Victorian Desalination Plant

Operational Marine Monitoring Program

Document No: ENV-000-PL-006

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List of Acronyms

Acronym	Definition
µS/cm	Microsiemens per centimetre
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BMMP	Baseline Marine Monitoring Program
CFD	Computational Fluid Dynamics
CIP	Clean in Process
D	Day
DELWP	Department of Environment, Land, Water and Planning.
DL	Discharge Licence
DLC	Discharge Licence Condition
DMPF	Dual Media Pressure Filter
DTSJV	Degrémont Thiess Services Joint Venture was the operation and maintenance contractor established during the design and construction phase. This organisation is now known as Watersure.
EC	Effective Concentration
EES	Environment Effects Statement
EMP	Environmental Management Plan
EPA	Environment Protection Authority
GL	Giga Litre
IC	Inhibitory Concentration
LC	Lethal Concentration
LOEC	Lowest Observed Effective Concentration
LOIC	Lowest Observed Inhibitory Concentration
LOLC	Lowest Observed Lethal Concentration
MBACI	Multiple-Before-After-Control-Impact
Mg	Milligram
ML	Mega Litre
MZ	Mixing Zone
NOEC	No Observed Effective Concentration
NOIC	No Observed Inhibitory Concentration
NOLC	No Observed Lethal Concentration
NTU	Nephelometric Turbidity Units
O&M	Operation and Maintenance
OMMP	Operational Marine Monitoring Program
ORP	Oxidation Reduction Potential
PC	Protective Concentration
PRs	Performance Requirements
PSU	Practical Salinity Unit
QA/QC	Quality Assurance and Quality Control
RO	Reverse Osmosis
SEPP (WoV)	State Environment Protection Policy (Waters of Victoria)
SOP	Standard Operating Procedures
VDP	Victorian Desalination Project
WAA	Works Approval Application
WAC	Works Approval Condition
WTS	Watersure are the operation and maintenance contractor, formerly known as the Degrémont Thiess Services Joint Venture.

SUMMARY

This Operational Marine Monitoring Program (OMMP) has been developed to address the requirements of the Discharge Licence, the Performance Requirements (PRs) specified for the Victorian Desalination Project (VDP) and the risks identified in the Operation and Maintenance (O&M) Environmental Management Plan (EMP). These requirements address environmental issues relating to intake of seawater and discharge of water, including brine, from the desalination plant during the Operations Phase.

The objectives of the program are to monitor plant and diffuser performance, water quality parameters and ecological components of the marine and coastal environment and where appropriate provide mechanisms in order to manage the spatial extent and levels of impact attributable to operation of the VDP, with respect to:

- Compliance with environmental legislation and regulations, protection of water quality and surrounding environmental values;
- Compliance with the project Performance Requirements; and
- Compliance with the Discharge Licence Conditions (DLC).

In order to meet the above requirements, four components have been developed as part of the OMMP as follows:

- **In-Plant Water Quality Monitoring** – to continuously monitor plant performance and calculate dilutions at the Mixing Zone boundary;
- **Diffuser Performance Monitoring** – to verify the calculated dilutions, confirm correct operation of the diffusers and demonstrate compliance;
- **Ecological Monitoring** – continuation of the flora and fauna monitoring commenced as part of the Baseline Marine Monitoring Program (BMMP). Analysis to determine impacts to flora and fauna; and
- **Direct Toxicity Assessment** – testing and verification of the VDP discharge as required.

Further details of the OMMP, together with the relevant PRs and DLCs are provided in the Table below:

Quick Check Table of Operational Marine Monitoring Program

Description	PR/DLC	Component	Frequency
In-Plant Water Quality Monitoring			
Monitoring in-plant will be undertaken continuously for the early detection of potential exceedances at the Mixing Zone boundary	**PR:** 195, 197, 208, 210, 212 **DLC:** LI_G2, LI_G3, LI_G4, LI_G5, LI_DW2, LI_DW2.11, LI_DW2.12, LI_DW2.13, LI_DW3	Automated online analysers at the seawater lift pump station launder and outfall chamber will measure conductivity and temperature. Flow rate will also be monitored continuously to achieve the required velocities for discharge and bypass initiated if necessary to achieve the required velocities and subsequent dilution. Predicted dilution at the Mixing Zone boundary will be calculated by assessing whether the in-plant discharge salinity is expected to reach levels of 1 PSU above intake salinity.	Daily/continuous (total volume and flow rate of discharge, and physiochemical parameters). Measurements of chemical water quality parameters at the outfall chamber as required.
Diffuser Performance Monitoring			
Monthly monitoring of salinity will be used to collect field data to verify the diffuser performance. Inspections of the	**PR:** 195, 197, 208, 210, 212 **DLC:** LI_G2, LI_G3, LI_G4,	Monitoring of salinity at seven pre-determined sites, including within and outside the Mixing Zone, will occur on a monthly basis providing field verification data of diffuser performance. Divers to physically inspect structures and	Continuous monitoring of salinity. Data collected until sufficient data is available to determine compliance. Inspections of the

Description	PR/DLC	Component	Frequency
Diffusers to ensure they are operating correctly.	LI_G5, LI_DW2, LI_DW3	diffusers.	diffusers at key points during operation.
Ecological Monitoring			
Continuation of the baseline monitoring program of marine flora and fauna. Impact assessment by comparison of operational data vs baseline data.	**PR:** 195, 197, 207, 208, 210, 214 **DLC:** LI_G2, LI_G3, LI_G4, LI_G5, LI_DW3	Inshore reef canopy – Diver based assessment of the reef canopy at 8 sites, inside and outside areas expected to be impacted.	Quarterly during discharge of brine. Reviewed at the end of each Supply Period and in the event of an impact being detected.
		Inshore vertical reef faces – Diver based assessment of vertical reef faces to estimate percentage cover of sessile and sedentary mobile biota at 8 sites inside and outside areas expected to be impacted.	
		Offshore reef community – Remotely Operated Vehicle based assessment of reef communities at 12 sites, inside and outside areas expected to be impacted.	
		Deployment of settlement plates to monitor larval recruitment at sites inside and outside locations expected to be impacted – to be undertaken on the inshore and offshore reefs.	
Direct Toxicity Assessment			
Testing of the effluent to confirm the safe dilution factor.	**PR:** 197, 210, 217 **DLC:** LI_G2, LI_G3, LI_G4, LI_G5, LI_DW3	A suite of tests to confirm adoption of 30:1 as a safe dilution factor (no acute toxicity) is appropriate and that the representative concentrate (which contains representative chemical additives) will meet the requirements of the State Environment Protection Policy (Waters of Victoria) (SEPP WoV) environmental quality objectives of 99% ecosystem protection for largely unmodified aquatic ecosystems; and to confirm that the additives such as cleaning agents are not toxic to marine species at their discharge concentrations.	As required, e.g. following a change to the desalination process.

1 Introduction

The Victorian Desalination Project (VDP) is located near the town of Wonthaggi, on the Bass Coast within the Bass Coast Shire, and is approximately 90 km to the south-east of Melbourne (Figure 1-1). The marine infrastructure extends approximately 1 km offshore from Williamsons Beach at this location.

Figure 1-1: Regional Location of the VDP

AquaSure has been commissioned to finance, design, construct, operate and maintain the Desalinated Water Supply System (DWSS) associated with the VDP. Watersure is the appointed Operation and Maintenance (O&M) contractor.

The contractual O&M phase commenced following the Reliability Testing and Finalisation (RTF) when the plant was transferred from the D&C contractor at the end of the commissioning phase, to the O&M contractor (Watersure). The plant has an initial maximum production capacity of 150 GL/year of desalinated water, with the capability to expand to 200 GL/year if required. During operation, seawater is pumped into the desalination plant via the intake tunnel and the seawater lift pump station. Once on site, the seawater is pre-treated by a screening process (i.e. coarse screen at the intake, drum screen, dual media pressure filter (DMPF) and cartridge filter). Around half the intake water is extracted as freshwater by Reverse Osmosis (RO) and the other half is concentrated as brine of approximately 60 - 68 PSU (Practical Salinity Unit) (background salinity is typically 35-36 PSU). Refer to the O&M Environmental Management Plan (EMP) (Watersure, 2013) (ENV-000-PL-001) for a full description.

Maintenance of the plant includes backwashing of the DMPF and cleaning of membranes – where permeate is used to clean the RO units together with the addition of cleaning chemicals to remove any accumulation of materials, minerals or biofilm. These waters are then neutralised and stabilised (so that they are nontoxic) before being sent to the outlet.

The brine will therefore mostly contain elevated concentrations of compounds found in the intake seawater together with the very low concentrations of neutralised and stabilised RO membrane cleaning residue. The brine is discharged through an outlet with two diffusers, each with nine nozzles, to assist with initial dilution of the brine.

To meet all contractual and legislative requirements, monitor the discharge and where appropriate respond to any potential impacts upon the marine and coastal environments due to operation of the VDP, an

Operational Marine Monitoring Program (OMMP) (this document) has been developed. The OMMP is to be read in conjunction with the O&M EMP (Watersure, 2013) (ENV-000-PL-001).

1.1 Structure of this Document

The OMMP has the following structure:

- Section 2 of this document provides the various contractual and legislative requirements that the project must comply with.
- Section 3 discusses the Mixing Zone and the various inputs that have informed establishment under the Discharge Licence.
- Section 4 gives an overview of the monitoring and assessment components and how they integrate to allow a "weight of evidence" approach to determining impacts. This also includes a hierarchical approach to environmental safety where continuous daily measures are taken of plant performance and regular measurements in the environment to ensure that corrective actions can be initiated before plant activities result in ecological impacts.
- Section 5 outlines how this program adapts to the changing needs of the plant to respond to periods of brine production and periods of in-activity.
- Sections 6 – 9 describe the four monitoring/assessment components making up the OMMP:
    - In-Plant Water Quality Monitoring;
    - Diffuser Performance Monitoring;
    - Ecological Monitoring; and
    - Direct Toxicity Assessment (DTA).
- Section 10 describes the reporting and reviewing cycle of the OMMP. Incident reporting is required to ensure that corrective actions are initiated and to make the client and Victorian Environment Protection Authority (EPA) aware of potential impacts from VDP activities.

Comprehensive detail on the operational activities of the VDP are not discussed in this document and are provided in the O&M EMP (Watersure, 2013) (ENV-000-PL-001).

1.2 Review and Authorisation Process

This document has been prepared on behalf of Watersure. Authorisation of this document has included a review and approval process by Watersure environmental and operational personnel. Sections 7 and 8 (Diffuser Performance and Ecological Monitoring) of the document have also been externally reviewed by Subject Matter Experts to ensure the program is fit for purpose and adopts industry best practice. Confirmation of these reviews and any comments received from the Subject Matter Experts are included in Appendix A. This document has been submitted to the Department of Environment and Primary Industries capital projects division (DELWP) to ensure compliance with the project Performance Requirements, and to the EPA in order to satisfy the requirements of the Discharge Licence.

2 Legislative and Regulatory Requirements

The Environment Effects Statement (EES) (Department of Sustainability and Environment, 2008) for the VDP resulted in a number of Performance Requirements (PRs) which were subsequently incorporated into the Project Deed (see Section 2.1).

In addition, pursuant to the Environment Protection (Scheduled Premises and Exemptions Regulations) 2007 (Environment Protection Authority, 2007), desalination plants having a design capacity to process more than 1 megalitre (ML) per day of feed water are defined as a scheduled premises (Type Number K 04) and are subject to the Licensing provisions of the Environment Protection Act 1970 (i.e. the VDP requires an operational Discharge Licence).

The OMMP design is required to address the specific PRs and Discharge Licence Conditions (DLCs) to the satisfaction of the responsible environmental agency: DELWP (PRs) and the Victorian EPA (DLCs).

2.1 Performance Requirements

A total of 36 separate PRs in the Project Deed relate to the design, construction and operation of the intake and outlet. The majority of these relate to the design and siting of the intake and outlet (20) or to undertake a commitment to manage the environment to industry best practice (10). All marine performance requirements relating to the Design and Construction Phase were successfully complied with. 9 of the marine PRs relate directly to the need for monitoring in relation to operation of the intake and outlet (Table 2-1).

Table 2-1: List of Relevant Performance Requirements

PR	Driver	Description	Relevant Component
31195	Outlet	Minimise to the extent practicable the impacts on marine flora and fauna from Project Activities; Avoid impacts on the ecology of reefs with high biodiversity, to the extent practicable.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8)
31197	Outlet	Develop, implement and maintain methods and management systems to protect marine flora and fauna	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)
32207	Intake	Monitor and report on possible effects of entrainment on marine biota including changes to recruitment and marine community structure and demonstrate compliance with the relevant performance criteria.	Ecological Monitoring (Section 8)
33208	Outlet	Comply with State Environment Protection Policy (Waters of Victoria)	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8)
33210	Outlet	Meet the requirements of the EPA with regard to the Works Approval Application and Discharge Licence.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)
33212	Outlet	Define an area to be approved by the EPA which at its boundary achieves not more than 1 PSU (or as agreed with the EPA) above regional ambient salinity, 95% of the time on an annual basis, outside the designated areas presented in Figure PR Sensitivity Area – Marine Area in the Property Schedule.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7)
33214	Outlet	Develop and implement pre-construction survey prior to the construction of the outlet and post construction survey and monitoring program to : Demonstrate protection of beneficial use outside the areas to be approved by EPA; Assess the extent, magnitude and level of impacts of discharge on marine flora and fauna;	Ecological Monitoring (Section 8)

PR	Driver	Description	Relevant Component
		Assess the long term impacts of outlet discharge(s); Document the condition of high and moderate relief reef ecosystems in the vicinity of the Mixing Zone; and Otherwise demonstrate performance in compliance with the Performance Criteria.	
33217	Outlet	Direct toxicity assessment and water quality assessment shall be undertaken to confirm that representative concentrate (which contains representative chemical additives) meets the requirements of the State Environment Protection Policy (Waters of Victoria) environmental quality objectives of 99% ecosystem protection for largely unmodified aquatic ecosystems.	Direct Toxicity Assessment (Section 9)

2.2 Discharge Licence

To operate the plant and discharge the return water into the marine environment, the VDP requires a licence from the EPA under the provisions of the Environment Protection Act 1970. The Discharge Licence, the associated conditions and the respective components of this OMMP are presented in Table 2-2 below. The Discharge Licence establishes the Mixing Zone and is contingent on the DLCs and PRs being met during plant operation. Further details regarding the Mixing Zone and how this OMMP is designed to ensure compliance are provided in Section 3.

Table 2-2: Discharge Licence Conditions

DLC	Description	Relevant Component
LI_G2	You must immediately notify EPA of non-compliance with any condition of this licence.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)
LI_G3	By 30 September each year you must submit an annual performance statement to EPA for the previous financial year in accordance with the Annual Performance Statement Guidelines (EPA Publication 1320).	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)
LI_G4	Documents and monitoring records used for preparation of the annual performance statement must be retained at the premises for seven years from the date of each statement.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)
LI_G5	You must implement a monitoring program that enables you and EPA to determine compliance with this licence.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)
LI_DW2	Discharge of waste to surface waters must be in accordance with the 'Discharge to Water' Table. [Table 2-3].	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7)

DLC	Description	Relevant Component
LI_DW2.11	Discharge limits in the 'Discharge to water' table must be based on 24 hour averages.	In-Plant Water Quality Monitoring (Section 6)
LI_DW2.12	Minimum discharge flow rate from the premises must be 2.09 kilolitres/second when the plant is discharging brine more than the background salinity.	In-Plant Water Quality Monitoring (Section 6)
LI_DW2.13	Turbidity in NTU of the discharge must not be more than the background level in the receiving surface water plus the limit specified in the Discharge to Water Table.	In-Plant Water Quality Monitoring (Section 6)
LI_DW3	The Mixing Zone extends 180 metres radius from the 2 risers relative to the licensed waste discharge point.	In-Plant Water Quality Monitoring (Section 6) Diffuser Performance Monitoring (Section 7) Ecological Monitoring (Section 8) Direct Toxicity Assessment (Section 9)

Table 2-3: Discharge to Water Requirements

Indicator	Limit type	Unit	Discharge Limit	Relevant Component
Flow Rate	Max Daily Flow	ML/D	1,164	In-Plant Water Quality Monitoring (Section 6)
Dissolved oxygen	Minimum	mg/L	4	In-Plant Water Quality Monitoring (Section 6)
Electrical Conductivity	Maximum	µS/cm	100,000	In-Plant Water Quality Monitoring (Section 6)
Turbidity*	Maximum	NTU	6	In-Plant Water Quality Monitoring (Section 6)
pH	Maximum	pH	9	In-Plant Water Quality Monitoring (Section 6)
pH	Minimum	pH	6	In-Plant Water Quality Monitoring (Section 6)

* Note LI_DW2.13

3 Mixing Zone

3.1 Overview

A "Mixing Zone" (as outlined under Clause 30 of the SEPP (WoV) (Environment Protection Authority, 2003)) is a body of water into which a discharge of water (in this case the return water from the desalination process) takes place. Within this discharge environment, constituents are released into the marine environment where they mix with the ambient seawater and dilute to either levels close to background or below detection limits. The concept of "safe dilution" is the point at which the brine concentration returns to either near background, or to such a low level that it is not considered likely to pose a risk to the environment and 99% species protection is achieved, as required under the ANZECC & ARMCANZ Water Quality Guidelines (ANZECC & ARMCANZ, 2000a) (see Section 3.2.2 below). Within the Mixing Zone the prescribed water quality criteria are not necessarily met. However, water quality criteria apply at the boundary of the Mixing Zone and beyond. Water Quality criteria are based on ANZECC & ARMCANZ Water Quality Guidelines or site specific trigger values, as well as the results of the Direct Toxicity

Assessment undertaken as part of the EES, Works Approval Conditions 2.2 – 2.3 and under the Section 30A Commissioning Approval Application (Thiess Degrémont Joint Venture, 2012a) (TDV-0-EV-PL-0500).

In accordance with DLC LI_DW3 (see Table 2-2), the Mixing Zone is an area 180m radius from the centre point of the outlet structures. This encompasses the modelled 1 PSU above ambient (the maximum increase in salinity determined by DTA to achieve 99% species protection) 95th percentile contours for 50GL/yr and 150GL/yr equivalent flows (see Section 3.2.1). The following sections outline the processes and inputs that have been used to arrive at this definition.

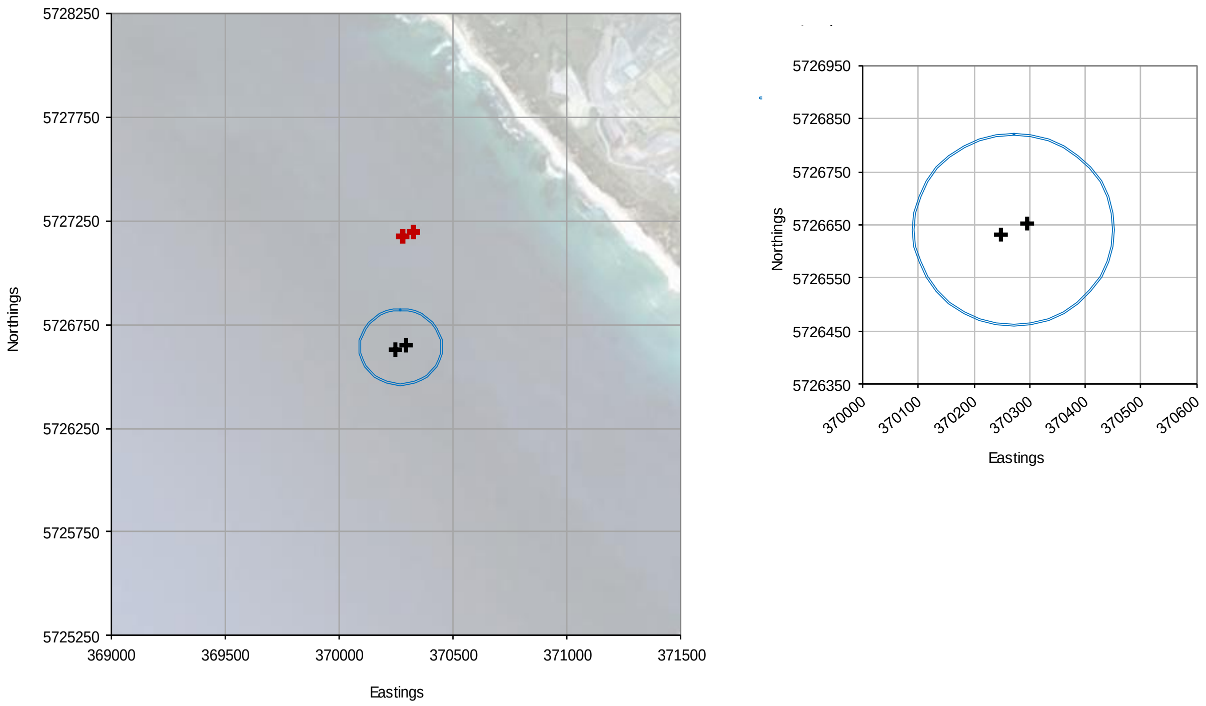

Figure 3-1: Mixing Zone

3.2 Defining the Mixing Zone

In addition to and consistent with the requirements set out in the Discharge Licence, the Mixing Zone has also been defined in accordance with PR 212, which requires an area approved by EPA "…which at its boundary achieves not more than 1 PSU (or as agreed with the EPA) above regional ambient salinity, 95% of the time on an annual basis…"**.** In refining the Mixing Zone, consideration has also been given to the following:

- Hydrodynamic modelling of salinity rise and measured salinity rise in the environment;
- Direct Toxicity Assessments of the brine discharge and resulting safe dilution factor; and
- The statistical "power" of the offshore components of the Ecological Monitoring component (Section 8) to detect impacts with any given arrangement of the available monitoring sites – that is the number of sites within and outside of the Mixing Zone.

3.2.1 Hydrodynamic Modelling

Several hydrodynamic models have been utilised to study dilution of discharged brine into ambient waters. Physical, numerical and computational fluid dynamics (CFD) models have been used to study the near-field turbulent mixing of the plume as it emerges from the outlet in the form of a jet. These models simulate processes that occur within approximately 50m of the outlet. An intermediate-field, 3D numerical hydrodynamic model, termed the 'environmental model', has been used to predict further dilution of the brine by environmental processes such as ambient currents. The environmental model extends for approximately 8km along the coast.

The CFD model is the most up-to-date modelling of the near-field mixing and the environmental model calibrated to the CFD model provides the best prediction of how well the diffusers will perform during operation (Thiess Degrémont Joint Venture, 2011).

The CFD model has also allowed the investigation of varied flow rates concluding that very low flow rates will result in poor mixing while high flow rates give improved mixing. The modelling indicates that adequate mixing is achieved for a brine discharge of 70.2 PSU into ambient waters of 37.1 PSU with flow rates at the outlet of 2.09 m^3/s (1 desalination unit in operation, equivalent to an annual production of 50GL/yr potable water) and above. Therefore lower flow rates will require by-pass of raw seawater from the intake to the outlet in order to provide additional velocity and improve mixing.

Although higher flow rates result in improved mixing, they also result in a larger area of influence and are therefore important when considering entrainment effects. Refer to Figure 3-2 for the CFD calibrated environmental model outputs for flows equivalent to 50GL/yr and 150 GL/yr.

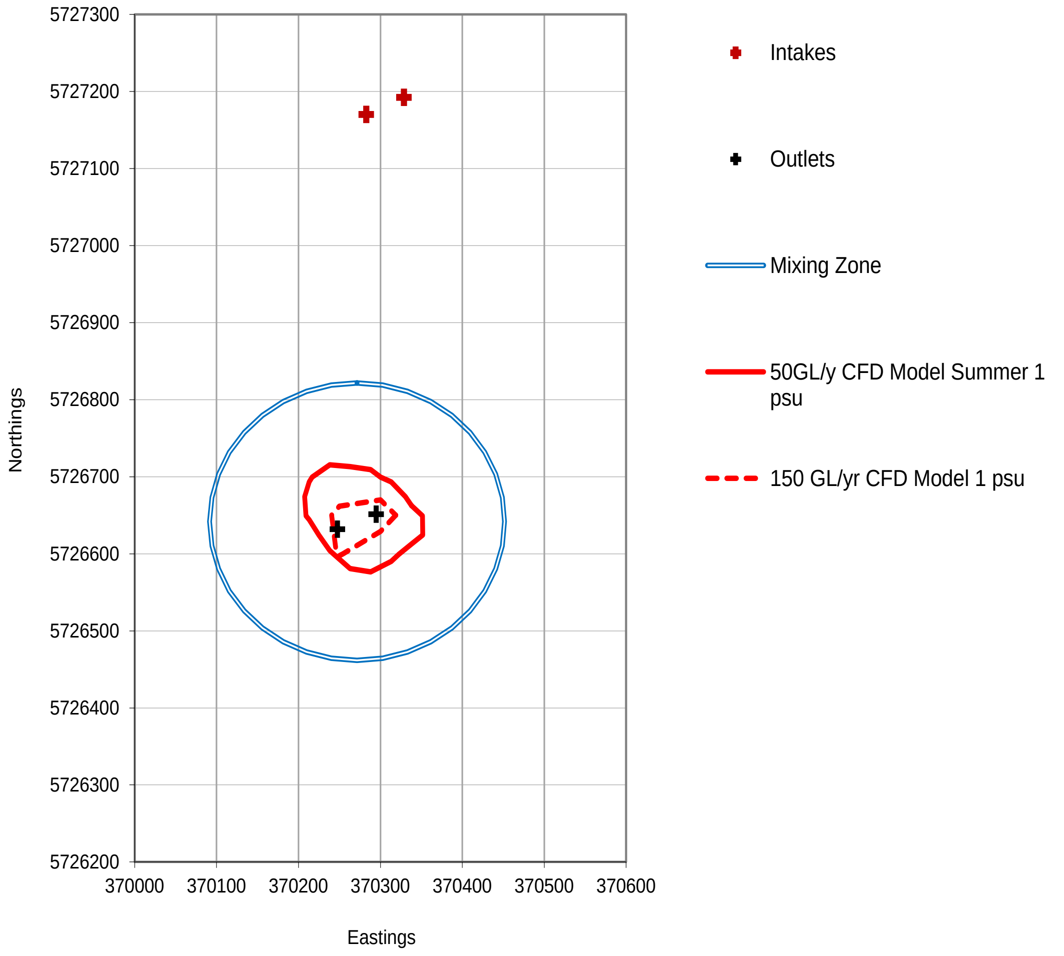

Figure 3-2: CFD Calibrated Environmental Hydrodynamic Model Outputs and Mixing Zone

3.2.1.1 Model Validation

To validate the intermediate-field (environmental model), a tracer test was performed during commissioning of the plant in 2012. The tracer test used a number of techniques including vessel-based conductivity-temperature-depth profiles and seabed data loggers measuring salinity changes with distance from the outlet during a two day period of continuous brine production. The aim was to match the frequency of occurrence of salinity rise for any given location against that predicted by the model, thereby validating the outcomes.

The results of the tracer tests are presented in TDV-0-CM-RP-008-01 and associated Cardno Summary Note of VDP Modelling (refer to AQS-2013-7045-HCh). A good level of similarity was observed between the measured and modelled data and has been accepted by the EPA. The models used, the associated outputs and salinity contours are therefore validated and are appropriate for informing the decision making process. The Mixing Zone has been established based on the modelled outputs and a flow rate of 2.09 m^3/s has been nominated as the minimum flow rate, without by-pass, during operation.

3.2.2 Direct Toxicity Assessment

Direct toxicity assessments use a range of species and tests to investigate the effect of various dilutions of a sample (in this case brine) on aspects such as fertilisation, growth and development. Statistical analysis of the resulting data is used to predict dilutions at which 99% of species are expected to be protected – the ‘safe dilution factor’.

A number of Direct Toxicity Assessments have been undertaken firstly for the Environment Effects Statement in 2008 (Department of Sustainability and Environment, 2008), followed by repeat testing undertaken for the Works Approval conditions 2.2 – 2.3 in 2010 (Thiess Degrémont Joint Venture, 2010b) (RP-TDV-EN-0-X-000-0004-0-00) and during the commissioning of the plant in 2012 (Thiess Degrémont Joint Venture, 2012c) (TDV-0-CM-RP-0001-D).

The EES investigation concluded that a dilution of 29:1 is necessary to meet the required 99% species protection level (SEPP WoV). Subsequent tests undertaken for the Works Approval conditions 2.2 – 2.3 and during commissioning confirmed the results concluding that desalination brine has a safe dilution factor of 30:1. Further details of the tests undertaken and methodologies are provided in Section 9.

The results of the ecotoxicity testing undertaken indicate that the biological effects seen in desalination plant discharges are attributed primarily, but not exclusively, to salinity. A range of salinities have been tested as outlined Table 3-1.

Table 3-1: Direct Toxicity Assessments and Results

Project Stage	Number of Effluent Scenarios Tested	Sample Salinities	Safe Dilution Factor
Environment Effects Statement	1	59.4 ppt	29:1
Works Approval (conditions 2.2 – 2.3)	4	66.9 – 68.9 ppt	30:1
Commissioning	1	61.8 ppt	12:1

3.2.3 Baseline Marine Monitoring Program

The Baseline Marine Monitoring Program (BMMP) (Thiess Degrémont Joint Venture, 2010a) (RP-TDV-EN-1-A-000-0000-0-04) was a requirement of the Minister for Environment and Climate Change approval of the Design and Construction Environmental Management Plan, the Project Deed PRs and also the Works Approval (conditions 2.4 – 2.6) issued to AquaSure during the design and construction phase of VDP. The objectives of the BMMP were to:

- Collect sufficient baseline data prior to operation for use in subsequent monitoring to assess the impact of the plant operations on the marine environment; and
- Collect sufficient baseline data prior to operation for use in subsequent monitoring to assess the impact of the plant operations on coastal processes.

The BMMP comprised two programs, the Ecological Monitoring Program and the Coastal Processes Monitoring Program. The Ecological Monitoring Program has been superseded by this OMMP while the Coastal Processes Monitoring Program has been superseded by the Operational Coastal Processes Monitoring Program (ENV-000-PL-007).

The BMMP provided the baseline or ‘before’ data against which potential impacts resulting from operation of the VDP can be measured. The Ecological Monitoring in this OMMP has retained the key monitoring instruments of the BMMP including inshore and offshore canopy/reef community surveys and settlement plate arrays.

An important consideration governing the Mixing Zone is the allocation of the available sites within and outside of the Mixing Zone. Suitable monitoring sites were selected early during the project design phase before the Mixing Zone had been identified, to enable sufficient data to be obtained. Subsequent designation of sites has been based on the power calculations for various configurations and aligning with all other available data, such as outputs from the hydrodynamic modelling, BMMP quarterly reports (including outcomes from the commissioning impact assessments) and the Direct Toxicity Assessments. The selection of these sites was endorsed by the BMMP Management Group.

Monitoring sites where an impact is expected and permitted are situated within the Mixing Zone and are collectively referred to as “Mixing Zone Sites”. Those sites where an impact is not expected but may occur are termed “Test Sites”. These sites are important as they are outside of the Mixing Zone and therefore any signs of impact at these locations that are not observed at Reference Sites or cannot be explained by other causes, may indicate that the plant is not operating as expected. “Reference Sites” are those situated some distance from the outlet diffusers and are expected to be free of any influence from the plant. A change at these sites is likely to indicate a broader change in the environment, rather than one due to plant operation.

Thus, in order to determine if there is an impact, it is necessary to compare the analysis of results for sites in each of the zones. Refer to Section 8.4 for further information regarding the ecological monitoring data analysis and site comparisons. In addition, when calculating concentrations and dilutions of the brine, required to demonstrate compliance, these will be done for each of the ecological monitoring sites listed in Table 8-2, using the distance from the outlet and expected dilutions predicted by the modelling (as validated by the Tracer Test(s)).

4 Monitoring Program

4.1 Scope of the Operational Marine Monitoring Program

The OMMP scope includes monitoring, impact assessment and where applicable, management of the intake of seawater and discharge of brine and other liquid waste streams to the marine environment.

4.2 Aims and Objectives of the Operational Marine Monitoring Program

The aims and objectives of the OMMP are to:

- Monitor plant and diffuser performance, water quality parameters and ecological components of the receiving environment;
- Assist operators to comply with the Discharge Licence;
- Detect and respond to changes (outside of the Mixing Zone), if any, to seawater quality due to discharge of brine from the outlet;
- Detect and respond to changes (outside of the Mixing Zone), if any, due to salinity exposure of the reef community in the path of the dispersing plume; and
- Detect and respond to changes, if any, to nearshore reef biodiversity due to combined entrainment effects from the intake and outlet.

4.3 Development Criteria of the Operational Marine Monitoring Program

The OMMP needs to:

- Consider all the regulatory requirements;
- Build on existing knowledge regarding desalination plants and associated discharges;
- Be both preventative and reactive so impacts are quickly detected and corrective action is rapid and effective;
- Use correct indicators to monitor for impacts at the most efficient time and space scales; and
- Adopt a weight of evidence approach using multiple lines of evidence to determine whether impacts are related to the plant or not.

In addition to addressing regulatory requirements, the design of the OMMP takes into account:

- The potential impact from increased salinity and water movements associated with intake of seawater and discharge of brine;
- Results from the most current hydrodynamic modelling;
- Results from monitoring undertaken for the Section 30A Commissioning Approval;
- Results of tests and assessments undertaken for the Section 30A Commissioning Approval; and
- Results and recommendations of the BMMP quarterly reviews.

4.4 Monitoring Framework

The OMMP components are designed to measure the plant performance and dilution at the Mixing Zone boundary and to ensure that corrective actions can be initiated before plant activities result in unexpected changes in the local marine environment.

The OMMP framework consists of three processes (Table 4-1):

- **Prevention:** In-plant water quality and flow monitoring of discharge to the outlet during operation. In-plant monitoring (Section 6) is the critical component of the OMMP. It is a regular check on the plant's performance. Preventative action to avoid impacts to the marine environment can be quickly implemented in response to exceedances at the outlet before they manifest offshore;
- **Environment:** *In situ* monitoring of the environment to ensure water quality, marine flora and fauna are not impacted outside of the Mixing Zone by activities of the VDP (Sections 7 and 8). Any exceedances can be mitigated through corrective or investigative action; and
- **Toxicity:** Confirmation of the safe dilution factor for the discharge, in the event of change to the desalination process or water quality (Section 9).

The fundamental basis of the OMMP is that all components are integrated. That is, if there are any exceedances in-plant then corrective actions can be implemented to prevent any impacts manifesting in the marine environment. Linking components allows a "weight of evidence" approach in decision making as recommended in the Australian Guidelines for Fresh and Marine Water Quality Monitoring and Reporting (ANZECC & ARMCANZ, 2000b). The weight of evidence approach is preferred to setting trigger levels because it takes a risk-based response to assessing impacts rather than discrete limits. It also allows insight into potential causes of change, the level and extent of potential impacts and allows for flexibility in management responses.

The four monitoring components that have been devised for the OMMP are outlined in Table 4-1.

Table 4-1: Monitoring and Assessment Components of the OMMP

Process	Component	Description	Doc Section
Preventative	In-Plant Water Quality Monitoring	Monitoring of physico-chemical elements in the plant prior to discharge to ensure plant is discharging as per requirements.	6
Environment	Diffuser Performance Monitoring	Verification of diffuser performance (dilution) through seabed salinity measurements and calculation of dilution at the Mixing Zone boundary to ensure plant is discharging as per requirements. Inspections of the diffusers to ensure that they are functioning as per design.	7
	Ecological Monitoring	Monitoring of the biological environment surrounding the diffusers and broader marine environment to validate that impacts do not take place outside of the Mixing Zone.	8
Toxicity	Direct Toxicity Assessment	Toxicity testing of VDP effluent in event of change to desalination process or water quality to confirm safe dilution factor.	9

In-Plant Water Quality Monitoring (Section 6) is undertaken to provide a regular check on the plant performance. Salinity at the plant intake can be compared with salinity at the plant outlet and together with flow rates provide an estimated dilution for the Mixing Zone boundary. If an exceedance is likely then corrective action can be initiated immediately. This component is the primary safety feature of the OMMP.

Monitoring of the Mixing Zone will take place with the Diffuser Performance Monitoring (Section 7), using fixed salinity loggers to calculate the actual dilution at the Mixing Zone boundary to ensure licensing conditions are met. This monitoring is expected to continue during brine production until sufficient data has been collected to determine compliance. Determination of what constitutes sufficient data will be done through external review by a Subject Matter Expert and consultation with the EPA. If operational monitoring yields an unexpected result such as reduced mixing then investigative actions will be taken to assess the nature and extent of any impact. In addition, the Diffuser Performance Monitoring includes an inspection regime to ensure the outlet structures and diffusers are operating as designed and without fault.

Ecological Monitoring (Section 8) will be implemented on a quarterly sampling time frame, or as determined by Watersure's specialists and Subject Matter Expert. This component will be maintained until Watersure are able to satisfy the EPA that impacts outside of the Mixing Zone have not occurred and are not likely to occur (assuming normal operating conditions).

Development of the OMMP will be a continuous process with data derived from implementation reported and reviewed and the program adjusted if necessary, see Figure 4-1.

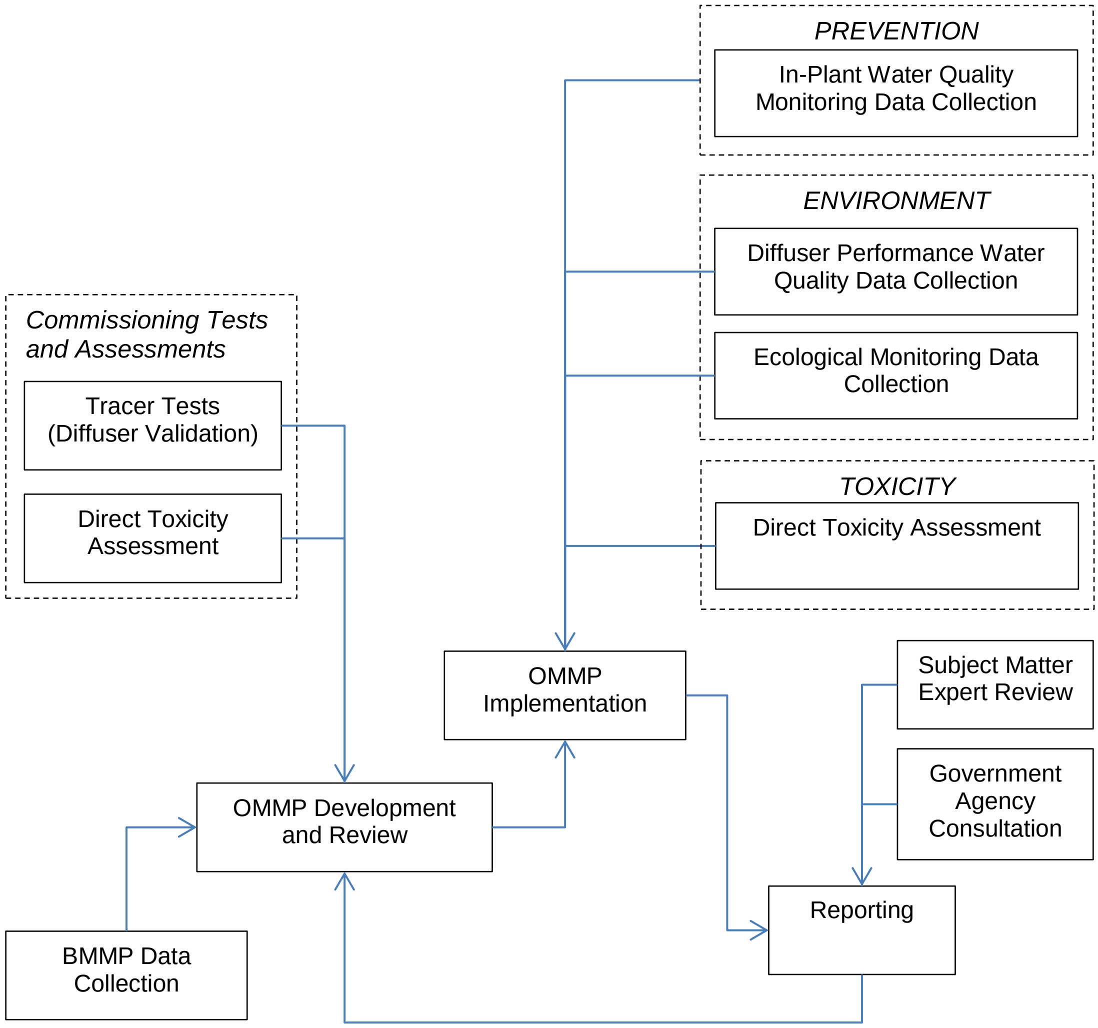

Figure 4-1: OMMP Framework

In addition to allowing a weight of evidence approach to impact assessment, integrating monitoring components also provides another critical function: early warning. This is arguably the most important aspect of monitoring as an early warning can be acted on before plant activities manifest a change in the marine environment. The early warning system is outlined in Table 4-2 and follows a hierarchical approach to risk. A tier one warning results from an abnormal in-plant measurement. If the issue persists after corrective actions are commenced then the tier two monitoring components should be evaluated. This involves checking actual dilution at the Mixing Zone boundary and other sites close to and distant from the outlets. If mixing under all conditions is sufficient to mitigate the risk then the operations can proceed as normal, however if there is a dilution exceedance (tier two warning) at the Mixing Zone boundary then a tier three investigation is warranted. This involves interrogating the *in situ* monitoring of the ecological environment that may be impacted as well as additional inspections of the outlet structures. If unexpected changes are recorded corrective action should commence immediately. Each of these components is described in detail through Sections 6 to 9.

Table 4-2: Hierarchical Warning System for the VDP

Tier	Description	Warning	Level of concern
1	In-plant salinity	Exceed estimated dilution at the Mixing Zone Boundary	Lowest
	In-plant water quality parameters	Exceed estimated dilution at the Mixing Zone Boundary	Lowest
2	Salinity at the Mixing Zone boundary	Exceeds actual safe dilution	Moderate

Tier	Description	Warning	Level of concern
3	Ecological monitoring	Impacts to flora and fauna outside of the Mixing Zone	Highest
	Diffuser inspections	Diffusers are not operating correctly or are defective. Potential or exceedance of actual safe dilution	Highest

4.5 Roles and Responsibilities

To facilitate management of the OMMP, the following roles and responsibilities have been identified:

Table 4-3: Roles and Responsibilities

Group	Role
Watersure Environmental Manager	Environmental compliance management applicable to the OMMP as summarised below: • Ensure that the requirements of all monitoring components are followed; • Ensure that the OMMP is implemented in full; • Perform ‘sanity checks’ of monitoring data to identify any anomalies; • Implementation of investigative monitoring if required; • Inform the Plant Director, Compliance Manager, AquaSure and Government Agencies of any incidents, test results and any exceedances and corrective action decisions; • Preparation of an incident report following the Environmental Incident Reporting Procedures and implementation of corrective actions; • Liaise with and advise others regarding environmental compliance and non-compliance, where required; • Reporting results of monitoring to AquaSure; and • Provide inputs into the O&M Monthly and Annual Report to the State. Notify relevant Government Agencies within 24 hours of any reportable breaches (exceedance).
Watersure Technical Group	Comprises field scientists, statisticians, modellers and environmental specialists. Roles include: • Undertake field survey work, and initial data entry and cleaning. The work will be governed by Standard Operating Procedures (SOPs), and survey protocols; • Hydrodynamic modelling; and • Conduct statistical analysis (governed by SOPs, and an analysis plan), data integration and report writing.
Subject Matter Experts	Review of reports for the OMMP (including relevant sections of this document), analysis plans and SOPs. Subject Matter Experts have been appointed for the following: • Ecological Monitoring • Diffuser Performance

5 Water Production and Monitoring Need

The VDP operates in three modes: Production, Idle and Long Term Preservation.

Production Mode: the State of Victoria issues on the 1st of April a Supply Notice indicating the amount of Desalinated Water to be produced during the Supply Period. Watersure develops in response, a Supply Plan outlining the approach to delivering the required volume of water over the course of the year. The plant then starts delivering Desalinated Water to the Transfer Pipeline and discharging brine to the outlet structures: this constitutes the trigger for the implementation of this OMMP. Watersure may operate the plant in a number of ways such that they are able to take advantage of seasonal variations in efficiency of the desalination process, energy costs and operation and maintenance considerations. Thus, for any given yearly scenario the VDP may have periods of brine production (associated with drinking water production) and/or periods where there is no brine production. During periods of drinking water production the discharge will include brine and therefore salinity will be elevated within the Mixing Zone.

Idle Mode: Most equipment remains active and bulk chemicals are available on site. No Desalinated Water is delivered to the Transfer Pipeline and no brine is discharged to the outlet structures. The OMMP is not activated.

Long Term Preservation Mode: when the plant is not required to produce water for extended period of time, the equipment are decommissioned or disconnected, RO membranes preserved in Sodium Bisulphite solution and most bulk chemicals removed from site. No Desalinated Water is delivered to the Transfer Pipeline and no brine is discharged to the outlet structures. The OMMP is not activated.

In Idle and Long Term Preservation mode, Watersure will undertake testing and maintenance tasks associated with preserving the reverse osmosis membranes and other vital equipment and instrumentation. During these periods, discharge to the outlets may occur, but this will not involve brine and the discharge will have a negligible impact. Whole of system testing may occur for short durations during non-production periods. This involves production of brine and permeate immediately recombined as sea water prior to discharge to the marine environment. During this period, very short periods of slightly elevated salinity may occur in the outfall chamber. This does not constitute brine discharge and does not trigger the implementation of the ecological and diffuser monitoring components of this program.

The OMMP is designed to provide flexibility so that monitoring is targeted at risk. Table 5-1 below outlines which components are required at any given time.

Table 5-1: Water Production and Monitoring Need

Monitoring Component	Monitoring Need
In-Plant Water Quality Monitoring (Section 6)	This is a continuous component and is required at all times for all discharges, regardless of whether the plant is producing water, undertaking maintenance or in stand-by.
Diffuser Performance Monitoring (Section 7)	This component relates specifically to elevated salinity and given that following cessation of activities changes in the water column are relatively short lived, this component will be implemented only during periods when brine is being discharged. This component also includes an inspection regime to ensure the outlet structures are operating correctly – these inspections will be undertaken when the plant is discharging, either brine or recirculated sea water. Seabed loggers will be deployed 1 month prior to discharge commencing. Monitoring is to be undertaken until sufficient data has been collected to demonstrate mixing is as predicted (this will be determined in consultation with the Subject Matter Expert and EPA).
Ecological Monitoring (Section 8)	The monitoring is required during operation when brine is being discharged, until Watersure and the External Subject Matter Expert are able to confirm there are no impacts outside of the Mixing Zone (assuming normal plant operations). Surveys are to commence at the issue of a Supply Notice or as soon as practicably possible thereafter. Monitoring is to be reviewed at the end of Supply Period. A period of Recovery Monitoring will be included if necessary. The duration and nature of Recovery Monitoring will be dependent on various factors to be considered at the end of Supply Period review.
Direct Toxicity Assessment (Section 9)	Required only when the character of the discharge changes, or if the desalination process is modified. Direct toxicity assessments may also be undertaken at the request of EPA for the purposes of meeting the requirements of the discharge licence.

6 In-Plant Water Quality Monitoring

IN-PLANT WATER QUALITY MONITORING – quick check matrix

Who	**Watersure Environmental Manager**
What	• Continuous monitoring of plant operations to include total volume, flow rate of discharge, conductivity, dissolved oxygen, turbidity, temperature and pH; and • Measurements of chemical water quality parameters in the outfall chamber (metals and nutrients).
When	• Monitoring of the plant's intake water and outlet water began on commencement of seawater intake and will be conducted throughout the O&M phase of the Project; • Daily monitoring of intake and outlet water salinity (TDS calculation from conductivity and temperature), total volume, flow rate of discharge calculation, conductivity, dissolved oxygen, turbidity, temperature and pH; and • Testing for metals in the outfall chamber every six months during discharge operations.
Where	• Sampling panels located at the seawater lift pump station launder and outfall chamber.
Why	• Regular checking of plant performance; • To initiate early preventative action if there is an exceedance in-plant; and • To allow a weight of evidence approach in response to detecting *in situ* impacts (marine environment and coastal process monitoring).
How	• Automated online analysers at the seawater lift pump station launder and outfall chamber; and • Chemical analysis of water from the outfall chamber.

6.1 Objectives

The objectives of the In-Plant Water Quality Monitoring are:

- To assist operators to comply with the Discharge Licence and conditions LI_G2, LI_G3, LI_G4, LI_G5, LI_DW2, LI_DW2.11, LI_DW2.12, LI_DW2.13 and LI_DW3;
- To determine the daily average ambient salinity (as calculated from electrical conductivity and temperature) of the intake for comparison to the outlet;
- Provide an early warning of any unexpected changes in water quality at the plant prior to discharge to the marine environment;
- Calculate the expected degree of mixing within the Mixing Zone using salt as a proxy; and
- To assist operators to comply with the Performance Requirements 31195, 31197, 33208, 33210 and 33212.

6.2 Overview

In-plant monitoring is a key component of the early warning of potential impacts in the marine environment. Continuous monitoring of the plant is a safety feature to ensure that corrective actions can be initiated before they manifest as impacts in the marine environment. This monitoring component is a Tier 1 component and is closely aligned with the Diffuser Performance Monitoring (Section 7) and Ecological Monitoring (Section 8) components as follows:

- The ambient salinity as measured at the intake can be compared to the results of the in-plant monitoring at the outlet to determine if the plant is operating as expected; and
- The salinity as calculated from the in-plant monitoring (and therefore dilution of other constituents) can be compared to the actual salinity measurements taken from the seabed loggers (refer to Section 7). This can then be used in the impact assessment undertaken for the Ecological Monitoring (Section 8).

6.3 Method and Control System

The Plant Control System is fully automated and will automatically shut down immediately if the appropriate triggers occur. Online analysers continuously monitor water quality parameters at the Plant Outlet (Outfall Chamber where all liquid streams are collected prior to entering the outlet tunnel). These analysers are connected to a plant wide control system (computer control) which also receives information on water quality from online analysers at other systems and sub systems, including the Plant Intake and Intake Launder (where seawater is drawn into the Seawater Lift Pump Station). The control charting system approach described below applies to all of the monitored systems and sub systems, although the parameters at the outlet have increased importance (due to risk to the environment) and are more closely monitored by operations personnel (i.e. they are “High Priority”, see below). Thus, the Outfall Chamber water quality monitoring can be seen as a final step in continuous monitoring and control of water moving through the plant from the intake to discharge.

The management of the plant to ensure that water quality is maintained, both in terms of the potable water production and the discharge to the outlet, is through control charting, using specific ranges for each parameter. At the most basic level, when the monitoring system detects that a parameter has moved outside of those limits, the process is adjusted in order to bring the parameter back within an acceptable range. Note that parameters may have both upper and lower limits (e.g. pH) or may be ‘open ended’ with either a lower limit or an upper limit – examples are turbidity which has no lower limit and dissolved oxygen which has no upper limit.

For the Outfall Chamber, all monitored parameters (see Table 6-1) are considered ‘High Priority’ and any Warnings or Triggers require immediate action from operations personnel if the system does not automatically respond or is unable to correct the problem. High Priority applies to any parameter monitored that may impact outlet water quality or drinking water quality. If appropriate action to correct the process cannot be taken the Plant will “automatically shut down” and prevent any discharge to the offsite environment.

The following sections outline how the system controls and responds to changes in water quality, through use of Process Target Ranges, Warnings and two levels of Trigger action and reporting.

6.3.1 Process Target Range

The Process Target Range is what would be considered normal operation and defines the water quality required to achieve a specific process outcome (see Figure 6-1) and also to ensure the Discharge Licence Discharge to Water Requirements (see Table 2-3) are not exceeded. The control system will continuously monitor and automatically adjust the control actions to maintain the process parameter within this range.

6.3.2 Warning Triggers, Level 1 Triggers and Level 2 Triggers

Responses to excursions outside of the Process Target Range are controlled by a hierarchy of Warning → Level 1 Trigger → Level 2 Trigger. In all cases the Warning Trigger, Level 1 Trigger and Level 2 Trigger are automatic responses to a parameter exceeding a given value for a pre-set period of time (see Table 6-1 and see Figure 6-1).

If a parameter moves outside of the Process Target Range then the operator will adjust the process to return to the desired value. However, if the parameter continues to rise or fall and exceeds the Warning Limit value a countdown begins until the pre-set period is reached (normally 60 consecutive minutes). At this time, the Warning Trigger is initiated and a Warning will be displayed on the control system. This indicates that the system therefore requires an immediate response to investigate the excursion and bring the process parameter back into the Process Target Range. If the excursion continues the parameter may rise above or drop below the Level 1/Level 2 Trigger limits which are set at the Discharge Licence Discharge to Water Requirements. In the case of a Level 1 Trigger, this is a response to the parameter exceeding the limit for a pre-set duration of time (normally 60 consecutive minutes). This in itself is not a non-compliance with the Discharge Licence as the limits are for measurements averaged over 24 hours. Therefore a Level 2 Trigger is a response to the parameter exceeding the limit over a 24-hour averaged period (see Figure 6-1 and Table 6-1).

Under normal situations, it is expected that intervention by operations personnel and rectification will bring the process parameter back into the Target Range, within the trigger time period. Should the excursion persist and a Warning or the Level 1 Trigger is reached, the fault is elevated for further investigation (and action) by the wider team. If the excursion persists further and the daily (24hr) average is exceeded then the fault is reported to external parties, including EPA. If a Level 2 Trigger is incurred, the operations personnel will perform calculations to determine the concentration of all components in the environment, in accordance with the Diffuser Performance component (see Section 7). A Level 2 Trigger is considered the most serious excursion and would require immediate rectification and may result in shut down of the sub system, system or the entire plant.

Figure 6-1 represents a hypothetical situation pictorially, with the sequence of initiation of the Warning and Triggers discussed above with the parameters and limits shown in Table 6-1.

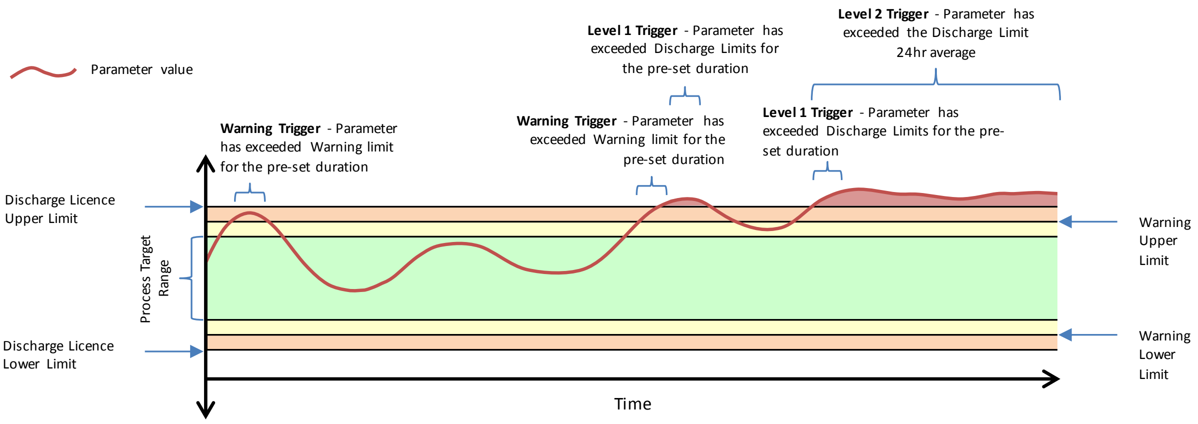

Figure 6-1: Process Parameter Warning and Trigger Definitions

Notes to Figure 6-1: Process Parameter Warning and Trigger Definitions:

The yellow zone indicates that the parameter has exceeded the Process Target Range but has not reached the Warning Limit. The system will automatically attempt to bring the parameter back within the Target Range.

A Warning is triggered if the parameter remains in the orange zone for the pre-set period (60 consecutive minutes). The operator is notified and will attempt to rectify the problem to bring the parameter back to within the Process Target Range.

The red zones indicate an exceedance of the Discharge Limit value. If the exceedance persists for the pre-set period (60 consecutive minutes) then a Level 1 Trigger will be initiated. The system will continue to automatically adjust the process but the excursion will be elevated for further investigation (and action) by the wider team.

If over a 24-hour period the parameter average has exceeded the Discharge Limit then a Level 2 Trigger is initiated. In this case reporting to external parties, including the EPA is necessary. Shut down of the sub system or system responsible may be initiated.

6.3.3 Outfall Water Quality Parameters

Table 6-1 below outlines the High Priority water quality parameters measured at the Outfall Chamber together with the relevant ranges and triggers.

Table 6-1: Outfall Water Quality Parameters

Water Quality Parameter	Process Target Range	Warning Trigger	Level 1 Trigger	Level 2 Trigger
Dissolved Oxygen (mg/L)	> 6 mg/L	< 4.5 mg/L more than 60 consecutive min.	< 4 mg/L more than 60 consecutive min.	Daily (24hr) average < 4 mg/L
Electrical Conductivity (mS/cm)	<90 mS/cm	> 98 mS/cm more than 60 consecutive min.	> 100 mS/cm more than 60 consecutive min.	Daily (24hr) average > 100 mS/cm
Turbidity (NTU)	< 4 NTU + surface water (SW) turbidity	> 5 NTU+ SW turbidity more than 60 consecutive min.	> 6 NTU+ SW turbidity more than 60 consecutive min.	Daily (24hr) average > 6 NTU+ SW turbidity
pH	6.5 to 8.5	> 8.8 or < 6.2 more than 60 consecutive min.	> 9.0 or < 6 more than 60 consecutive min.	Daily (24hr) average > 9.0 or < 6

Note: Background data is obtained from the intake online analysers.

Salinity as TDS will be calculated automatically by the control system from temperature and conductivity. The TDS/conductivity ratio is determined based on NATA accredited laboratory monitoring results.

In addition to the continuous monitoring described above, the following daily calculations will also be made. Data will be obtained from the control system:

- The total volume and average flow rate of the discharge going into the marine environment (determined from mass balance and/or the number of seawater lift pumps in operation); and
- Daily average salinity of the discharge to marine waters.

6.3.4 In-Plant Chemical Water Quality Monitoring

As daily plant measures are simply proxies for concentration of chemical constituents, in-plant chemical water quality monitoring will also be undertaken to ensure that the discharge constituents are as predicted.

Three replicate grab samples will be taken from the Outfall Chamber at each sampling event. A comprehensive analysis of the water quality of the discharge will confirm the on-going use of daily plant parameters as sufficient proxies of brine discharge quality. Testing for metals and non-metals will be conducted every six months during operations.

The metals to be monitored in-plant (at the Outfall Chamber) include those listed in Table 6 5, which were identified in the Works Approval Application (Section 14.5.5.3) as the metals of concern. Once measured and analysed, a calculation can be made to determine whether concentrations of parameters exceed ANZECC & ARMCANZ (2000a) trigger values (or otherwise) in the environment, by determining their likely dilution based on Diffuser Performance Monitoring (Section 7).

Table 6-2: Metals to be measured for Discharge Water Quality Monitoring (Outfall Chamber)

Analyte	Symbol	Unit	Method	LOR
Aluminium (Filterable)	Al	mg/L	ICP-AES	0.01
Aluminium (Total)	Al	mg/L	ICP-AES	0.01
Arsenic	As	mg/L	ICP-AES	0.002
Boron	B	mg/L	ICP-AES	0.003
Cadmium	Cd	mg/L	ICP-AES	0.002
Chromium	Cr	mg/L	ICP-AES	0.001
Copper	Cu	mg/L	ICP-AES	0.001
Lead	Pb	mg/L	ICP-AES	0.002
Filterable Iron	Fe	mg/L	ICP-AES	0.002
Total Iron	Fe	mg/L	ICP-AES	0.01
Filterable Manganese	Mn	mg/L	ICP-AES	0.0002
Total Manganese	Mn	mg/L	ICP-AES	0.0002
Mercury	Hg	mg/L	ICP-AES	0.0005
Molybdenum	Mo	mg/L	ICP-AES	0.0005
Nickel	Ni	mg/L	ICP-AES	0.004
Selenium	Se	mg/L	ICP-AES	0.002
Silver	Ag	mg/L	ICP-AES	0.001
Tin	Sn	mg/L	ICP-AES	0.01
Vanadium	V	mg/L	ICP-AES	0.001

Analyte	Symbol	Unit	Method	LOR
Zinc	Zn	mg/L	ICP-AES	0.002

ICP-AES = Inductively coupled plasma atomic emission spectroscopy; LOR = Limit of Reporting

6.4 Data Analysis and Calculations

In-plant measures of constituent concentrations and the expected/measured dilution (D) at the Mixing Zone sites and Test Zone sites will be used to calculate the concentration (C) of each water quality parameter at the Mixing Zone sites and Test Zone sites. The 30:1 dilution (based on ecotoxicology results provided in the Ecotoxicology Assessment for Works Approval 2.2 – 2.3 (Thiess Degrémont Joint Venture, 2010b) (TDV-EN-0-X-000-0004-0-00) and the Direct Toxicity Assessment for the Section 30A Commissioning Approval (Thiess Degrémont Joint Venture, 2012c) (TDV-0-CM-RP-0001-D) will be used in this calculation, or the actual dilution, as measured according to the Diffuser Performance Monitoring component (Section 7) will be used. The concentration (C) of each water quality parameter at the Mixing Zone sites and Test Zone sites will be determined using:

$$C = (CB) / (D)$$

where:

CB = concentration of the constituent in the desalination effluent discharge.

D = the dilution at the Mixing Zone sites and Test Zone sites.

6.5 Corrective and Investigative Actions

In the event that data analysis determines a potential impact (e.g. if concentrations of a constituent exceed the 30:1 safe dilution at Test Sites (refer to Table 7-1) or the ANZECC Water Quality Guidelines (ANZECC & ARMCANZ, 2000a) or in the event of a Level 2 Trigger), corrective actions will be implemented and include the following:

- Log the Exceedance/Trigger;
- Investigate the source and cause of the Exceedance/Trigger;
- Rectify the fault that caused the Exceedance/Trigger. In the case of a Trigger, this could include stopping the section of the plant that is causing the fault;
- Instate rectification procedure and preventative procedures in place to ensure that the breach does not reoccur; and
- By-pass with raw seawater until dilution target is achieved. The plant may not always operate at full capacity. 2.09 m3/s flow rate is the minimum flow rate of brine without by-pass (see Section 3.2.1):
    - If required, by-pass flow will be used to maintain a minimum discharge flow of 2.09 m3/s; and
    - If the daily average salinity recorded at the plant outlet (as calculated from electrical conductivity and temperature) is less than a calculated mixing of 30:1 at any of the Test Zone Sites, the plant will by-pass the discharge of brine until the salinity is reduced to a level that will achieve a dilution ratio of 30:1.
- Consult with relevant Government Agencies to determine if further investigative monitoring is required.

Should there be multiple breaches caused by the same component / subsystem, the component is to be taken out of service and a detailed investigation and rectification performed to ensure the breach does not reoccur.

6.6 Reporting and Review

Daily plant operations will be reviewed and provided in a monthly report to be issued to AquaSure and DELWP. The ongoing plant performance report will also be included in the end of Supply Period, Recovery Monitoring and/or exception (e.g. impact) reporting for the Ecological Monitoring component (refer to Section 8).

A Level 2 Trigger will be reported to AquaSure, DELWP and EPA within twenty-four hours by telephone or email. An Incident Report will be prepared for any Level 2 Trigger, when a value exceeds ANZECC & ARMCANZ (2000a) trigger at any of the Test Sites and/or if the 30:1 dilution is not met.

7 Diffuser Performance Monitoring

DIFFUSER PERFORMANCE – quick check matrix

Who	**Watersure Environmental Manager.**
What	• Monitoring of salinity around the outlets and Mixing Zone and confirmation of the integrity of the diffuser structures.
When	• Salinity logger monitoring will be conducted on a continuous basis during production when brine is discharged, until sufficient data has been collected to demonstrate mixing is as predicted, after which the monitoring program may be reduced or removed. • The diffusers will be visually inspected prior to discharge of brine, within 2 weeks of first brine discharge and on a monthly basis. The inspection regime will be subject to a 6-monthly review. • During periods of idle operation and long term preservation the diffusers will be visually inspected on an annual basis.
Where	• Mixing Zone and diffuser structures.
Why	• Diffuser Performance Monitoring is required to meet Performance Requirements and as part of the plant Discharge Licence under the Environment Protection Act 1970.
How	• Continuous Measurements of salinity using fixed logger locations and inspections of the diffuser structures.

7.1 Objectives

The objectives of the Diffuser Performance Monitoring component are to:

- To assist operators to comply with the Discharge Licence and conditions LI_G2, LI_G3, LI_G4, LI_G5, LI_DW2, and LI_DW3;
- Assess and validate the performance of the diffusers with respect to dilution of the discharge in the vicinity of the outlets;
- Confirm the integrity of the outlet structure and check for leaks;
- Validate the In-Plant Water Quality Monitoring and dilution calculations;
- Confirm that beneficial uses are maintained at Test Sites (see Table 7-1) and compliance with SEPP (WoV); and
- To assist operators to comply with the Performance Requirements 31195, 31197, 33208, 33210 and 33212.

7.2 Overview

As baseline conditions have been established previously (EES Technical Appendix 23, (Department of Sustainability and Environment, 2008)), it is not necessary to measure water quality parameters (other than salinity) in the receiving environment, as these will be calculated using brine concentration as a proxy for dilution. The monitoring has been designed to allow continuous collection of data from a number of sites around the outlet in order to determine actual dilutions and thus how well the diffusers are performing. This also allows confirmation that the safe dilution factor of 30:1 is met. The 30:1 dilution has been selected to ensure that salinity is within 1 PSU of background based on the hydrodynamic modelling (see Section 3.2.1).

Fixed site monitoring of salinity at seven sites, co-located with those used for the Ecological Monitoring component (refer to Table 7-1 for sites selected) will occur on a continuous basis during brine production providing field verification data of diffuser performance. The seven sites have been selected as these provide sufficient spatial coverage, including Mixing Zone and Test Zone sites. This site selection also facilitates collection and changeover of the loggers within a short time period (i.e. the total field time required to visit and exchange all loggers is 1-2 days). These loggers will monitor the salinity at a frequency of at least once per minute and be collected and replaced monthly when in use.

During commissioning of the plant a construction defect occurred with the outlet structures that resulted in leakage of water from areas other than the designated points. This defect was rectified and testing of the structures successfully completed, confirming the performance. Visual inspection of the diffuser structures will be used to confirm the ongoing performance of the diffusers.

7.3 Method

7.3.1 *In situ* Salinity Monitoring

Fixed site salinity loggers will be co-located with offshore ecological monitoring sites that are in close proximity to the area of expected impact (Table 7-1, Figure 7-1). This will ensure a weight of evidence approach is possible when assessing for salinity impact.

Two types of logger will be used, the Seabird Electronics SBE37 salinity logger (or equivalent) and the Seabird Electronics SBE16plus (or equivalent) salinity and dissolved oxygen logger.

The salinity loggers are mounted on frames attached to the seabed and are easily deployed or exchanged by diver. Watersure will ensure loggers are in place as soon as practicable, but ideally 1 month prior to brine discharge following issue of a Supply Notice (note deployment will be weather dependent). Data from fixed salinity loggers will be collected on a monthly basis, subject to weather conditions, for the first 12 operational months following the first Supply Notice or until sufficient data has been collected to demonstrate that mixing is as predicted by previous modelling work. Determination of what constitutes sufficient data will be done through external review by a Subject Matter Expert and consultation with the EPA. The loggers will be retrieved and a new set deployed at the same time.

Table 7-1: Monitoring Sites for the Diffuser Performance Monitoring

Site No	Designation	Parameters	Easting	Northing	Distance from outlet	95thpercentile PSU increase above ambient	
						50 GL/yr	150 GL/yr
236	Test Zone 1	Salinity	369903	5727155	632m	0.25	0.40
233	Test Zone 2	Salinity	370111	5726739	188m	0.78	0.78
234	Test Zone 3	Salinity	370164	5726483	192m	0.48	0.65
242	Mixing Zone 1	Salinity	370185	5726692	100m	1.25	0.93
243	Mixing Zone 2	Salinity and Dissolved Oxygen	370310	5726611	49m	0.65	0.94
244	Mixing Zone 3	Salinity	370353	5726584	100m	0.56	0.68
235	Mixing Zone 4	Salinity	370391	5726560	145m	0.60	0.64

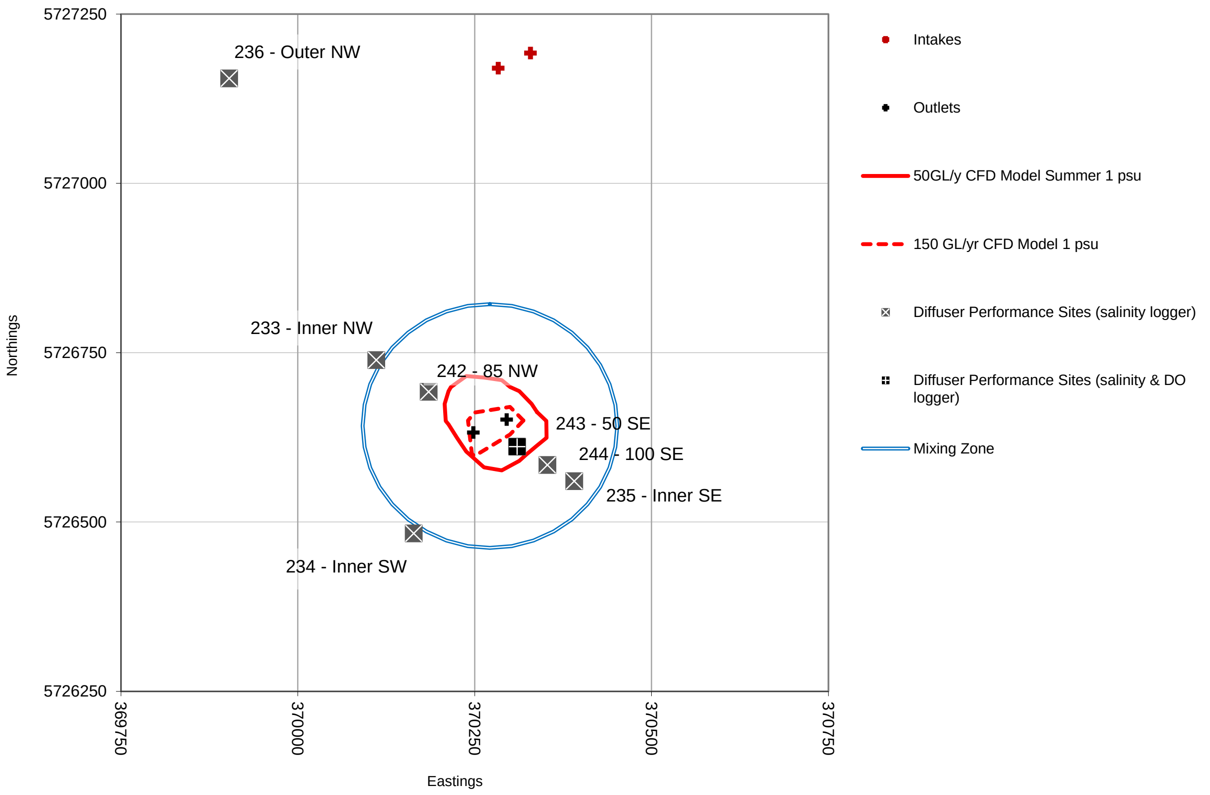

Figure 7-1: Diffuser Performance Monitoring Locations

7.3.1.1 Seawater Sampling

When the loggers are first deployed and subsequently exchanged thereafter, a seawater sample will be collected at each site as close as practical to the logger and, in any case, as close as practical to the same height off the seabed as the logger, and the time logged to allow direct comparison with logged data. These samples will then be sent to an appropriately qualified laboratory for high precision salinity determination.

7.3.2 Diffuser Inspections

To ensure that the discharge is exiting the diffuser nozzles at the correct points and no leakage is present, visual inspections will be completed by qualified divers (under suitable weather conditions). The inspection regime will be as follows:

- Annual visual inspections during periods of idle operation and long term preservation. Seawater will be circulated during inspections and the diffusers checked for leakage.
- A visual inspection will be completed prior to first brine discharge with seawater circulating at 150GL/yr equivalent flow rate.
- A visual inspection will be completed within 2 weeks of first brine discharge (or as soon as possible in the event of adverse weather conditions)
- Monthly diffuser inspections will be completed during the first twelve months of brine production after which the inspection regime will be reviewed in consultation with EPA.
- Divers will report any leakage as soon as practical or immediately upon completing the inspections and when safe to do so, to the Plant Environmental Manager who will in turn immediately notify AquaSure, EPA and DELWP.

The inspection regime documented and described in detail in the Computerised Management and Maintenance Scheduler (CMMS).

7.4 Data Analysis and Calculations

7.4.1 *In situ* Salinity Monitoring

The increase in salinity (ΔS) at the Mixing Zone and Test Zone sites above ambient (in-plant intake) is calculated as follows:

$\Delta S = SM - SS$

while the dilution or dilution factor at the Mixing Zone and Test Zone sites is calculated using the following formula:

Dilution Factor = $D = (SB - SS) / \Delta S$

where:

SB = salinity of the discharge;

SM = averaged salinity for each Mixing Zone and Test Zone site; and

SS = background salinity of the seawater (in-plant at the intake launder).

These dilutions can then also be compared with the dilutions predicted by the hydrodynamic modelling.

An incident will be triggered in the event that the discharge has exceeded 1 PSU above ambient on average, outside of the Mixing Zone, for more than 5% of the Supply Period (as measured over 12 months).

7.4.2 Seawater Samples

Salinity of the seawater samples will be compared to salinity computed from data collected by the benthic loggers. The sample data is used to provide an absolute reading against which all measurements can be compared. If necessary, the benthic logger data can be adjusted to ensure consistency across multiple units.

7.5 Corrective and Investigative Actions

In the event that the diffusers are not achieving the dilution target (either through inspection or *in situ* salinity measurements) and/or there is an increase in excess of 1 PSU above ambient on average, outside of the Mixing Zone, for more than 5% of the Supply Period (as measured over 12 months), the following will be implemented:

- Inspection of the diffusers (only under suitable weather conditions);
- Completion of any required maintenance to the diffusers;
- Consult with relevant Government Agencies to determine if further investigative monitoring is required. Investigative monitoring to be designed in consultation with relevant Government Agencies;
- A review of, and potential changes to operational procedures (e.g. changes to seawater by-pass). Following consultation with the relevant Government Agencies this may include ceasing operation if appropriate; and
- Review of the diffuser design and modifications to the diffusers if necessary.

7.6 Reporting and Review

Reports of *in situ* salinity monitoring will be issued to AquaSure, and DELWP on a monthly basis or as soon as practical in the event of delays caused by adverse weather conditions.

AquaSure, DELWP and EPA will be notified within twenty-four hours or as soon as practicable by telephone or email of any incidents and/or defects in the diffusers. Reports of diffuser inspections and any rectification works will be reported to AquaSure, DELWP and EPA following completion of the works.

8 Ecological Monitoring

ECOLOGICAL MONITORING – quick check matrix

Who	**Watersure Environmental Manager**
What	Monitoring of marine flora and fauna: • Reef canopy cover and benthic community: (entrainment effects 18 m to 20 m approximate depth, saline discharge 24 m to 26 m depth) quantified image analysis e.g., video frame; • Vertical reef face community: (entrainment effects 18 m to 20 m approximate depth) quantified image analysis e.g., photoquadrats; and • Recruitment: (entrainment effects 18 m to 20 m approximate depth, saline discharge 24 m to 26 m depth) settling plate methods.
When	• On a quarterly basis (or as otherwise determined by Watersure's technical group in consultation with the Subject Matter Expert and EPA), during brine production, until a number of operational surveys needed to determine an agreed level of impact outside of the Mixing Zone, assuming normal plant operations. Monitoring will commence immediately upon a Supply Notice, or as soon as practicable (for example monitoring is weather dependent). Monitoring will be reviewed at the end of the Supply Period and Recovery Monitoring will then commence if required. The duration and nature of Recovery Monitoring will be dependent on events during operation, data analysis etc.
Where	• Twelve offshore sites (Water depths >15m) within and outside of the Mixing Zone; • Eight inshore sites (water depth <15m).
Why	• Validate that the potential impacts to flora and fauna are within the scale predicted by the EES; • Detect changes due to salinity exposure on the reef community in the path of dispersing plume; • Detect changes to nearshore reef biodiversity due to combined effects of larval entrainment into intake and transport of reef larvae away from nearshore reefs by brine discharge induced currents; and • Inform environmental managers of the need for further targeted assessment or investigation, future mitigation or immediate action.
How	• Reef communities using video frames and photoquadrat methods; and • Recruitment using settlement plates.

8.1 Objectives

The objectives of the marine ecological monitoring are to:

- To assist operators to comply with the Discharge Licence and conditions LI_G2, LI_G3, LI_G4, LI_G5 and LI_DW3;
- Detect changes due to salinity exposure on the reef community in the path of dispersing plume;
- Detect changes to nearshore reef biodiversity due to combined effects of larval entrainment into intake and transport of reef larvae away from nearshore reefs by brine discharge induced currents;
- Inform environmental managers of the need for further targeted assessment or investigation, future mitigation or immediate action; and
- To assist operators to comply with the Performance Requirements 31195, 31197, 32207, 33208, 33210 and 33214.

8.2 Overview

The risk and impact assessments have shown that marine communities associated with reef habitat at depths of approximately 20 m (indirect effects) and 24 m (combined direct and indirect effects) are most at risk from operation of VDP. Sessile benthic plants and animals associated with the reefs are most likely to express the combined consequence of entrainment and brine discharge and as such have been selected as the most appropriate indicator group. Hence, the monitoring focuses on:

- The naturally occurring sessile benthic species such as kelps and other macroalgal species and larger sessile (and mobile) invertebrates that occur on vertical reef faces and crevices; and
- Patterns (spatial and temporal) of recruitment of benthic sessile species onto artificial habitats.

The monitoring is broadly divided into two regions (Offshore and Inshore) with different potential impacts influencing each region. In each region there are Monitoring Components which target specific monitoring indicators (see Section 8.3.4).

The following methods have been selected for use in the Ecological Monitoring component:

- Reef canopy / benthic community: (entrainment effects 18 m to 20 m approximate depth, saline discharge effects 24 m to 26 m depth) quantified image analysis e.g., photoquadrat, video grab;
- Reef vertical face and/or crevice community: (entrainment effects 18 m to 20 m approximate depth) quantified image analysis e.g., photoquadrat, video grab; and
- Recruitment: (entrainment effects 18 m to 20 m approximate depth, saline discharge effects 24 m to 26 m depth) settling plates.

8.3 Method

Detailed survey methods and techniques are provided in the Standard Operating Procedures (SOP's) developed for the BMMP and are summarised below.

1. **Offshore Region** - offshore monitoring is based on 12 sites which include four sites within the Mixing Zone, four sites within the Test Zone and four sites within the Reference Zone (see Section 3.2.3 for the significance of these designations and Figure 8-1). The Mixing Zone is adjacent to the outfall diffusers, the Test Zone is adjacent to the Mixing Zone and the Reference Zone is distant from the Mixing Zone (> 1000m). The monitoring methods are:
    - Reef canopy video based surveys. 30 frames are collected from each site/transect; and
    - Settlement plates.
2. **Inshore Region** - power of the sampling design is expressed in terms of the ability to detect differences between four central inshore sites and four peripheral inshore sites. The monitoring methods are:
    - Reef canopy video based surveys. 50 frames are collected from each site/transect;
    - Reef vertical faces. 30 photoquadrats per site; and
    - Settlement plates.

8.3.1 Monitoring Duration

For all methods, monitoring is to commence upon issue of a Supply Notice or as soon as practicable (e.g. monitoring is weather dependent). Monitoring is to continue on a quarterly basis throughout operation until the required number of operational surveys have been completed (refer to Sections 8.4.1.1 to 8.4.1.5), after which Watersure will make a determination, in consultation with the Subject Matter Expert and EPA if further monitoring is required.

8.3.2 Recovery Monitoring

Recovery Monitoring is a continuation following delivery of a water order. The need, design, extent and duration of this monitoring will be determined by the Watersure in consultation with the Subject Matter Expert and EPA, at the end of Supply Period review. Recovery Monitoring may be implemented in response to an actual or suspected impact being detected or in the event that there is insufficient data or confidence to be able to conclude that impacts have not occurred.

8.3.3 Monitoring Locations

Monitoring locations and coordinates are given in Table 8-2, Table 8-2 and plotted in Figure 8-1.

Table 8-1: Inshore Monitoring Locations and Analysis Designations

Site Number	Site Name	Designation	Easting	Northing	Distance from Outlet (centre)
224	Northern Step	Impact Zone 1	370234	5727382	741m
103	Shallow central B	Impact Zone 2	370392	5727590	956m
104	Shallow central	Impact Zone 3	370814	5727130	730m
231	Park Boundary	Impact Zone 4	370900	5726900	679m
111	Far site west	Reference Zone 1	369143	5729018	2631m
112	Far site east	Reference Zone 2	371461	5726059	1325m
102	Shallow northwest	Reference Zone 3	369943	5728079	1474m
105	Shallow southeast	Reference Zone 4	371907	5725489	2001m

Table 8-2: Offshore Monitoring Locations and Analysis Designations

Site Number	Site Name	Designation	Easting	Northing	Distance from Outlet (centre)	95thpercentile PSU increase above ambient	
						50GL/yr	150GL/yr
240	1500 W	Reference Zone 1	369358	5727823	1493m	0.09	0.10
241	1000 W	Reference Zone 2	369712	5727471	1000m	0.15	0.20
236	Outer NW	Test Zone 1	369903	5727155	632m	0.25	0.40
233	Inner NW	Test Zone 2	370111	5726739	188m	0.78	0.78
242	85 NW	Mixing Zone 1	370185	5726692	100m	1.25	0.93
243	50 SE	Mixing Zone 2	370310	5726611	49m	0.65	0.94
244	100 SE	Mixing Zone 3	370353	5726584	100m	0.56	0.68
235	Inner SE	Mixing Zone 4	370391	5726560	145m	0.60	0.64
234	Inner SW	Test Zone 3	370164	5726483	192m	0.48	0.65
206	Outer SE	Test Zone 4	370550	5726266	468m	0.22	0.45
245	1000 E	Reference Zone 3	370956	5725914	999m	0.12	0.20
246	1500 E	Reference Zone 4	371216	5725486	1487m	0.10	0.16

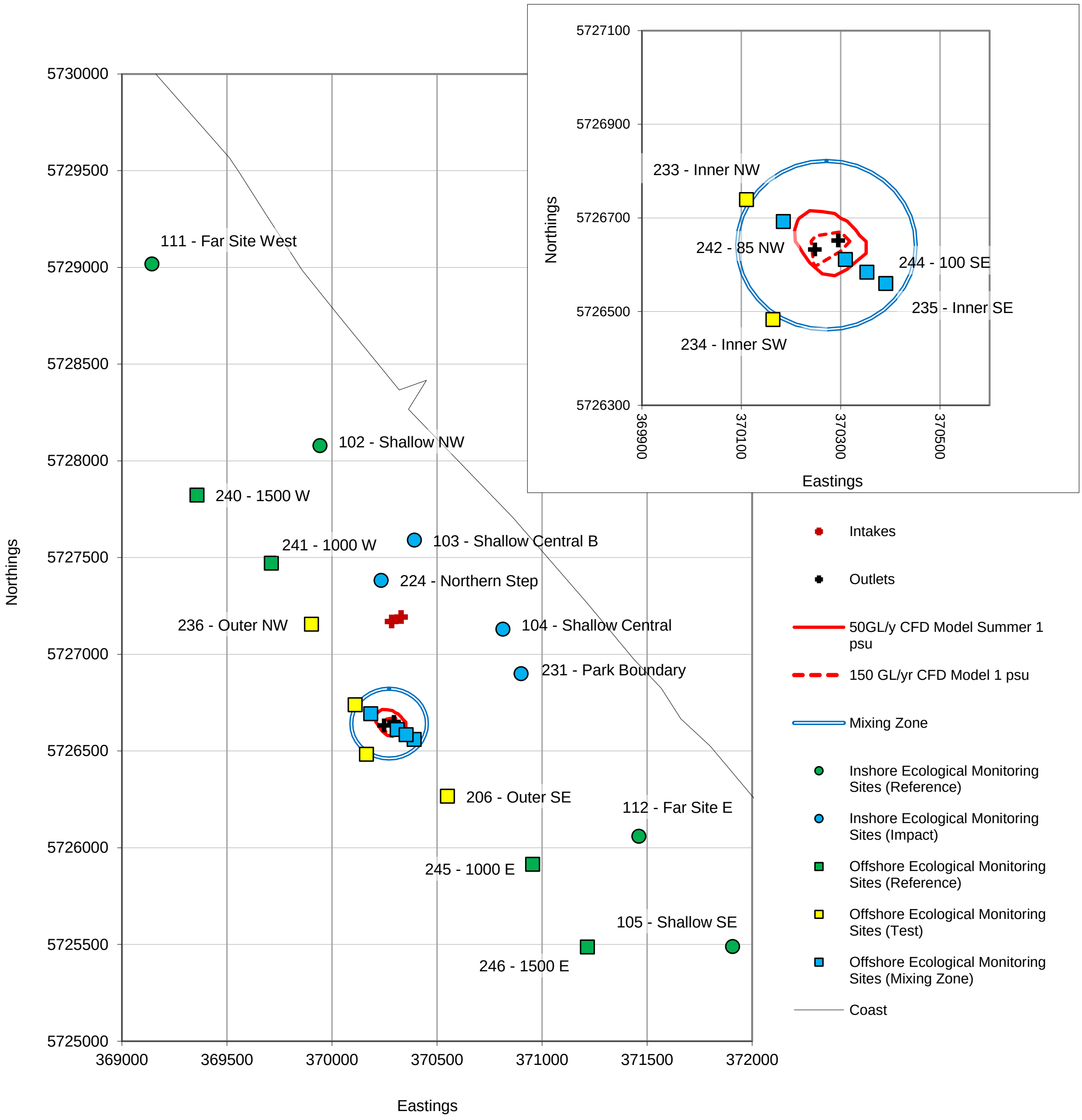

Figure 8-1: Monitoring Sites and Salinity Contours for 50GL/yr and 150GL/yr (95thpercentile) Equivalent Desalinated Water Production

8.3.4 Indicators

Different indicators are measured for each monitoring component, depending on the composition and abundance of the flora and fauna (Table 8-3). Monitoring indicators have been designated as primary or secondary. A primary monitoring indicator has strong biological relevance, and can be estimated with reasonable precision. Secondary indicators are generally rarer than primary indicators and are estimated with lower precision.

Table 8-3: Indicators of the Ecological Monitoring Component.

Method	Sites	Unit	Analysis	Indicator	Indicator Type	No. Indicators
Inshore Reef Canopy	8	50	Horizontal point count	% cover of: *Ecklonia + Phyllospora*, *Ecklonia, Phyllospora*, other Rhodophyta	Primary	4
				Brown algae, Encrusting Corallines	Secondary	2
Inshore Reef Vertical Faces	8	30	Vertical point count	% cover of Rhodophyta, Encrusting Corallines, Encrusting Sponges, Hydroids	Primary	4
				Sonderpelta/Peyssonnelia, *Echinochalina* sp., Erect corallines , Ascidia	Secondary	4
Inshore Settlement Plates	8	4	Visible under microscope	Shannon Diversity, Gini-Simpson Diversity, Taxon Richness	Primary	3
				% cover of Serpulids, Forams, Didemnids	Secondary	3
Offshore Reef Community	12	30	Horizontal point count	% cover of Rhodophyta, Encrusting corallines, *Sonderapelta/Peyssonnelia*	Primary	3
				Brown Algae, Erect Corallines, Phaeophyta	Secondary	3
Offshore Settlement Plates	12	4	Visible under microscope	Shannon Diversity, Gini-Simpson Diversity, Taxon Richness	Primary	3
				%cover of Serpulids, Forams, Sponge Vases, Didemnids, Spirobids, Encrusting bryozoa	Secondary	3

8.4 Data Analysis

8.4.1 Summary of Baseline Data

The aims and objectives of the BMMP were to collect a robust baseline data set against which potential impacts resulting from operation of the VDP could be measured.

The baseline period commenced in October 2010 and finished with commissioning activities and discharge of brine in September 2012. A detailed summary of the baseline data is provided in the Quarterly Reports and in particular BMMP End of Baseline and Quarterly Report No. 10 (Degrémont Thiess Services Joint Venture, 2014) (ENV-000-RP-003).

The following summarises the quantity and quality of data collected for each monitoring method.

8.4.1.1 Inshore Reef Canopy

The baseline period for inshore reef canopy (8 sites) numbered 11 surveys. This design has 80% power to detect a 50% reduction after 2 years of monitoring (e.g. 8 surveys), for most taxa. Power is lower for *Phyllospora*, which has 80% power to detect a 60% reduction after 2 years or will require 5 years post operational surveys (20 in total) to have 80% power to detect a 50% reduction. The composite measure of *Ecklonia+Phyllospora* is much better than either *Phyllospora* or *Ecklonia* alone having 80% power to detect a 50% reduction for the composite after 2 years of operational monitoring.

Increases in power beyond 12 surveys (3 years) are marginal as the variance becomes dominated by the variation in the baseline data rather than actual changes observed in the environment.

8.4.1.2 Inshore Reef Vertical Faces

The baseline period for the vertical reef faces (8 sites) numbered 11 surveys. Following 6 operational surveys, this monitoring design has >80% power to detect a 50% reduction for all common taxa (5 surveys are required for *Echinochalina*, 4 surveys for encrusting sponges and 3 surveys for massive sponges, erect coralines, unkown Hydroids and Rhodophyta).

8.4.1.3 Inshore Settlement Plates

The baseline period for the inshore settlement plates (8 sites) numbered 11 surveys. This monitoring design has low to marginal power for most common taxa, but very good power for richness and diversity indices, with >80% power to detect a 50% or more reduction following 4 operational surveys for the Shannon diversity index and 2 operational surveys in the Gini-Simpson diversity index.

8.4.1.4 Offshore Reef Community

The baseline period for offshore reef community (12 sites) numbered 10 surveys. With 4 sites in the Reference Zone and 4 sites in the Test Zone, 10 operational surveys (2 ½ years) are required to detect a 50% reduction in all taxa with >80% power (5 surveys are required to detect a 50% reduction in unidentified brown algae with >80% power, and 3 operational surveys are required to detect a 50% reduction in encrusting coralines, erect coralines, Phaeophyta, other Rhodophyta or *Sonderpelta/Personnelia)*.

8.4.1.5 Offshore Settlement Plates

The baseline period for offshore settlement plates (12 sites) numbered 10 surveys, with two partial deployments. With 4 sites in the Reference Zone and 4 sites in the Test Zone, 8 operational surveys are required to detect a 50% reduction in encrusting bryozoa, 18 operational surveys are required to detect a 50% reduction in Spirobids and 20 or more surveys are required for all other taxa, where detect implies 89% power. Although power for the individual taxa is marginal or poor, the species richness and diversity indices have excellent power. Three post operational surveys are sufficient to give 80% power to detect a 50% reduction in the Shannon index and species richness, and two are sufficient for the Gini Simpson index.

8.4.2 Operational Data Analysis

Comprehensive details of the statistical analysis that are used in the Ecological Monitoring are provided in the BMMP Report (Thiess Degrémont Joint Venture, 2010a) (RP-TDV-EN-1-A-000-0000-0-04) and subsequent Quarterly Reports (specifically refer to BMMP End of Baseline and Quarterly Report No. 10 (Degrémont Thiess Services Joint Venture, 2014) (ENV-000-RP-003). Briefly however, two distinct monitoring paradigms are considered within each of the regions:

- Multiple-Before-After-Control-Impact (MBACI) approach (that considers changes in sites between pre and post operational periods); and
- Gradient approach (that considers changes in post operational conditions along a gradient of impact). Note the gradient approach is included as secondary tool as the MBACI is typically more powerful. It is included as it may provide additional insight when used in conjunction.

To determine whether the VDP is impacting flora and fauna a number of linear comparisons are made with respect to the offshore and inshore locations.

To date, statistical analyses have been based on generalised linear mixed models, analysed using penalised quadratic likelihood approaches. Penalised quadratic likelihood techniques for the generalised linear mixed model are readily available, and are computationally cheap. But it is clear that they do not provide a robust solution to the data generated during the monitoring programme. A generally accepted rule of thumb is that they should not be used when the expected number of counts per unit is less than 5 (Bolker, 2009). For the percentage cover data, only Rhodphyta in the off shore reef canopy satisfy this condition.

Approaches based on the Laplace approximation are more robust, but even the Laplace approximations may break down for low incidence taxa, especially when the variance components are large (Breslow, 2003). For the Marine Ecology monitoring the analysis strategy is to be based on Markov Chain Monte Carlo methods with Gelfland's centering parameterisation (A.E. Gelfand, 1996).

8.4.2.1 Offshore

For the offshore sites (12) these include:

- Reference versus Test. This contrasts the four Reference Zone sites with the four Test Zone sites (which are close to the Mixing Zone). The sites are balanced with respect to any natural NW to SE gradient. This is a primary monitoring comparison. A statistically significant result for this function may indicate an impact outside the Mixing Zone;
- Outer Trend. This is a linear trend statistic for sites outside the Mixing Zone. This may be more powerful than the reference versus impact comparison in the event that reference sites also show some impacts. This is a primary monitoring comparison. A statistically significant result for this function may indicate an impact outside the Mixing Zone;
- Mixing Zone versus Other. This compares sites within the Mixing Zone with sites outside the Impact Zone. This is a secondary monitoring comparison. A statistically significant result for this comparison does not necessarily indicate impacts outside the Mixing Zone; and
- Overall Trend. This is an overall trend test with distance from the risers. This is a secondary monitoring comparison. A statistically significant result for this comparison does not necessarily indicate impacts outside the Mixing Zone. This comparison will be used to help interpret the results in the event of a statistically significant result on a primary comparison. This comparison allows analysis of differences between sites within the Mixing Zone, as a function of distance from the outlet diffusers.

Primary comparisons have a high likelihood of indicating an environmental impact as the analysis is focused on sites that are not expected to be impacted. Secondary comparisons have a lower likelihood of indicating an impact as the analysis includes sites that are expected to show some degree of change. These comparisons will be performed for all monitoring indicators (refer to Table 8-3).

8.4.2.2 Inshore

For the inshore sites (8), comparisons are defined as linear combinations of site means for each monitoring indicator.

Two linear combinations are considered:

1. Reference versus Impact. This contrasts the four sites nearest to the plant (where any larval entrainment is likely to be greatest) with the four sites furthest from the plant. This is a primary comparison, since a statistically significant result will provide evidence of an impact. It should be noted that this comparison may well detect impacts, even if the reference sites are themselves impacted. For the comparison to be effective it requires only that any impact be greater for the four sites nearest to the plant than for the four sites furthest away (and of course, that the magnitude of such a difference is sufficient, see below); and
2. Trend. This contrast estimates a linear trend with distance from the VDP. This comparison may be more effective than the Reference versus Impact comparison in the event that the two nearer reference sites are impacted.

These comparisons will be performed for all monitoring indicators (refer to Table 8-3).

8.5 Impact Assessment

A statistically significant result in itself is not a trigger that (in isolation) can be directly related to operation of the plant. A statistically significant result will instigate further review and analysis of results to ascertain whether the result can be attributed to the plant.

During operations results will be analysed on a quarterly basis. In the event that an impact is detected through the analysis, which cannot be reasonably ruled out (e.g. due to seasonality or temporal effects), Watersure supported by Watersure’s technical group and the Subject Matter Expert, will consider whether or not, on the balance of probability, there is evidence for an environmental impact beyond that expected. In forming this judgement, Watersure will consider any triggers flagged in reports, and will take a balance of evidence approach: integrating data from across the program. A difference from expected impact will be defined in terms of existence (an effect altogether un-anticipated), spatio-temporal scale and intensity. Any detection of an impact will result in reporting to the EPA together with Watersure’s justification for the determination i.e. a real impact or an artefact due to non-plant related causes.

The framework for Watersure’s decision making, in relation to an exceedance is provided is as follows:

- Analysis and reporting of data from the monitoring program. This will focus on pre-defined primary monitoring indicators and comparisons, and will be supported by secondary indicators and comparisons;
- A statistically significant result on a primary indicator will be taken as providing *prima facie* evidence of an impact, and will trigger review of monitoring results;
- A statistically significant result on a secondary monitoring index (following adjustment using Holm's method) will also be considered to provide *prima facie* evidence of an impact, and will trigger review of monitoring results;
- Reviews will be based on balance of evidence, and will consider the full range of results from primary and secondary monitoring indicators. The outcome of any review will be documented and reported; and
- If the Watersure determines that, on the balance of evidence, there is a plant related impact, then corrective action defined in Section 8.7 will be undertaken.

8.6 Program Adaptation

This monitoring component is not designed to be implemented *ad infinitum*. Instead it is adaptable and may be scaled down or ceased in the event that there are no impacts detected. For example, in the offshore reef community surveys, statistical analyses (see 8.4.1) indicate that between 3 and 10 operational surveys (depending on taxa) are required in order to determine an impact of a 50% reduction with >80% power for all taxa. While greater impacts may be detected earlier, this threshold is considered an industry benchmark and was the target for all monitoring components. Therefore, following the required number of operational surveys (which may be spread over multiple years depending on the Supply Notices received and plant operation) it is possible that a decision may be made that the plant is not resulting in impacts outside of the Mixing Zone (as far as the offshore reef communities component is concerned) and reliance on the other components such as the In-Plant Water Quality Monitoring (Section 6) and/or other Ecological Monitoring methods will be sufficient to maintain compliance with the Discharge Licence. Watersure will undertake ongoing review of each monitoring method to determine if and when the relevant objectives have been met and this component will be adapted accordingly.

8.7 Corrective and Investigative Actions

Corrective and investigative actions for ecological monitoring are related to the in-Plant Water Quality Monitoring and the Diffuser Performance Monitoring (Sections 5 and 7):

1. A water quality exceedance or warning from an in-plant exceedance will result in corrective actions being initiated as required for the In-Plant Monitoring;
2. An *in situ* water quality exceedance at the Test Zone sites will result in corrective actions being initiated as required for the Diffuser Performance Monitoring; and
3. If an impact is detected in a primary or secondary indicator through the BMMP and exceedances in items 1 and 2 above are observed, then the following actions may be initiated:
    - Undertake an investigation to determine if Recovery Monitoring is required and implement if necessary;
    - Toxicity testing in accordance with Section 9, to determine if the discharge is resulting in chronic impacts;
    - Identifying the chemicals contributing to the toxic effects and reducing the usage of those chemicals or substituting them as appropriate;
    - Review of operational procedures. For example, seawater by-pass could be increased at low flow rates to increase dilution;
    - Subject to consultation with the relevant Government Agencies and depending on the severity of any impact detected, ceasing operation of the plant; and
    - Review the diffuser design and modify the diffusers if required.

8.8 Reporting and Review

The results of the Ecological Monitoring will be reviewed and reported at the end of the Supply Period and again at the end of the Recovery Monitoring, if required. In the event of an impact being detected, this will be reported as soon as practicable to AquaSure, DELWP and EPA by telephone or email and in a detailed

Incident Report. Reports will detail any proposed changes to the program and will be subject to review by the Subject Matter Expert.

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9 Direct Toxicity Assessment

DIRECT TOXICITY ASSESSMENT – quick check matrix

Who	**Watersure Environmental Manager**
What	• Laboratory testing of VDP discharge to determine toxicity to selected marine species.
When	• To be undertaken in the event of changes to plant process or water quality.
Where	• Sampling panels located at the seawater lift pump station launder and outfall chamber / off-site laboratory.
Why	• To confirm the safe dilution of the VDP discharge.
How	• Collection of samples from the outfall chamber, transport to an ecotoxicology lab and a series of test performed with varying concentrations. • Analysis of data using accepted software to determine safe dilution factor.

9.1 Objectives

The objectives of this Direct Toxicity Assessment (DTA) are to:

- To assist operators to comply with the Discharge Licence and conditions LI_G2, LI_G3, LI_G4, LI_G5 and LI_DW3;
- Demonstrate that the adoption of 30:1 as a safe dilution factor (no acute toxicity) is appropriate and that the representative concentrate (which contains representative chemical additives) will meet the requirements of the State Environment Protection Policy (Waters of Victoria) (SEPP WoV) environmental quality objectives of 99% ecosystem protection for largely unmodified aquatic ecosystems;
- Confirm that the additives such as cleaning agents are not toxic to marine species at their discharge concentrations; and
- To assist operators to comply with the Performance Requirements 31197, 33210 and 33217.

9.2 Overview

As part of the Environment Effects Statement (EES) investigations, ecotoxicity testing was conducted on local biota to derive a dilution target to achieve 99% species protection level (with 50% confidence) at the boundary of the Mixing Zone. Sampling of the Perth Desalination Plant waste stream water was conducted on two occasions (28th of April 2008 and 23rd of June 2008) to test potential impacts on locally endemic marine biota exposed to an RO discharge. The Perth Desalination Plant provided a representative waste stream to broadly understand the likely ecotoxicity of locally-derived RO discharge (Hobbs and Warne, 2008).

The results of the EES ecotoxicity testing indicated that the biological effects seen in desalination plant discharges are attributed primarily, but not exclusively, to salinity. The EES investigation concluded that a dilution of 30:1 is necessary to meet the required 99% species protection level (SEPP WoV).

To address WAC 2.2 – 2.3, which required confirmation that the safe dilution factor of 30:1 is applicable to the VDP discharge, an ecotoxicology assessment was conducted using an effluent generated with a laboratory scale pre-treatment and RO system using seawater taken from Bass Strait (Wonthaggi). Where possible, the same test species and assessment methods were used, in accordance with the EES ecotoxicology studies (EES Technical Appendix 24, (Department of Sustainability and Environment, 2008)) with any deviations from the EES methods approved by the EPA (Thiess Degrémont Joint Venture, 2010b) (RP-TDV-EN-0-X-000-0004-0-00).

The WAC 2.2 – 2.3 ecotoxicity tests covered 4 sampling regimes that included the average discharge quality together with extremes to cover the worst cases, in terms of expected toxicity (e.g. highest salinity, inclusion of cleaning additives, biocide, pre-chlorination etc. - see Effluent Characterisation Procedure (Thiess Degrémont Joint Venture, 2010c) (RP-TDV-EN-1-A-101-0004)). Results from these tests were consistent with the EES assessment, that a dilution of 30:1 is required to meet the required 99% species protection levels.

Finally, to confirm that actual VDP effluent was consistent with the previous tests, two effluent samples were collected for DTA during the commissioning period. The samples had the appropriate addition of all constituents used in the RO process. These included very small amounts of Clean in Process (CIP) chemicals (cleaning solutions and biocides) at the concentration that they would be found in the effluent (if in use). These studies also confirmed the safe dilution factor of the VDP effluent to be 30:1 (Thiess Degrémont Joint Venture, 2012b).

In the event that the desalination process is modified or the nature of the discharge is substantially altered then further DTA will be performed to ensure the requirements of the State Environment Protection Policy (Waters of Victoria) (SEPP WoV) environmental quality objectives of 99% ecosystem protection for largely unmodified aquatic ecosystems are met. This Section outlines the necessary methodology that should be followed to ensure consistency with previous assessments and to allow for a direct comparison.

9.3 Sampling Method

9.3.1 Sample Collection Method

Extreme care will be taken during collection to avoid contamination of the samples. All equipment to be used for sampling will be cleaned prior to use.

Samples will be taken from the nominated sampling points, with the sampling ports cleaned prior to collecting the samples. The stagnant portion of the pipe work between the sampling line and the sampling port will be flushed through prior to collecting any sample.

The sample bottles will be supplied by the testing laboratory in a clean condition and should only be opened immediately prior to filling. Each sample bottle will be triple rinsed with the sample before completely filling, ensuring no headspace.

9.3.2 Diluent Raw Seawater Collection

Diluent raw seawater will be collected from a manual sampling valve at the Raw Water Sampling Panels. A total of 150 litres of raw seawater will be required.

The raw seawater sample will be filtered through 0.45µm filters to remove all macro-invertebrates, microalgae and most of the bacteria that may confound toxicity test results. Test samples will be analysed for pH, salinity and temperature immediately prior to use.

9.3.3 Discharge Water Sampling

The primary sample collection location of brine for DTA will be taken from the outfall sampling panels.

Sample collection will follow strict quality assurance and quality control procedures. The collected samples are then prepared as described in Section 9.3.4 below.

9.3.4 Sample Preparation

In the event that at the time of sampling the outfall discharge water does not contain all of the chemical constituents, these will be added under lab conditions in order to arrive at the final composition.

The preparation of the sample for DTA will be in accordance with Sample 3 of Section 3.5 in Brine and Permeate Production and Sample Preparation Procedure (Thiess Degrémont Joint Venture, 2010d) (RP-TDV-EN-1-A-101-0005). Sample preparation will follow strict quality assurance and quality control procedures.

If required, CIP solutions, including the chemicals as defined in the Effluent Characterisation for Whole of Effluent Toxicity Tests for Works Approval WA64404 (Thiess Degrémont Joint Venture, 2010c) (RP-TDV-EN-1-A-101-0004), being a combination of cleaning solutions and biocide, will added to the DTA sample.

Each suite of ecotoxicity test requires approximately 3L of DTA sample. An additional DTA sample will also be prepared for chemical analysis.

The prepared DTA samples will be stored in sealed food-grade drums chilled on ice to reduce sample temperature to below 4^{o}C or placed immediately in a refrigerator. Immediately prior to shipment, the samples will be packed (well-padded to avoid breakage) in a cool box with ice bricks, to ensure the sample reaches the laboratory in a chilled state. These samples will be sent to a NATA accredited laboratory for analysis.

9.3.5 Sampling and Sample Preparation Quality Assurance and Quality Control

The field sampling and preparation of samples will be undertaken with extreme care and with strict adherence to the VDP operation phase laboratory procedures, which includes a detailed laboratory SOP for equipment calibration, equipment cleaning and equipment maintenance etc.

In order to avoid potential for contaminants all sampling equipment and sample preparation equipment will be rinsed three times with the collected sample water prior to filling.

9.3.6 Timing

DTA will be performed in the event that the desalination process is modified or the nature of the discharge is substantially altered. This could be at any time during the operation of the VDP.

Subsequent DTA may or may not be required depending on the results of the first round.

9.4 Laboratory Tests and Data Analysis

9.4.1 Chemical Analysis

The key physiochemical property of potential effluent from the VDP is salinity. The salinity of the diluent and undiluted samples is to be measured and verified by an independent laboratory. A chemical analysis of the prepared sample will also be performed to verify its constituents (as per Table 9-1). Dissolved oxygen will be measured prior to commencement of the DTA and throughout the tests.

At each step of the dilution, the salinity will be remeasured.

Table 9-1: Components to be Measured by Chemical Analysis

Analyte	Unit	Limit of Reporting
Electrical Conductivity @25°C	µS/cm	1
Total Dissolved Solids @180°C	mg/L	1
Turbidity	NTU	0.1
Dissolved Oxygen	mg/L	1
Sulfate as SO4 - Turbidimetric	mg/L	1
Boron	mg/L	0.5
Chloride	mg/L	1
Calcium	mg/L	1
Magnesium	mg/L	1
Sodium	mg/L	1
Potassium	mg/L	1
Arsenic	mg/L	0.005
Cadmium	mg/L	0.002
Chromium	mg/L	0.001
Copper	mg/L	0.002
Lead	mg/L	0.002
Nickel	mg/L	0.005

Analyte	Unit	Limit of Reporting
Zinc	mg/L	0.02
Iron	mg/L	0.05
Nitrite & Nitrate as N	mg/L	0.01
Total Kjeldahl Nitrogen as N	mg/L	0.3
Total Nitrogen as N	mg/L	0.3
Reactive Phosphorus as P	mg/L	0.05
Total Organic Carbon	mg/L	1

9.4.2 Toxicity Tests

9.4.2.1 Species Selection

Where possible, the test species will be in accordance with previous tests. The final species selection will be subject to availability and consultation with the EPA:

- Microalgae (*Nitzschia closterium*);
- Seaweed (*Hormosira banksii*);
- Doughboy scallop (*Mimachlamys asperrima*) or Blue mussel (*Mytilus galloprovincialis*);
- Sea urchin (*Heliocidaris tuberculata*);
- Crustacean amphipod (*Allorchestes compressa*); and
- Larval fish - Kingfish (*Seriola lalandi*) or Pink Snapper (*Pagrus auratus*).

9.4.2.2 Analysis Method

The methods used previously to assess the toxicity of saline brine will be used in order to permit valid comparisons of the results (TDJV 2010b). Four measures of toxicity will be calculated for each DTA test: the concentration that causes a 10% effect (Lethal Concentration (LC)10/Effective Concentration (EC)10/Inhibition Concentration (IC)10), the concentration that causes a 50% effect (LC50/EC50/IC50), the highest tested concentration observed to not cause a statistically significant effect (P>0.05) compared to the control (No Observed (NO)LC)/NOEC/NOIC) and the lowest tested concentration observed to cause a statistically significant effect (P≤ 0.05) compared to the control (Lowest Observed (LO)LC/LOEC/LOIC).

The EC10 and EC50 values will be calculated using TOXCALC V5.0 software. The NOEC and LOEC values will be determined using Dunnett's Test or an appropriate non-parametric test in the TOXCALC V5.0 software. However, only the LC10/EC10/IC10 values will be presented and used in subsequent PC99 determinations.

The DTA tests include both acute (the fish and amphipod) and chronic toxicity tests (the remaining four species) and therefore an acute to chronic ratio (ACR) will be used to convert the acute data to estimates of chronic toxicity. The Australian and New Zealand Water Quality Guidelines (ANZECC & ARMCANZ, 2000a) recommend that ACR values for a chemical should be used in preference to the default value of 10 if they are available. Acute to chronic ratios are generally applied to acute LC50/EC50 values to provide estimates of chronic toxicity (ANZECC & ARMCANZ, 2000b). The conservative ACR of 2.5 used previously (Hobbs & Warne, 2008) will be applied to the acute LC10/EC10 data. The justification for this value is provided in Hobbs and Warne (2008).

The chronic and estimated chronic toxicity data will be entered into the BurrliOZ software package provided as part of Australian and New Zealand Water Quality Guidelines (ANZECC & ARMCANZ, 2000a). The SEPP (WoV) states that the open coasts of Victoria are largely unmodified and that a 99% Protective Concentration applies, therefore, the concentration that should protect 99% of species (i.e. Protective Concentration (PC)99) will be calculated. Whether there are significant differences between the safe dilution factors for the current study and the previous assessment will be determined using the methods outlined above for toxicity data.

Table 9-2: Proposed DTA Tests and Test Endpoints

Test Species	Duration	Test Endpoint
Microalgae (*Nitzschia closterium*)	72-hour growth inhibition test based on USEPA Method 1003.0 and Stauber et al. 1996	IC10
Seaweed (*Hormosira banksii*)	72-hour germination test (based on method described by Kevekordes and Clayton 1995 and fertilisation test by Gunthorpe et al. 1997 for the National Pulp Mills Research Program)	EC10
Doughboy scallop (*Mimachlamys asperrima*) or Blue mussel (*Mytilus galloprovincialis*)	48-hour larval development test (based on Krassoi et al. 1996 for the National Pulp Mills Research Program)	EC10
Sea urchin (*Heliocidaris tuberculata*)	1-hour egg fertilisation test; and 72-hour larval development test, (based on APHA Method 8810D and Simon and Laginestra 1997)	EC10
Crustacean amphipod (*Allorchestes compressa*)	96-hour acute amphipod survival test (based on USEPA methods)	LC10
Larval fish (Kingfish *Seriola lalandi* or Pink Snapper *Pagrus auratus)*	96-hour fish imbalance test using larval marine fish (based on USEPA 1993 and OECD Method 203)	EC10
Microalgae (*Nitzschia closterium*)	72-hour growth inhibition test based on USEPA Method 1003.0 and Stauber et al. 1996	IC10

9.4.3 Laboratory Quality Assurance and Quality Control

Rigorous quality assurance procedures will be in place during the DTA test, including water quality monitoring throughout the tests.

The laboratory undertaking the ecotoxicity test must have rigorous Quality Assurance and Quality Control (QA/QC) components incorporated into their routine test procedures, which must be documented in a Laboratory Procedure Manual or similar. Routine QA/QC components of the test programme must include the use of reference toxicants (positive controls), detailed equipment calibration and maintenance logs, sample chain of custody, sample tracking and disposal.

The laboratories used for undertaking the assessment will be NATA endorsed to perform the relevant tests.

9.5 Corrective and Investigative Actions

In the event that results are not as expected (i.e. consistent with previous DTA) then a review will be undertaken to determine the cause. This will include review of water quality information to determine if a trace contaminant is responsible.

If the Test Dilution is less than the Target Dilution (30:1), and thus is not protective of 99% of species outside of the Impact Zone (for the purposes of the commissioning phase, or Mixing Zone for operations), additional tests will be conducted.

If further toxicity tests show that a higher dilution is required to achieve 99% species protection level, then one or more of the following contingency actions will be implemented:

- Identifying the chemicals contributing to the toxic effects and reducing the usage of those chemicals or substituting them; and
- Review of operational procedures. For example, seawater by-pass could be increased at low flow rates to increase dilution.

9.6 Reporting and Review

Results will be issued in a written report to AquaSure, DELWP and EPA following completion of the tests.

10 OMMP Reporting and Review

The OMMP is a "live" document that can be updated in response to regular reporting and review. The reporting and review process is adaptive and is intended to evolve in the light of data and information accrual. The process contains adequate controls to ensure that planned change is subject to appropriate technical and legislative review.

Specifically the OMMP needs to incorporate:

- Reporting to ensure that ecologically important impacts are detected, and an appropriate management response is initiated in response to acute and chronic events; and
- Review to refine the program, and to ensure the relevance, performance and efficiency of the monitoring program, in the light of accruing data and information.

The reporting and review framework embodies several key quality management principles. These are:

- Standardised survey protocols, subject to regular review and to change control;
- Standardised analysis plans, subject to regular review and to change control;
- Exception reporting for deviation from standardised survey protocols and analysis plans; and
- Continuous improvement through scheduled re-appraisal of techniques and designs.

In addition, all contractors conducting surveys, and providing data or analyses for reports and reviews will be required to have appropriate and documented QA/QC processes in place, and may be subject to audits. All project data will be maintained in a central database.

10.1 Reporting

Reporting consists of:

- Routine reporting at selected intervals for the OMMP; and
- Incident reporting if there is an exceedances of any trigger levels.

All reporting requirements are summarised Table 10-1.

Table 10-1: Summary of Reporting Requirements for the VDP

Component	Timing	Reporting
In-Plant Water Quality Monitoring (Section 6)	Monthly during operation End of Supply Period Incidents (i.e. Level 2 Triggers)	• Plant operations. • The total volume and average flow rate of the discharge going into the marine environment (determined from mass balance); Daily average salinity of the discharge to marine waters (as calculated from electrical conductivity and temperature measured at the seawater lift pump station launder and outfall chamber).
Diffuser Performance Monitoring (Section 7)	Monthly during operation End of Supply Period Following diffuser inspections Incidents	• *In situ* salinity, dilution calculations and compliance with Mixing Zone. • Integrity of diffusers
Ecological Monitoring (Section 8)	End of the Supply Period End of Recovery Monitoring	• Review of monitoring and methods • Results and analysis from Ecological Monitoring (Section 8). • Cross-check with In-Plant Monitoring (Section 6) and Diffuser Performance Monitoring (Section 7).

Component	Timing	Reporting
	Incidents	
Direct Toxicity Assessment (Section 9)	As required, following completion of the tests	• Direct Toxicity Assessment results. • Confirmation of safe dilution factor.

10.1.1 Routine Reporting

During the O&M phase reporting will include the following ongoing reporting for the life of the OMMP:

- Daily in-plant monitoring results – monthly report;
- Following diffuser inspections.
- End of Supply Period reports (including results of the plant intake and outlet monitoring results and summary of ecological data collected).
- End of Recovery Monitoring report – as required for the Ecological Monitoring component.

10.1.2 OMMP Incident Reporting

Note: this reporting procedure is in addition to the Environmental Incident Response Procedure outlined in the O&M EMP (Watersure, 2013) (ENV-000-PL-001).

Reporting of an incident is required where the incident:

- Is a breach of a project approval condition/permit;
- Contravenes established legislation; and
- Is an exceedance of a level provided in Sections 6 to 9 and summarised in Table 10-2.

AquaSure, the DELWP and EPA will be notified of all reportable incidents within twenty-four hours or as soon as practicable. At the time of reporting a timeframe will be agreed for the submission of formal reporting.

Table 10-2: Reportable Incidents

Reportable Incident	Monitoring Component
Any exceedance of the Mixing Zone trigger levels measured at any time of the year, outside the Mixing Zone and determined by multiple lines of evidence from plant operations. Any occurrence of a Level 2 Trigger for the In-Plant monitoring (Section 6.3.3).	In-Plant Water Quality Monitoring) (Section 5) Diffuser Performance Monitoring (Section 7)
A change to the safe dilution factor (increase above 30:1).	Direct Toxicity Assessment (Section 9)
An exceedance of 1 PSU above background outside of the Mixing Zone (for more than 5% of the Supply Period).	Diffuser Performance Monitoring (Section 7)
Any defects to the diffusers or evidence that the diffusers are not operating correctly	Diffuser Performance Monitoring (Section 7)
A statistically significant result on a primary indicator. A statistically significant result on a secondary monitoring index.	Ecological Monitoring (Section 8)

The Watersure Environmental Manager will follow the incident response process (shown conceptually in Figure 10-1 and described below):

- Inform the Plant Director, Compliance Manager, AquaSure and EPA of test results and any exceedances and corrective action decisions;
- Preparation of an incident report following the Environmental Incident Reporting Procedures and implementation of any actions described; and

- Liaise with and advise others regarding environmental compliance and non-compliance, where required.

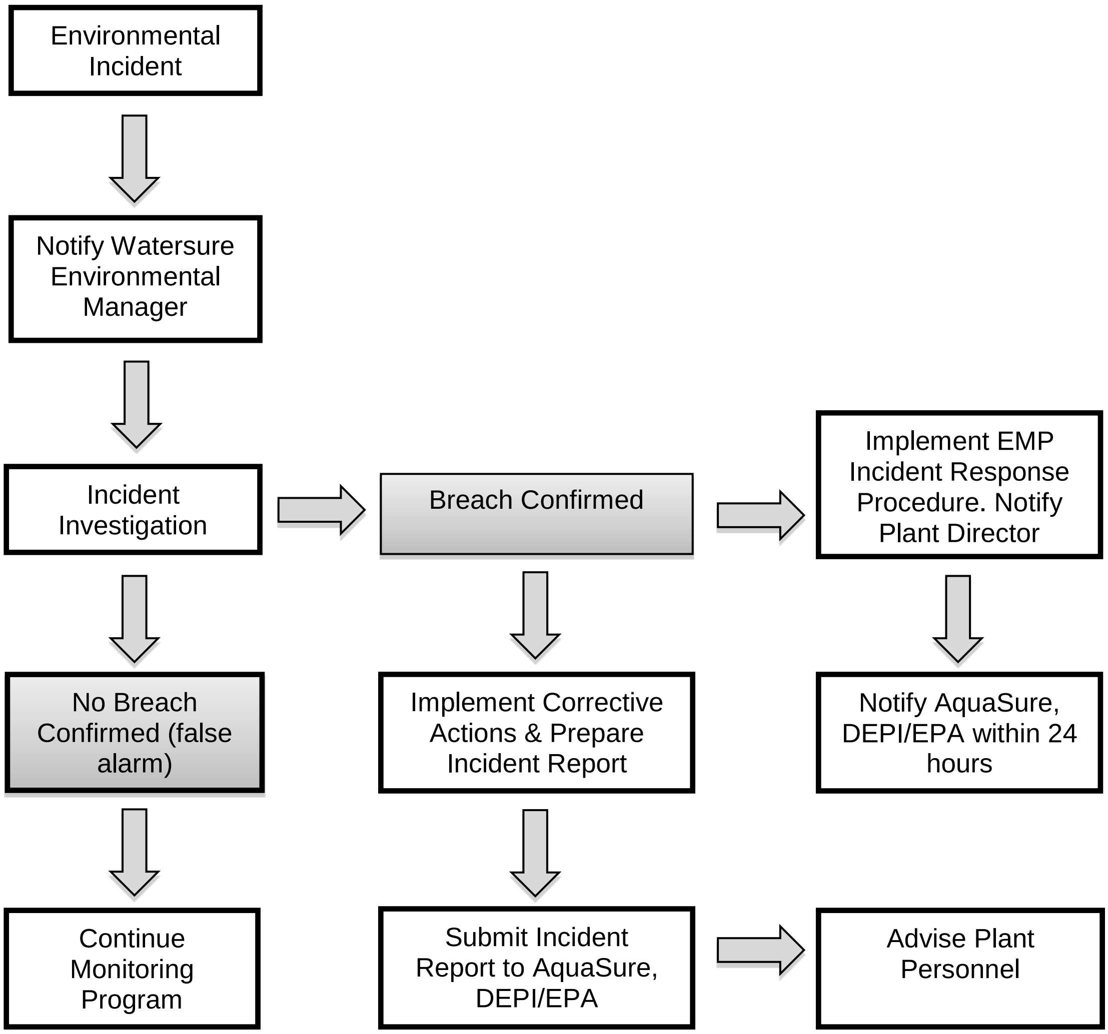

Figure 10-1: OMMP Incident Response Procedure

10.2 Review Schedule and Changes to the OMMP

Watersure will meet/consult with the Subject Matter Expert to consider the Ecological Monitoring component end of Supply Period Report, Recovery Monitoring Report or Incident Report.

During the O&M phases the following review process will be followed:

1. Watersure, supported by Watersure's Technical Group and in consultation with the Subject Matter Expert will consider whether or not, on the balance of probability, there is evidence for an environmental impact beyond that expected. In forming this judgement, any exceedances flagged in the end of Supply Period, Recovery Monitoring Report or Incident Reports will be considered, and a balance of evidence approach will be adopted: integrating data from across the program. A difference from expected impact will be defined in terms of existence (an effect altogether un-anticipated), spatio temporal scale and intensity.
2. Watersure will advise AquaSure as to whether or not a change to the monitoring program is required. Change will be defined in terms of:
    a. Change in the overall structure and function of the program;
    b. Changes in sampling techniques;
    c. Changes in data-analysis methods; and
    d. Changes in reporting and reviewing.

3. The OMMP will be reviewed at the end of each Supply Period and Recovery Monitoring with a reduction in monitoring effort should in-plant and *in situ* measurements show that the VDP is operating as or better than predicted. This will be in terms of, but not restricted to:
    a. Near and far-field mixing in relation to the Mixing Zone. If mixing is as or better than expected under all conditions then the scale and frequency of other monitoring components should be reduced in response;
    b. No significant impacts in the marine environment. This suggests that acute impacts are unlikely. Monitoring frequency may then be reduced to assessing for chronic changes (e.g. annually); and
    c. Stability of in-plant operations. If large changes in discharge volume do not result in corresponding changes near and far–field mixing under all conditions then plant operations may be considered a proxy for future monitoring.
4. Assuming normal plant operations and in the event that impacts are as or less than expected, components will be phased out once they have fulfilled their objectives as follows:
    a. If after a full year of monitoring, mixing at the Mixing Zone boundary is as expected or better than predicted under all conditions, particularly long periods of calm weather, then the in situ salinity component of the Diffuser Performance Monitoring will be phased out of the OMMP; and
    b. If after sufficient data (e.g. number of operational surveys), the impacts to flora and fauna are not detected outside of the Mixing Zone, then the Ecological Monitoring will be phased out of the OMMP. They may be replaced by annual or less frequent sampling subject to recommendations by the Subject Matter Expert and following consultation with the EPA.

   After a given period of plant operation the OMMP may therefore comprise of In-Plant and Investigative Monitoring (if required on an *ad hoc* basis) only. This will ensure regular checks on the plant performance and a feedback loop to ensure that corrective actions are initiated before impacts manifest in the environment.
5. Minutes of meetings will be issued to AquaSure and copied to DELWP and the EPA.

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