MAM) initially completed, within six months of full operation of the new works, to confirm it is compliant against the 'odour control summary'; and
(b) develop contingencies/ mitigation measures where any failures/ exceedences have been found to occur against the MAM verification.

2 Emissions

2.1 General

2.1.1 The Licensee shall record and investigate the exceedance of any descriptive or numerical limit specified in any part of section 2 of this Licence.

2.2 Point source emissions to air

2.2.1 The Licensee shall ensure that where waste is emitted to air from the emission points in Table 2.2.1 and identified on the map of emission points in Schedule 1, it is done so in accordance with the conditions of this Licence.

Table 2.2.1: Emission points to air

Emission point reference and location on Map of emission points	Emission Point	Emission point height (m)	Source, including any abatement
Odour control facility	Chemical scrubber inlet	-	Hydrogen sulphide emitted. Chemical odour scrubbers in use.
	Chemical scrubber outlet (prior to entering discharge stack)	-	
	Discharge stack	50 m	
Tanker receival facility	Chemical scrubber	-	
	Discharge stack	12 m	

2.3 Point source emissions to surface water

2.3.1 The Licensee shall ensure that where waste is emitted to surface water from the emission points in Table 2.3.1, and identified on the map of emission points in Schedule 1, it is done so in accordance with the conditions of this Licence.

Table 2.3.1: Emission points to surface water

Emission point reference and location on Map of emission points	Description	Source including abatement
Sepia Depression Ocean Outfall Landline (SDOOL)	Discharge pipeline to ocean outfall[1]	Treated effluent.
Woodman Point Ocean Outlet	Discharge pipe to ocean	Treated effluent only discharged during routine maintenance or emergency situations, in order of priority, to: • Woodman Point Ocean Outlet; and • Jervoise Bay Ocean Outlet.
Jervoise Bay Ocean Outlet		

Note 1: Combined discharge volumes are regulated under Ministerial Statement 665.

2.4 Odour

2.4.1 The Licensee must ensure odour emissions are managed in accordance with the documents, or parts of documents, specified in Table 2.4.1.

Table 2.4.1: Management Plans

Management Plan Reference	Parts	Date of Document
Odour Improvement Plan, Water Corporation.	All	December 2006
Odour Management Plan and Mitigation Strategy	All	
Woodman Point Wastewater Treatment Plant Upgrade – Odour Control Summary (Identified as Appendix 1 within Woodman Point Wastewater Treatment Plant Licence Application – Supporting Document, Ref. AQUA #13945397) (Water Corporation independent document reference number AQUA#14290847).	All, including appendices	2 February 2016

3 Monitoring

3.1 General monitoring

3.1.1 The licensee shall ensure that:
- (a) all water samples are collected and preserved in accordance with AS/NZS 5667.1;
- (b) all surface water sampling is conducted in accordance with AS/NZS 5667.9
- (c) all wastewater sampling is conducted in accordance with AS/NZS 5667.10;
- (d) all groundwater sampling is conducted in accordance with AS/NZS 5667.11;
- (e) all microbiological samples are collected and preserved in accordance with AS/NZS 2031; and
- (f) all laboratory samples are submitted to and tested by a laboratory with current NATA accreditation for the parameters being measured unless indicated otherwise in the relevant table.

3.1.2 The Licensee shall ensure that :
- (a) monthly monitoring is undertaken at least 15 days apart;
- (b) quarterly monitoring is undertaken at least 45 days apart; and
- (c) annual monitoring is undertaken at least 9 months apart.

3.1.3 The Licensee shall ensure that all monitoring equipment used on the Premises to comply with the conditions of this Licence is calibrated in accordance with the manufacturer's specifications.

3.1.4 The Licensee shall, where the requirements for calibration cannot be practicably met, or a discrepancy exists in the interpretation of the requirements, bring these issues to the attention of the CEO accompanied with a report comprising details of any modifications to the methods.

3.2 Monitoring of point source emissions to air

3.2.1 The Licensee shall undertake the monitoring in Table 3.2.1 according to the specifications in that table.

Table 3.2.1: Monitoring of point source emissions to air

Emission point reference	Parameter	Units[1]	Limit	Averaging period	Frequency[2]	Method
Odour control facility	Hydrogen sulphide – Chemical scrubber inlets (S1008217/ S20 & S1008219/ S21)	ppm	-	Monthly to achieve a 90% availability	Continuous	-
	Hydrogen sulphide - chemical scrubber outlet prior to entering discharge stack (S100761/ S27)	ppb	1,500			
	Volumetric flow rate (S1008217 & S1008219)	m^3/hr	-		Continuous	USEPA Method 2
Odour control facility – discharge stack sampling (FT07011/ M48 & AT07002/ M49)	Hydrogen sulphide (concentration)	mg/ m^3	5	Spot sample	Annual	Manual
	Hydrogen sulphide (rate)	g/s	0.25			-
	Volumetric flow rate	m^3/s	-			USEPA Method 2
	Stack exit temperature	°celsius	-			-
	Odour units	OU	-			AS 4323.1 AS 4323.3
Tanker receival facility – stack sampling (S1004857)	Hydrogen sulphide	mg/ m^3	5	Spot sample	Annual	Manual
	Volumetric flow rate	m^3/s	-			USEPA Method 2
	Stack exit temperature	°celsius	-			-
	Odour units	OU	-			AS 4323.1 AS 4323.3

Note 1: All units are referenced to STP dry.
Note 2: Monitoring shall be undertaken to reflect normal operating conditions and any limits or conditions on inputs or production.

3.3 Monitoring of point source emissions to surface water

3.3.1 The Licensee shall undertake the monitoring in Table 3.3.1 according to the specifications in that table.

Table 3.3.1: Monitoring of point source emissions to surface water

Emission point reference	Parameter	Units	Frequency
Treated Water channel, at new Reclaimed Water pump station (S1002273/ S9)	pH[1]	-	Monthly
	Total suspended solids	mg/L	
	Total dissolved solids		
	Biological oxygen demand		
	Total nitrogen		
	Total phosphorus		
	Ammonium-nitrogen		
	Nitrate+nitrite-nitrogen		
	E. coli[3]	cfu/ 100 ml	
	Cadmium	mg/L	Quarterly
	Copper		
	Chromium		
	Lead		
	Mercury		
	Nickel		
	Zinc		
	Contaminant loading[2]	kg/d	Annual

Note 1: In situ non-NATA accredited sampling permitted.
Note 2: Each parameter identified within the table assessed using flow-weighted data, excluding pH and *E.coli.*
Note 3: Actual units are to be reported except where the result is greater than the highest detectable level of 24,000 cfu/100mL. In this case the reporting of the highest detectable level is permitted.

3.4 Monitoring of inputs and outputs

3.4.1 The Licensee shall undertake the monitoring in Table 3.4.1 according to the specifications in that table.

Table 3.4.1: Monitoring of inputs and outputs

Input/Output	Monitoring point reference	Parameter	Units	Averaging period	Frequency
Wastewater input	WWTP Inflow meter (S1001222/ S1)	Volumetric flow rate (cumulative)	m^3/day; or ML/ day	Monthly	Continuous
	Tanker receival facility	Liquid waste			Each load received to the facility
Wastewater output	WWTP Outflow meter (S1004373/ M10)	Volumetric flow rate (cumulative)			Continuous
Biosolids output	ABD	Sewage biosolids	m^3/day; or tonnes	Monthly	Each load leaving the premises

3.5 Process monitoring

3.5.1 The Licensee shall undertake the monitoring in Table 3.5.1 according to the specifications in that table.

Table 3.5.1: Process monitoring

Monitoring point reference	Process description	Parameter	Units	Frequency	Method
Tanker Receival Facility	Compliance assessment of all tankered controlled waste received against condition 1.3.1	Flow	-	Each load received to or rejected from the premises	Visual
	Tankered controlled waste received	pH	-		None specified
		electrical conductivity			

4 Improvements

4.1.1 The Licensee shall complete the improvements in Table 4.1.1 by the date of completion in Table 4.1.1.

Table 4.1.1: Improvement program

Improvement reference	Improvement	Date of completion
IR1	The Licensee shall install an analyser that can suitably measure and (if applicable) calculate the Hydrogen Sulphide (H2S) emissions from the Tanker Receival Facility stack. Data recorded from the analyser shall be undertaken as per the requirements stated within conditions 1.3.5, 2.2.1 and 3.2.1 of the Licence, on an annual basis.	31/01/2017

5 Information

5.1 Records

5.1.1 All information and records required by the Licence shall:
- (a) be legible;
- (b) if amended, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval;
- (c) except for records listed in 5.1.1(d) be retained for at least 6 years from the date the records were made or until the expiry of the Licence or any subsequent licence; and
- (d) for those following records, be retained until the expiry of the Licence and any subsequent licence:
  - (i) off-site environmental effects; or
  - (ii) matters which affect the condition of the land or waters.

5.1.2 The Licensee shall complete an Annual Audit Compliance Report indicating the extent to which the Licensee has complied with the conditions of the Licence, and any previous licence issued under Part V of the Act for the Premises for the previous annual period.

5.1.3 The Licensee shall:

(a) implement a complaints management system that shall record the following information (if known or provided) about complaints received at the Premises concerning any environmental impact of the activities undertaken at the Premises:

(i) name and address of the complainants (if consented);
(ii) date and time of complaint;
(iii) date and time of alleged incident;
(iv) alleged source of the incident;
(v) general description of the alleged incident, including any environmental or health impacts reported by the complainant;
(vi) wind direction, wind speed and temperature at time of alleged incident;
(vii) likely source of the alleged incident; and
(viii) actions taken by the Licensee to address the complaint, including the outcome of any investigation(s) and action(s) to verify any impacts.

(b) complete an annual analysis and review of complaints recorded under 5.1.3(a) to identify any common factors and root cause of complaints and proposals to address these.

5.2 Reporting

5.2.1 The Licensee shall submit to the CEO an Annual Environmental Report within 63 calendar days after the end of the annual period (1 September). The report shall contain the information listed in Table 5.2.1 in the format or form specified in that table.

Table 5.2.1: Annual Environmental Report

Condition or table (if relevant)	Parameter	Format or form[1]
-	Summary of any failure or malfunction of any pollution control equipment and any environmental incidents that have occurred during the annual period and any action taken	None specified
Table 1.3.4	Summary of Management actions undertaken	None specified
Table 3.2.1	Summary of Monitoring of point source emissions to air	None specified
Table 3.3.1	Summary of Monitoring of point source emissions to surface water	None specified
Table 3.4.1	Summary of Monitoring of inputs/ outputs	None specified
Table 3.5.1	Summary of Process monitoring	None specified
5.1.2	Compliance	Annual Audit Compliance Report (AACR)
5.1.3	Complaints summary	None specified

Note 1: Forms are in Schedule 2

5.2.2 The Licensee shall ensure that the Annual Environmental Report also contains:

(a) any relevant process, production or operational data recorded; and
(b) an assessment of the information contained within the report against previous monitoring results and Licence limits.

5.2.3 The Licensee shall submit the information in Table 5.2.2 to the CEO according to the specifications in that table.

Table 5.2.2: Non-annual reporting requirements

Condition or table (if relevant)	Parameter	Reporting period	Reporting date (after end of the reporting period)	Format or form
-	Copies of original monitoring reports submitted to the Licensee by third parties	Not applicable	Within 14 days of the CEOs request	As received by the Licensee from third parties
-	Record of tankered third party waste (date/ time)	Not applicable		As recorded by Licensee

5.3 Notification

5.3.1 The Licensee shall ensure that the parameters listed in Table 5.3.1 are notified to the CEO in accordance with the notification requirements of the table.

Table 5.3.1: Notification requirements

Condition or table (if relevant)	Parameter	Notification requirement[1]	Format or form[2]
-	Any maintenance works on the SDOOL that will require the use of the Woodman Point or Jervoise Bay Ocean Outlets	Two weeks prior to planned maintenance operations taking place; or As soon as practicable but no later than 5pm of the next usual working day after becoming aware of any emergency maintenance operations undertaken.	None specified
1.3.5	Limit exceedance where management action taken	As soon as practicable but no later than 5pm of the next usual working day after becoming aware of any confirmed measurement that was not rectified within four hours of detection.	None specified
		Submit to the CEO a written report within five working days of receiving the confirmed measurement and shall include, but not limited to: (i) Date and time of exceedence; (ii) Results of continuous monitoring required by conditions 2.2.1 and 3.2.1 at the time of the exceedence; (iii) Cause of the exceedence; (iv) Indication of potential or known environmental impacts of the exceedence; and (v) Any corrective actions undertaken to prevent recurrence.	Email or letter
1.3.1, 1.3.4 and 3.2.1	Breach of any descriptive or numerical limit specified in the Licence	Part A: As soon as practicable but no later than 5pm of the next usual working day. Part B: As soon as practicable	N1

3.1.4	Calibration report	As soon as practicable.	None specified

Note 1: Notification requirements in the Licence shall not negate the requirement to comply with s72 of the Act

Note 2: Forms are in Schedule 2

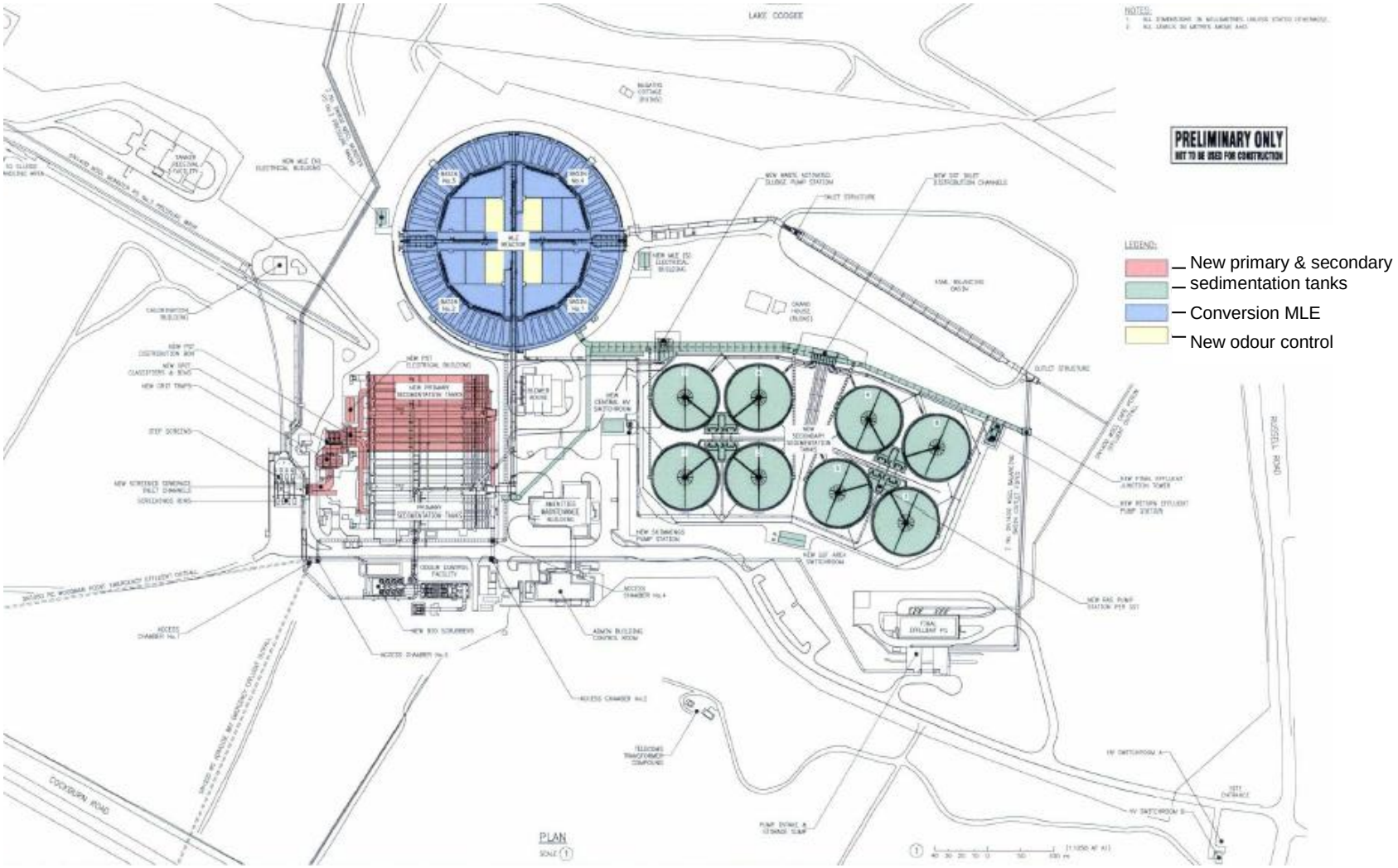
Schedule 1: Maps

Premises map

The Premises is shown in the maps below. The blue line depicts the Premises boundary.

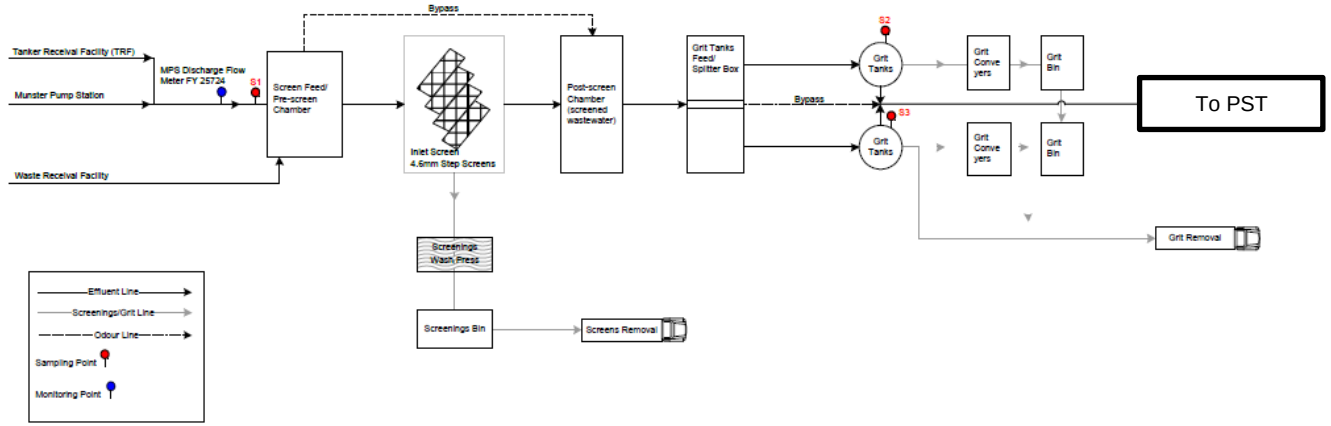
Premises map of discharge pipeline

Map of proposed works upgrade to the premises

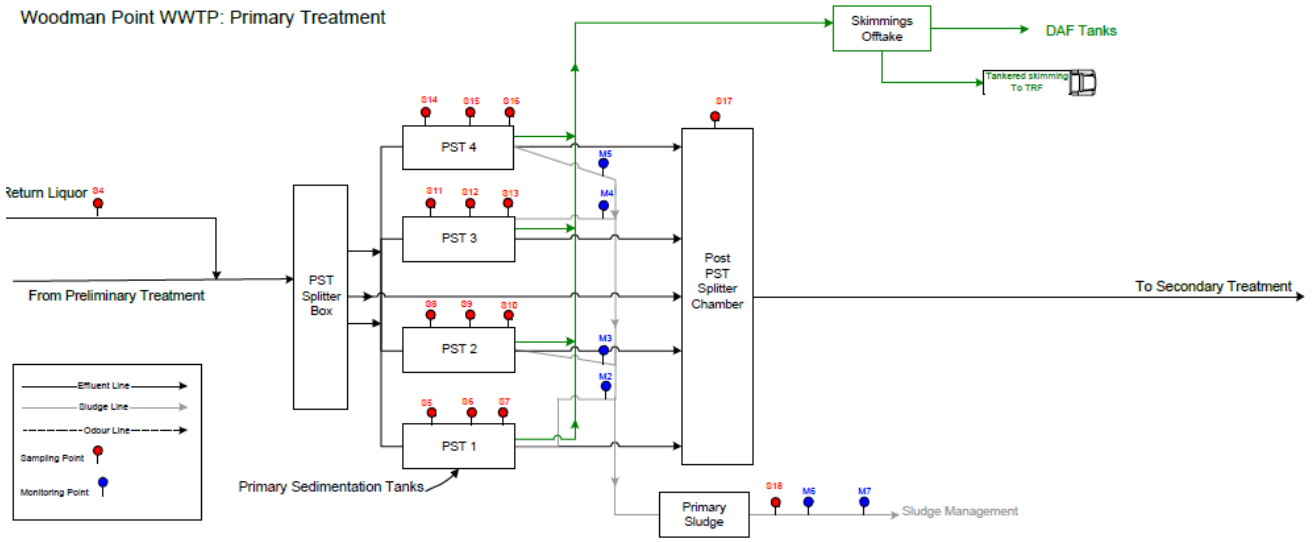


Map of WWTP emission and monitoring points

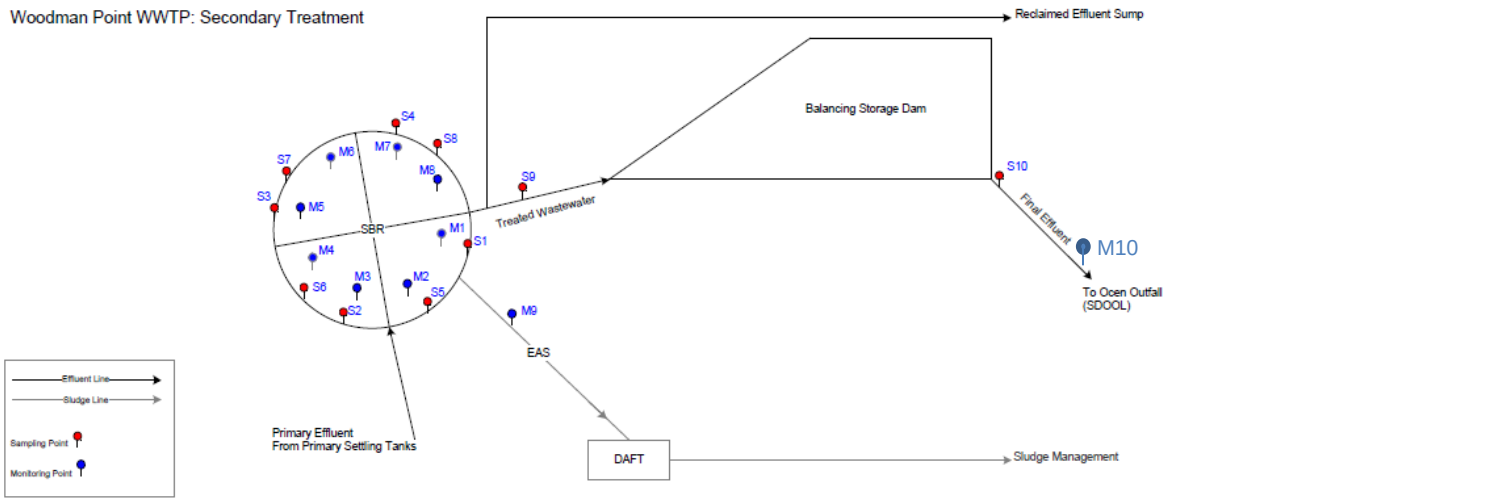
Woodman Point WWTP: Preliminary Treatment



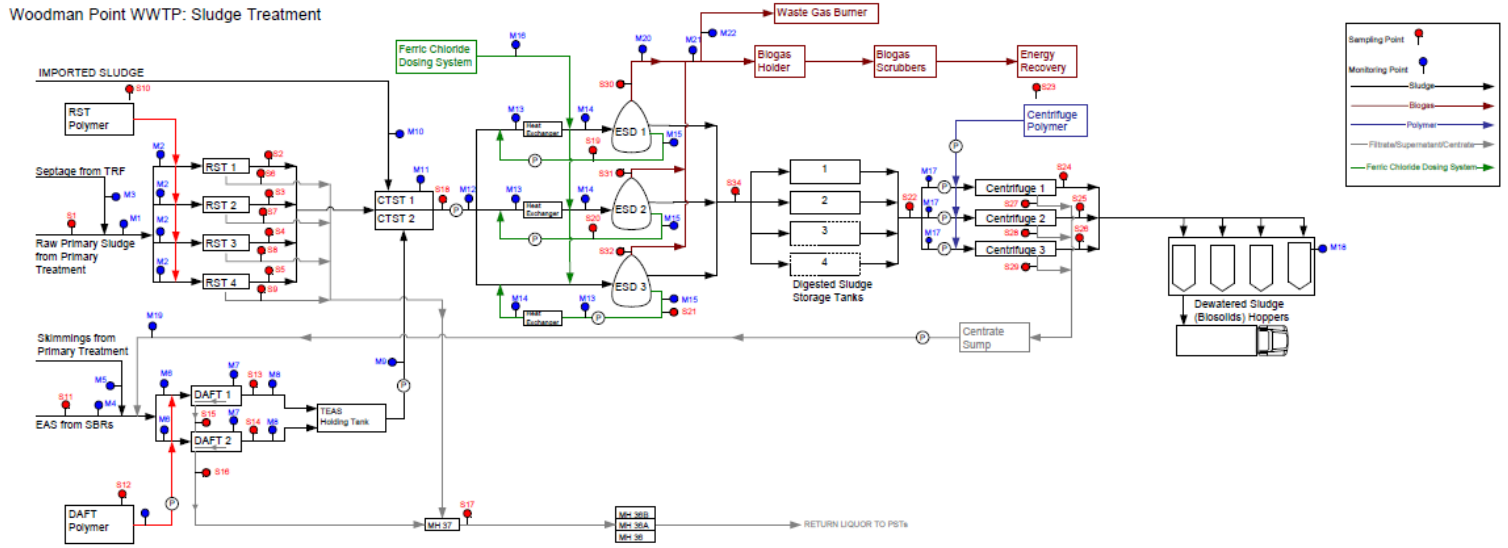
Woodman Point WWTP: Primary Treatment



Woodman Point WWTP: Secondary Treatment

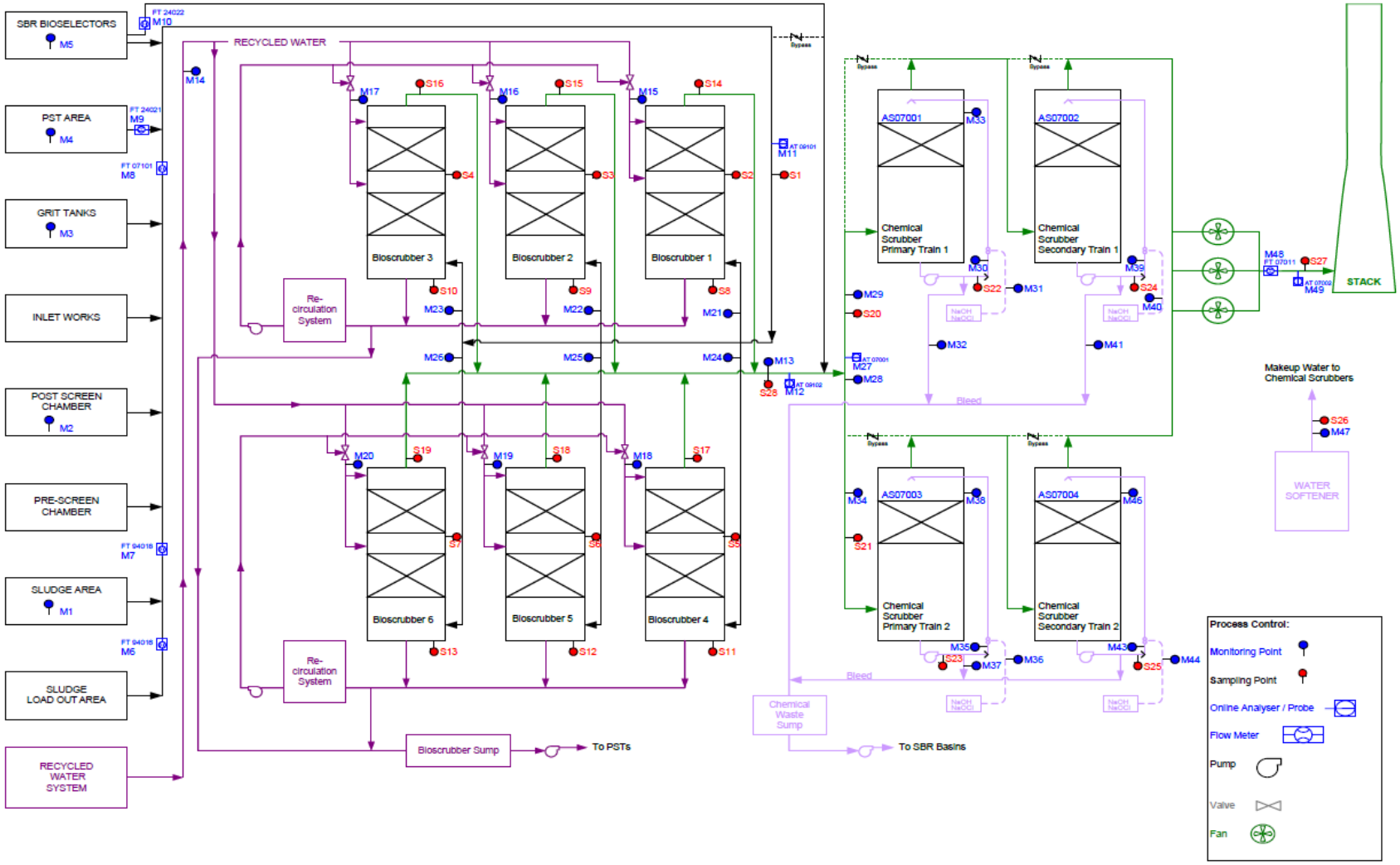


Woodman Point WWTP: Sludge Treatment

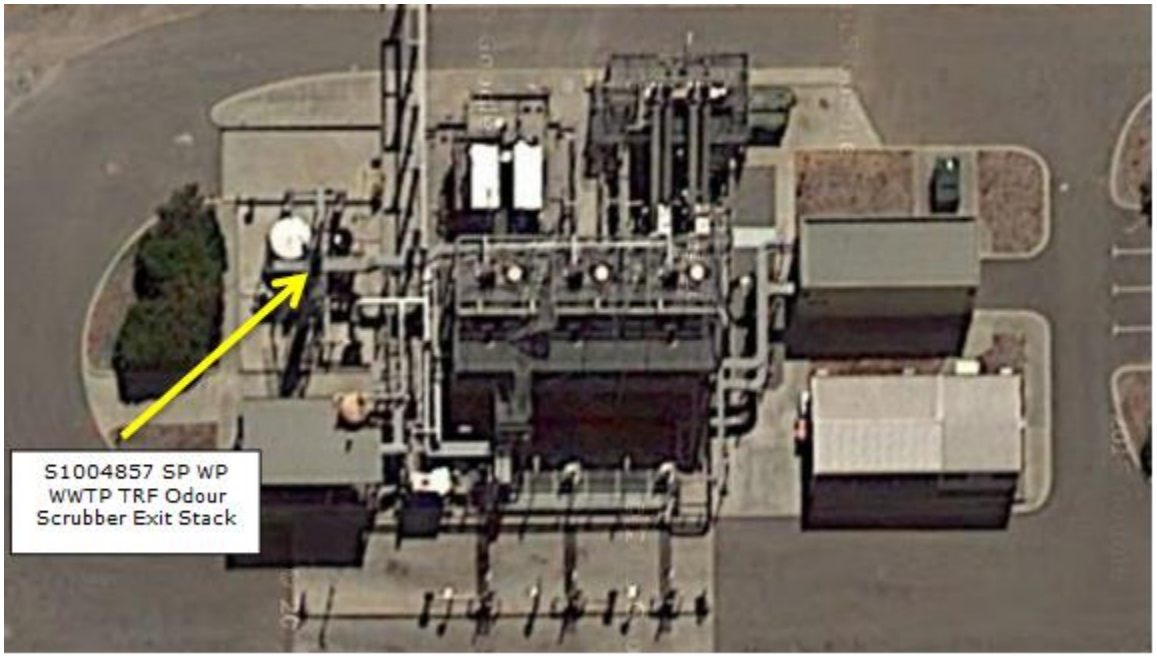


Map of Odour Control Facility emission and monitoring points

Woodman Point WWTP – Odour Control Stage 1



Map of Tanker Receival Facility emission point



Schedule 2: Reporting & notification forms

These forms are provided for the proponent to report monitoring and other data required by the Licence. They can be requested in an electronic format.

ANNUAL AUDIT COMPLIANCE REPORT PROFORMA

SECTION A

LICENCE DETAILS

Licence Number:	Licence File Number:
Company Name: Trading as:	ABN:
Reporting period: _____ to _____	

STATEMENT OF COMPLIANCE WITH LICENCE CONDITIONS

1. Were all conditions of the Licence complied with within the reporting period? (please tick the appropriate box)

Yes ☐ Please proceed to Section C

No ☐ Please proceed to Section B

Each page must be initialled by the person(s) who signs Section C of this Annual Audit Compliance Report (AACR).

Initial:

SECTION B

DETAILS OF NON-COMPLIANCE WITH LICENCE CONDITION.

Please use a separate page for each Licence condition that was not complied with.

a) Licence condition not complied with:	
b) Date(s) when the non compliance occurred, if applicable:	
c) Was this non compliance reported to DER?:	
☐ Yes ☐ Reported to DER verbally Date _____ ☐ Reported to DER in writing Date _____	☐ No
d) Has DER taken, or finalised any action in relation to the non compliance?:	
e) Summary of particulars of the non compliance, and what was the environmental impact:	
f) If relevant, the precise location where the non compliance occurred (attach map or diagram):	
g) Cause of non compliance:	
h) Action taken, or that will be taken to mitigate any adverse effects of the non compliance:	
i) Action taken or that will be taken to prevent recurrence of the non compliance:	

Each page must be initialled by the person(s) who signs Section C of this AACR

Initial:

SECTION C

SIGNATURE AND CERTIFICATION

This Annual Audit Compliance Report (AACR) may only be signed by a person(s) with legal authority to sign it. The ways in which the AACR must be signed and certified, and the people who may sign the statement, are set out below.

Please tick the box next to the category that describes how this AACR is being signed. If you are uncertain about who is entitled to sign or which category to tick, please contact the licensing officer for your premises.

If the licence holder is		The Annual Audit Compliance Report must be signed and certified:
An individual	□	by the individual licence holder, or
	□	by a person approved in writing by the Chief Executive Officer of the Department of Environment Regulation to sign on the licensee's behalf.
A firm or other unincorporated company	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A corporation	□	by affixing the common seal of the licensee in accordance with the *Corporations Act 2001*; or
	□	by two directors of the licensee; or
	□	by a director and a company secretary of the licensee, or
	□	if the licensee is a proprietary company that has a sole director who is also the sole company secretary – by that director, or
	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A public authority (other than a local government)	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
a local government	□	by the chief executive officer of the licensee; or
	□	by affixing the seal of the local government.

It is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give information on this form that to their knowledge is false or misleading in a material particular. There is a maximum penalty of $50,000 for an individual or body corporate.

I/We declare that the information in this annual audit compliance report is correct and not false or misleading in a material particular.

SIGNATURE: _____

NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

SIGNATURE: _____

NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

SEAL (if signing under seal)

Licence: L4201/1991/11 Licensee: Water Corporation
Form: N1 Date of breach:

Notification of detection of the breach of a limit.

These pages outline the information that the operator must provide.
Units of measurement used in information supplied under Part A and B requirements shall be appropriate to the circumstances of the emission. Where appropriate, a comparison should be made of actual emissions and authorised emission limits.

Part A

Licence Number	
Name of operator	
Location of Premises	
Time and date of the detection	

Notification requirements for the breach of a limit	
Emission point reference/ source	
Parameter(s)	
Limit	
Measured value	
Date and time of monitoring	
Measures taken, or intended to be taken, to stop the emission	

Part B

Any more accurate information on the matters for notification under Part A.	
Measures taken, or intended to be taken, to prevent a recurrence of the incident.	
Measures taken, or intended to be taken, to rectify, limit or prevent any pollution of the environment which has been or may be caused by the emission.	
The dates of any previous N1 notifications for the Premises in the preceding 24 months.	

Name	
Post	
Signature on behalf of Water Corporation	
Date	

Government of Western Australia
Department of Environment Regulation

Decision Document

Environmental Protection Act 1986, Part V

Proponent: Water Corporation

Licence: L4201/1991/11

Registered office: 629 Newcastle Street
LEEDERVILLE WA 6007

Premises address: Woodman Point Wastewater Treatment Plant
Cockburn Road
MUNSTER WA 6166
Being Lot 9 on Diagram 31097

Issue date: Thursday, 28 October 2010

Commencement date: Monday, 1 November 2010

Expiry date: Friday, 31 October 2031

Decision

Based on the assessment detailed in this document the Department of Environment Regulation (DER), has decided to issue an amended licence. DER considers that in reaching this decision, it has taken into account all relevant considerations.

Decision Document prepared by: Caroline Conway-Physick
Licensing Officer

Decision Document authorised by: Caron Goodbourn
Delegated Officer

Contents

1 Purpose of this Document

This decision document explains how DER has assessed and determined the application and provides a record of DER's decision-making process and how relevant factors have been taken into account. Stakeholders should note that this document is limited to DER's assessment and decision making under Part V of the *Environmental Protection Act 1986.* Other approvals may be required for the proposal, and it is the proponent's responsibility to ensure they have all relevant approvals for their Premises.

2 Administrative summary

Administrative details		
Application type	Works Approval ☐ New Licence ☐ Licence amendment ☒ Works Approval amendment ☐	
Activities that cause the premises to become prescribed premises	**Category number(s)**	**Assessed design capacity**
	54 – Sewage facility	160,000 cubic metres per day
	61 – Liquid waste facility	50,000 tonnes per annual period
Application verified Application fee paid	Date: N/A Date: N/A	
Works Approval has been complied with Compliance Certificate received	Yes☐ No☐ N/A☒ Yes☐ No☐ N/A☒	
Commercial-in-confidence claim	Yes☐ No☒	
Commercial-in-confidence claim outcome	N/A	
Is the proposal a Major Resource Project?	Yes☐ No☒	
Was the proposal referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986*?	Yes☐ No☒	Referral decision No: Managed under Part V ☐ Assessed under Part IV ☐
Is the proposal subject to Ministerial Conditions?	Yes☒ No☐	Ministerial statement No: 490 & 665 EPA Report No: Mandatory Audit Report, 2013/0000447726.
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the *Environmental Protection Act 1986*)?	Yes☐ No☒ Department of Water consulted Yes ☐ No ☒	
Is the Premises within an Environmental Protection Policy (EPP) Area Yes☒ No☐ Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 – revoked; Environmental Protection (Kwinana)(Atmospheric Wastes) Policy 1999 and Regulations 1992 (Area C) - enacted. Relates to atmospheric emissions of SO_2 and fugitive (dust emissions).		
Is the Premises subject to any EPP requirements? Yes☐ No☒ Emission types from the primary activities of the premises do not fall within the EPP requirements within which the premises exists.		

3 Executive summary of proposal and assessment

The Woodman Point Wastewater treatment Plant (WWTP) is owned and operated by Water Corporation and is located approximately 25km south west of Perth. The premises is surrounded by 'Special Use' town planning scheme zoned areas to the east, south and west, and is adjacent to the 'Jervoise Bay Cove' to the west. The premises services the southern suburbs of Perth which has a nominal contributing population of approximately 700,000.

The WWTP consists of pre-treatment, primary treatment and secondary treatment, which includes a four quadrant sequencing batch reactor (SBR) and an anaerobic sludge digestion process.

Treated wastewater is discharged to the Sepia Depression via a 23km Sepia Depression Ocean Outfall Landline (SDOOL) and ocean outfall via the Jervoise Bay Cove.

An Odour Control Facility (OCF) treats odours from the pre-treatment and primary treatment facility, the SBR bio-selectors and the sludge handling area. The plant also has a Tanker Receiver Facility (TRF), which accepts third party waste. The TRF has a separate dedicated chemical odour scrubber to control odour. Dewatered sludge is removed from the premises and disposed of to landfill, with the liquid fraction from the WWTP and TRF being discharged to the flow balancing dam.

The plant is designed to treat up to 160 ML influent per day, with the average daily inflow currently at 141ML/d, for the 2014/ 2015 reporting period. As the premises is nearing capacity, the Licensee has proposed an upgrade to the premises which will increase the design capacity to 180 ML/d. This will require the current operation to be taken off line and operated through a temporary (150 ML/d) system until the works are completed. The proposed works will be constructed over a 2.5 year period consisting of three stages that will include construction of the following:

Stage one –

- Two new 9.75 m vortex grit tanks;
- Four new primary sedimentation tanks;
- Eight secondary sedimentation tanks (temporarily designed as aeration tanks, four with lift out diffused aeration grids and four operated as clarifiers);
- New recycled water pump station and filtration system.

Stage two –

- Conversion of the SBR to a Modified Ludzack-Ettinger (MLE) configuration (Treated wastewater from the primary sedimentation tanks will bypass the SBR to the temporary secondary sedimentation tanks for a period of nine months).

Stage three –

- Secondary sedimentation tanks retrofitted from temporary aeration tanks to fully functioning secondary sedimentation tanks;
- Mixed liquor transferred to MLE quadrants over 2-3 days and blended with imported seed sludge.

A desk top assessment of groundwater bore (Site Id. 20022946) on the western boundary of the premises identifies depth to groundwater at approximately 10.4 mBGL, with TDS approximately 5,000 mg/L (saline). The groundwater forms part of the Murray River Basin and Bartram Road Catchment.

The closest sensitive residential receptor has been identified by the Licensee as approximately 0.5 km south of the premises. The premises operation includes an odour buffer of 750 m to the nearest land use.

The premises is subject to conditions within Ministerial Statement 665.

The main potential emissions during construction are expected to be odour issues from the change in operational process and noise and dust emissions from site construction.

This Licence is a DER initiated amendment to undertake administrative changes from the previous amendment process carried out for the works upgrade at the premises. Comments from the draft review process were omitted within the final draft submitted for signing.

4 Decision table

All applications are assessed in line with the *Environmental Protection Act 1986*, the *Environmental Protection Regulations 1987* and DER's Operational Procedure on Assessing Emissions and Discharges from Prescribed Premises. Where other references have been used in making the decision they are detailed in the decision document.

DECISION TABLE			
Works Approval / Licence section	**Condition number** **W = Works Approval** **L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Interpretation	L1.1.2	**Construction and operation** Conditions 1.1.1 – 1.1.4 require that terminology used within the Licence is referenced to the appropriate definitions where applicable, and that any reference to a standard or guideline is to the most current version of that standard or guideline. An administrative change has been undertaken to amend minor changes to the Licence from a previous amendment process. Definitions have been updated. Condition 1.1.2 includes additional definitions in relation to an 'engineered containment system' and 'tanker receival facility discharge stack'.	General provisions of the *Environmental Protection Act 1986*.
General conditions	L1.2.3 L1.2.7 L1.2.9	**Construction and operation** An administrative change has been undertaken to amend minor changes to the Licence from a previous amendment process. Condition 1.2.3, Table 1.2.1, Note 1: Updated to reflect conditions under the Licence. Condition 1.2.7 amended to require the submission of the compliance document "within one month" following construction of each stage. The wording "and prior to operating the new works" has been removed as the proponent determined that this would not be feasible/ possible within the previous timeframe. Condition 1.2.9 has been amended with the removal of CEO approval and inclusion of	Application supporting documentation. General provisions of the *Environmental Protection Act 1986*.

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		'in accordance with Licence conditions 1.2.6-1.2.8'.	
Premises operation	L1.3.3	**Construction and operation** An administrative change has been undertaken to amend minor changes to the Licence from a previous amendment process. Condition 1.3.3, Table 1.3.2 'Waste processing' has been amended with the removal of pH range from the liquid waste section and with the addition of reporting requirements within condition 4.3.1. Condition 1.3.5, Table 1.3.4, 'Management actions', point a) amended to define "corrective actions" instead of "management actions". Point d) removed from the table, and point e) includes "in writing". Condition 1.3.6 (a) amended to require compliance to condition 1.3.5 and removal of "recorded the actions taken to maintain compliance with the Licence".	General provisions of the *Environmental Protection Act 1986.* Application supporting documentation. *Environmental Protection (Controlled Waste) Regulations 2004* *Environmental Protection (Noise) Regulations 1997* *Environmental Protection (Unauthorised Discharges) Regulations, 2004.* Australian and

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
			New Zealand guidelines for fresh and marine water quality – *2000.*
Improvements	L4.1.1	**Operation** Emission Description *Emission:* Discharge of Hydrogen Sulphide (H2S) from the Tanker Receival Facility stack at the premises *Impact:* Reduced local air quality and odour emissions which could potentially interfere with the health welfare, convenience, comfort or amenity of any person. *Controls:* The proponent monitors parameters for point source emissions at the Tanker Receival Facility (TRF) stack (S1004857) which includes H2S. The TRF includes a chemical scrubber and discharge stack (50 m). Water Corporation have an 'Odour Improvement Plan and Mitigation Strategy' in place and have undertaken an odour control summary to assess emissions from the premises operation (as defined within condition 2.4.1 of the Licence. The closest residential receptor is 500 m south of the premises. Risk Assessment *Consequence*: Moderate *Likelihood:* Possible *Risk Rating:* Moderate Regulatory Controls Condition 1.3.5 has been included to require monitoring of H2S emission levels at the Tanker Receival Facility stack and includes management actions in the event of	General provisions of the *Environmental Protection Act, 1986*.

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		exceedences of the limit specified. Condition 2.4.1 defines the operating documents for consideration in and management of odour emissions at the premises. Condition 3.2.1 requires monitoring of point source emissions to air at the premises which includes the Tanker Receival Facility (TRF). Condition 4.1.1, Improvement Programme has been included within the Licence as it has been identified, through the review of the draft Licence amendment documentation by Water Corporation, that the TRF does not have an operational H2S analyser to determine H2S emissions as defined within condition 1.3.5. It is considered that the ability to assess if the TRF is emitting emission levels above the required limit set that the Licensee is able to more promptly respond to the exceedence and implement appropriate management actions to mitigate and manage such issues and potential complaints. It is considered that this will assist in reducing the volume of odour emissions from the premises and improve monitoring of H2S emissions at the premises. <u>Residual Risk</u> *Consequence*: Minor *Likelihood:* Possible *Risk Rating:* Moderate	
Information	L5.2.1	**Operation** Condition 5.2.1, Table 5.2.1 includes a summary for reporting of any exceedences according to guidance as defined within Ministerial Statement 665, relating to the premises. This relates specifically to Table 3.3.1 of the Licence.	N/A

DECISION TABLE			
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Licence Duration	N/A	The current Licence will expire on 31 October 2016 in line with DER 'Licence duration, May 2015', guidance statement. "Woodman Point WWTP (Lot 9) is reserved as 'Public Purposes - Water Authority of WA'. Lot 20 is reserved "Public Purposes - special uses'. Development Approval is not required for Woodman Point WWTP (Note: A Development Approval is not required for development on reserved land that is owned by or vested in a public authority for the purpose of the supply, treatment, drainage or conveyance of water or wastewater (Clause 16(1a) of the MRS) where the land is: reserved for Water Corporation 'Public Purpose' use; vested in, or owned by the Water Corporation, and does not involve the clearing of regionally significant bushland in a Bush Forever Area)."	N/A

5 Advertisement and consultation table

Date	Event	Comments received/Notes	How comments were taken into consideration
30/05/2016	Proponent sent a copy of draft instrument	Comments on draft received from Water Corporation, Danielle Berry, via email to Chris Slavin (DER) on 20 April 2016, that were not addressed through the initial works upgrade amendment process: 1) Minor change- Bold "Tanker Receival Facility Discharge Stack" at the top of page 7. 2) Remove the definition for "Freeboard" – it is not referenced in this Licence. 3) Define 'engineered containment system' in the definitions. 4) Note 1 (below table 1.2.1) refers to the Licence as a Works Approval. Please replace the words 'Works Approval' with 'Licence' (as this is not a WA). 5) It doesn't make sense to refer to the Licence Amendment Supporting Document here. A lot of the information in this document is background info (including current operation of the plant), and was submitted to provide information for the DER to enable them to draft this revised Licence. The upgrade information in section 6 is repeating what is listed in table 1.2.2 of the draft Licence. The DER should have extracted the various sections of this document, and used the info to develop conditions relating to the upgrade works. 6) General comment – whilst we have put a lot of effort into defining exactly what we want in the BDC documents eg. 5No. MLR pumps, the Delivery Alliance will still be able to offer	DER initiated amendment on comments not addressed, as follows: 1) Definition placed within condition 1.1.2; 2) Removed; 3) Definition placed within condition 1.1.2; 4) Changed; 5) Statement. No change. This does not relate to the application or premises but a formatting approach. 6) No change. Noted. The Licence is based on current operation with the amendment defining what the proposed works upgrade incorporates. Once the upgrade is completed, then an amendment is required to update the Licence to the new and final operation design. This cannot be done until all works are completed and a compliance document submitted as per condition 1.2.7 and 1.2.8 of the Licence. 7) No change. The specifics of the upgrade must be defined within the documentation in order to define the basis of the risk assessment on what is proposed (DER process). See comment above regarding conditions 1.2.4, 1.2.5 and 1.2.6.

Date	Event	Comments received/Notes	How comments were taken into consideration
		alternatives if they can demonstrate a significant NPV advantage to the Corporation. Stage 1, Item 7: I think that this should be either left out or simplified. The Alliance may be able to come up with a better NPV alternative to the proposed 720kW RAS system, which may only require 4No. pumps instead of 16No. Stage 2 is quite prescriptive, and could be reduced to three Items, in the order No. 3, No. 1 and No. 2. Leave the rest out, as how we reconfigure the SBR to an MLE reactor is entirely up to us? 7) As per Wayne's comment above the licence shouldn't specify the design details. Condition's 1.2.4 and 1.2.5 are confusing and contradict each other. 8) What if the change in specification is not minor, but improves the functionality of the infrastructure? The last line states 'and all other conditions in this Licence are still satisfied'. If you change the specs listed in Table 1.2.2, we may not be compliant with the doc referenced in Table 1.2.1. 9) This doesn't allow time for the compliance report to be written (following construction and prior to commissioning applies commissioning cannot commence until the compliance document has been submitted however the compliance document cannot be written until construction is complete. I.e. this condition implies works will have to stop while the report is written and submitted? 10) We cannot provide a commitment at the end of construction that there are no material defects. Defects are sometimes not discovered until commissioning is undertaken. Remove the reference to /no material defects'.	8) No change – see condition 1.2.5 which clarifies this point. 9) Amended. 10) No change. The requirement for a suitably qualified professional engineer or builder is to give surety that to the best of their ability/ knowledge it has been adequately constructed to operate as defined. This is a standard condition within DER. 11) No change. This will be removed on completion of the upgrade and submission of a compliance report for review, through the final amendment process to reflect the final upgrade once in place. The interim process has been designed at the lower capacity therefore full capacity for the interim operational phase is not permitted. 12) Amended. 13) No change. Defined within Licence – see condition 1.3.4, Table 1.3.3. 14) Removed. Seawater pH range is considered approximately between 7.5-8.4. Emissions to Ocean of pH 4 is not considered appropriate. Assessment of the 2014/ 2015 AER identifies that the premises discharge pH parameter is currently achieving a suitable pH range. 15) No change – comment does not correlate

Date	Event	Comments received/Notes	How comments were taken into consideration
		11) Contradicting to limit the premises capacity to 160 ML/d, when Table 1.3.1, 1.3.2 and the premise category (pg. 1) states 180 ML/d. Cannot control inflow – please remove this condition. 12) If the condition has to stay in, Define 'reviewed'? Does this refer to DER acknowledging the submission of the reports or do we require the CEO's approval? 13) Expand acronym 'ASD' 14) Current pH acceptable range is 4-8 (Licence specifies 6.5-8). Please amend. 15) Fifth entry should be "MLE reactor" 16) We do not have online H2S analyser at the TRF, as such this is not relevant. Please remove the Tanker Receival Facility from this Table. 17) What is the difference between a management action and a corrective action? I would have thought that a corrective action IS a management action. Suggest changing to: "Implement Management Actions including: Assess operation to determine any failure… Undertake corrective action… Restore normal operation… Notify CEO…" 18) It is impractical to state that we shall not restart operations until we have recorded all actions taken to maintain compliance with the Licence. Is the intention of that condition to only mean actions taken in relation to the OCF (not the whole Licence). The top priority is to ensure that the odour control facilities are back up and operational – any report/records will be completed as soon as practicable (but not necessarily before operations are restarted). The problem will be 'rectified' as	to Table 1.3.3? 16) Discharge points are identified at both facilities for H2S and monitoring is required at both facilities. Table 1.3.4 defines management actions/ approach required on emission levels. Please explain how assessment has been undertaken from this part of the facility, and reported in the past, as an emissions stack is present? 17) Amended. 18) Condition 1.3.6 amended. 19) No change. Section 5.5 of the submitted application supporting documentation identifies the 'Odour Control Summary' as Appendix 1, within AQUA no. 13945397. 20) Amended, with inclusion into Table 4.3.1. 21) No change. Table requires continuous monitoring frequency with a monthly averaging by use of inflow/ outflow meters.

Date	Event	Comments received/Notes	How comments were taken into consideration
		part of management actions in accordance with Table 1.3.4. Please remove condition 1.3.6. 19) The Odour Management Plan and Mitigation Strategy for the upgrade refers to doc PM#13945397. This doc is in word version – and DOES NOT include the referenced Appendix 1. In other words, the Licence keeps referencing a document which doesn't contain the specified odour mgt plan. This needs amending to the correct PM#- which is 14290847. 20) Note 2: please exclude pH and E.Coli from the contaminant loading requirements. Note 4: why is MS 665 referenced here? Not sure what this note means or its relevance as MS 665 doesn't define that emission point. 21) How can we monitor cumulative ML/day flow rates each month? Needs to be monthly cumulative flow rates in ML, AND/OR daily averaged flow rates in ML/d. Comments received back from Danielle Berry on 17 June 2016 as a result of 21 day consultation period of the Licence amendment process. Comments included: 1) General comment – there is potential that the contractor tenders may propose slightly different and potentially more efficient/effective infrastructure therefore a reduce level of detail would be prudent to avoid the need for a licence amendment down the track when final design is confirmed. 2) Stage 2, Item 7 should read" into each MLE basin". Stage 3, Item 1 – does the number of SSTs	DER response to comments received on 17 June 2016: 1) Refer to condition 1.2.4, 1.2.5 and 1.2.6 of the Licence with regards to 'Departures' 2) The Licence amendment incorporates a works upgrade as per the details supplied in the application supporting documentation. The risk assessment has been based on the design specification supplied. Any departures from the design specifications supplied are to be addressed through conditions 1.2.4, 1.2.5 and 1.2.6 of the Licence. 3) Incorrect. No change.

Date	Event	Comments received/Notes	How comments were taken into consideration
		need to be specified? Stage 3, Items 2 & 3 – the Construction Alliance may decide on a different configuration. Does the level of detail specified need to be this specific? 3) Condition's 1.2.4 and 1.2.5 contradict each other. 4) 1.2.5: If the construction Alliance change the specs listed in Table 1.2.2, we may not be compliant with the doc referenced in Table 1.2.1. Is this level of infrastructure to be construction required? 5) 1.2.8: Can the reference to no material defects' be removed? Compliance doc will confirm the infrastructure has been constructed as described however defects potentially won't be identified until commissioning and can be reported via the commissioning report. 6) 1.3.3: Expand acronym 'ASD' 7) 1.3.5: We do not have online H2S analyser at the TRF. Please remove the Tanker Receival Facility from this Table. 8) The condition states that we can't restart until we have complied with condition 1.3.5. This is an issue because condition 1.3.5 requires a written notification to DER. We cannot wait until we have notified DER in writing to restart the odour control facility. Please amend Table 1.3.4 to remove "in writing". 9) The TRF stack is 50m. 10) Can the AQUA#13945397 be changed to AQUA#14290847? 11) There is no continuous monitoring device to record volumetric flow rate of the TRF. Can only record volumes of liquid waste as each	4) Any departures from the design specifications supplied are to be addressed through conditions 1.2.4, 1.2.5 and 1.2.6 of the Licence. 5) No change. Condition is consistent with those used by DER. 6) The initial application referenced ASB which was defined as the Anaerobic Biosolids Digester which was defined within the respective condition – addressed in previous comments sent to Water Corporation above (30/5/2016). The acronym has now been changed from ASD to ABD. 7) The condition has been amended however an improvement condition has now been proposed within Section 4 Improvement programme for the installation of an H2S analyser. 8) No change. Written correspondence can be notification via any written form confirming operation is now rectified e.g. email. 9) Amended stack height. 10) As previously stated, the Application Supporting Document does not reference this number however I have included this number as follows within Table 2.4.1: "(Water Corporation independent document reference number AQUA#14290847)". 11) Amended to each load received. 12) Removed and placed within Table 5.2.1. 13) Amended from 3.1.3 to 3.1.4.

Date	Event	Comments received/Notes	How comments were taken into consideration
		truck comes in. Please amend to reflect this process. 12) This new text needs to be removed. MS 665 is not specifically on Woodman Point WWTP - it is on the SDOOL line (which includes a number of dischargers/participants). An exceedance of criteria therefore cannot be attributed necessarily to Woodman Point WWTP. MS 665 exceedances are managed through the MMP (which states that the DER is to be notified), and should not be regulated through the DER Licence. 13) This should reference condition 3.1.4 (not condition 3.1.3), as the condition refers to the calibration reports that need to be developed if calibration requirements can't be met. Final comments received from Danielle Berry via email (6 July 2016) through the draft referral process included: 1) 1.3.1: Table 1.3.2 states that dewatered biosolids to be sent to registered landfill. Biosolids sent to storage facility or to farm (licenced facilities) - not to landfill. Please amend/remove. 2) 1.3.5: Table 1.3.4 should refer to 5.3.1, not 4.3.1 3) 1.3.6: States that we cannot restart operations until we have complied with all the management actions in Table 1.3.4. We cannot wait until we have assessed H2S issue, rectified and notified DER before we restart operations. We need to be able to restart operations as soon as possible to avoid unnecessary odour emissions. Please amend. 4) 2.2.1: amended the height of the wrong	DER response to comments received from draft referral process, as follows: 1) Changed biosolids to read: "Dewatered biosolids to be removed for offsite disposal 2) Typographical error: changed to 5.3.1 3) Condition 1.3.5 and 1.3.6 must be read in the context of Table 5.3.1 – No change. 4) Amended. 5) Removed. The summary of exceedences does incorporate other premises and as such the independent reporting of any exceedence should be emailed through to DER CEO, outside of the Licence. 6) Awaiting confirmation of construction details/ permeability from Licensee. 7) Typographical error. Amended. 8) Amended to 31/01/2017 (six months). 9) Amended to read: "… and ocean outfall

Date	Event	Comments received/Notes	How comments were taken into consideration
		stack. OCF is 50m high, TRF is 12 m high. Please amend 5) 5.2.1: the requirements in MS665 relate to overall SDOOL discharge, not individual plants. It is unreasonable to include a summary of any exceedance relating to Woodman Point operations, as a MS exceedance cannot necessarily be attributed to Woodman Point WWTP (or effluent quality as referred to in the decision doc). DER will be notified of EQO exceedances as per the Ministerial. Please amend or remove. 6) 1.3.4: Table 1.3.3 refers Flow Balancing Dam as "constructed of concrete". Please amend to "plastic lined". 7) 1.3.4: Table 1.3.3 – Please correct "Anerobic biosolids disgestor" to "Anaerobic biosolids digester" (typo) 8) IR condition - September 2016 is not feasible (need 6-12 months). 9) Premises Description: Talks about discharge of final effluent through the SDOOL and 4.2km Ocean Outlet through "Jervoise Bay Cove". Ocean outlet is 4.2 km from Point Peron to Sepia Depression. 10) 2.3.1, Table 2.3.1: Spelt "Priority" wrong.	via the Jervoise Bay Cove." 10) Typographical error. Amended.

6 Risk Assessment

Note: This matrix is taken from the DER Corporate Policy Statement No. 07 - Operational Risk Management

Table 1: Emissions Risk Matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	Moderate	High	High	Extreme	Extreme
Likely	Moderate	Moderate	High	High	Extreme
Possible	Low	Moderate	Moderate	High	Extreme
Unlikely	Low	Moderate	Moderate	Moderate	High
Rare	Low	Low	Moderate	Moderate	High

Appendix A

Point source emissions to air including monitoring
For the Woodman Point Wastewater Treatment Plant facility, the principle emissions of concern are emissions to air (odour from Hydrogen sulphide emissions). DER has reviewed the proponent's impact assessment for emissions to air from the premises and is satisfied with the assessment provided by the proponent.

The proponent has an 'Odour Management Plan and Mitigation Strategy' and 'Odour Improvement Plan' and is required to comply with Ministerial requirements for the reduction of odour emissions by at least 50% since 2005 within three years for the premises. The long term objective has been defined by the Licensee as "*achieving [a] long term 73% reduction in odour emissions as envisaged in the SER (Strategic Environmental Review),...to the extent that there are no noticeable odour beyond the existing buffer zone*" (Appendix 1 – Odour Control Summary, application supporting documentation).

The proposed works upgrade is considered by the Licensee to have the ability to further improve odour emissions from the premises through improved technology installation (conversion of SBR to MLE and providing separate secondary clarifiers within the new MLE).

The proponent has undertaken two Odour monitoring and modelling programmes (MAM) since 2008/ 2009 to assess compliance against Ministerial requirements and in 2010 determined that the premises has reduced emissions by 55% since the Ministerial determination in 2005.

The upgraded premises, at full capacity of 180 ML/ day, is expected to have odour emissions of 118,500 OU/s as compared to emissions before 2009 of 297,100 OU/s.

The odour analysis/ assessment and modelling (Appendix A 'Odour modelling' within Odour Control Summary Appendix 1 of the application supporting documentation) provided was submitted to DER Air Quality Branch on 29 February 2016 for review. The review determined that the risk is considered low once operational, with low to moderate risk during the operation of the temporary facility configuration (construction phase/ concurrent operation). The secondary treatment facility is considered to be overloaded during the SBR retrofitting phase.

The drafting of the Odour Improvement Plan (OIP) in accordance with the East Rockingham Wastewater Treatment Plant is considered appropriate, which the proponent has committed to undertaking. The OIP is to comprehensively assess risk related to:
- sources and operations on site;
- their monitoring;
- corrective actions to be implemented if necessary; and
- contingencies should the corrective actions not be effective.

The WWTP is expected to continue growing to its anticipated ultimate capacity of 320ML/ day in the future, based on the capacity of the catchment and the main sewer system feeding the Munster Pumping Station. An upgrade to 220ML/ day will require a separate plant to be built onto the site which may impact the current buffer separation distance currently within the premises (750 m). This expansion is approximately 40 years into the future.

Emission Risk Assessment – Construction and Operation
Emission Description
Emission: Odorous emissions (Hydrogen sulphide) from the Tanker Receival Facility, Odour Control Facility operations, pre-treatment works, stack emissions, SBR operation (normal operation) and as a

result of the proposed works upgrade (abnormal operations/ alteration of process by taking current process off line to operate through a temporary process).
Impact: Reduction in local air quality. Nearest sensitive residential receptor is approximately 1.2 km south of the premises.
Controls: All odour emissions from the operation of the premises are directed through to the Odour Control Facility (OCF). The enclosed OCF and enclosed Tanker Receival Facility (TRF) both have chemical scrubbers to assist in the reduction of odour emissions. Sewage sludge is processed and stored within the enclosed Anaerobic Sludge Digestors (ASD) facility prior to discharge off site to an authorised landfill.

The following has been determined from Appendix 1 – Odour Control Summary (from the application supporting documentation):

Preliminary/ Pre-treatment: Grit removal
Entire process train from each tank to collection container for the inlet screening is to be enclosed to minimise fugitive emissions. Foul air extraction incorporated for the grit washing and classification systems.

Primary treatment (PST's)
The new PST's 5-8 will be covered and sealed as per the existing PST's 1-4 but with improved sealing on the skimming (scum) line. Foul air collection ductwork will be extended from the current PST's to service the new PST's.

SBR to MLE Conversion
Conversion to MLE continuous process with separate clarifiers is considered to be a more stable operation. The proponent has determined that similar operations at the Beenyup WWTP have "confirmed that there will be a considerable reduction in odour from a continuously aerated reactor as in the MLE format." This has predominantly been determined as a result of the spike in odour emissions caused from the start-up of the aeration process within the current SBR, which will be eliminated from the MLE conversion.

Additional covers and ventilation will be provided for the first anoxic zones in each MLE basin to counteract potential emissions from turbulence caused by mixing of the Mixed Liquor Recycle (MLR) and selector outlet streams. The Odour Control Summary, section 5.2, (Appendix 1 of the application supporting documentation) further identifies odour control efficiency requirements for the odour control facility for OU and H_2S and in relation to upgrades on the odour covers (section 5.3, Appendix 1, of the application supporting documentation).

Solids treatment area (ASD)
The works upgrade will not alter or increase any aspect of the current process, therefore no change to odour emissions from this area of the premises is expected.

Risk Assessment
Consequence: Moderate
Likelihood: Possible
Risk Rating: Moderate

Regulatory Controls
Condition 1.2.10 limits the increase in design capacity until review of the compliance documents for all stages of the works upgrade has been completed.

Condition 1.3.5 requires the management of hydrogen sulphide emission levels at the premises.

Condition 1.3.9 requires the Licensee to develop an 'Odour Monitoring Strategy' for the premises.

Condition 1.3.10 requires an odour monitoring and modelling (MAM) programme verification and the development of contingencies/ mitigation measures where any failures/ risks have been identified.

Condition 2.4.1 requires the Licensee to manage odour emissions according the specific management plans relevant to the premises operation.

Condition 3.2.1 requires the Licensee to monitor odour emissions for hydrogen sulphide from the premises operations.

Condition 4.1.3 includes a detailed complaints management system requirement for the recording of complaints.

Condition 4.2.1 requires the reporting of all complaints.

Condition 4.3.1 requires the reporting/ notification of all limit exceedences where management action was taken.

Residual Risk
Consequence: Minor
Likelihood: Possible
Risk Rating: Moderate

Government of **Western Australia**
Department of **Environment Regulation**

Licence

Environmental Protection Act 1986, Part V

Licensee: **Water Corporation**

Licence: **L4726/1991/15**

Registered office: 629 Newcastle Street
LEEDERVILLE WA 6007

Premises address: Subiaco Wastewater Treatment Plant
Lemnos Street
SHENTON PARK WA 6008
Being Lot 3150 on Plan 149501, Lot 5286 on Plan 162620 and Lot 6815 on Plan 166929 as depicted in Schedule 1.

Issue Date: Thursday, 30 October 2014

Commencement date: Saturday, 1 November 2014

Expiry date: Tuesday, 31 October 2017

Prescribed Premises Category
Schedule 1 of the *Environmental Protection Regulations 1987*

Category number	Category description	Category production or design capacity	Approved Premises production or design capacity
54	Sewage facility premises – (a) on which sewage is treated (excluding septic tanks); or (b) from which treated sewage is discharged onto land or into waters.	100 cubic metres or more per day	64,000 cubic metres per day – no more than 20,000 tonnes per annual period shall be liquid waste
61	Liquid waste facility: premises on which liquid waste produced on others premises (other than sewage waste) is stored, reprocessed, treated or irrigated.	100 tonnes or more per year	

Conditions
This Licence is subject to the conditions set out in the attached pages.

.....
Officer delegated under section 20
of the *Environmental Protection Act 1986*

Contents

Introduction

This Introduction is not part of the Licence conditions.

DER's industry licensing role
The Department of Environment Regulation (DER) is a government department for the state of Western Australia in the portfolio of the Minister for Environment. DER's purpose is to advise on and implement strategies for a healthy environment for the benefit of all current and future Western Australians.

DER has responsibilities under Part V of the *Environmental Protection Act 1986* (the Act) for the licensing of prescribed premises. Through this process DER works with the business owners, community, consultants, industry and other representatives to prevent, control and abate pollution and environmental harm to conserve and protect the environment. DER also monitors and audits compliance with works approvals and licence conditions, takes enforcement action as appropriate and develops and implement licensing and industry regulation policy.

Licence requirements
This licence is issued under Part V of the Act. Conditions contained within the licence relate to the prevention, reduction or control of emissions and discharges to the environment and to the monitoring and reporting of them.

Where other statutory instruments impose obligations on the Premises/Licensee the intention is not to replicate them in the licence conditions. You should therefore ensure that you are aware of all your statutory obligations under the Act and any other statutory instrument. Legislation can be accessed through the State Law Publisher website using the following link:
http://www.slp.wa.gov.au/legislation/statutes.nsf/default.html

For your Premises relevant statutory instruments include but are not limited to obligations under the:

- *Environmental Protection (Unauthorised Discharges) Regulations 2004* – these Regulations make it an offence to discharge certain materials such as contaminated stormwater into the environment other than in the circumstances set out in the Regulations.

- *Environmental Protection (Controlled Waste) Regulations 2004* – these Regulations place obligations on you if you produce, accept, transport or dispose of controlled waste.

- *Environmental Protection (Noise) Regulations 1997* – these Regulations require noise emissions from the Premises to comply with the assigned noise levels set out in the Regulations.

You must comply with your licence. Non-compliance with your licence is an offence and strict penalties exist for those who do not comply.

Licence holders are also reminded of the requirements of section 53 of the Act which places restrictions on making certain changes to prescribed premises unless the changes are in accordance with a works approval, licence, closure notice or environmental protection notice.

Other Guidelines which you should be aware of include:

- *Western Australian Guidelines for Biosolids Management*, Department of Environment and Conservation, December 2012 (as amended from time to time).

Licence Fees
If you have a licence that is issued for more than one year, you are required to pay an annual licence fee prior to the anniversary date of issue of your licence. Non payment of annual licence fees will result in your licence ceasing to have effect meaning that it will no longer be valid and you will need to apply for a new licence for your Premises.

Ministerial conditions
If your Premises has been assessed under Part IV of the Act you may have had conditions imposed by the Minister for Environment. You are required to comply with any conditions imposed by the Minister.

Premises description and Licence summary
The operations at Water Corporation's Subiaco Wastewater Treatment Plant include:

- the treatment of domestic and commercial sewage via an activated sludge treatment plant which treats the wastewater to a secondary standard;
- reuse of treated wastewater as process water and for landscape irrigation;
- reuse of treated wastewater at McGillivray Oval for landscape irrigation;
- discharge of surplus treated wastewater to the ocean via an ocean outlet located off Swanbourne Beach; and
- treatment and storage of sewage sludge on-site within sludge treatment and storage tanks.

The main potential emissions from the site are discharges of treated wastewater to water and fugitive emissions in the form of odour.

Discharges of treated wastewater to water are managed by treating wastewater to a defined water quality level and undertaking compliance monitoring prior to discharge.

Odour is managed on-site through scrubbing combined odours from the influent channel, pre-treatment building, primary treatment and sludge treatment in the primary odour scrubbers at the odour control facility. Gas extracted from the secondary aeration tanks is combined with the air discharged from the primary scrubbers and scrubbed in the two odour-guard scrubbers. The odour control system is currently monitored by an external service provider. Tests for temperature, air flow rates and H2S concentrations are conducted on a quarterly basis.

This Licence is the successor to licence L4726/1991/14 and the existing licence has been converted to a new format REFIRE licence. This does not alter any emissions or discharges from the premises.

The licences issued for the Premises since 20/10/2003 are:

Instrument log		
Instrument	**Issued**	**Description**
L4726/1991/7	27/09/2002	Licence re-issue
L4726/1991/8	20/10/2003	Licence re-issue
L4726/1991/9	27/09/2004	Licence re-issue

L4726/1991/10	31/10/2005	Licence re-issue
L4726/1991/11	27/10/2006	Licence re-issue
L4726/1991/12	26/10/2007	Licence re-issue
L4726/1991/13	31/10/2008	Licence re-issue
L4726/1991/14	13/10/2011	Licence re-issue
L4726/1991/15	30/10/2014	Licence re-issue – conversion to REFIRE format
L4726/1991/15	05/03/2014	Licence Amendment

Severance

It is the intent of these Licence conditions that they shall operate so that, if a condition or a part of a condition is beyond the power of this Licence to impose, or is otherwise *ultra vires* or invalid, that condition or part of a condition shall be severed and the remainder of these conditions shall nevertheless be valid to the extent that they are within the power of this Licence to impose and are not otherwise *ultra vires* or invalid.

END OF INTRODUCTION

Licence conditions

1 General

1.1 Interpretation

1.1.1 In the Licence, definitions from the *Environmental Protection Act 1986* apply unless the contrary intention appears.

1.1.2 For the purposes of this Licence, unless the contrary intention appears:

'Act' means the *Environmental Protection Act 1986;*

'annual period' means the inclusive period from 1 July until 30 June in the following year;

'AS/NZS 2031' means the Australian Standard AS/NZS 2031 *Selection of containers and preservation of water samples for microbiological analysis;*

'AS/NZS 5667.1' means the Australian Standard AS/NZS 5667.1 *Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples;*

'AS/NZS 5667.10' means the Australian Standard AS/NZS 5667.10 *Water Quality – Sampling – Guidance on sampling of waste waters;*

'averaging period' means the time over which a limit or target is measured or a monitoring result is obtained;

'CEO' means Chief Executive Officer of the Department of Environment Regulation;

'CEO' for the purpose of correspondence means;

Manager Licensing (Greater Swan)
Department of Environment Regulation
Locked Bag 33
CLOISTERS SQUARE WA 6850
Telephone: (08) 9333 7510
Facsimile: (08) 9333 7550
Email: grswanbooragoon@der.wa.gov.au;

'CEMS' means continuous emissions monitoring system;

'CEMS Code' means the current version of the Continuous Emission Monitoring System (CEMS) Code for Stationary Source Air Emissions, Department of Environment & Conservation, Government of Western Australia;

'cfu/100 mL' means colony forming units per 100 millilitres;

'code of practice for the storage and handling of dangerous goods' means the document titled "Storage and handling of dangerous goods: Code of Practice" published by the Department of Mines and Petroleum, as amended from time to time;

'controlled waste' has the definition in *Environmental Protection (Controlled Waste) Regulations 2004;*

'covers' means metallic or non-metallic covers used to cover the pre-treatment, primary treatment and secondary aeration areas of the treatment plant;

'dangerous goods' has the meaning defined in the *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007;*

'environmentally hazardous material' means material (either solid or liquid raw materials, materials in the process of manufacture, manufactured products, products used in the manufacturing process, by-products and waste) which if discharged into the environment from or within the premises may cause pollution or environmental harm. Note: Environmentally hazardous materials include dangerous goods where they are stored in quantities below placard quantities. The storage of dangerous goods above placard quantities is regulated by the Department of Mines and Petroleum;

'fugitive emissions' means all emissions not arising from point sources identified in Sections 2.2, 2.3, 2.4 and 2.5;

'Geobag' means a geotextile dewatering bag that allows solids to dewater over time while containing the solid component.

'hardstand' means a surface with a permeability of 10^{-9} metres/second or less;

'Leachate' means liquid released by or water that has percolated through waste and which contains some of its constituents;

'Licence' means this Licence numbered L4726/1991/15 and issued under the *Environmental Protection Act 1986;*

'Licensee' means the person or organisation named as Licensee on page 1 of the Licence;

'NATA' means the National Association of Testing Authorities, Australia;

'NATA accredited' means in relation to the analysis of a sample that the laboratory is NATA accredited for the specified analysis at the time of the analysis;

'odour boundary' means the outer boundary of odour modelled at 5 odour units (OU) at 99.9 percentile 1 hour averaging as depicted on the Map of Odour Boundary in Schedule 1;

'Premises' means the area defined in the Premises Map in Schedule 1 and listed as the Premises address on page 1 of the Licence;

'**Process equipment**' means any wastewater or sludge containment infrastructure or wastewater treatment vessel;

'quarterly' means the four inclusive periods from 1 July to 30 September, 1 October to 31 December and 1 January to 31 March and 1 April to 30 June in the following year.

'Schedule 1' means Schedule 1 of this Licence unless otherwise stated;

'Schedule 2' means Schedule 2 of this Licence unless otherwise stated;

'six-monthly' means the two inclusive periods from 1 July to 30 December and 1 January to 30 June in the following year;

'spot sample' means a discrete sample representative at the time and place at which the sample is taken;

'STP, dry' means standard temperature and pressure (0°C and 101.325 kilopascals); dry;

'Subiaco Main Drain' means Subiaco Main Drain Outlet extending approximately 50 metres off the shore as depicted on the Map of Perth Main Drain and Swanbourne Ocean Outlet Landline in Schedule 1;

'Swanbourne Ocean Outlet' means Swanbourne Ocean Outlet extending 1.1 kilometres off the shore as depicted on the Map of Perth Main Drain and Swanbourne Ocean Outlet Landline in Schedule 1;

'Waste Code' means the Waste Code assigned to a type of controlled waste for purposes of waste tracking and reporting as specified in the Department of Environment Regulation "Controlled Waste Category List" (July 2014), as amended from time to time;

'wastewater treatment vessels' means any vessel or tank containment infrastructure associated with the treatment of wastewater and includes, but not limited to oxidation ditches and clarifiers.

'USEPA' means United States (of America) Environmental Protection Agency;

'usual working day' means 0800 – 1700 hours, Monday to Friday excluding public holidays in Western Australia;

1.1.3 Any reference to an Australian or other standard in the Licence means the relevant parts of the standard in force from time to time during the term of this Licence.

1.1.4 Any reference to a guideline or code of practice in the Licence means the version of that guideline or code of practice in force from time to time, and shall include any amendments or replacements to that guideline or code of practice made during the term of this Licence.

1.2 General conditions

1.2.1 Nothing in the Licence shall be taken to authorise any emission that is not mentioned in the Licence, where the emission amounts to:
(a) pollution;
(b) unreasonable emission;
(c) discharge of waste in circumstances likely to cause pollution; or
(d) being contrary to any written law.

1.2.2 The Licensee shall maintain all pollution control and monitoring equipment to the manufacturer's specification or any relevant and effective internal management system.

1.2.3 The Licensee, except where storage is prescribed in section 1.3, shall ensure that environmentally hazardous substances are stored in accordance with the Code of Practice for the Storage of dangerous goods.

1.2.4 The Licensee shall immediately recover, or remove and dispose of spills of environmentally hazardous materials outside an engineered containment system.

1.3 Premises operation

1.3.1 The Licensee shall record and investigate the exceedance of any descriptive or numerical limit, and/or target in this section.

1.3.2 The Licensee shall only allow waste to be accepted on to the Premises if:
(a) it is of a type listed in Table 1.3.1; and
(b) the quantity accepted is below any limit listed in Table 1.3.1; and
(c) it meets any specification listed in Table 1.3.1

Table 1.3.1: Waste acceptance

Waste	Waste Code	Quantity Limit	Specification[1]
Putrescible and Organic wastes			
Sewage	N/A	64,000 m^3/day (average per year)	Accepted through sewer inflow(s) only
Septage wastes (Sewage) – domestic wastes from apparatus for the treatment of sewage	K210	20,000 t/annual period	Tankered into the premises and discharged in the pre-treatment area Controlled Waste Inlet Port via an enclosed pipeline. Tankered into the premises and discharged via the Pump Station receivable point.

1.3.3 The Licensee shall ensure that the wastes accepted onto the Premises are only subjected to the process(es) set out in Table 1.3.2 and in accordance with any process requirements described in that table.

Table 1.3.2: Waste processing

Waste type	Process	Process requirements
Sewage	Screening, grit removal, disinfection and filtration. And Physical, biological and chemical treatment. **Preliminary treatment** • Screening and Grit removal **Primary treatment** • Primary Sedimentation tanks **Secondary treatment** • Aeration tanks and secondary sedimentation tanks **Tertiary treatment and disinfection** • Filtration and chlorination	Treatment of sewage and septage waste shall be targeted at or below the assessed treatment capacity of 64,000 m^3/day – no more than 20,000 tonnes per annual period shall be liquid waste.
Septage wastes (Sewage) – domestic wastes from apparatus for the treatment of sewage		
Sewage sludge and Waste activated sludge	Sludge treatment and storage	None specified

1.3.4 The Licensee shall ensure that material is only stored and/or treated within vessels or compounds provided with the infrastructure detailed in Table 1.3.3.

Table 1.3.3: Containment infrastructure

Storage vessel or compound	Material	Requirements
Inlet/preliminary works: Mechanical Step Screens and Grit Removal Tanks	Screenings and Grit	Recovered screenings and grit to be stored in a sealed bin which is stored within a bunded hardstand area or a hardstand area that is graded to a collection drain which returns sludge leachate to the start of the treatment process.
Primary Sedimentation Tanks (PST 7-10)	Wastewater	Ensure that the covers on the primary and aeration tank areas of the plant are kept in place at all times except when removal is required for maintenance operations or during emergency situations.
Aeration Treatment (tanks 1-11)		
Secondary Sedimentation Tanks (SST 1-12)		None specified
Sludge blending tanks (SBT 1-2)	Sludge and leachate	Returns sludge leachate to the start of the treatment process.
Lime amended Biosolids Storage Silos (Silo 1 – Silo 6)	Lime amended biosolids	None specified

1.3.5 The Licensee shall manage the wastewater treatment tanks such that:
- (a) overtopping of the tanks does not occur; and
- (b) stormwater runoff is prevented from entering the tanks; and
- (c) there is no discernible seepage loss from the tanks; and
- (d) vegetation and floating debris (emergent or otherwise) is prevented from growing or accumulating in the tanks.

1.3.6 The Licensee shall manage the irrigation of treated wastewater such that:
- (a) no irrigation generated run-off, spray drift or discharge occurs beyond the boundary of the defined irrigation area(s); and
- (b) treated wastewater is evenly distributed over the irrigation area; and
- (c) no soil erosion occurs; and
- (d) irrigation does not occur on land that is waterlogged; and
- (e) vegetation cover is maintained over the irrigation area.

2 Emissions

2.1 General

2.1.1 The Licensee shall record and investigate the exceedance of any descriptive or numerical limit or target specified in any part of section 2 of this Licence.

2.2 Point source emissions to air

2.2.1 The Licensee shall ensure that where waste is emitted to air from the emission points in Table 2.2.1 and identified on the Map of Plant Infrastructure in Schedule 1 it is done so in accordance with the conditions of this Licence.

Table 2.2.1: Emission points to air

Emission point reference	Emission Point reference on Map of plant infrastructure	Emission point height (m)	Source, including any abatement
Treated air at stack	Chemical Scrubber Stack	50	Stack via chemical scrubbing system

2.2.2 The Licensee shall not cause or allow point source emissions to emissions to air greater than the limits listed in Table 2.2.2.

Table 2.2.2: Point source emission limits to air

Emission point reference	Parameter	Limit (including units)[1]	Averaging period
Treated air at stack	Hydrogen Sulphide	5 mg/m^3 at STP dry	N/A
		0.14g/s at STP dry	

2.2.3 The licensee shall maintain a log of all CEMS calibration curve correlations and make this log available on request.

2.3 Point source emissions to surface water

2.3.1 The Licensee shall ensure that where waste is emitted to surface water from the emission points in Table 2.3.1 and identified on the Map of Perth Main Drain and Swanbourne Ocean Outlet Landline in Schedule 1 it is done so in accordance with the conditions of this Licence.

Table 2.3.1: Emission points to surface water

Emission point reference	Emission point reference on Map of Perth Main Drain and Swanbourne Ocean Outlet Landline	Description	Source including abatement
Swanbourne Ocean Outlet map	Swanbourne Ocean Outlet	Discharge of treated wastewater via the Swanbourne Ocean Outlet extending 1.1 kilometres offshore	Treated wastewater
Perth Main	Perth Main Drain (via	Discharge of treated	Treated wastewater

Drain Map	emergency overflow drain)	wastewater during unforeseen pump station failures	

2.3.2 The Licensee shall not cause or allow point source emissions to surface water greater than the limits listed in Table 2.3.2.

Table 2.3.2: Point source emission limits to surface waters

Emission point reference	Parameter	Limit (including units)	Averaging period
Secondary effluent to ocean outfall	Total Nitrogen	3300 kg/d	Annual Period
	Total Phosphorus	1000 kg/d	

2.4 Point source emissions to groundwater

There are no specified conditions relating to point source emissions to groundwater in this section.

2.5 Emissions to land

2.5.1 The Licensee shall ensure that where waste is emitted to land from the emission points in Table 2.5.1 it is done so in accordance with the conditions of this Licence.

Table 2.5.1: Emissions to land

Emission point reference	Emission point reference	Description	Source including abatement
Effluent Discharge Pumping Station Sample point (Map of Infrastructure)	Irrigation areas within the Premises	Final plant outlet channel feeding irrigation areas	Treated wastewater

2.6 Fugitive emissions

There are no specified conditions relating to fugitive emissions in this section.

2.7 Odour

2.7.1 The Licensee shall ensure that odour emitted from the Premises does not unreasonably interfere with the health, welfare, convenience, comfort or amenity of any person beyond the odour boundary as depicted in the Map of Odour Boundary in Schedule 1.

2.8 Noise

There are no specified conditions relating to noise in this section.

3 Monitoring

3.1 General monitoring

3.1.1 The licensee shall ensure that:
(a) all water samples are collected and preserved in accordance with AS/NZS 5667.1;
(b) all wastewater samples are collected in accordance with AS/NZS 5667.10;
(c) all microbiological samples are collected in accordance with AS/NZS 2031;
(d) all laboratory samples are submitted to a laboratory with current NATA accreditation for the parameters to be measured unless indicated otherwise in relevant table.

3.1.2 The Licensee shall ensure that :
(a) monthly monitoring is undertaken at least 15 days apart;
(b) quarterly monitoring is undertaken at least 45 days apart; and
(c) six monthly monitoring is undertaken at least 5 months apart.

3.1.3 The Licensee shall record production or throughput data and any other process parameters relevant to any non-continuous or CEMS monitoring undertaken.

3.1.4 The Licensee shall ensure that all monitoring equipment used on the Premises to comply with the conditions of this Licence is calibrated in accordance with the manufacturer's specifications.

3.1.5 The Licensee shall, where the requirements for calibration cannot be practicably met, or a discrepancy exists in the interpretation of the requirements, bring these issues to the attention of the CEO accompanied with a report comprising details of any modifications to the methods.

3.2 Monitoring of point source emissions to air

3.2.1 The Licensee shall undertake the monitoring in Table 3.2.1 according to the specifications in that table.

Table 3.2.1: Monitoring of emissions to air

Emission point reference	Parameter	Units[1]	Frequency[2]	Method
Treated air at stack	Hydrogen sulphide	ppb	Continuous	CEMS
	Hydrogen sulphide	mg/m^3 g/s	Quarterly	NATA accredited method for the measurement and analysis of hydrogen sulphide emissions from stationary sources
	Volumetric flow rate	m^3/s		Thermal mass flow meters calibrated against USEPA Method 2
	Stack exit temperature	degrees Celsius		None specified

Note 1: All units are referenced to STP dry
Note 2: Monitoring shall be undertaken to reflect normal operating conditions and any limits or conditions on inputs or production.

3.2.2 The Licensee shall ensure that sampling required under Condition 3.2.1 of the Licence is undertaken at sampling locations in compliance with the AS 4323.1 or relevant part of the CEMS Code.

3.2.3 The Licensee shall ensure that all non-continuous sampling and analysis undertaken pursuant to condition 3.2.1 for the parameters specified in Table 3.2.1 is undertaken by a holder of NATA accreditation for the relevant methods of sampling and analysis.

3.2.4 For any parameter in Table 3.2.1 requiring continuous monitoring, the Licensee shall ensure that the CEMS is regularly operated, maintained and calibrated in accordance with the CEMS Code.

3.3 Monitoring of point source emissions to surface water

3.3.1 The Licensee shall undertake the monitoring in Table 3.3.1 according to the specifications in that table.

Table 3.3.1: Monitoring of emissions to surface waters

Emission point	Monitoring point reference and location	Parameter	Units	Averaging period	Frequency
Swanbourne Ocean Outlet	Magflow to Ocean Outfall	Volumetric flow rate (cumulative)	L/s m^3/day	Monthly	Continuous
Perth Main Drain (via emergency overflow drain)	None specified				
Swanbourne Ocean Outlet and Perth Main Drain (via emergency overflow drain)	Effluent Discharge Pumping Station Sample point	pH[1]		Spot or composite sample	Monthly
		Total Nitrogen	mg/L		
		Total Phosphorus			
		Total Suspended Solids	mg/L		Six-monthly
		Total Dissolved Solids			
		Biochemical Oxygen Demand			
		Oil and Grease			
		Arsenic			
		Cadmium			
		Copper			
		Chromium			
		Lead			
		Mercury			
		Nickel			
		Zinc			

Note 1: In-field non-NATA accredited analysis permitted.

3.4 Monitoring of point source emissions to groundwater

There are no specified conditions relating to monitoring of point source emissions to groundwater in this section.

3.5 Monitoring of emissions to land

3.5.1 The Licensee shall undertake the monitoring in Table 3.5.1 according to the specifications in that table.

Table 3.5.1: Monitoring of emissions to land

Emission point	Monitoring point reference and location	Parameter	Units	Averaging period	Frequency
Effluent Discharge Pumping Station Sample point (Map of Infrastructure)	Magflow to on-site irrigation	Volumetric flow rate (cumulative)	L/s m^3/day	Monthly	When irrigating
	Magflow to reuse at McGillvray Oval				
	Effluent Discharge Pumping Station Sample point	pH[1]		Spot or composite sample	Monthly
		Total Nitrogen	mg/L		
		Total Phosphorus			
		Escherichia coli	Cfu/100ml		Quarterly
		Total Suspended Solids	mg/L		Six-monthly
		Total Dissolved Solids			
		Biochemical Oxygen Demand			

Note 1: In-field non-NATA accredited analysis permitted.

3.6 Monitoring of inputs and outputs

3.6.1 The Licensee shall undertake the monitoring specified in Table 3.6.1 according to the specifications in that table.

Table 3.6.1: Monitoring of inputs and outputs

Input/Output	Monitoring point reference	Parameter	Units	Averaging period	Frequency
Sewage - Inlet Flow	Inlet Channel Flow Meter (FT201)	Volumetric flow rate (cumulative)	L/s m^3/day	Monthly	Continuous
Septage wastes (Sewage) – domestic wastes from apparatus for the treatment of sewage	None specified	Volume (cumulative) of Controlled waste (by category) received at the WWTP	m^3/day tonnes	Monthly	Continuous
Treated wastewater discharged to on-	Outflow meter (M2)	Volumetric flow rate	m^3/day	Monthly	Continuous

site irrigation area		(cumulative)			
Treated wastewater discharged to off-site irrigation area (McGillivray Oval)	Outflow meter (M2)	Volumetric flow rate (cumulative)	m^3/day	Monthly	Quarterly

3.7 Process monitoring

There are no specified conditions relating to process monitoring in this section.

3.8-3.9 Ambient environmental quality and meteorological monitoring

There are no specified conditions relating to ambient environmental quality or meteorological monitoring in this section.

4 Improvements

4.1 Improvement program

There are no specified improvement conditions in this section.

5 Information

5.1 Records

5.1.1 All information and records required by the Licence shall:
- (a) be legible;
- (b) if amended, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval;
- (c) except for records listed in 5.1.1(d) be retained for at least 6 years from the date the records were made or until the expiry of the Licence or any subsequent licence; and
- (d) for those following records, be retained until the expiry of the Licence and any subsequent licence:
  - (i) off-site environmental effects; or
  - (ii) matters which affect the condition of the land or waters.

5.1.2 The Licensee shall ensure that:
- (a) any person left in charge of the Premises is aware of the conditions of the Licence and has access at all times to the Licence or copies thereof; and
- (b) any person who performs tasks on the Premises is informed of all of the conditions of the Licence that relate to the tasks which that person is performing.

5.1.3 The Licensee shall complete an Annual Audit Compliance Report indicating the extent to which the Licensee has complied with the conditions of the Licence, and any previous licence issued under Part V of the Act for the Premises for the previous annual period.

5.1.4 The Licensee shall:
- (a) implement a complaints management system that shall record the following information (if known or provided) about complaints received at the Premises concerning any environmental impact of the activities undertaken at the Premises:
  - (i) name and address of the complainants (if consented);
  - (ii) date and time of complaint;
  - (iii) date and time of alleged incident;
  - (iv) alleged source of the incident;

(v) general description of the alleged incident, including any environmental or health impacts reported by the complainant;
(vi) wind direction, wind speed and temperature at time of alleged incident;
(vii) likely source of the alleged incident; and
(viii) actions taken by licensee to address complaint, including the outcome of any investigation(s) and action(s) to verify any impacts.

(b) complete an annual analysis and review of complaints recorded under 5.1.4(a) to identify any common factors and root cause of complaints and proposals to address these.

5.2 Reporting

5.2.1 The Licensee shall submit to the CEO an Annual Environmental Report within 63 calendar days after the end of the annual period. The report shall contain the information listed in Table 5.2.1 in the format or form specified in that table.

Table 5.2.1: Annual Environmental Report

Condition or table (if relevant)	Parameter	Format or form[1]
-	Summary of any failure or malfunction of any pollution control equipment and any environmental incidents, that have occurred during the annual period and any action taken	None specified
Table 1.3.2	Summary of any treatment capacity target exceedances and any action taken.	None specified
3.2.1	Monitoring of emissions to air	None specified
3.3.1	Monitoring of emissions to surface waters	None specified
	Contaminant loading (kg/day – monthly average) to water (W1 and W2) of parameters monitored in Table 3.3.1 (except pH and Escherichia coli)	None specified
	Methodology and calculations used to estimate the daily volumetric flow rate of treated wastewater discharged to W2 and results of those calculations.	
3.5.1	Monitoring of emissions to land	None specified
	Contaminant loading (kg/day – monthly average) to land (for on-site irrigation areas – L1) of parameters monitored in Table 3.5.1 (except pH and Escherichia coli)	None specified
3.6.1	Monitoring of inputs and outputs	None specified
5.1.3	Compliance	AACR
5.1.4	Complaints summary	None specified
-	Summary of any changes to site boundaries, or sampling point location/name	None specified
-	The quantity of sewage sludge removed from the Premises	

Note 1: Forms are in Schedule 2

5.2.2 The Licensee shall ensure that the Annual Environmental Report also contains:
(a) any relevant process, production or operational data recorded under conditions of this licence; and
(b) an assessment of the information contained within the report against previous monitoring results and Licence limits and/or targets.

5.2.3 The Licensee shall submit the information in Table 5.2.2 to the CEO at the Contact Address according to the specifications in that table.

Table 5.2.2: Non-annual reporting requirements				
Condition or table (if relevant)	**Parameter**	**Reporting period**	**Reporting date (after end of the reporting period)**	**Format or form**
-	Copies of original monitoring reports submitted to the Licensee by third parties	Not Applicable	Within 14 days of the CEOs request	As received by the Licensee from third parties

5.3 Notification

5.3.1 The Licensee shall ensure that the parameters listed in Table 5.3.1 are notified to the CEO at the Contact Address and in accordance with the notification requirements of the table.

Table 5.3.1: Notification requirements			
Condition or table (if relevant)	**Parameter**	**Notification requirement[1]**	**Format or form[2]**
-	Taking process equipment offline for maintenance works that may result in increase odour emissions.	No less than 72 hours in advance of works	None specified
2.1.1	Breach of any limit specified in the Licence	Part A: As soon as practicable but no later than 5pm of the next working day Part B: As soon as practicable	N1
-	Any failure or malfunction of any pollution control equipment or any incident which has caused, is causing or may cause pollution		
2.5.1	Discharges of treated wastewater into the Emergency overflow basin and then into Subiaco Main Drain.	Within 24 hours of becoming aware of such discharges.	None specified
3.1.5	Calibration report	as part of the AER	None specified

Note 1: No notification requirement in the Licence shall negate the requirement to comply with s72 of the Act.
Note 2: Forms are in Schedule 2

Schedule 1: Maps

Premises map

The Premises is shown in the map below. The pink line depicts the Premises boundary.

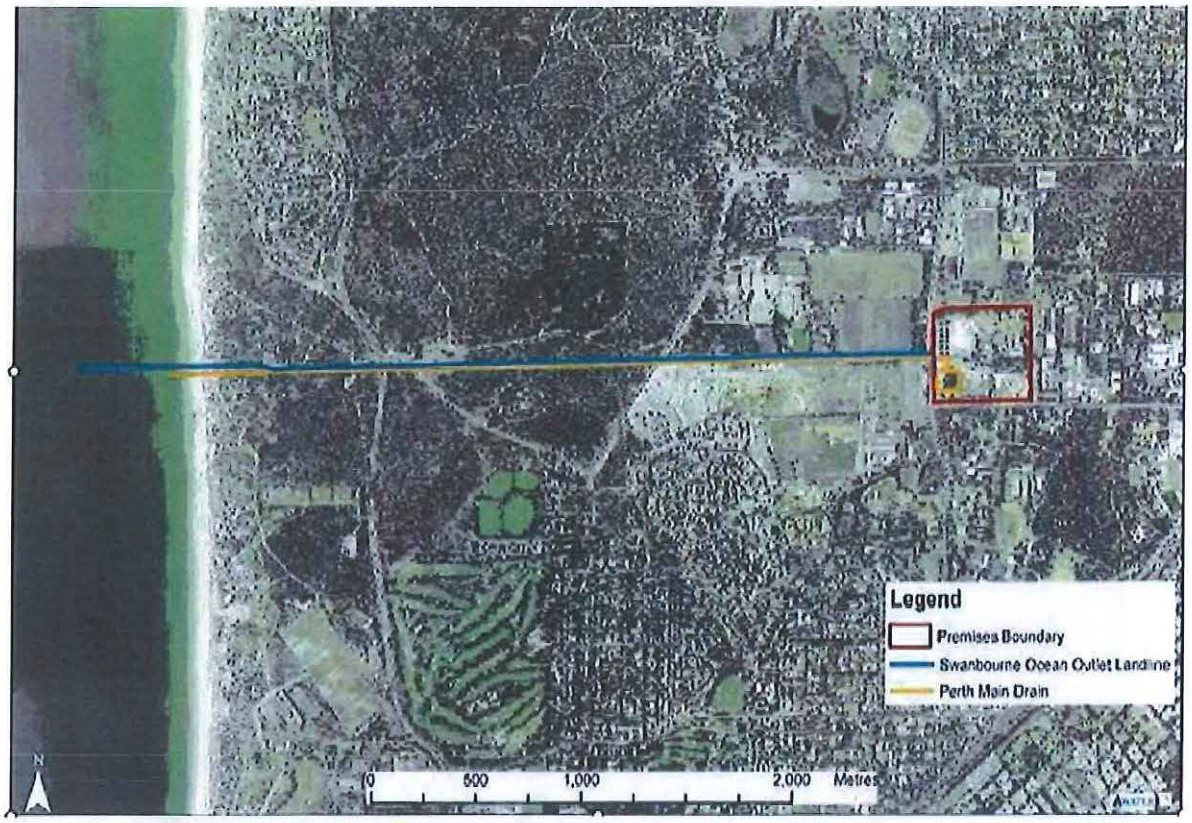
Premises Boundary

Map of plant infrastructure

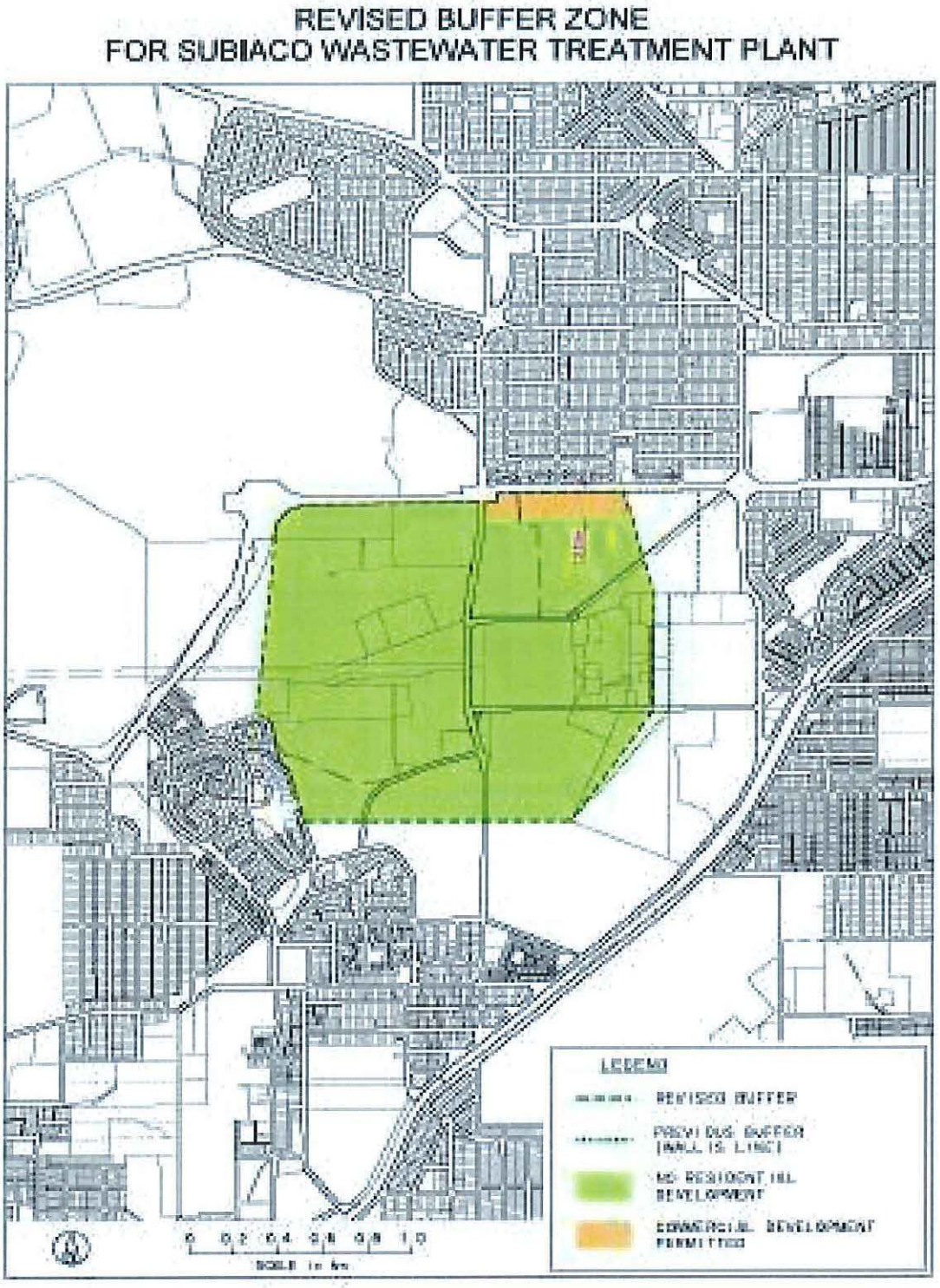
The plant infrastructure is shown in the map below.

Map of Perth Main Drain and Swanbourne Ocean Outlet Landline

The Perth Main Drain and Swanbourne Ocean Outlet Landline are shown in the map below.



Map of Odour Boundary



Schedule 2: Reporting & notification forms

These forms are provided for the proponent to report monitoring and other data required by the Licence. They can be requested in an electronic format.

ANNUAL AUDIT COMPLIANCE REPORT PROFORMA

SECTION A

LICENCE DETAILS

Licence Number:	Licence File Number:
Company Name: Trading as:	ABN:
Reporting period: _____ to _____	

STATEMENT OF COMPLIANCE WITH LICENCE CONDITIONS

1. Were all conditions of the Licence complied with within the reporting period? (please tick the appropriate box)

Yes ☐ Please proceed to Section C

No ☐ Please proceed to Section B

Each page must be initialled by the person(s) who signs Section C of this Annual Audit Compliance Report (AACR).

Initial:

SECTION B

DETAILS OF NON-COMPLIANCE WITH LICENCE CONDITION.

Please use a separate page for each licence condition that was not complied with.

a) Licence condition not complied with:	
b) Date(s) when the non compliance occurred, if applicable:	
c) Was this non compliance reported to DER?:	
☐ Yes ☐ Reported to DER verbally Date _____ ☐ Reported to DER in writing Date _____	☐ No
d) Has DER taken, or finalised any action in relation to the non compliance?:	
e) Summary of particulars of the non compliance, and what was the environmental impact:	
f) If relevant, the precise location where the non compliance occurred (attach map or diagram):	
g) Cause of non compliance:	
h) Action taken, or that will be taken to mitigate any adverse effects of the non compliance:	
i) Action taken or that will be taken to prevent recurrence of the non compliance:	

Each page must be initialled by the person(s) who signs Section C of this AACR

Initial:

SECTION C

SIGNATURE AND CERTIFICATION

This Annual Audit Compliance Report (AACR) may only be signed by a person(s) with legal authority to sign it. The ways in which the AACR must be signed and certified, and the people who may sign the statement, are set out below.

Please tick the box next to the category that describes how this AACR is being signed. If you are uncertain about who is entitled to sign or which category to tick, please contact the licensing officer for your premises.

If the licence holder is		The Annual Audit Compliance Report must be signed and certified:
An individual	□	by the individual licence holder, or
	□	by a person approved in writing by the Chief Executive Officer of the Department of Environment Regulation to sign on the licensee's behalf.
A firm or other unincorporated company	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A corporation	□	by affixing the common seal of the licensee in accordance with the *Corporations Act 2001*; or
	□	by two directors of the licensee; or
	□	by a director and a company secretary of the licensee, or
	□	if the licensee is a proprietary company that has a sole director who is also the sole company secretary – by that director, or
	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
A public authority (other than a local government)	□	by the principal executive officer of the licensee; or
	□	by a person with authority to sign on the licensee's behalf who is approved in writing by the Chief Executive Officer of the Department of Environment Regulation.
a local government	□	by the chief executive officer of the licensee; or
	□	by affixing the seal of the local government.

It is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give information on this form that to their knowledge is false or misleading in a material particular. There is a maximum penalty of $50,000 for an individual or body corporate.

I/We declare that the information in this annual audit compliance report is correct and not false or misleading in a material particular.

SIGNATURE: _____

NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

SIGNATURE: _____

NAME:
(printed) _____

POSITION: _____

DATE: _____/_____/_____

SEAL (if signing under seal)

Licence: L4726/1991/14 Licensee: Water Corporation
Form: N1 Date of breach:

Notification of detection of the breach of a limit or any failure or malfunction of any pollution control equipment or any incident which has caused, is causing or may cause pollution.

These pages outline the information that the operator must provide.
Units of measurement used in information supplied under Part A and B requirements shall be appropriate to the circumstances of the emission. Where appropriate, a comparison should be made of actual emissions and authorised emission limits.

Part A

Licence Number	
Name of operator	Water Corporation
Location of Premises	
Time and date of the detection	

Notification requirements for the breach of a limit	
Emission point reference/ source	
Parameter(s)	
Limit	
Measured value	
Date and time of monitoring	
Measures taken, or intended to be taken, to stop the emission	

Notification requirements for any failure or malfunction of any pollution control equipment or any incident which has caused, is causing or may cause pollution	
Date and time of event	
Reference or description of the location of the event	
Description of where any release into the environment took place	
Substances potentially released	
Best estimate of the quantity or rate of release of substances	
Measures taken , or intended to be taken, to stop any emission	
Description of the failure or accident	

Part B

Any more accurate information on the matters for notification under Part A.	
Measures taken, or intended to be taken, to prevent a recurrence of the incident.	
Measures taken, or intended to be taken, to rectify, limit or prevent any pollution of the environment which has been or may be caused by the emission.	
The dates of any previous N1 notifications for the Premises in the preceding 24 months.	

Name	
Post	
Signature on behalf of Water Corporation	
Date	

Government of **Western Australia**
Department of **Environment Regulation**

Decision Document

Environmental Protection Act 1986, Part V

Proponent: Water Corporation

Licence: L4726/1991/15

Registered office: 629 Newcastle Street
LEEDERVILLE WA 6007

Premises address: Subiaco Wastewater Treatment Plant
Lemnos Street
SHENTON PARK WA 6008
Being Lot 3150 on Plan 149501, Lot 5286 on Plan 162620 and Lot 6815 on Plan 166929 as depicted in Schedule 1.

Issue date: Thursday, 30 October 2014

Commencement date: Saturday, 1 November 2014

Expiry date: Tuesday, 31 November 2017

Decision

Based on the assessment detailed in this document the Department of Environment Regulation (DER), has decided to issue a licence. DER considers that in reaching this decision, it has taken into account all relevant considerations and legal requirements and that the Licence and its conditions will ensure that an appropriate level of environmental protection is provided.

Decision Document prepared by: Josephine Tuohy
Licensing Officer

Decision Document authorised by: Rebecca Kelly
Manager Licensing (Waste Sector)

Contents

1 Purpose of this Document

This decision document explains how DER has assessed and determined the application and provides a record of DER's decision-making process and how relevant factors have been taken into account. Stakeholders should note that this document is limited to DER's assessment and decision making under Part V of the *Environmental Protection Act 1986*. Other approvals may be required for the proposal, and it is the proponent's responsibility to ensure they have all relevant approvals for their Premises.

Works approval and licence conditions
DER has three types of conditions that may be imposed on works approvals and licences. They are as follows;

Standard conditions (SC)

DER has standard conditions that are imposed on all works approvals and licences regardless of the activities undertaken on the Premises and the information provided in the application. These are included as the following conditions on works approvals and licences:

Works approval conditions: 1.1.1-1.1.4, 1.2.1, 1.2.2, 5.1.1 and 5.1.2.

Licence conditions: 1.1.1-1.1.4, 1.2.1-1.2.4, 5.1.1-5.1.4 and 5.2.1.

For such conditions, justification within the Decision Document is not provided.

Optional standard conditions (OSC)

In the interests of regulatory consistency DER has a set of optional standard conditions that can be imposed on works approvals and licences. DER will include optional standard conditions as necessary, and are likely to constitute the majority of conditions in any licence. The inclusion of any optional standard conditions is justified in Section 4 of this document.

Non standard conditions (NSC)

Where the proposed activities require conditions outside the standard conditions suite DER will impose one or more non-standard conditions. These include both premises and sector specific conditions, and are likely to occur within few licences. Where used, justification for the application of these conditions will be included in Section 4.

2 Administrative summary

Administrative details		
Application type	Works Approval ☐ New Licence ☒ Licence amendment ☐ Works Approval amendment ☐	
Activities that cause the premises to become prescribed premises	**Category number(s)**	**Assessed design capacity**
	54	Not more than 64,000 m^3 per day
	61	Not more than 20,000 tonnes per annual period
Application verified Application fee paid	Date: 23/07/2014 Date:18/08/2014	
Works Approval has been complied with Compliance Certificate received	Yes☐ No☐ N/A☒ Yes☐ No☐ N/A☒	
Commercial-in-confidence claim	Yes☐ No☒	
Commercial-in-confidence claim outcome		
Is the proposal a Major Resource Project?	Yes☐ No☒	
Was the proposal referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986*?	Yes☐ No☒	Referral decision No: Managed under Part V ☒ Assessed under Part IV ☐
Is the proposal subject to Ministerial Conditions?	Yes☐ No☒	Ministerial statement No: EPA Report No:
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the *Environmental Protection Act 1986*	Yes☐ No☒ Department of Water consulted Yes ☐ No ☒	
Is the Premises within an Environmental Protection Policy (EPP) Area Yes☐ No☒ If Yes include details of which EPP(s) here.		
Is the Premises subject to any EPP requirements? Yes☐ No☒ If Yes, include details here, eg Site is subject to SO_2 requirements of Kwinana EPP.		

3 Executive summary of proposal and assessment

Water Corporation has operated the Subiaco Wastewater Treatment Plant (WWTP) under the *Environmental Protection Act 1986* Licence L4726/1991/14.

The operations at Water Corporation's Subiaco Wastewater Treatment Plant include:

- the treatment of domestic and commercial sewage via an activated sludge treatment plant which treats the wastewater to a secondary standard;
- reuse of treated wastewater as process water and for landscape irrigation;
- reuse of treated wastewater at McGillivray Oval for landscape irrigation;
- discharge of surplus treated wastewater to the ocean via an ocean outlet located off Swanbourne Beach; and
- treatment and storage of sewage sludge on-site within sludge treatment and storage tanks.

The main potential emissions from the site are discharges of treated wastewater to water and fugitive emissions in the form of odour.

Discharges of treated wastewater to water are managed by treating wastewater to a defined water quality level and undertaking compliance monitoring prior to discharge.

Odour is managed on-site through scrubbing combined odours from the influent channel, pre-treatment building, primary treatment and sludge treatment in the primary odour scrubbers at the odour control facility. Gas extracted from the secondary aeration tanks is combined with the air discharged from the primary scrubbers and scrubbed in the two odour-guard scrubbers. The odour control system is currently monitored by an external service provider. Tests for temperature, air flow rates and H2S concentrations are conducted on a monthly basis.

This licence has been issued as an amendment that was requested by the proponent for minor administrative changes. During the amendment process, DER has not reassessed the acceptability or impacts of emissions and discharges from the premises or re-visited any existing emission control levels.

4 Decision table

All applications are assessed in line with the *Environmental Protection Act 1986*, the *Environmental Protection Regulations 1987*, DEC's Policy Statement - Limits and targets for prescribed premises (2006), and DER's Operational Procedure on Assessing Emissions and Discharges from Prescribed Premises. Where other references have been used in making the decision they are detailed in the decision document.

DECISION TABLE				
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**OSC or NSC**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
General conditions	L1.3.2 – L1.3.3	OSC	The quantity of sewage waste accepted on site has been amended from 61,400m³/day to 64,000m³/day which is the current capacity of the system.	
Point source emissions to air including monitoring	L2.2.1 - L2.2.2	OSC	All references to S9 (Process control table) have been replaced with Treated air at stack as emission point S9 refer to the Subiaco WWTP process control tables (PCT's) and are not otherwise referenced within the licence.	Application supporting documentation General provisions of the *Environmental Protection Act 1986*
Point source emissions to surface water including monitoring	L2.3.2	OSC	All references to S1000939 (PCT) has been replaced with Secondary effluent to ocean outfall as emission point S1000939 refer to the Subiaco WWTP process control tables (PCT's) and are not otherwise reference within the licence.	Application supporting documentation General provisions of the *Environmental Protection Act 1986*

DECISION TABLE				
Works Approval / Licence section	**Condition number W = Works Approval L= Licence**	**OSC or NSC**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Monitoring general	L3.2.1	OSC	all references to S9 (Process control table) have been replaced with Treated air at stack as emission point S9 refer to the Subiaco WWTP process control tables (PCT's) and are not otherwise referenced within the licence.	General provisions of the *Environmental Protection Act 1986*
Information	L5.2.1	SC	The Annual Environmental Report due date has been amended from 60 to 63 days after the annual period, which is in line with other Water Corporation Licence's.	
Licence Duration	N/A	N/A	The Licence duration has not been reassessed as part of this Amendment.	

5 Advertisement and consultation table

Date	Event	Comments received/Notes	How comments were taken into consideration
13/02/2015	Proponent sent a copy of draft instrument for 21 day comment	21 day waiver form recieved	Licence issued as soon as possible

6 Risk Assessment

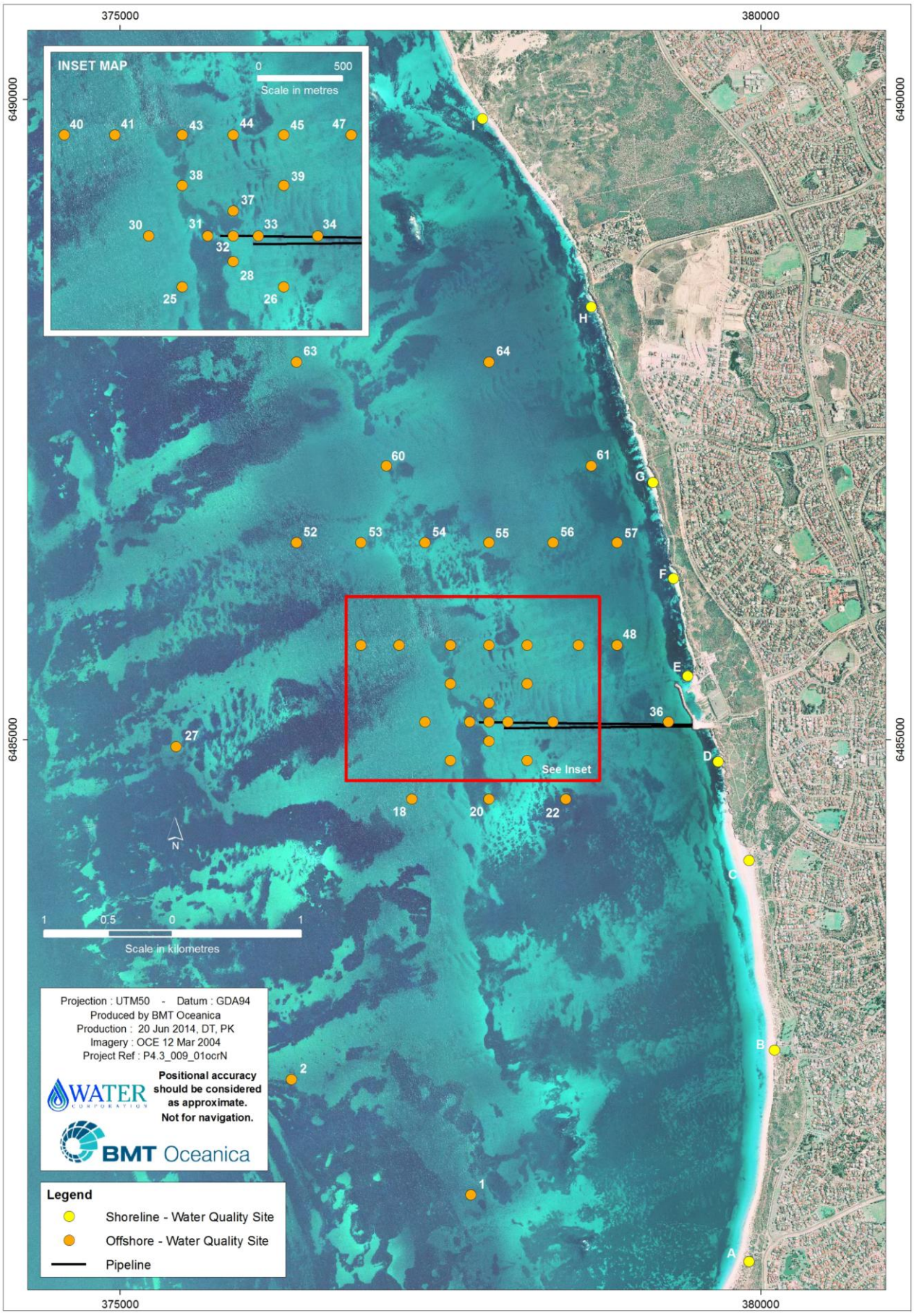
Note: This matrix is taken from the DER Corporate Policy Statement No. 07 - Operational Risk Management

Table 1: Emissions Risk Matrix

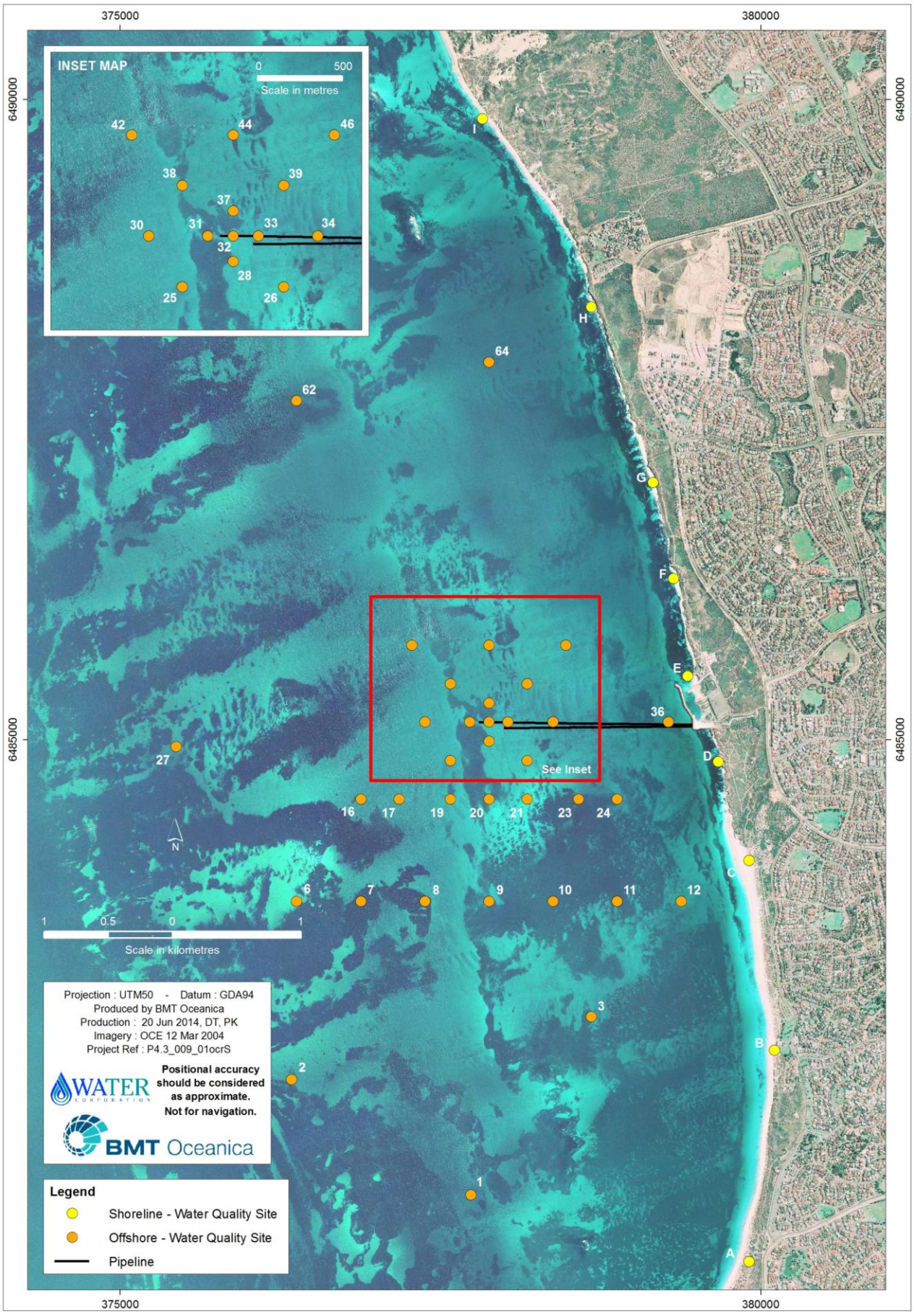
Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	Moderate	High	High	Extreme	Extreme
Likely	Moderate	Moderate	High	High	Extreme
Possible	Low	Moderate	Moderate	High	Extreme
Unlikely	Low	Moderate	Moderate	Moderate	High
Rare	Low	Low	Moderate	Moderate	High

Appendix B – Sampling grids and coordinates

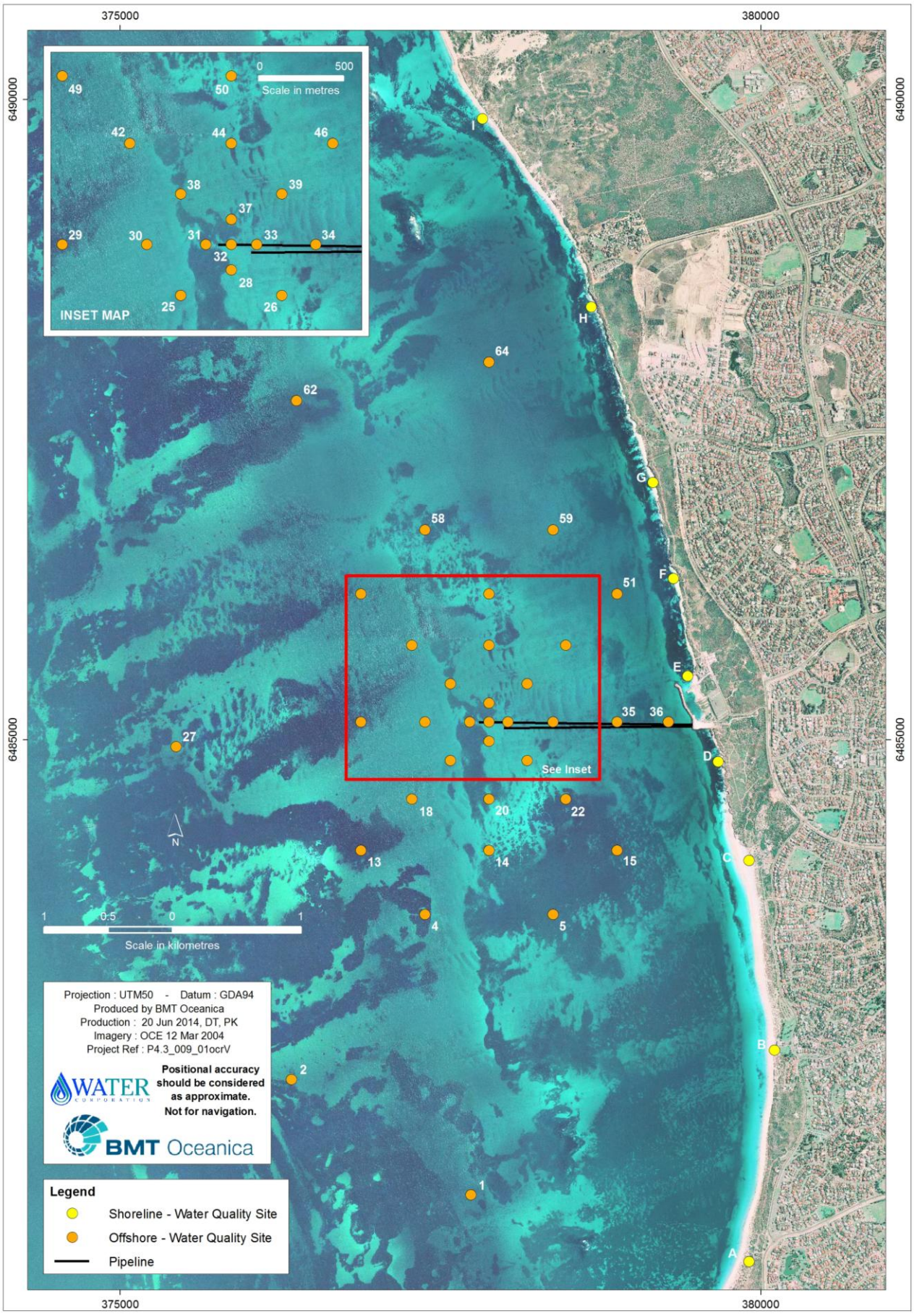
Ocean Reef Sample Sites – Northerly Flow Grid and Shoreline Sites



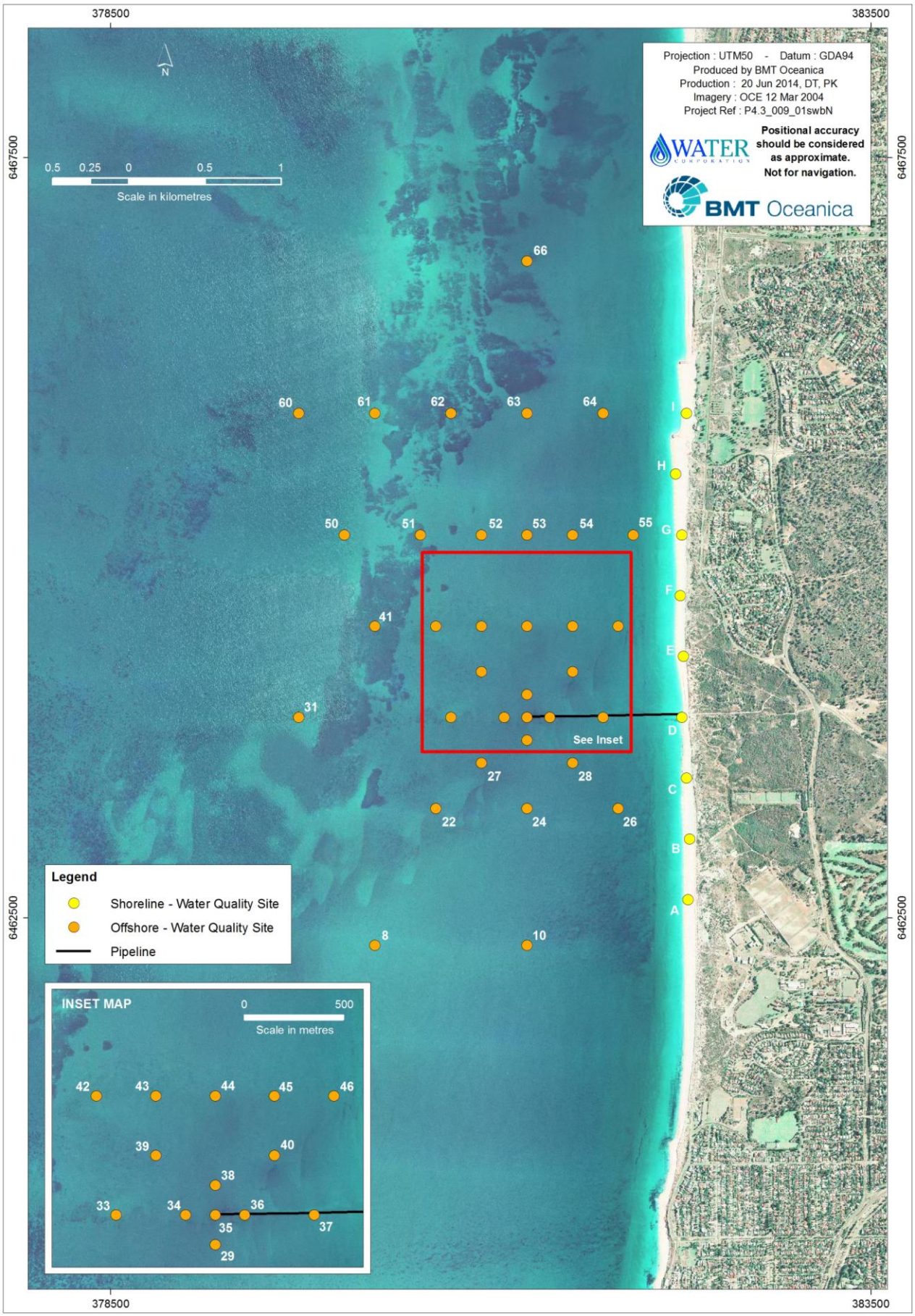
Ocean Reef Sample Sites – Southerly Flow Grid and Shoreline Sites



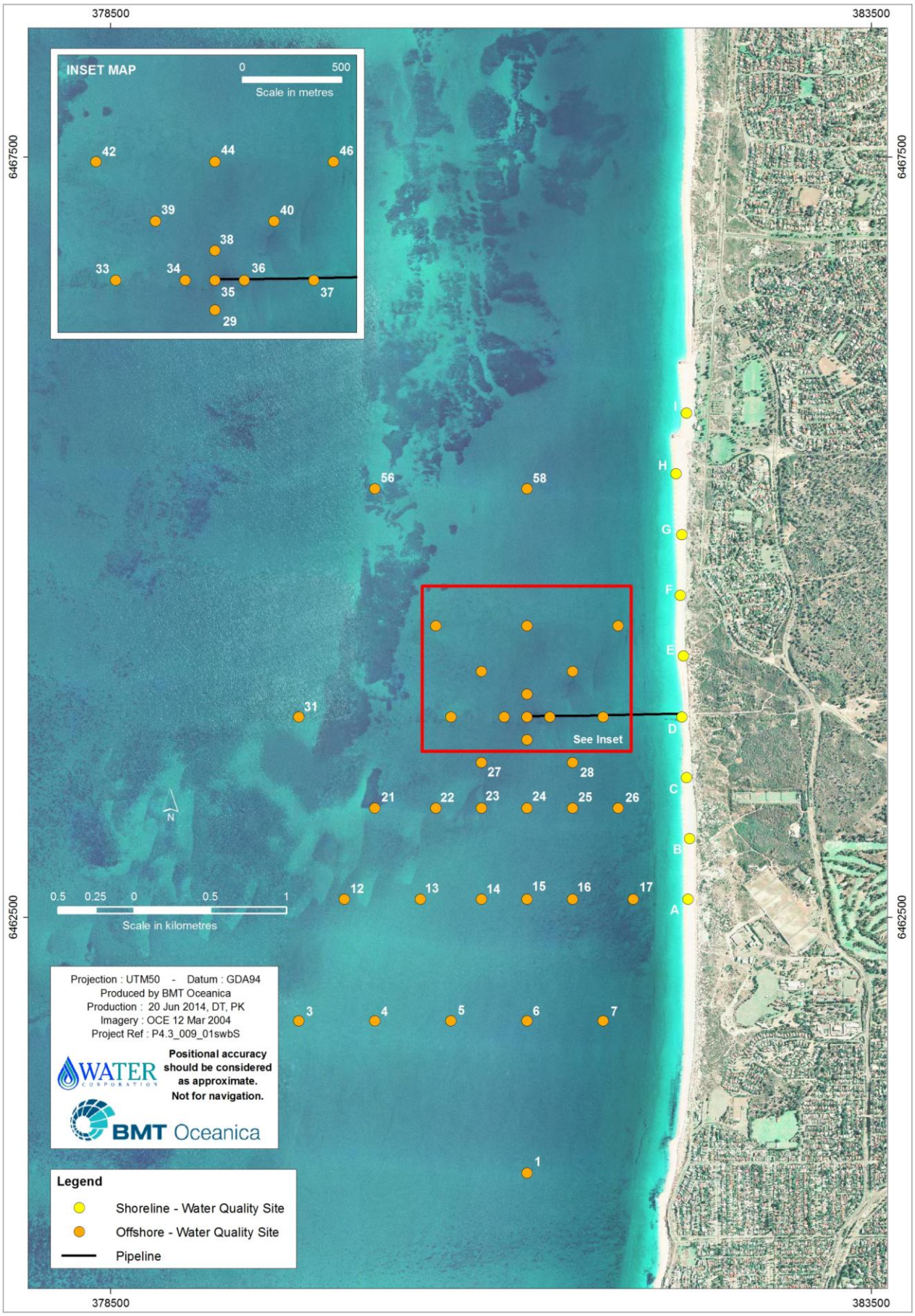
Ocean Reef Sample Sites – Light/Variable Flow Grid and Shoreline Sites



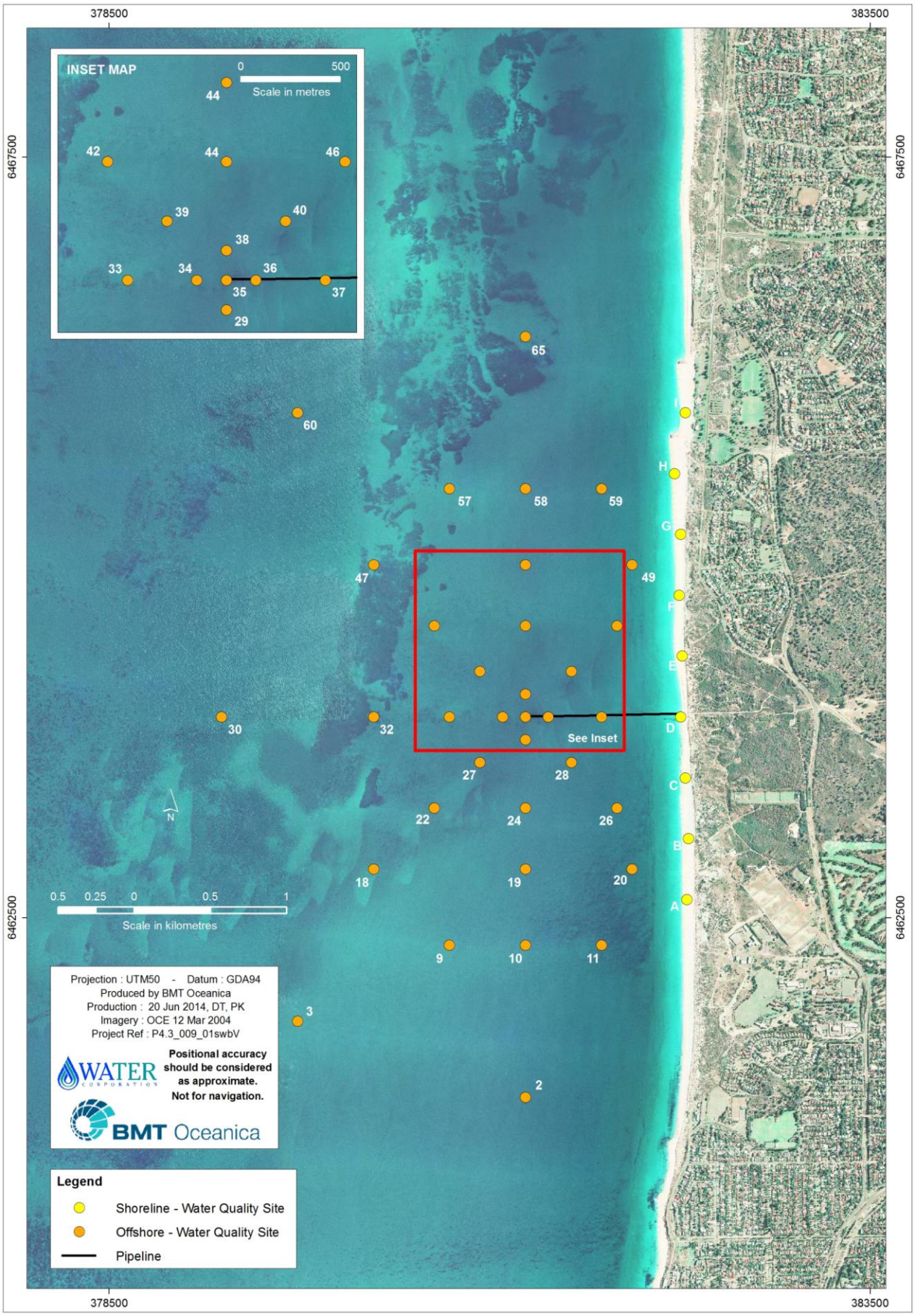
Swanbourne Sample Sites – Northerly Flow Grid and Shoreline Sites



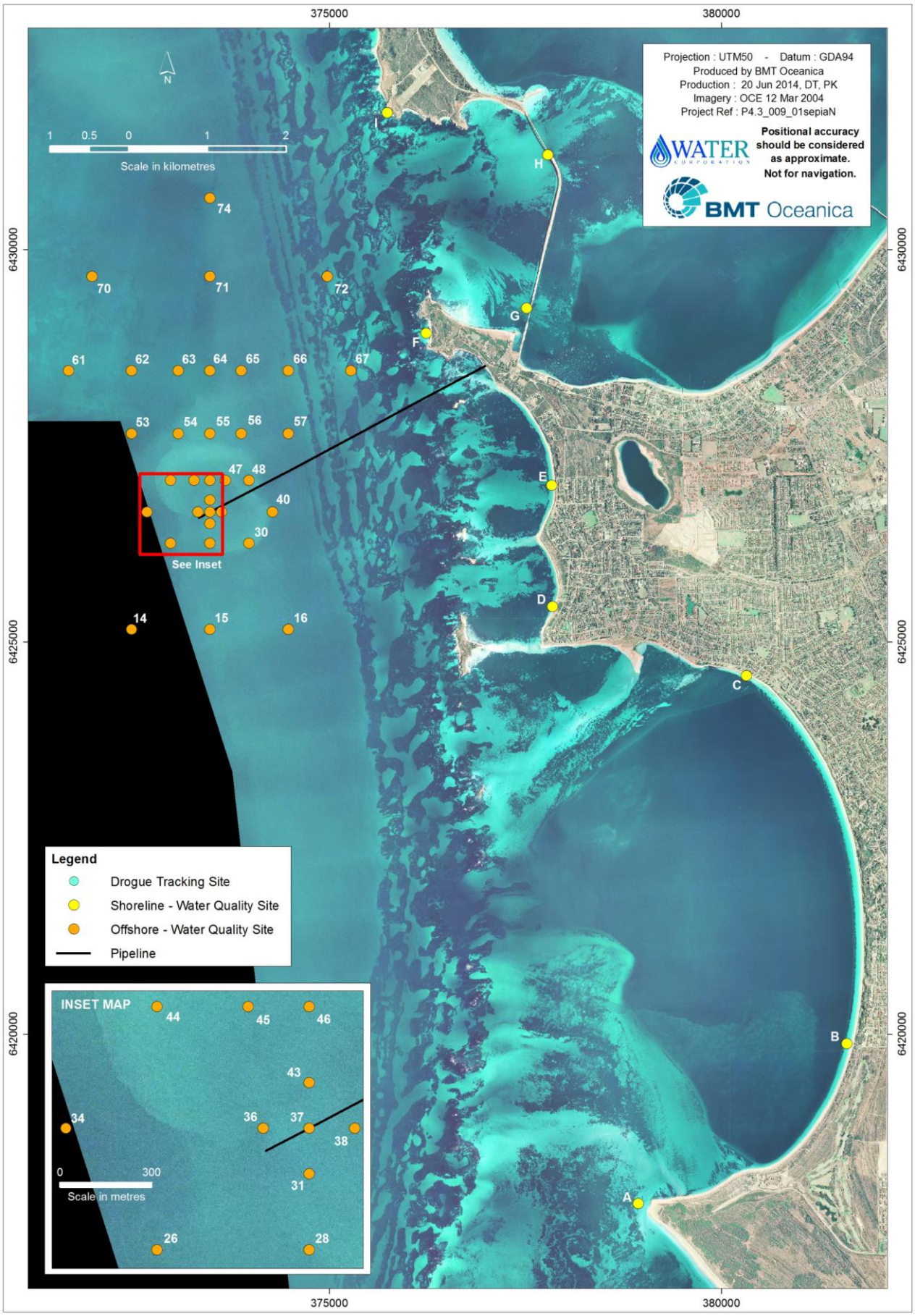
Swanbourne Sample Sites – Southerly Flow Grid and Shoreline Sites



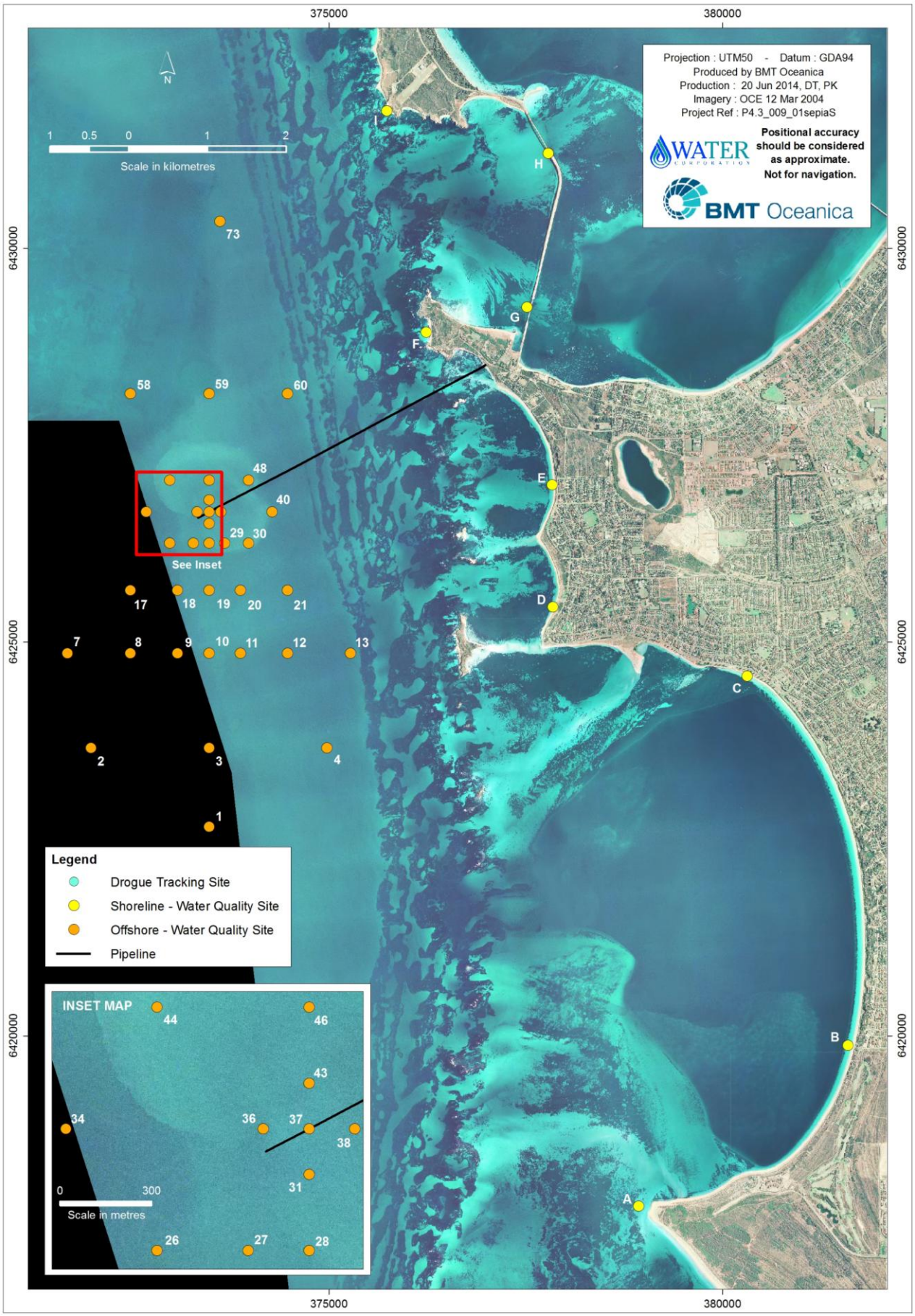
Swanbourne Sample Sites – Light/Variable Flow Grid and Shoreline Sites



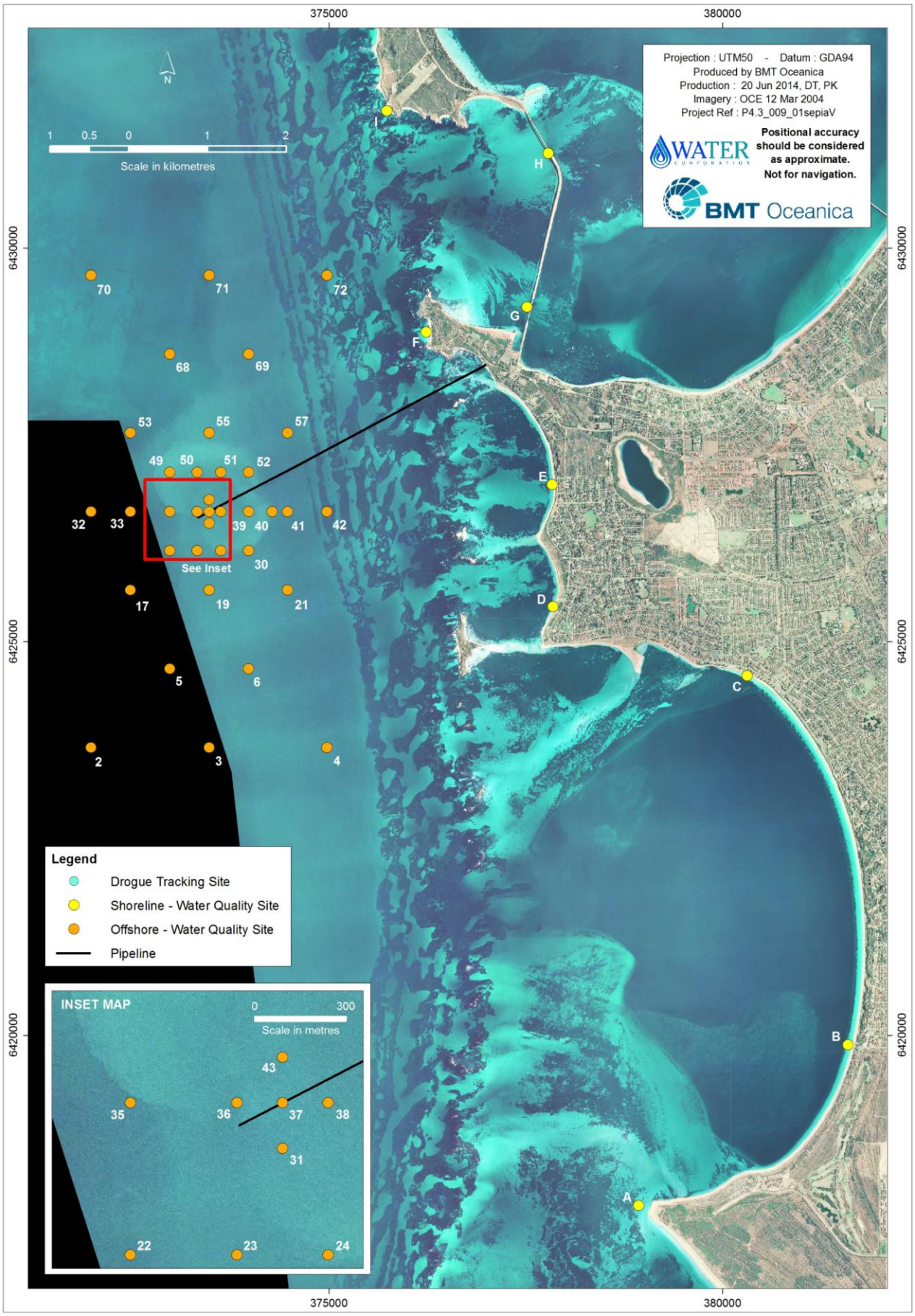
Sepia Depression Sample Sites – Northerly Flow Grid and Shoreline Sites



Sepia Depression Sample Sites – Southerly Flow Grid and Shoreline Sites



Sepia Depression Sample Sites – Light/Variable Flow Grid and Shoreline Sites



Appendix C – UM3Initial Dilution Model Output

Ocean Reef A

```
/ UM3. 5/11/2017 3:42:04 PM
Case 1; ambient file c:\plumes\VP plume 58.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn    Density
         m        m/s        deg        psu          C       kg/kg       s-1        m/s        deg  m0.67/s2    sigma-T
       0.0      0.152     -267.4      36.34      22.72        0.0        0.0          -          -        0.0      25.05
      11.8      0.135     -267.4       36.3       22.7        0.0        0.0          -          -        0.0      25.03

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
     (m)     (m)   (deg) (N-deg)      ()     (m)     (m)     (m)     (m)   (MLD)   (psu)     (C) (kg/kg)
   0.125    0.76     0.0   357.4    50.0     4.0   100.0   150.0   11.04    62.5    0.06    27.2      0.1

Simulation:
Froude number:        6.3; effleunt density (sigma-T)    -3.435; effleunt velocity     1.179(m/s);
          Depth   Amb-cur     P-dia   Polutnt    Dilutn  CL-diln    x-posn    y-posn
Step        (m)    (cm/s)       (m)  (kg/kg)        ()       ()       (m)       (m)
   0      11.04     13.61     0.125      0.1       1.0      1.0       0.0       0.0;
 100      10.67     13.66     0.644   0.0138     7.071    2.941   -0.0697     1.536;
 200      8.838     13.93     2.243  0.00191     51.05    18.05      -0.2     4.414;
 252      7.169     14.17     4.005  0.00068     142.9    45.25    -0.336     7.407; merging;
 277      5.865     14.35     5.746 0.000415     234.5    85.98    -0.461     10.16; stream limit reached;
 300      3.954     14.62     8.607 0.000263     369.7    181.1    -0.654      14.4;
 301       3.85     14.64     8.765 0.000258     377.1    184.6    -0.664     14.63; surface;
 ;
3:42:04 PM. amb fills: 2
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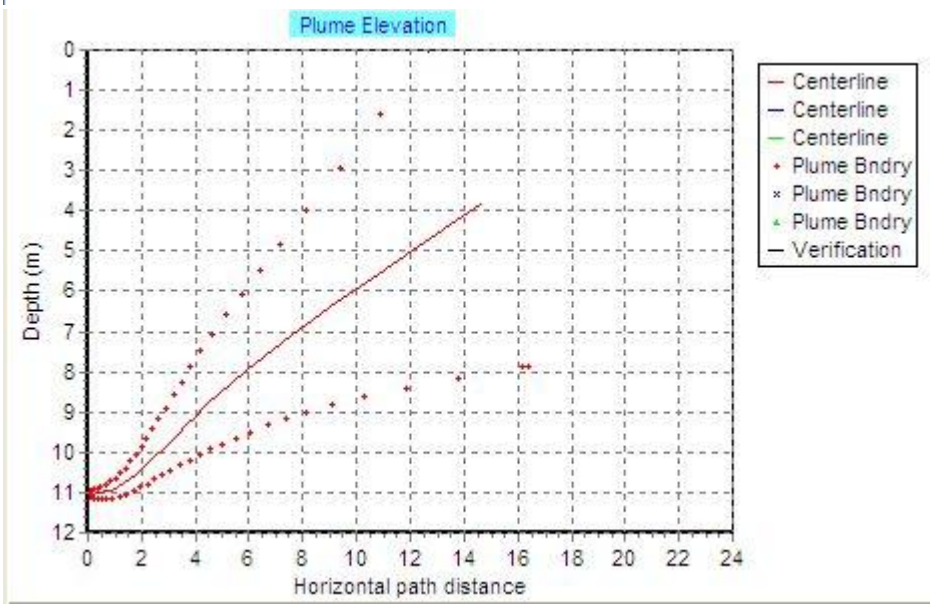
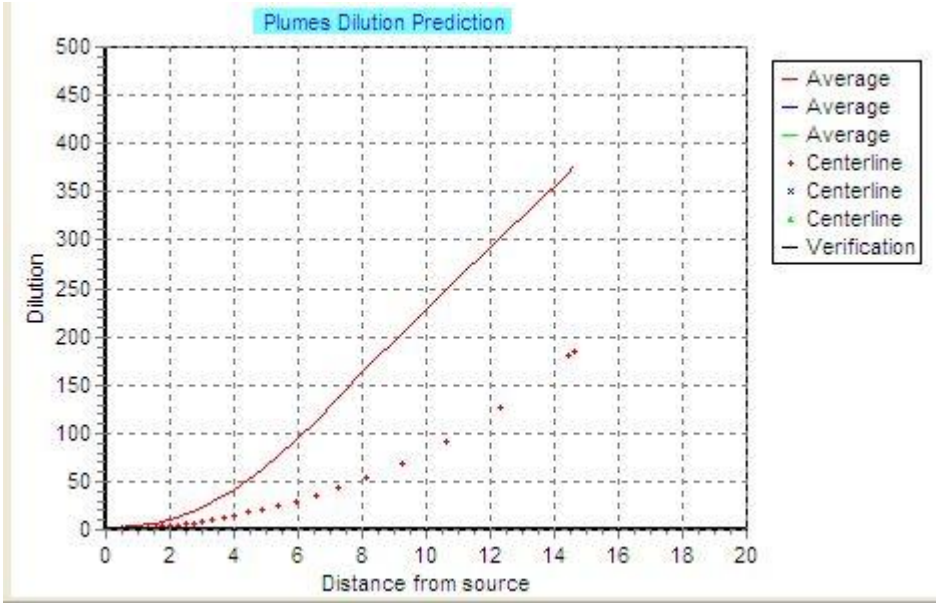




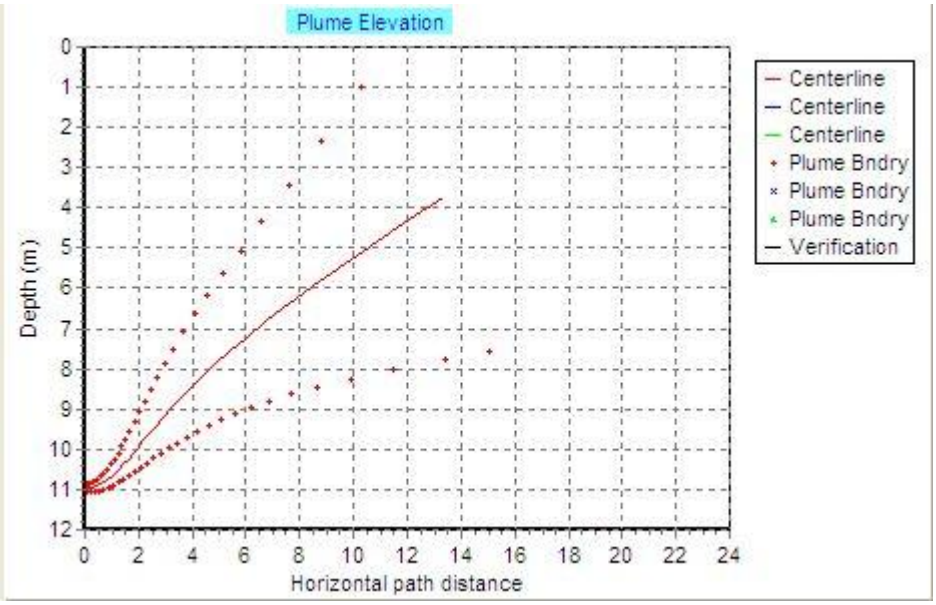
Ocean Reef B

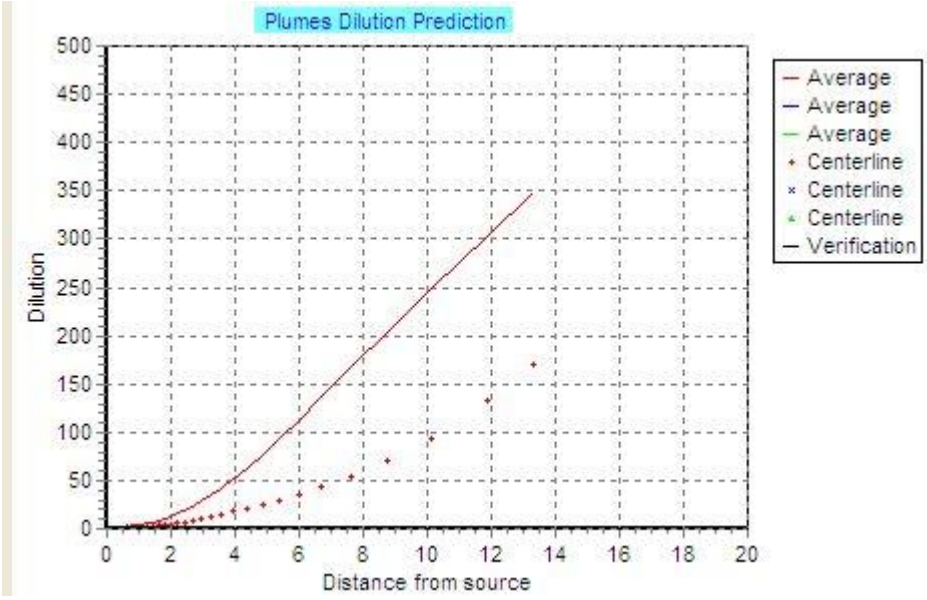
```
/ UM3. 5/11/2017 3:48:56 PM
Case 1; ambient file c:\plumes\VP plume 58.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol      Decay   Far-spd   Far-dir   Disprsn   Density
         m       m/s       deg       psu         C      kg/kg       s-1       m/s       deg  m0.67/s2   sigma-T
       0.0     0.152    -267.4     36.34     22.72       0.0       0.0         -         -       0.0     25.05
      11.8     0.135    -267.4      36.3      22.7       0.0       0.0         -         -       0.0     25.03

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
     (m)     (m)   (deg) (N-deg)      ()     (m)     (m)     (m)     (m)   (MLD)   (psu)     (C) (kg/kg)
    0.16    0.84     0.0   357.4    48.0     4.0   100.0   150.0   10.96    62.5    0.06    27.2      0.1

Simulation:
Froude number:      3.541; effleunt density (sigma-T)    -3.435; effleunt velocity      0.75(m/s);
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step      (m)   (cm/s)      (m)  (kg/kg)       ()       ()      (m)      (m)
   0    10.96    13.62     0.16      0.1      1.0      1.0      0.0     0.0;
 100    10.37    13.71      0.7   0.0138    7.071    2.929  -0.0653   1.438;
 200    8.463    13.98    2.323  0.00191    51.05    17.95   -0.179   3.946;
 250    6.843    14.21    4.023 0.000708    137.4    43.49   -0.305   6.708; merging;
 277    5.397    14.42    5.961 0.000415    234.5    87.99   -0.439   9.666; stream limit reached;
 297    3.716    14.66    8.461 0.000279    348.4    170.8   -0.604   13.29; surface;
 ;
3:48:56 PM. amb fills: 2
```





Swanbourne

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| UM3. 5/11/2017 3:13:30 PM
Case 1; ambient file c:\plumes\VP plume 58.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn    Density
         m        m/s        deg        psu          C      kg/kg       s-1        m/s        deg  m0.67/s2    sigma-T
       0.0     0.0825     -202.8      36.71       22.2        0.0       0.0          -          -        0.0       25.48
       9.9      0.073     -202.8       36.7       21.8        0.0       0.0          -          -        0.0       25.59

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
     (m)      (m)   (deg) (N-deg)      ()     (m)     (m)     (m)     (m)    (MLD)    (psu)     (C) (kg/kg)
    0.17     1.0      0.0   292.8    20.0     5.0   100.0   150.0     8.9     57.9     0.58    28.6      0.1

Simulation:
Froude number:        6.7; effleunt density (sigma-T)    -3.443; effleunt velocity     1.476(m/s);
         Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step       (m)   (cm/s)      (m)  (kg/kg)       ()       ()      (m)      (m)
   0       8.9   7.396     0.17      0.1      1.0      1.0      0.0      0.0;
 100     8.295   7.452    0.908   0.0148    6.597     3.11   -1.933    0.813;
 200     3.132   7.942    3.132  0.00206    47.11    21.97   -5.507    2.315;
 201     3.052   7.949    3.171  0.00202    48.05    22.39   -5.552    2.334; matched energy radial vel = 0.0527m/s;
 218     1.588   8.089    3.922  0.00144    67.28    30.87    -6.38    2.682; matched energy radial vel =  0.115m/s;
 224     1.027   8.142    4.229  0.00128    75.76    34.53   -6.704    2.818; surface;
 ;
3:13:30 PM. amb fills: 2
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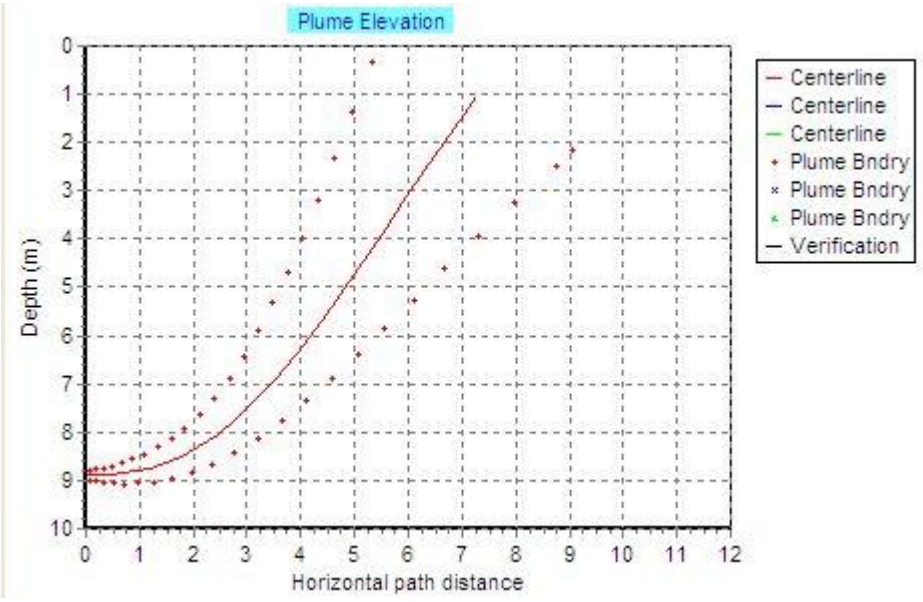

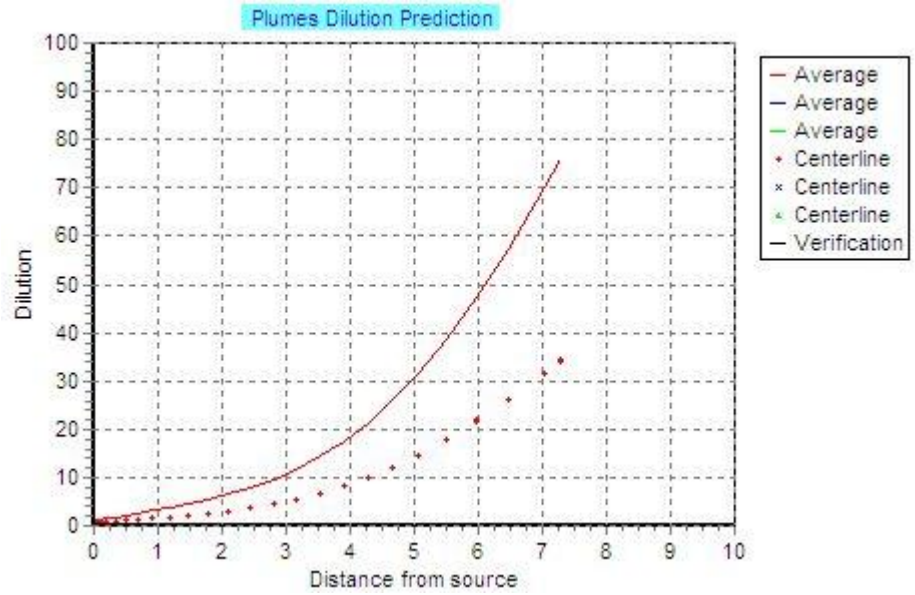

Sepia Depression

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/ UM3. 5/11/2017 3:27:56 PM
Case 1; ambient file c:\plumes\VP plume 58.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:
     Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol     Decay   Far-spd   Far-dir   Disprsn   Density
         m       m/s       deg       psu         C     kg/kg       s-1       m/s       deg  m0.67/s2   sigma-T
       0.0     0.149    -267.1     36.03     22.28       0.0       0.0         -         -       0.0     24.94
      19.6     0.114    -267.1     36.08     22.16       0.0       0.0         -         -       0.0     25.02

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
     (m)     (m)   (deg) (N-deg)      ()     (m)     (m)     (m)     (m)   (MLD)   (psu)     (C) (kg/kg)
   0.135    0.75     0.0   357.1    68.0    4.65   100.0   150.0   18.85  154.31    0.06    26.8      0.1

Simulation:
Froude number:      9.458; effleunt density (sigma-T)    -3.325; effleunt velocity     1.835(m/s);
        Depth  Amb-cur    P-dia  Polutnt    Dilutn  CL-diln   x-posn   y-posn
Step      (m)   (cm/s)      (m)  (kg/kg)        ()       ()      (m)      (m)
   0     18.85    11.54    0.135      0.1       1.0      1.0      0.0      0.0;
 100     18.55    11.59    0.789   0.0138     7.072    3.135  -0.0957     1.89;
 200     15.56    12.12    2.938  0.00191     51.06    20.19   -0.309    6.091;
 239     13.58    12.48    4.668  0.00088     110.5    40.21   -0.436    8.599; merging;
 253     12.62    12.65    5.706 0.000667     145.8    55.84   -0.503    9.938; stream limit reached;
 300     6.839    13.68    13.54 0.000263     369.8    188.7   -0.957    18.89;
 304     6.104    13.81    14.64 0.000243     400.2    202.9    -1.02    20.13; surface;
 ;
3:27:56 PM. amb fills: 2
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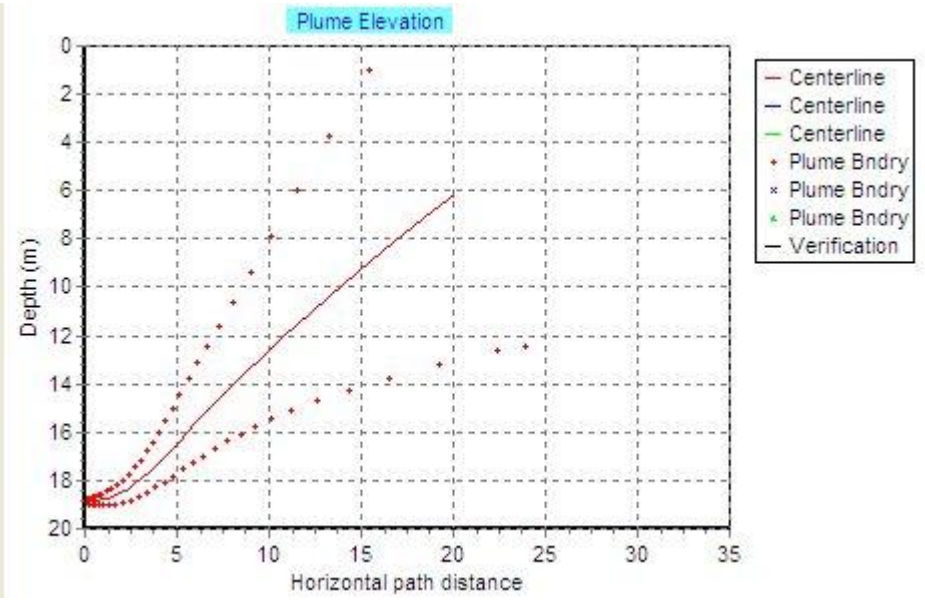

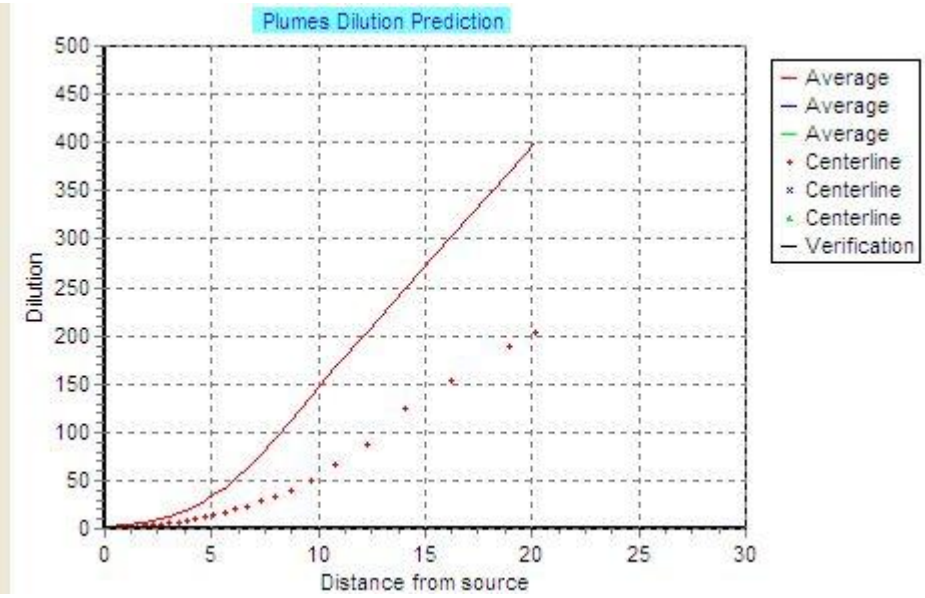

Appendix D – Water Quality Sampling sites and Data

Ocean Reef

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
A	7/02/2016	7	9	49	23	200	0.9	<0.2		30	<10
B	7/02/2016	12	10	67	26	260	0.8	0.3		20	20
C	7/02/2016	6	8	30	19	140	0.5	<0.2		<10	<10
D	7/02/2016	16	10	20	21	170	0.4	0.2		<10	<10
E	7/02/2016	15	10	42	29	280	0.7	1.4		<10	<10
F	7/02/2016	12	6	33	17	180	0.9	1.7		<10	<10
G	7/02/2016	9	7	9	16	140	0.5	1.3		<10	<10
H	7/02/2016	19	5	26	18	220	0.7	1.3		<10	<10
I	7/02/2016	9	6	26	17	160	0.6	1.5		<10	<10
1A-T	7/02/2016	<3	3	<2	14	90	0.2	<0.2	0.2	<10	<10
1A-B	7/02/2016	<3	4	4	15	90			0.2	<10	<10
1B-T	7/02/2016	<3	3	<2	14	90	0.2	<0.2	0.2	<10	<10
1B-B	7/02/2016	<3	4	5	15	90				<10	<10
1C-T	7/02/2016	<3	2	<2	13	90	0.2	<0.2	0.3	<10	<10
1C-B	7/02/2016	<3	4	6	13	90				<10	<10
2-T	7/02/2016	<3	4	6	13	100			0.3	<10	<10
2-B	7/02/2016	<3	3	9	14	100			0.4	<10	<10
20-T	7/02/2016	<3	3	<2	15	90			0.3	<10	<10
20-B	7/02/2016	<3	4	<2	15	100			0.3	<10	<10
25-T	7/02/2016	<3	4	5	14	100			0.2	<10	<10
25-B	7/02/2016	<3	4	6	14	90			0.2	<10	<10
26-T	7/02/2016	<3	4	<2	15	100			0.3	<10	<10
26-B	7/02/2016	<3	4	6	15	110			0.4	<10	<10
27-T	7/02/2016	<3	3	4	12	90	0.3	<0.2	0.2	<10	<10
27-B	7/02/2016	<3	3	4	12	90			0.3	<10	<10
28-T	7/02/2016	<3	4	<2	16	100			0.3	10	<10
28-B	7/02/2016	<3	4	10	16	100			0.3	<10	<10
30-T	7/02/2016	<3	4	5	14	90			0.4	<10	<10
30-B	7/02/2016	<3	3	5	15	90			0.3	<10	<10
31-T	7/02/2016	<3	33	86	46	180			0.4	64	<10
31-B	7/02/2016	<3	4	3	16	100			0.3	<10	<10
32-T	7/02/2016	<3	62	170	75	260			0.4	280	<10
32-B	7/02/2016	<3	6	6	18	110			0.3	<10	<10
33-T	7/02/2016	<3	35	88	47	180			0.3	180	<10
33-B	7/02/2016	<3	6	3	17	110			0.4	10	<10
34-T	7/02/2016	<3	5	2	15	100			0.4	<10	<10
34-B	7/02/2016	<3	4	4	16	120			0.3	<10	<10
36-T	7/02/2016	<3	5	<2	16	110	0.4	<0.2	0.3	<10	<10
36-B	7/02/2016	<3	4	<2	18	120			0.4	<10	<10
37-T	7/02/2016	<3	33	84	45	180			0.4	72	<10
37-B	7/02/2016	<3	5	3	22	140			0.4	<10	<10
38-T	7/02/2016	<3	4	3	15	90			0.5	<10	<10

METHOD SAMPLE CODE	Sampling Date	AMMONIA µg.N/L	ORTHO-P µg.P/L	NO3+NO2 µg.N/L	TOTAL-P µg.P/L	TOTAL-N µg.N/L	CHLOROPHYLL'a' µg/L	PHAEOPHYTIN'a' µg/L	FLUORESCENCE CHLOROPHYLL'a' µg/L	TTC CFU/100 ml	Enterococci MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
38-B	7/02/2016	<3	5	4	15	100			0.5	<10	<10
39-T	7/02/2016	<3	20	46	33	140			0.4	20	<10
39-B	7/02/2016	<3	6	6	20	140			0.4	10	<10
44-T	7/02/2016	<3	19	43	31	140	0.5	<0.2	0.5	30	<10
44-B	7/02/2016	<3	6	6	18	120			0.4	20	<10
64-T	7/02/2016	<3	6	<2	18	110	0.6	<0.2	0.8	<10	<10
64-B	7/02/2016	<3	5	<2	18	120			0.8	<10	<10
61 -T	7/02/2016	<3	3	<2	16	90			0.4	<10	<10
61 -B	7/02/2016	<3	4	<2	16	100			0.4	<10	<10
57 -T	7/02/2016	<3	4	<2	16	90			0.5	<10	<10
57 -B	7/02/2016	<3	4	<2	16	100			0.3	<10	<10
60 -T	7/02/2016	<3	13	26	24	120	0.6	<0.2	0.5	<10	<10
60 -B	7/02/2016	<3	13	26	25	160			0.5	<10	<10
41 -T	7/02/2016	<3	4	4	13	100			0.5	<10	<10
41 -B	7/02/2016	<3	3	4	14	100			0.3	<10	<10
40 -T	7/02/2016	<3	3	3	14	100			0.4	<10	<10
40 -B	7/02/2016	<3	3	11	14	100			0.4	<10	<10
18 -T	7/02/2016	<3	4	7	14	100			0.4	<10	<10
18 -B	7/02/2016	<3	4	7	13	80			0.5	<10	<10
22 -T	7/02/2016	<3	3	<2	15	90			0.4	<10	<10
22 -B	7/02/2016	<3	4	2	14	120			0.3	<10	<10
47 -T	7/02/2016	<3	4	<2	14	90			0.3	<10	<10
47 -B	7/02/2016	<3	4	<2	17	120			0.5	<10	<10
48 -T	7/02/2016	<3	4	<2	17	100			0.4	<10	<10
48 -B	7/02/2016	<3	4	<2	17	130			0.3	<10	<10
45 -T	7/02/2016	<3	13	24	27	160			0.5	10	10
45 -B	7/02/2016	<3	12	22	26	130			0.6	<10	<10
52 -T	7/02/2016	<3	3	<2	13	80			0.4	<10	<10
52 -B	7/02/2016	<3	3	2	14	90			0.5	<10	<10
43 -T	7/02/2016	<3	16	37	29	130			0.5	20	<10
43 -B	7/02/2016	<3	5	6	19	140			0.4	10	<10
53 -T	7/02/2016	<3	3	2	14	80			0.7	<10	<10
53 -B	7/02/2016	<3	3	3	14	110			0.6	<10	10
54 -T	7/02/2016	<3	16	35	28	130			0.6	<10	<10
54 -B	7/02/2016	<3	16	36	31	170			0.5	<10	<10
56 -T	7/02/2016	<3	7	9	19	200			0.5	<10	<10
56 -B	7/02/2016	<3	7	9	21	140			0.5	<10	<10
63 -T	7/02/2016	<3	5	5	17	110			0.7	<10	<10
63 -B	7/02/2016	<3	5	6	18	100			0.7	<10	<10
55 -T	7/02/2016	<3	14	27	28	130			0.6	<10	<10
55 -B	7/02/2016	<3	5	4	21	100			0.8	<10	<10

Swanbourne

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
A	24/01/2017	4	7	<2	17	130	0.3	<0.2		<10	<10
B	24/01/2017	<3	3	<2	16	130	0.3	<0.2		300	<10
C	24/01/2017	<3	4	5	16	140	0.3	<0.2		56	<10
D	24/01/2017	<3	3	5	15	120	0.3	<0.2		20	<10
E	24/01/2017	<3	4	5	15	130	0.2	<0.2		10	<10
F	24/01/2017	<3	3	3	15	140	0.2	<0.2		10	<10
G	24/01/2017	3	3	2	15	120	0.3	<0.2		<10	<10
H	24/01/2017	<3	3	3	16	120	0.2	<0.2		<10	<10
I	24/01/2017	10	6	16	15	130	0.3	<0.2		<10	<10
22-T	24/01/2017	<3	<2	<2	11	100			0.2	<10	<10
22-B	24/01/2017	<3	<2	<2	12	100			0.2	<10	<10
24-T	24/01/2017	<3	<2	<2	12	100			0.2	<10	<10
24-B	24/01/2017	<3	<2	<2	13	100			0.3	<10	<10
26-T	24/01/2017	<3	<2	<2	13	110			0.3	<10	<10
26-B	24/01/2017	<3	<2	<2	13	110			0.3	<10	<10
27-T	24/01/2017	<3	<2	<2	11	100			0.2	<10	<10
27-B	24/01/2017	<3	<2	<2	13	100			0.3	<10	<10
28-T	24/01/2017	<3	2	<2	14	100			0.5	10	<10
28-B	24/01/2017	<3	<2	<2	14	100			0.5	20	<10
29-T	24/01/2017	<3	11	20	25	120			0.4	36	<10
29-B	24/01/2017	<3	4	7	17	110			0.4	30	<10
34-T	24/01/2017	<3	8	15	20	110			0.3	40	<10
34-B	24/01/2017	<3	7	12	18	100			0.3	40	10
35-T	24/01/2017	<3	21	34	32	140			0.4	150	10
35-B	24/01/2017	<3	4	7	16	110			0.3	20	10
36-T	24/01/2017	<3	19	31	30	130			0.3	10	20
36-B	24/01/2017	<3	<2	2	15	100			0.4	20	<10
37-T	24/01/2017	<3	2	2	15	110			0.3	10	<10
37-B	24/01/2017	<3	2	<2	14	110			0.4	<10	<10
38-T	24/01/2017	<3	18	59	39	140			0.3	91	<10
38-B	24/01/2017	<3	3	4	15	120			0.4	10	<10
39-T	24/01/2017	<3	<2	<2	12	90			0.4	<10	<10
39-B	24/01/2017	<3	<2	<2	14	100			0.3	<10	<10
40-T	24/01/2017	<3	<2	<2	15	110			0.4	<10	<10
40-B	24/01/2017	<3	<2	2	16	110			0.4	10	<10
42-T	24/01/2017	<3	2	<2	12	90			0.2	<10	<10
42-B	24/01/2017	<3	<2	<2	12	80			0.3	<10	<10
44-T	24/01/2017	<3	7	11	20	110			0.4	<10	<10
44-B	24/01/2017	<3	6	9	18	100			0.4	20	10
46-T	24/01/2017	<3	4	3	16	100			0.4	<10	<10
46-B	24/01/2017	<3	3	<2	14	100			0.3	<10	<10
61-T	24/01/2017	<3	2	<2	12	90			0.1	<10	<10

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
61-B	24/01/2017	<3	2	<2	12	90			0.2	<10	<10
62-T	24/01/2017	<3	<2	<2	12	90			0.2	<10	<10
62-B	24/01/2017	<3	2	<2	13	90			0.2	<10	<10
64-T	24/01/2017	<3	5	<2	19	110			0.9	<10	<10
64-B	24/01/2017	<3	2	<2	14	100			0.5	<10	<10
66-T	24/01/2017	<3	4	<2	18	110	1	<0.2	1	<10	<10
66-B	24/01/2017	<3	<2	<2	14	120			0.4	<10	<10
63-T	24/01/2017	<3	5	<2	19	110			0.8	<10	<10
63-B	24/01/2017	<3	2	<2	14	100			0.4	10	<10
60-T	24/01/2017	<3	<2	<2	11	90			0.1	<10	<10
60-B	24/01/2017	<3	<2	<2	12	90			0.2	<10	<10
43-T	24/01/2017	<3	6	7	17	110			0.4	<10	<10
43-B	24/01/2017	<3	4	5	16	110			0.4	<10	<10
33-T	24/01/2017	<3	<2	<2	12	90			0.2	<10	<10
33-B	24/01/2017	<3	<2	<2	12	90			0.3	<10	<10
54-T	24/01/2017	<3	3	<2	16	100	0.7	<0.2	0.8	<10	10
54-B	24/01/2017	<3	3	<2	17	110			0.6	<10	<10
52-T	24/01/2017	<3	<2	<2	11	90			0.2	<10	<10
52-B	24/01/2017	<3	<2	<2	12	90			0.1	<10	<10
55-T	24/01/2017	<3	2	<2	13	100	0.3	<0.2	0.4	<10	<10
55-B	24/01/2017	<3	<2	<2	14	110			0.4	<10	<10
50-T	24/01/2017	<3	<2	<2	12	80			<0.1	<10	<10
50-B	24/01/2017	<3	2	3	12	110			0.2	<10	<10
53-T	24/01/2017	<3	4	<2	16	110			0.5	<10	<10
53-B	24/01/2017	<3	4	2	16	100			0.5	<10	<10
31-T	24/01/2017	<3	2	3	11	90	0.2	<0.2	0.2	<10	<10
31-B	24/01/2017	<3	<2	<2	12	90			0.2	<10	<10
41-T	24/01/2017	<3	<2	<2	11	90			0.2	<10	<10
41-B	24/01/2017	<3	<2	<2	12	90			0.1	<10	<10
10B-T	24/01/2017	<3	<2	<2	13	100	0.2	<0.2	0.3	<10	<10
10B-B	24/01/2017	<3	<2	<2	13	110				<10	<10
10C-T	24/01/2017	<3	<2	<2	13	100	0.2	<0.2	0.2	<10	<10
10C-B	24/01/2017	<3	<2	<2	14	100				<10	<10
51-T	24/01/2017	<3	2	<2	12	90			0.2	<10	<10
51-B	24/01/2017	<3	2	3	11	90			0.1	<10	<10
45-T	24/01/2017	<3	6	13	18	100			0.4	<10	<10
45-B	24/01/2017	<3	7	8	19	100			0.4	<10	<10
10A-T	24/01/2017	<3	2	<2	14	100	0.3	<0.2	0.2	<10	<10
10A-B	24/01/2017	<3	<2	<2	13	100			0.4	<10	<10
8-T	24/01/2017	<3	2	<2	20	230			0.3	<10	<10
8-B	24/01/2017	<3	<2	<2	16	170			0.3	<10	<10

Sepia Depression

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
A	28/02/2017	20	5	9	18	180	1.1	0.3		10	<10
B	28/02/2017	5	4	10	16	120	0.6	<0.2		<10	<10
C	28/02/2017	12	3	5	15	180	0.9	0.3		20	10
D	28/02/2017	9	5	4	14	160	0.3	<0.2		<10	<10
E	28/02/2017	38	9	3	24	190	0.8	0.2		10	<10
F	28/02/2017	4	4	3	17	150	0.4	0.4		<10	10
G	28/02/2017	5	3	<2	17	180	1.4	0.3		<10	<10
H	28/02/2017	12	14	5	31	180	0.6	0.4		<10	<10
I	28/02/2017	5	4	4	14	110	0.2	0.4		<10	<10
31-T	28/02/2017	<3	3	<2	12	90			0.2	10	10
31-B	28/02/2017	<3	3	<2	13	100			0.2	<10	<10
36-T	28/02/2017	25	10	6	21	120			0.2	780	51
36-B	28/02/2017	<3	2	<2	12	90			0.2	10	<10
37-T	28/02/2017	<3	3	<2	12	90			0.2	20	<10
37-B	28/02/2017	<3	4	<2	13	90			0.2	20	<10
38-T	28/02/2017	<3	3	<2	12	90			0.4	<10	<10
38-B	28/02/2017	<3	2	<2	12	90			0.2	<10	<10
40-T	28/02/2017	<3	3	<2	11	80			0.2	<10	<10
40-B	28/02/2017	<3	2	<2	12	90			0.3	<10	<10
43-T	28/02/2017	37	15	7	26	120	0.3	<0.2	0.3	2400	230
43-B	28/02/2017	24	10	4	20	110			0.2	1400	120
28-T	28/02/2017	<3	3	<2	12	80			0.3	<10	<10
28-B	28/02/2017	<3	3	<2	12	80			0.3	<10	<10
47-T	28/02/2017	50	13	2	24	140			0.3	5700	640
47-B	28/02/2017	<3	3	<2	14	100			0.4	260	10
61-T	28/02/2017	<3	3	<2	12	70	0.2	<0.2	0.2	<10	<10
61-B	28/02/2017	<3	4	7	12	80			0.3	<10	<10
62-T	28/02/2017	<3	2	<2	11	80			0.2	<10	<10
62-B	28/02/2017	<3	3	2	11	80			0.2	<10	<10
48-T	28/02/2017	<3	2	2	12	80			0.2	<10	<10
48-B	28/02/2017	<3	3	<2	12	90			0.3	50	<10
66-T	28/02/2017	<3	2	3	12	80			0.3	<10	<10
66-B	28/02/2017	<3	2	<2	13	90			0.2	<10	<10
65-T	28/02/2017	24	8	2	19	100			0.4	20	20
65-B	28/02/2017	3	3	<2	13	90			0.3	40	<10
71-T	28/02/2017	8	5	3	15	90			0.3	<10	<10
71-B	28/02/2017	<3	3	<2	12	80			0.4	<10	<10
74-T	28/02/2017	5	5	<2	14	90	0.3	<0.2	0.5	<10	<10
74-B	28/02/2017	<3	4	<2	13	90			0.3	40	10
72-T	28/02/2017	<3	4	5	12	80	0.3	<0.2	0.3	<10	<10
72-B	28/02/2017	<3	4	6	14	90			0.2	<10	<10
44-T	28/02/2017	<3	3	<2	11	80			0.2	<10	<10

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
44-B	28/02/2017	<3	2	<2	12	90			0.3	<10	<10
45-T	28/02/2017	41	11	<2	22	130			0.3	2700	460
45-B	28/02/2017	<3	3	<2	12	80			0.2	120	10
67-T	28/02/2017	<3	4	8	14	100	0.3	<0.2	0.4	<10	<10
67-B	28/02/2017	<3	3	5	14	100			0.3	<10	<10
63-T	28/02/2017	28	10	<2	20	120			0.2	20	63
63-B	28/02/2017	<3	3	<2	12	80			0.3	10	<10
70-T	28/02/2017	<3	3	<2	12	80			0.2	<10	<10
70-B	28/02/2017	<3	3	3	13	90			0.4	<10	<10
64-T	28/02/2017	23	9	2	19	100			0.2	<10	63
64-B	28/02/2017	<3	4	2	13	90			0.4	150	20
26-T	28/02/2017	<3	<2	<2	11	80			0.2	<10	<10
26-B	28/02/2017	<3	<2	<2	12	80			0.2	<10	<10
46-T	28/02/2017	47	12	<2	23	130			0.4	3500	300
46-B	28/02/2017	5	3	<2	13	80			0.3	560	20
34-T	28/02/2017	<3	<2	<2	12	80			0.2	<10	<10
34-B	28/02/2017	<3	2	<2	12	80			0.2	<10	<10
53-T	28/02/2017	<3	<2	<2	12	80			0.2	<10	<10
53-B	28/02/2017	<3	<2	<2	12	80			0.2	<10	<10
54-T	28/02/2017	25	9	5	20	120			0.3	380	31
54-B	28/02/2017	<3	2	<2	12	90			0.2	40	<10
57-T	28/02/2017	<3	<2	<2	12	80			0.3	<10	<10
57-B	28/02/2017	<3	<2	<2	12	100			0.2	<10	<10
30-B	28/02/2017	<3	<2	<2	11	100			0.3	<10	<10
30-T	28/02/2017	<3	2	3	11	90			0.2	<10	<10
16-T	28/02/2017	<3	2	4	10	100			0.2	<10	<10
16-B	28/02/2017	<3	<2	<2	12	100			0.3	<10	<10
56-T	28/02/2017	25	8	4	18	130			0.2	780	120
56-B	28/02/2017	<3	<2	<2	11	90			0.2	20	<10
14-T	28/02/2017	<3	<2	<2	11	80			0.2	<10	<10
14-B	28/02/2017	<3	2	6	12	90			0.1	<10	<10
55-T	28/02/2017	12	5	3	14	110			0.3	110	20
55-B	28/02/2017	<3	<2	<2	12	90			0.2	160	10
15B-T	28/02/2017	<3	<2	<2	10	80	0.3	<0.2	0.2	<10	<10
15B-B	28/02/2017	<3	2	<2	11	90				<10	<10
15A-T	28/02/2017	<3	2	<2	10	90	0.3	<0.2	0.2	<10	<10
15A-B	28/02/2017	<3	<2	<2	10	90			0.3	<10	<10
15C-T	28/02/2017	<3	<2	<2	10	90	0.3	<0.2	0.2	<10	<10
15C-B	28/02/2017	<3	2	<2	10	90				<10	<10

Appendix E - Sample replicates and QA/QC

Ocean Reef

METHOD	Sampling							FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
1A-T	7/02/2016	<3	3	<2	14	90	0.2	<0.2	0.2	<10	<10
1B-T	7/02/2016	<3	3	<2	14	90	0.2	<0.2	0.2	<10	<10
1C-T	7/02/2016	<3	2	<2	13	90	0.2	<0.2	0.3	<10	<10
1A-B	7/02/2016	<3	4	4	15	90			0.2	<10	<10
1B-B	7/02/2016	<3	4	5	15	90				<10	<10
1C-B	7/02/2016	<3	4	6	13	90				<10	<10

Swanbourne

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
10B-T	24/01/2017	<3	<2	<2	13	100	0.2	<0.2	0.3	<10	<10
10C-T	24/01/2017	<3	<2	<2	13	100	0.2	<0.2	0.2	<10	<10
10A-T	24/01/2017	<3	2	<2	14	100	0.3	<0.2	0.2	<10	<10
10B-B	24/01/2017	<3	<2	<2	13	110				<10	<10
10C-B	24/01/2017	<3	<2	<2	14	100				<10	<10
10A-B	24/01/2017	<3	<2	<2	13	100			0.4	<10	<10

Sepia Depression

METHOD	Sampling								FLUORESCENCE		
SAMPLE CODE	Date	AMMONIA	ORTHO-P	NO3+NO2	TOTAL-P	TOTAL-N	CHLOROPHYLL'a'	PHAEOPHYTIN'a'	CHLOROPHYLL'a'	TTC	Enterococci
		µg.N/L	µg.P/L	µg.N/L	µg.P/L	µg.N/L	µg/L	µg/L	µg/L	CFU/100 ml	MPN/100 ml
Reporting Limit		<3	<2	<2	<5	<50	<0.1	<0.2	<0.1	<10	<10
15B-T	28/02/2017	<3	<2	<2	10	80	0.3	<0.2	0.2	<10	<10
15A-T	28/02/2017	<3	2	<2	10	90	0.3	<0.2	0.2	<10	<10
15C-T	28/02/2017	<3	<2	<2	10	90	0.3	<0.2	0.2	<10	<10
15B-B	28/02/2017	<3	2	<2	11	90				<10	<10
15A-B	28/02/2017	<3	<2	<2	10	90			0.3	<10	<10
15C-B	28/02/2017	<3	2	<2	10	90				<10	<10

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