CATHODIC PROTECTION SYSTEM ASSESSMENT
MOA POINT WASTE WATER OUTFALL PIPELINE

WELLINGTON WATER LIMITED
MOA POINT WWT PLANT

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PURPOSE AND SCOPE

This document was developed to address the following requirements:

- To outline the methodology Corrosion Control Engineering employees followed during the survey
- Present and discuss the results of the survey
- Provide recommendations to improve/maintain the cathodic protection system

DISTRIBUTION

WWL: – Craig Shuttleworth, Joemar Cacnio, Blair Johnson

TECHNICAL REVIEW

CONSULTED PERSON	POSITION/CERTIFICATION	SIGNATURE
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DOCUMENT CONTROL

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UPDATES SINCE LAST REVISION

New document

Definitions and Abbreviations

TERMS	DEFINITION
AS	Australian standard
Cathodic protection (CP)	A technique used to reduce the corrosion of a metal surface by making the surface the cathode of an electrochemical cell.
CCE	Corrosion Control Engineering (NZ) Ltd
Coating	The material adhering to the bare structure to prevent interaction of the steel with soil, water, and contaminants.
CSE (Also $Cu/CuSO_4$)	Copper/copper sulphate reference electrode.
DC	Direct current
Depolarised potential	The change in potential of a structure over time due to the interruption of applied current.
DMM	Digital multimeter
Electrolyte	A chemical substance containing ions that migrate in an electric field such as water, soil, or concrete.
FIK	Flange insulation kit
Galvanic (sacrificial) anode	A metal that provides cathodic protection current to more noble metals because of its position in the Electromotive Force Series when the two are connected electrically in an electrolyte.
IJ	Insulating joint
Instant off-potential	The measured structure-to-electrolyte potential taken immediately after all influencing cathodic protection systems have been de-energised. Also referred to as polarised potential.
IR	Resistance potential – the part of a measured potential from the passage of current through the resistance. Removed to obtain a true off-potential.
KCl	Potassium chloride
mA	Milliamperes (10^{-3} A)
mV	Millivolts (10^{-3} V)
Native potential	The mixed potential of a freely corroding metal surface with respect to a reference cell in contact with the same electrolyte (also referred to as corrosion, static or initial potential).
Off-potential	The measured structure-to-electrolyte potential taken with all influencing cathodic protection systems de-energised.
On-potential	The measured structure-to-electrolyte potential with cathodic protection current applied. The components of the on-potentials include the native potential, polarisation, and IR drop.
Polarisation	The deviation from the native potential of an electrode resulting from the application of current between the electrode and electrolyte.
Potential gradient	A change in potential with respect to distance expressed in volts (mV) per unit of distance.
Reference electrode	A portable or permanently installed half-cell, usually CSE or SSC, which is used to take coupon or structure-to-electrolyte potentials from grade, inside the coupon test station's reference tube or from a permanently installed buried location.
SACP	Sacrificial anode cathodic protection
SSC (also Ag/AgCl)	Silver/silver chloride reference electrode.
Structure-to-electrolyte potential	The potential difference between the metallic surface and the electrolyte that is measured with respect to a reference electrode in contact with the electrolyte.
TP	Test point
V_{CSE}	Voltage with respect to a copper/copper sulphate reference electrode.
V_{SSC}	Voltage with respect to a silver/silver chloride reference electrode.
V_{ZRE}	Voltage with respect to a zinc reference electrode.
ZRE	Zinc reference electrode

Executive Summary

Corrosion Control Engineering conducted the cathodic protection system assessment for the Wellington Water Moa Point waste water outfall pipeline.

Onshore Section of Pipeline CP Inspection was carried out by CCE personnel on 4 March 2024.

Subsea Section of Pipeline CP Inspection was carried out by Undersea Construction Ltd. Personnel.

Cathodic Protection System Assessment

Onshore Section of Pipeline CP Inspection

Undersea welded sacrificial anodes could not be interrupted therefore Instant off potentials could not be measured on the pipeline. To assess the cathodic protection potential criterion as per Australian Standard Cathodic Protection of Metals AS 2832.1:2015 Pipes and Cables and AS 2832.5:2008 Steel in Concrete, we have introduced temporary coupon testing.

Temporary coupon tests conclude the potentials measured on the coupon temporarily connected to Moa Point waste water outfall pipeline met the criterion for cathodic protection as outlined in Australian Standard AS 2832.1.2015 and AS 2832.5:2008.

Subsea Section of Pipeline CP Inspection Review

Undersea welded sacrificial anodes could not be interrupted therefore Instant off potentials could not be measured on the pipeline due to which AS 2832.5:2008 cathodic protection of metals – steel in concrete structures could not be assessed. However, recorded potentials at the diffusers has met the -0.80 V_{SSC} cathodic protection potential criterion as per Australian Standard AS 2832.3:2005 Cathodic Protection of Metals: Fixed immersed structures.

General

The sacrificial anode CP system is operating since 27 years and is performing satisfactorily for Moa Point waste water outfall pipeline. Based on the potentials recorded the anodes are performing satisfactorily. Compared to previous readings they do not show evidence of approaching the end of their life (i.e. trending more positive results).

Recommendations

The following actions are recommended to ensure effective operation of the cathodic protection system:

- WWL shall consider the following
  - Investigate the isolation location and/or make a plan for achieving isolation in the test point manhole should the existing unknown isolation fail.
  - Including the entire buried portion of the pipeline within the CP system.
- Continue to inspect the cathodic protection system of Moa Point waste water outfall pipeline on annual basis by trained and qualified cathodic protection personnel.

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1. Introduction

Corrosion Control Engineering (NZ) Ltd. was contracted by Wellington Water Limited to conduct the assessment of the cathodic protection system operating on Moa Point waste water outfall pipeline.

The onshore section of pipeline CP Inspection was completed by CCE personnel, Mike Molyneaux on 4 March 2024.

The subsea section of pipeline CP Inspection was completed by Undersea Construction Ltd. Personnel.

1.1 Structure Description

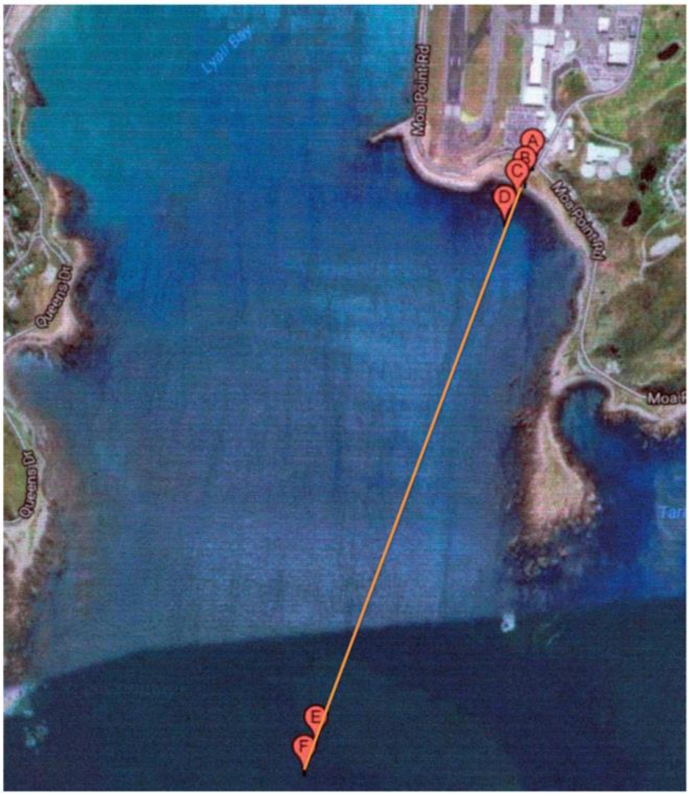
The Moa Point wastewater outfall pipeline spans a length of 1870 meters, extending into the outer waters of Lyall Bay. Apart from the shallow water inshore exposed section, the pipeline is buried beneath the seabed, with a minimum cover of 1.0 – 1.5 meters.

The outfall comprises a 1321mm outer diameter concrete-lined and coated steel pipeline, encased in a reinforced concrete weight coating approximately 125mm thick.

At the seaward end termination, there are 18 diffuser risers.

The pipeline was installed in 1997.

Figure 1, Pipeline route and key reference positions
(Reference: Undersea Construction Ltd./Doc No. UCL-VEOLIA-MOA POINT PIPELINE – Rev.0 Mar.2023)



Pipeline route and distances between reference points from figure-1 is as follows:
A: 0m|B: 52m|C: 84.2m| D: 175m|E: 1765m|F: 1858m

1.2 Cathodic Protection System Description

The sacrificial anode cathodic protection system comprises 26 off WZ18 zinc alloy sacrificial anodes, each with the following specifications:

- Anode Type: WZ18
- Net Mass: 17.0 Kg
- Gross Mass: 18.3 Kg
- Material: Zinc Base Alloy
- Specification: AS 2239 Designation ZI

These anodes are positioned along the pipeline in 13 pairs, with each pair diametrically opposed. The spacing between each pair of anodes is 150 ± 15 meters.

Each anode is embedded longitudinally in the concrete weight coating, with its outer face exposed end flush with the external concrete surface. Electrical contact with the pipeline is achieved through two studs at appropriate height and spacing centres, welded to the pipe surface. Anodes are electrically isolated from all steel reinforcement within the weight coating.

Additionally, the design includes a test point at the shore end of the pipeline.

It should be noted that there are limitations to cathodic protection of concrete coated structures. If there is delamination and cracking of the concrete it may be the case that CP current will not flow to the delaminated surface (due to geometry considerations) this cannot be detected by the CP survey.

1.3 Scope of Work

The scope of work was to undertake cathodic protection system assessment on the Moa Point waste water outfall pipeline as per Australian Standards AS2832.

Onshore Section of Pipeline CP Inspection

- Measure and record the pipeline ON potentials
  - Inside the manhole (2 cable terminations on a mounting plate) near coast line
  - Pipe riser near the old pump station
- Protection demonstration by using temporary coupon and Datalogger at the manhole cable terminations
- Undertake a general visual inspection for the accessible test points
- Confirm effective operation of isolation joints
- Prepare and provide a detailed technical report including recommendations for maintenance or future works

Subsea Section of Pipeline CP Inspection Review

- Review the underwater inspection data provided by Undersea Construction Ltd. for 2024 underwater survey report and cover the assessment in this report.
  - Pre & Post Dive CP meter calibration
  - Visual Inspection of diffusers and exposed pipe underwater
  - Photograph/Video of diffusers and exposed pipe underwater
  - Pipe potentials with respect to Ag/AgCl reference at the diffusers

1.4 Reference Documents

The survey complied with the requirements of the following standards, codes, and other related documents.

1.4.1 Australian Standards, Codes, and Regulations

The jurisdictional regulations and legal requirements that apply to this report are:

Table 1, Applicable Standards, Codes and Regulations

Standard	Title	Revision
AS 2832.1	Cathodic protection of metals – Pipes and cables	2015
AS 2832.5	Cathodic protection of metals – Steel in concrete structures	2008 [R2018]
AS 2832.3	Cathodic protection of metals – Fixed immersed structures	2005 [R2016]

1.4.2 Client Documentation

The document that applies to this report is:

Table 2, Applicable Client Documentation

Document	Title	Revision
UCL-VEOLIA-MOA POINT PIPELINE	UCL. Moa Point Wastewater Ocean Outfall Pipeline & Seabed 2023 Survey	00
QMS – Item: CP Testing – Project Note 2	UCL.-QMS-IMS-CP (Cathodic Protection) Testing – Moa Point Pipeline - 2024	00
DWG #:MP 0005	UCL. Moa Point Pipeline Diffuser Layout	--
DWG #:MP 0004	UCL. Moa Point Pipeline Cathodic Protection	--

1.5 Personnel

The following qualified and experienced CCE personnel completed the scope of work:

Table 3, Personnel

Personnel Name	Position	Certification
Mike Molyneaux	Senior Corrosion Engineer	ACA CP Advanced course # 5064
Mohammed Abdul Basith	Senior Corrosion Engineer	NACE CP Technologist # 28239
Alan O'Connor	NZ Manager / Senior Corrosion Engineer	NACE CP Technologist # 72402

2. Criterion for Cathodic Protection

The CP system is somewhat in unusual in that the structure to be protected is a buried and immersed concrete coated pipeline. The protection criteria for this are included in the below standards.

2.1 Pipes and Cables

AS 2832.1 Cathodic protection of metals: Pipes and cables states the criterion for corrosion protection of a buried ferrous structure shall be the achievement of potentials equal to, or more negative than, -0.85 V_{CSE}.

To ensure that overprotection does not cause accelerated disbondment of the coating, or other deleterious effects, the polarised potential should not be more negative than -1.20 V_{CSE}.

The above potentials should not include the error associated with the voltage gradient caused by the flow of cathodic protection current in the electrolyte, and hence, the instant off-potential should be measured.

AS 2832.1 Cathodic protection of metals: Pipes and cables states an alternative criterion for corrosion protection of a buried structure shall be to maintain an instantaneous off-potential on all parts of the structure, which is at least 100 mV more negative that the depolarized potential.

2.2 Steel in Concrete Structures

The criteria for cathodic protection of steel in concrete are outlined in *AS 2832.5 Cathodic protection of metals: Steel in concrete structures*.

The standard states the initial and continuous adjustment of the cathodic protection system shall be based on meeting at least one of the following criteria (listed in no order of priority):

a) Potential decay criterion: A potential decay over a maximum of 24 hrs of at least 100 mV from the instant off-potential.
b) Extended potential decay criterion: A potential decay over a maximum of 72 hrs of at least 100 mV from the instant off-potential subject to a continuing decay and the use of reference electrodes (not potential decay sensors or pseudo reference electrodes) for the measurement extended beyond 24 hrs.
c) Absolute potential criterion: An instant off-potential (measured between 0.1 s and 1 s after switching the DC circuit open) more negative than -720 mV with respect to Ag/AgCl/0.5M KCl.
d) Absolute passive criterion: A fully depolarised potential, or a potential which is continuing to depolarise over a maximum of 72 hrs after the cathodic protection system has been switched off, which is consistently less negative than -150 mV with respect to Ag/AgCl/0.5M KCl.

Compliance with at least one of the above criteria shall be maintained on a continuous basis for the life of the system. If any of the monitoring sensors do not confirm adequacy of protection, additional testing shall be undertaken to confirm the rate of corrosion is insignificant.

In addition, the standard states that to avoid the deleterious effects resulting from overprotection, no instant off steel/concrete potential shall be more negative than -1100 mV with respect to Ag/AgCl/0.5M KCl for plain steel or -900 mV with respect to Ag/AgCl/0.5M KCl for prestressed steel.

2.3 Fixed Immersed Structures

AS 2832.3 Cathodic protection of metals: Fixed immersed structures states the criterion for cathodic protection of steel in sea water shall be the achievement of potentials equal to, or more negative than, - 0.80 V_{SSC}.

However, in tropical waters where steel structures may be subject to microbiological influenced corrosion (MIC) or accelerated low water corrosion, a potential of - 0.90 V_{SSC} (or more negative) is recommended.

To ensure that overprotection does not cause accelerated disbondment of the coating, or other deleterious effects, the polarised potential should not be more negative than -1.15 V_{SSC}.

The above potentials should not include the error associated with the voltage gradient caused by the flow of cathodic protection current in the electrolyte, and hence, the instant off-potential should be measured.

3. Methodology

Onshore Section of Pipeline CP Inspection

The following cathodic protection tests were carried out by CCE during the onshore section of pipeline survey:

- DC "on" potentials of the structure
- Polarization and Depolarization, ON and Instant off-potentials of a temporary buried coupon
- Insulating joint tests

3.1 Structure Potential Measurements

The CP current source could not be interrupted due to galvanic anodes directly connected to the pipeline underwater. At all accessible land based test locations, the following measurements were recorded with respect to a portable copper/copper sulphate reference electrode

- DC on-potential

3.2 Temporary Coupon Potential Measurements

A steel coupon was buried approx. 10cm below ground over the pipe route and approx. 5m form the manhole adjacent to Moa Point Road where cable connections to the pipeline are accessible.

The steel coupon was electrically connected to the cable terminal labelled "Protected Pipe."

Temporary coupon was set to polarize for one hour.

External current interrupter was operated between pipe and coupon with an interruption cycle of 12 seconds On – 3 seconds off.

Datalogger was setup to record the temporary coupon potential measurements polarization and depolarization, total data logging was setup and continued for four hours.

The following measurements were recorded with respect to a portable copper/copper sulphate reference electrode

- Polarization data measurements
- DC on-potential data logging graph
- DC instant off-potential data logging graph
- Depolarization data logging graph

3.3 Insulating Joints

DC “on” potentials were measured, with respect to a copper/copper sulphate reference electrode, on pipe riser near the old pump station upstream from the suspected isolation joint. The isolating joint is considered to be effectively isolated if a minimum of 50 mV potential difference is recorded between the protected side and isolated side of the flange.

Subsea Section of Pipeline CP Inspection

Methodology consistent with the philosophy of operation set out in the Undersea Construction Ltd. CP Testing - Moa Point Pipeline – 2024 report (Ref # QMS - Item: CP Testing - Project Note 2 - Rev.00)

4. Discussion

The onshore field works commenced and finished on 4 March 2024 by CCE. The work was conducted over 1 field trip.

Weather conditions during the survey were storm and rain. The results are attached in the Appendix A and are discussed in further detail in the sections below.

4.1 Onshore Section of Pipeline CP Inspection

Pipeline

The ON potentials measured on the onshore section accessible test locations were more negative than -1000mVcse similar to previous survey. This indicates that the anodes are in a satisfactory condition.

Undersea welded sacrificial anodes could not be interrupted therefore Instant off potentials could not be measured on the pipeline.

To assess the cathodic protection potential criterion as per Australian Standard Cathodic Protection of Metals AS 2832.1:2015 Pipes and Cables and AS 2832.5:2008 Steel in Concrete, we have introduced temporary coupon testing as detailed in next section.

The test point at the manhole near the coast line has two labelled terminals. One as protected and the other unprotected, this indicated that this was the original isolation point (to prevent CP current being lost to the plant). Testing indicated that these two terminals (or pipe sections) are electrically continuous at this joint. The buried pipe is continuing to the riser near the pump station therefore it is acceptable to be continuous at this location although this is a deviation from the as designed CP system. As the location or method of isolation is not known, should the isolation fail (which may result in a loss of protection for the entire pipeline) there may not be an easy or quick remediation. It is best practice to have all isolation locations documented.

At the pipe riser near the old pump station, an electrical connection was also made to an exposed nut and bolt on the top centre of what appears to be a thickly wrapped flanged joint at the point where the onshore section of the pipeline emerges from underground. ON potential for this part of the pipeline measured -355 mV versus portable Copper electrode and did not indicate any variations during 10 minutes observation, confirming that this part of the onshore section is electrically isolated from the subsea section of the pipeline. There is buried portion of pipe without CP and Isolation from the protected pipeline is unknown.

Temporary Coupon Testing

A steel coupon was buried approx. 10 centimetres below ground over the pipe route and approx. 5 meters from the manhole adjacent to Moa Point Road where cable connections to the pipeline are accessible. The steel coupon was electrically connected to the cable terminal labelled "Protected Pipe."

After one hour the coupon potential versus a portable Copper electrode had slowly polarised from -394 mVcse to -564 mVcse indicating that the anodes on the subsea section of the pipeline were polarizing the coupon to the same potential as the pipeline in this vicinity.

The pipe cable connection to the coupon was then systematically interrupted with interval of 12 seconds ON and 3 seconds OFF, potential measurements for the coupon were recorded.

Appendix A, Figure-2, provides a representative extract of ON and OFF potential measurements for the coupon, with all readings compressed into a single graph to display key variables of the recording for the first 2 hours.

After 2 hours these measurements indicated further polarization of the coupon to -750 mV.

After 4 hours the coupon appeared to have attained the same potential as the pipeline in this vicinity, indicated by only slight changes in both ON and Instant OFF potential measurements. The coupon was then disconnected from the pipeline to allow a depolarization test: Within 10 minutes the potential of the coupon had changed from -687 to -547, a difference of 140 mV, indicating that the pipeline is protected against corrosion in this vicinity by the 100-mV criterion of the Australian Standard AS 2832.1:2015 and AS 2832.5:2008.

Appendix A, Figure-3, provides a representative extract of potential measurements for the coupon while carrying out a depolarization test.

4.2 Subsea Section of Pipeline CP Inspection Review

Undersea Construction Ltd (UCL) divers use a Buckleys BathyCorrometer (BCM) cathodic potential meter to take ON readings.

The report supplied (UCL.-QMS-IMS-CP (Ref: Cathodic Protection) Testing – Moa Point Pipeline - 2024) was reviewed by CCE and found to be satisfactory.

Calibration checks of BCM was completed by UCL pre & post dive.

The ON potentials measured on the underwater pipeline diffusers 1, 6, 10, 14 and 18 were more negative than -990mVcse similar to previous survey. This indicates that the anodes are in a satisfactory condition.

Undersea welded sacrificial anodes could not be interrupted therefore Instant off potentials could not be measured on the pipeline due to which AS 2832.5:2008 cathodic protection of metals – steel in concrete structures could not be assessed. However, recorded potentials has met the -0.80 V_{SSC} cathodic protection potential criterion as per Australian Standard AS 2832.3:2005 Cathodic Protection of Metals: Fixed immersed structures.

Shallow water exposed section of the pipeline is not yet inspected by UCL at the time of writing this report due to sea conditions.

4.3 General

The Sacrificial cathodic protection system is operating satisfactorily. The sacrificial anodes are providing sufficient CP current to protect the pipeline.

5. Conclusions

5.1 Onshore Section of Pipeline CP Inspection

The cathodic protection system is operating effectively. The potentials measured on the structure at all tested locations met the criterion for cathodic protection as detailed in AS 2832.1:2015 and AS 2832.5:2008.

5.2 Subsea Section of Pipeline CP Inspection Review

The cathodic protection system is operating effectively. The potentials measured on the structure at all tested locations met the criterion for cathodic protection as detailed in AS 2832.3:2005

5.3 General

The sacrificial anode CP system is operating since 27 years and is performing satisfactorily for Moa Point waste water outfall pipeline. Based on the potentials recorded the anodes are performing satisfactorily. Compared to previous readings they do not show evidence of approaching the end of their life (i.e. trending more positive results).

Description	Conclusions
Anode Performance	Satisfactory
Cabling	Satisfactory
Test locations / Flanges	Satisfactory
Cathodic Protection	Satisfactory with an exception of a short buried portion with no CP from the pipe riser to an unknown isolation location prior to the test point.
FIKs Isolation	The isolation at the manhole test point is not operating satisfactorily. There is an unknown isolation between the manhole test point and pipe riser.

6. Recommendations

The following actions are recommended to continue effective operation of the cathodic protection system:

- WWL shall consider the following
  - Investigate the isolation location and/or make a plan for achieving isolation in the test point manhole should the existing unknown isolation fail.
  - Including the entire buried portion of the pipeline within the CP system.
- Continue to inspect the cathodic protection system of Moa Point waste water outfall pipeline on annual basis by trained and qualified cathodic protection personnel.

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Appendix A: CATHODIC PROTECTION TEST RESULTS

TEST LOCATION – ONSHORE SECTION MANHOLE NEAR COAST LINE

Test Location	Structure Vs Portable CSE (mV)		Remarks
	On	Off	
Tested at the manhole cable termination plate (Labelled: Protected pipe)	-1032	NA	Testing indicated that these two pipe sections are electrically continuous at this joint. And the buried pipe is continuing to the riser near the pump station therefore it is acceptable to be continuous.
Tested at the manhole cable termination plate (Labelled: Unprotected pipe)	-1032	NA	
Potential difference between both the above terminals	NA	NA	There was no potential difference between the two terminals

TEST LOCATION – ONSHORE SECTION MANHOLE NEAR COAST LINE (TEMPORARY COUPON TESTED)

Test Location	Structure Vs Portable CSE (mV)		Remarks
	On	Off	
Coupon native potential	NA	-394	10mins after burying the coupon
Coupon potentials when connected to the protected pipe via the manhole cable termination	-394 to -995	-394 to -750	2 Hrs. Polarization time
Coupon potentials when disconnected from pipe (Depolarization test)	NA	-687 to -547	Coupon potential shift of 140mV within 10 mins. of depolarization / disconnection of coupon from pipe

TEST LOCATION – ONSHORE SECTION OF PIPE RISER NEAR OLD PUMP STATION (AS FOUND)

Test Location	Structure Vs Permanent RE (mV)		Remarks
	On	Off	
Tested at above ground pipe (Unprotected pipe section)	-355	NA	There is buried portion of pipe without CP and Isolation from the protected pipeline is unknown

Moa Point Waste Water Pipeline
Datalogging of Temporary Coupon Potentials (Depolarization)

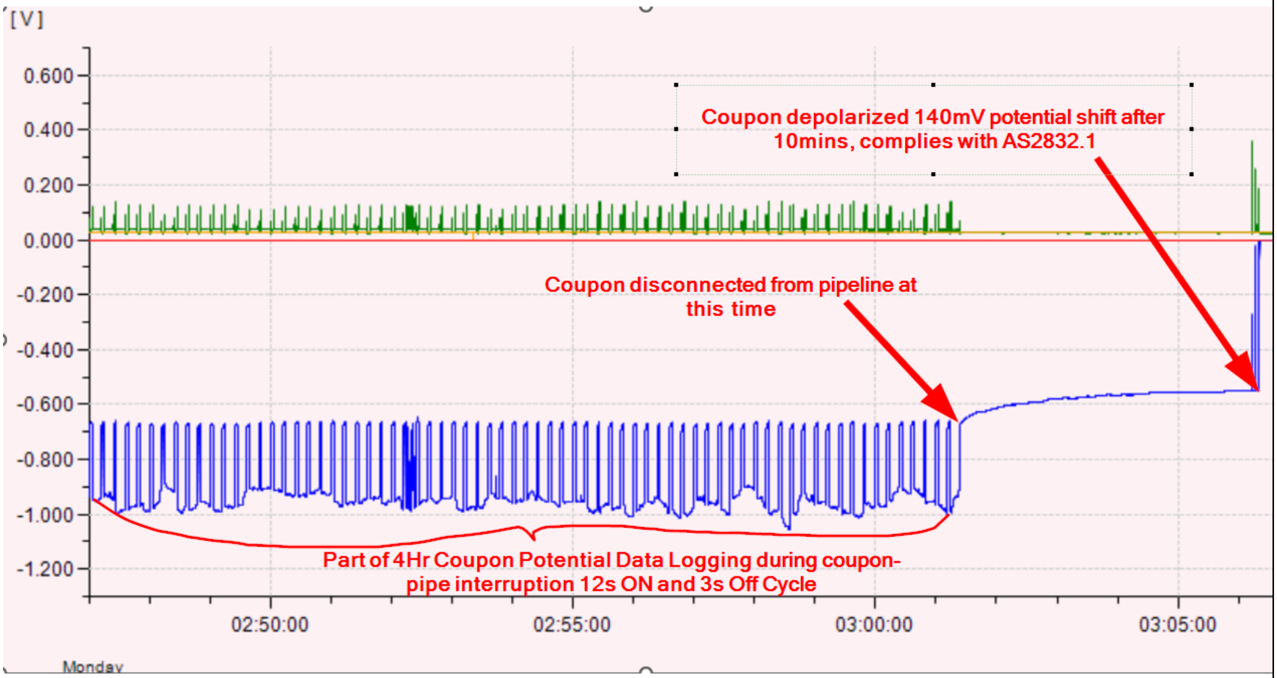

Figure 2, Datalogging of Temporary Coupon Potentials (Depolarization)

Moa Point Waste Water Pipeline
Temporary Coupon Potentials - Part of 4Hr Data Logging
On (12s) & Off (3s) Interruption between coupon and pipeline

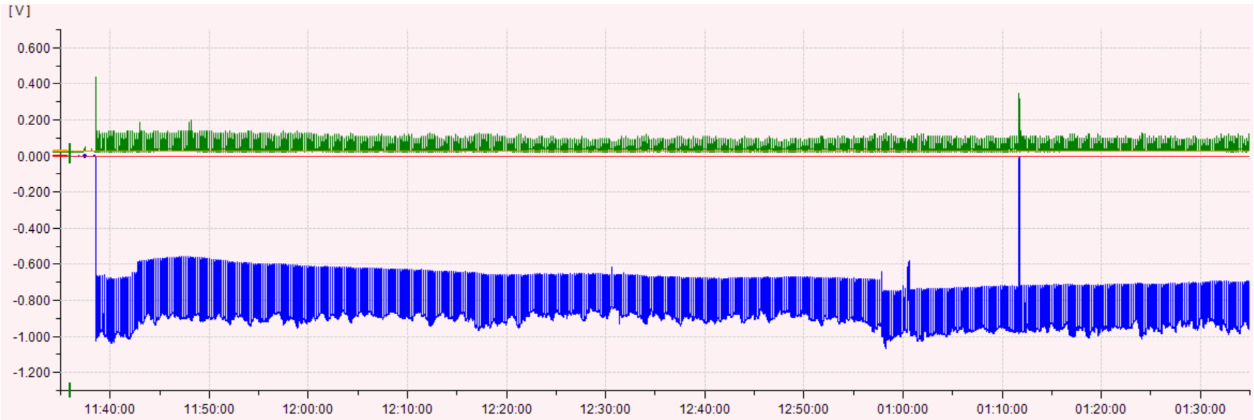

Figure 3, Datalogging of Temporary Coupon Potentials (Part of 4Hr Data Logging)

Appendix B: CP SYSTEM SCHEMATIC

Pipe Section & CP

(Reference: Undersea Construction Ltd./Doc No. UCL-VEOLIA-MOA POINT PIPELINE – Rev.0 Mar.2023)

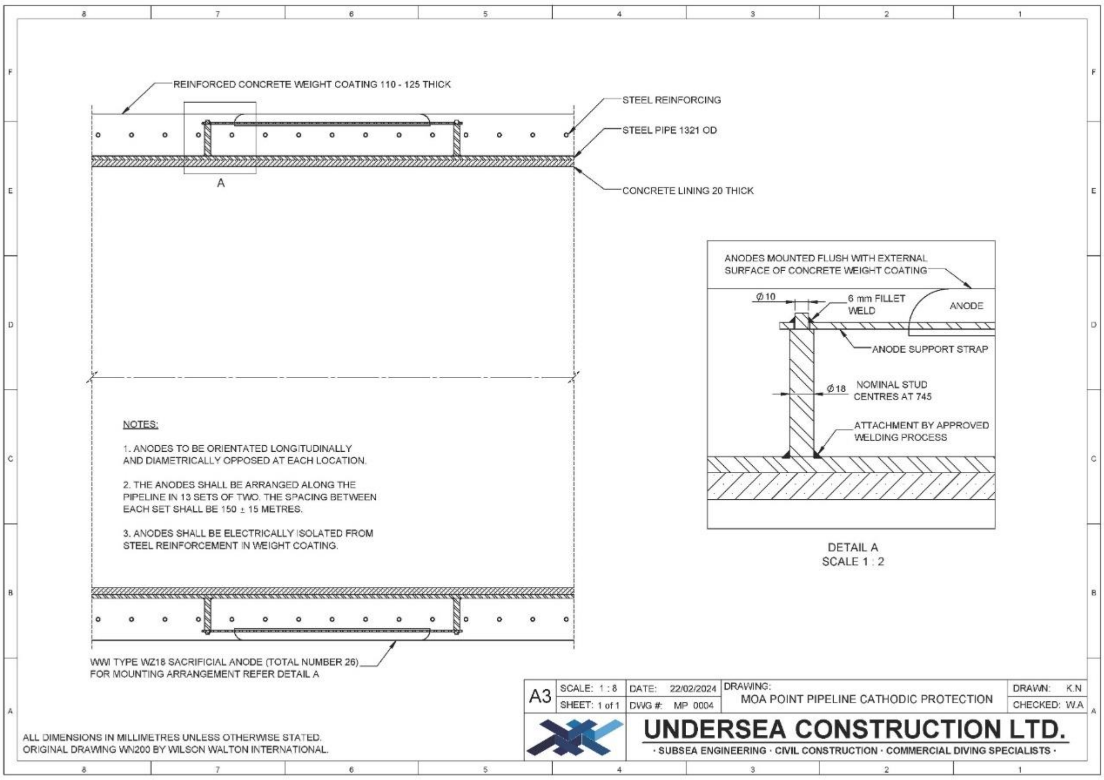

Figure 4, Pipe section & CP

In-Ground Section of the Pipeline

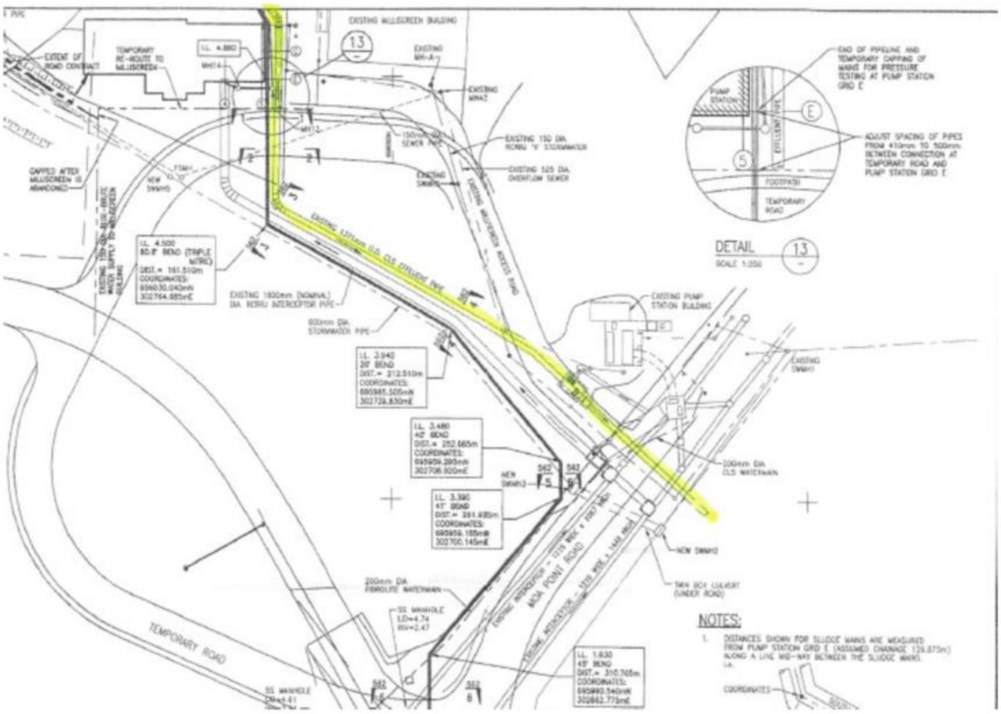

Figure 5, In-Ground Section of the Pipeline

In-Water Section of the Pipeline

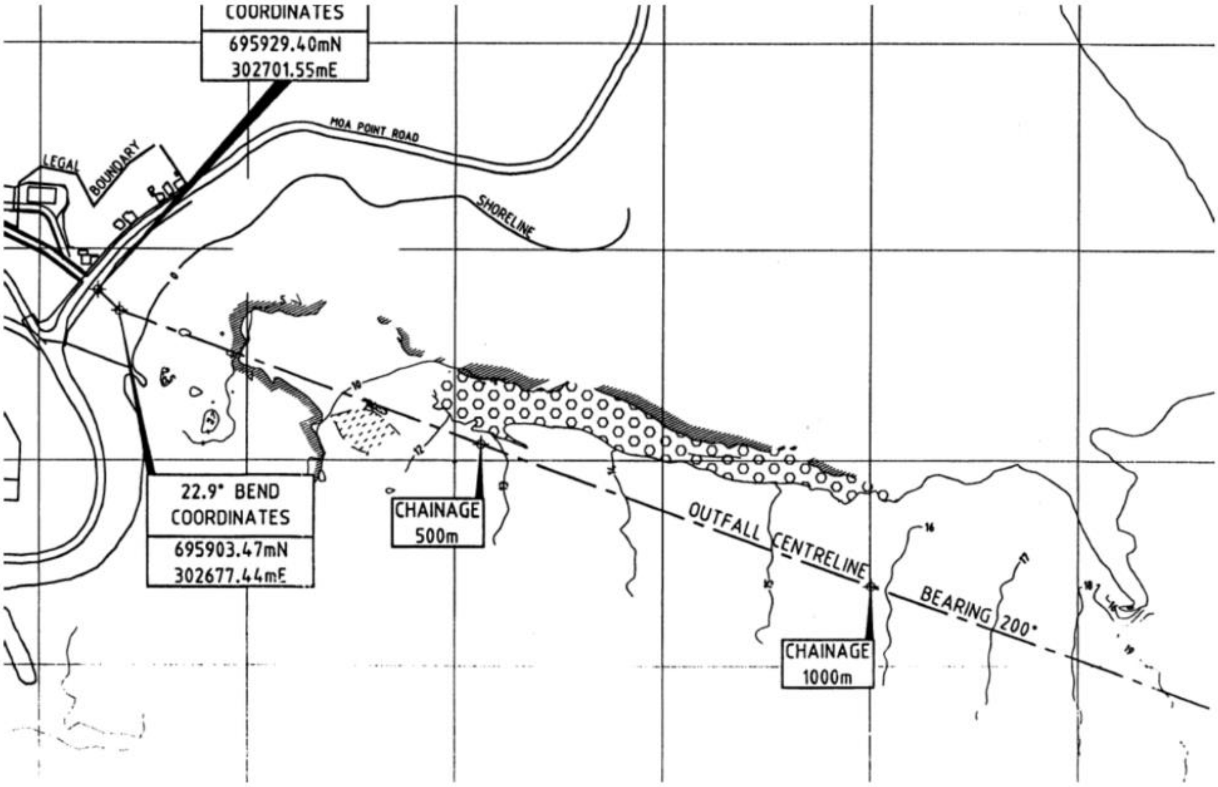

Figure 5, In-Water Section of the Pipeline

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Document No.	QMS – Item: Inspection – Moa Point Pipeline – Feb./March 2024 – Rev. 0
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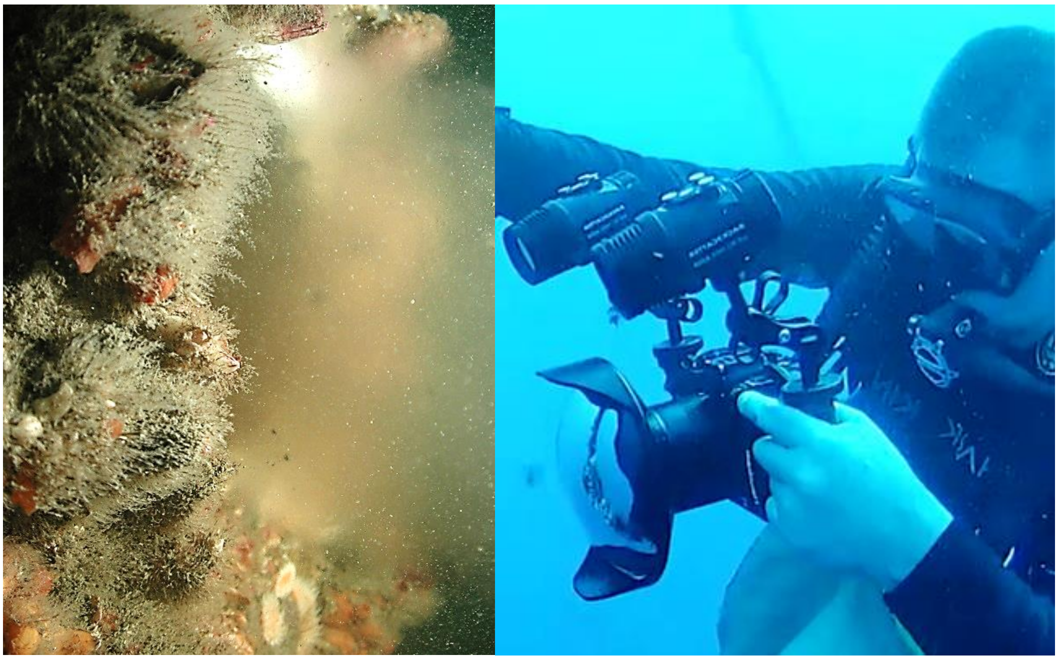

UNDERSEA VERIFICATION SURVEY

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February / March 2024

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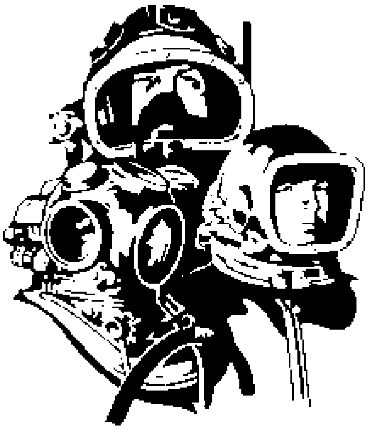
VEOLIA WATER

MOA POINT WASTEWATER OUTFALL PIPELINE – ANNUAL INSPECTION

February / March 2024



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1. PREFACE

Assets such as Coastal Outfall Pipelines are typically subjected to harsh operational and environmental degradation; therefore, for these reasons they are particularly susceptible to numerous and considerable deteriorating processes. For Councils, Government Authorities, and other Stakeholder Parties to obtain the maximum working life and return on their initial investment from assets in marine environments it is important that they be maintained to an acceptable and safe working standard.
Their life cycle management represent major planning and engineering efforts; therefore, to ensure the continuing safe operational performance of their asset; programmed inspections and monitoring are crucial to verify that operational and structural integrity are maintained at an acceptable level.

When Coastal Outfall Pipelines and their ancillary components come into service, it is hoped that they're free of all significant defects. This of course depends on the professional standards applied to quality assurance and quality control by the various Parties involved in design and planning; component fabrication; asset construction and installation.
To ensure a continuous working life for any asset, it is necessary to maintain an adequate Asset Integrity Management (AIM) programme. Such a programme must be capable of detecting potential problems at an early stage; thus, allowing the designers and engineers time to analyse the inspection information and suggest remedial action(s) if required.

Experience has shown that the vast majority of all faults; damage / defects / deterioration found in marine structures and their components have been done so visually. Visual information is of utmost importance, in both programmed visual condition assessment inspections, and in general asset management.
Throughout the progression of these inspections, qualified personnel observe and record data on numerous components in varying condition states.
The consequences of failure to what initially may only be a minor fault; especially sudden failure, can be catastrophic and very expensive, both in terms of repairs; lost business; and risks to health, safety and the environment.
Programmed condition assessment inspections and monitoring, along with asset audits; and subsequent service maintenance and repairs, are completed to ensure the continued operational integrity and functional efficiency of structures are maintained throughout their life. Providing the Asset Owner, and subsequently public stakeholders with an assurance of reliability in the integrity of the structure.

Condition assessment is an important step in the life cycle management process of Structural Assets; particularly those in marine and hazardous environments.
One of UCL's major specialties of work and experience is in the inspections, condition assessment and reporting on numerous inshore coastal, offshore, and underwater structural assets throughout New Zealand and overseas. It is a facet of work that we derive immense satisfaction from; when being able to detect potential problems at an early stage, then work in partnership with Clients towards achieving common goals and economic solutions. Thus, minimising risk and therefore maintaining the Clients valuable asset in safe and efficient operational condition – "fitness-for-service".

2. ASSET INTEGRITY MANAGEMENT (AIM)

Introduction

Asset Integrity Management (AIM) is the process of ensuring a Structural Assets fitness-for-service over its entire life; from conceptual engineering (design) to potential life extension.

It is a process for managing the effects of deterioration, changes in loading, accidental damage, and responses to component failure.

The objectives of an AIM process include detection of possible degradation or failure of a component at a sufficiently early stage to allow for remedial action. The integrity management process also provides a record of inspection, maintenance, and service data; all of which that will be required when considering future life extension.

The key components of AIM are illustrated in Figure 1: where the AIM process starts as early as the conceptual engineering phase and continues all the way to a potential life extension.

Asset Integrity Management

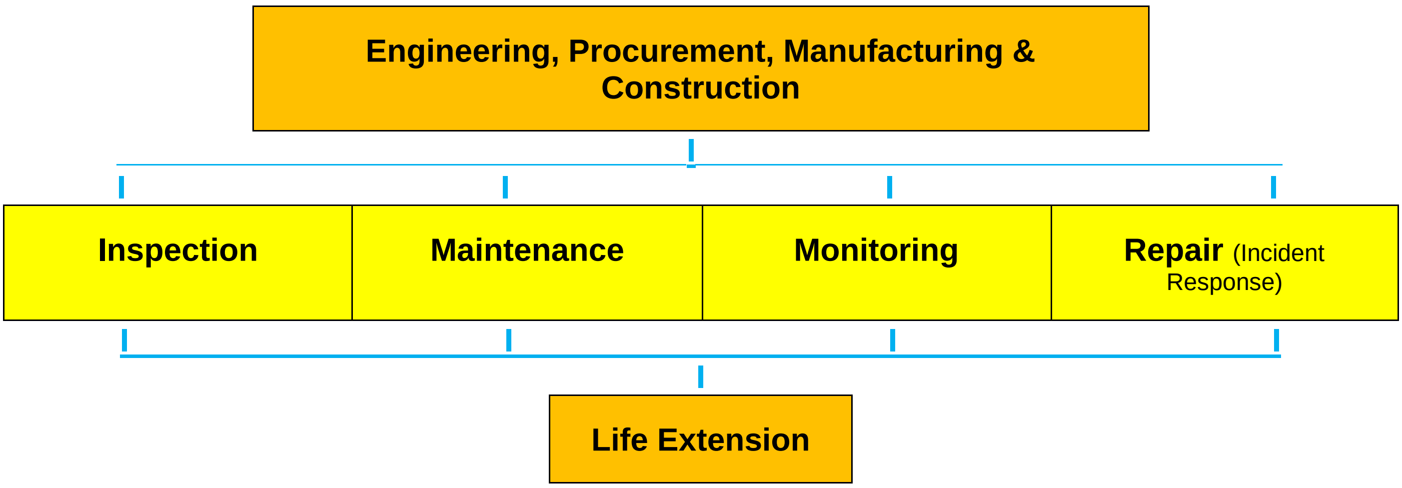

Figure 1: Components of Asset Integrity Management

Managing Asset Integrity Performance

The integrity management process provides the opportunity for Asset Owners and their engineers to adopt risk-based principles for developing strategies that take into account the current condition of the structure, the likelihood of damage or degradation of an integral component, and the potential consequences.

A risk-based approach recognises that structures with higher risks can warrant more frequent and more focused inspection than structures with lower risks (i.e. aging structures verses recent constructions). During the development of an inspection strategy, the structure's risk category can be used for determining inspection intervals and work scopes. The inspection work scope should take into account the latest lessons learned from other similar structures; changes in the design environmental conditions and their subsequent impacts; local anomolies; and the documented experiences of other Asset Owners with similar designed structures and service requirements.

Asset Integrity Management combine the processes of periodic inspection and testing, and the assessment and interpretation of the resultant data to provide an indication of the current condition of a specific asset, as to, the determination of the requirement for remedial action.
Asset condition assessments determine the current physical state of an asset that may affect the performance of the asset and the ability of the asset to provide the required level of service.

The benefits of knowing the current condition of an asset are:

- The ability to plan and manage the delivery of the required level of service to the asset.
- Avoiding premature asset failure by providing the option of cost-effective remediation.
- Providing an accurate estimate of future expenditure that is required.
- Determination and refinement of maintenance and rehabilitation strategies.

Asset maintenance to be undertaken over the balance of a marine structures service life is a major challenge to provide reliable and sustainable operation. Operating ageing structures efficiently and safely requires an asset maintenance cycle that includes; inspection diagnosis, evaluation and implementation of remediation processes.
It is a critical part of asset management to determine the remaining lifecycle of an asset and the capability of the asset to meet the designed performance and level of service requirements.

Being unaware of the current condition of an asset may lead to the premature failure of the asset; leaving limited options to the Asset Owner: with replacement being the most expensive option. Unforeseen failure of an asset provides major consequences that constitute a risk to business operations or potential loss to the Asset Owner. The benefits of knowing the current condition of an asset are; the ability to plan and manage the delivery of the required level of service to the asset; avoiding premature asset failure by providing the option of cost-effective remediation; providing an accurate estimate of future expenditure that is required; and the determination and refinement of maintenance and rehabilitation strategies.

Often there is limited information and drawings on original design; with drawings and construction and installation records often being partial and without update detail to manage "as built" changes.
Baseline data along with periodic asset condition assessment inspection plays a critical role in asset management for Owners and Stakeholders; as good inspection practices prevent failure incidents caused by the poor condition of structural components. Good record-keeping of inspections, monitoring, and repairs and maintenance are intended to function as the cornerstones for asset maintenance strategies; in which components of the structure are prioritised, aligned with their degree of deterioration and loss of function.

Assessment of damaged or deteriorated marine structures should only be made by qualified and experienced people specialising in this field of work; and the process should always include the aspects of the condition of the structure including all visible, non-visible and potential damage and defects, a review of the past, current and future operational functionality and service requirements.
An understanding of marine structures is critical in being able to provide comprehensive reporting on all aspects of the Asset Integrity envelope. Prior to diagnosing the causes of defects or failure within a structure it is important to understand that defects result from several factors: design; construction and installation practices; materials; the environment; stress and loading applied to the structures components.
Structural failure can be defined as the inability of a structure to serve its intended function with the desired levels of safety and serviceability.

Remediation / rehabilitation of structures
Over the past few decades, the desire of extending the useful service life of structures has become of paramount significance. Where ageing structures are a serious problem faced by countries across the world; premature deterioration has also emerged as a major problem that results in reduced service life of structural assets.

Failure of a structure or component of a structure may be attributed to a number of independent or interrelated factors.
In marine environments a structures components are constantly subjected to multiple fatigue and risk factors that result in deterioration over the course of their service lives.
Asset Condition Assessment gathered information assists with the determination of the remaining service life of an asset, and the scheduling of remediation requirements that are needed to reinstate the level of service that is provided by the asset to meet the desired standard.

With most damaged or deteriorated marine structures, Asset Owners have a number of options which will effectively decide the appropriate remediation strategy that will meet the future service requirements of the structure. These options will include doing nothing; downgrading the capacity or functional operation of the structure; preventing or reducing further damage without repair; improving, strengthening or refurbishing the structure; reconstructing all or part of the structure; or demolishing the structure.

Proper remediation methodology begins with inspection and testing to identify the type and extent of defects and degradation mechanisms; and the overall condition and quality of the structure. Remediation projects are prone to increasing in volume and costs once work has commenced – investing in comprehensive and accurate Asset Condition Assessments before remediation begins has proven cost effective in the long term.

3. ‘AIM’ SUMMARY

Structural assets exposed to the marine environment are subjected to considerable deteriorating processes. Of course, engineers take this into account when designing the various components that are used to construct marine assets; however local anomalies do occur and some detailed aspects of potential problems are often imperfectly understood.
All publicly accessed marine structures warrant careful monitoring on safety and engineering grounds. This indicates a need for documentation for marine assets, and the importance of these records should not be underestimated. The average working life of structures designed for marine environments is predicted to be between 15 – 50 years. During that life cycle, it would be reasonable to assume that defects of one type or another will occur. It therefore makes good sense, for both operational safety; engineering and economic reasons for any such defects / damage / deterioration to be dealt with on a planned basis: ‘AIM’.

4. GENERAL, OVERVIEW & POSITIONAL DATA

General
The Moa Point Ocean Outfall Pipeline is approximately 1858m in length; from position 'A' at the roadside southern embankment inspection chamber, then traversing in a southerly direction through Lyall Bay to the pipeline's southernmost diffuser (position 'F') in a water depth of approximately 23 metres and a GPS position of 41° 21.119' S 174° 48.080' E.

Wellington City Council holds Resource Consent WGN080003 (26180) to discharge treated wastewater from the Moa Point Wastewater Treatment Plant into Lyall Bay via the 1.8km offshore outfall pipeline.

Following correspondence between Ann Shibu (Veolia), Craig Shuttleworth (Wellington Water), and Wayne Angus (Undersea Construction Ltd.), in respect to carrying out underwater condition assessment inspections of the Moa Point Wastewater Outfall Pipeline; a Scope of Works was agreed to; as to, approval from Veolia to proceed with the work.

Following completion of the onsite works / inspection survey investigations, all resultant data is processed and compiled into a QMS Report for issue to the Client.

Overview
The emphasis of the inspections being to complete a thorough assessment as per the Scope of Work; with reporting being separated into the following items:

- Exposed Inshore Pipeline Section & Seabed,
- Buried Pipeline Outfall Route & Seabed,
- Offshore Diffuser Section – General Survey,
- Diffuser Section Cathodic Potential Survey.

Report prepared for:
Ann Shibu; Safety, Risk & Compliance Officer, &
Nico Robins; Operations Coordinator
Moa Point WWTP
Veolia Australia & NZ (Client)

Survey Inspection Investigations and Report completed by:
Wayne Angus, Civil Engineer / Construction Diver
Undersea Construction Ltd. (UCL) Marine Civil Works Engineering & Diving Contractor

Following completion of a Health & Safety Plan, Safe Work Method Statement (SWMS) and regulatory compliance documentation; UCL staff engaged in a brief 'toolbox' discussion on the survey scope and objectives, followed by staff completing the onsite underwater survey inspection activities as per the 'Scope' for the Moa Point Wastewater Ocean Outfall Pipeline and Seabed 2024 Survey.

Positional Data (as illustrated in Figure 2 Labelling)

MOA POINT WASTEWATER OUTFALL PIPELINE Geographic Positioning Data – 2024			
Position	**Designation / Description**	**UTM 60G**	**dd° mm.mmm'**
A	On shore manhole access to buried pipeline	316670 x – east 5421594 y – north	41° 20.178' S 174° 48.542' E
B	Mean High Water (MHW)	316652 x – east 5421545 y – north	41° 20.204' S 174° 48.528' E
C	Exposed pipeline – shallow water section – shoreward end	316636 x – east 5421517 y - north	41° 20.219' S 174° 48.516' E
D	Exposed pipeline – shallow water section – seaward end	316598 x – east 5421434 y - north	41° 20.263' S 174° 48.487' E
E	Shoreward end of pipeline diffuser section	316100 x – east 5419923 y - north	41° 21.073' S 174° 48.103' E
F	Seaward end (southern-most) of pipeline diffuser section	316070 x – east 5419836 y - north	41° 21.119' S 174° 48.080' E

Table 1: Geographic Positioning Data

Distance between points – (in metres)						
Reference	**A**	**B**	**C**	**D**	**E**	**F**
A	00.0	52.0	84.2	175.0	1765.0	1858.0
B	52.0	00.0	32.2	123.0	1713.0	1805.0
C	84.2	32.2	00.0	91.3	1682.0	1774.0
D	175.0	123.0	91.3	00.0	1591.0	1683.0
E	1765.0	1713.0	1682.0	1591.0	00.0	92.1
F	1858.0	1805.0	1774.0	1683.0	92.1	00.0

Table 2: Distances between 'label' designated positions

Figure 2: Moa Point Wastewater Outfall Pipeline – route through Lyall Bay

5. SCOPE OF WORK

- Formulate a survey inspection activity plan.
- Submit Worksafe NZ Notification of Work (Diving – Notifiable work).
- Produce a task orientated Health & Safety Plan, Safe Work Method Statement (SWMS) & Emergency Plan.
- Task assessments, hazard analysis, & a site-specific risk assessment.
- Specialised equipment preparation & calibration.
- Visual survey inspection of pipeline components:
  a) inshore exposed pipeline section; 2.5 – 8.0 metre water depth (positions ‘C – D’),
  b) buried pipeline route from diffuser # 18 (position ‘E’) on a heading back to position ‘D’,
  c) outfall diffuser section from southernmost diffuser # 1 (position ‘F’) to diffuser # 18 (position ‘E’).
  d) Cathodic Potential monitoring at diffuser test point & outlet nozzles.
- Dimensional measure of scour:
  a) at inshore exposed pipeline section (positions ‘C – D’). With reference to existing markers, set at 10 metre increments along the length of exposed pipe to establish repetitive monitoring reference at fixed positions,
  update CAD drawing for 2024 reference & reporting purposes,
  b) at diffuser section.
- Photograph items of interest.
- Video diffusers in operation.
- Monitor inshore exposed pipeline section, & compare data against historic values.
- Log all observations; defect / damage / deterioration etc., & assessment of general condition.
- Process recorded data, compile & submit a report covering all inspection results and observations.

Methodology / Procedure

Operating on both standard SCUBA, light-weight contaminated water equipment (Divator positive pressure masks), and using a breathing gas mixture of Nitrox 40 (40% O^2 / 60% N^2); divers working from a dive support vessel descended a down-line to the seafloor adjacent the southern-most diffuser, then inspected pipeline components as per the programmed Scope of Work: firstly the outfall diffuser section from southern-most diffuser # 1 (position 'F') to diffuser # 18 (position 'E'), completing visual survey of the diffusers and surrounding seabed, checking Cathodic Potential values, and elevation (scour depth) measurements of the diffusers – seafloor to top of diffuser casings.

Followed with a diver using a DPV to travel the buried pipeline route from diffuser # 18 (position 'E') on a heading of 18° East of True North until reaching position 'D', the Shallow Water exposed pipe section.

Then diving from the shoreline, inspecting the Shallow Water exposed pipeline section 3.0 – 8.0 metre water depth (positions 'C – D').

Divers completed the tasks as detailed within the scope of work: carrying out specific investigations, while also observing for any evidence of abnormal or aggressive wear, defect, damage, or deterioration, then logging all details accordingly.

Refer to relevant section of Report for further details.

UNDERSEA CONSTRUCTION LTD.

SUBSEA ENGINEERING, MARINE CIVIL, OFFSHORE MOORINGS, & COMMERCIAL DIVING SPECIALISTS.

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P. O. BOX 31081,
LOWER HUTT 5040
NEW ZEALAND.

DAILY RECORD OF INSPECTION OR NDT

DATES OF DIVES: 27th February & 21st March 2024
INSPECTION PERSONNEL: Scott McChesney, Jacques Angus, Rian Kriel, Wayne Angus
CLIENT: Veolia Australia & NZ
LOCATION: Moa Point WWTP, Lyall Bay, Wellington
INSPECTION COMPONENT: Wastewater Ocean Outfall Pipeline and Seabed – Annual Survey

TYPE OF DIVE:

SCUBA	SURFACE SUPPLY	MIXED GAS	OTHER
X		Nitrox 40 (40% O^2 / 60% N^2)	Divator + pressure mask

DIVE DETAILS: (multiple dives over the course of 2 days)

	DIVE 1	DIVE 2	DIVE 3	DIVE 4	DIVE 5
MAXIMUM DEPTH OF DIVE	24.0m max.	24.0m max.	23.0m max.	8.0m max.	
BOTTOM TIME (minutes)	27 Diffusers CP	18 Diffusers General	28 Pipeline route	43 Inshore section	

METHOD **CHECK** **PARTICULARS / EQUIPMENT**

VISUAL INSPECTION

GENERAL SURVEY:	X	Visual condition assessment of inspection components, & CP survey
STILL PHOTOGRAPHY:	X	Photograph items of interest; i.e. diffusers & surrounding seabed
VIDEO SURVEY:	X	Record video footage of diffusers in operation

NDT

POTENTIAL MEASUREMENT:	X	Cathodic Potential readings
DIMENSIONAL SURVEY:	X	Obtain seabed scour measurements – around diffusers, & inshore pipeline section
REMEDIAL GRINDING:		
M.P.I.:		
ULTRASONIC:		
OTHER:		

ANY OTHER REMARKS: Refer to this Report for Inspection data results.

APPROVED
NAME OF SUPERVISOR: Wayne Angus
SIGNATURE: *W. T. Angus*
DATE: 21st March 2024

NAME OF CLIENT'S REP: Ann Shibu
SIGNATURE:
DATE:

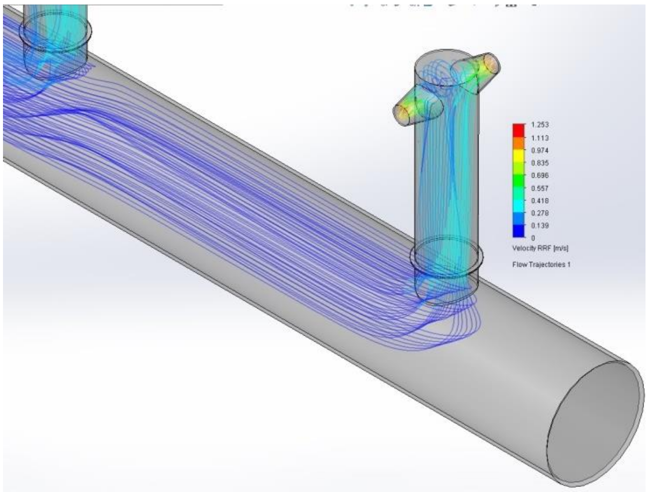
"To solve it easily, detect it early"

6. REFERENCE

Note:
For ease of interpretation, this document is separated into 4 individual reporting items, as follows: addresses and documents the pipeline inspection components in individual sections as follows:

- Exposed Inshore Pipeline Section & Seabed
- Buried Pipeline Outfall Route & Seabed
- Offshore Diffuser Section – General Survey
- Diffuser Section Cathodic Potential Survey

7. INSPECTION OBSERVATIONS



UNDERSEA CONSTRUCTION LTD.

MOA POINT WASTEWATER OCEAN OUTFALL PIPELINE & SEABED 2024 SURVEY

- ⚓ **Exposed Inshore Pipeline Section & Seabed**
- ⚓ **Buried Pipeline Outfall Route & Seabed**
- ⚓ **Offshore Diffuser Section – General Survey**
- ⚓ **Diffuser Section Cathodic Potential Survey**

Exposed Inshore Pipeline Section & Seabed

Figure 3: Shallow Water Section – Exposed Pipeline between positions C & D

SCOUR DEPTH DATA			
Position [m]	2024		
	West (mm)	East (mm)	Comment
C 00.0	100	100	
10.0	100	150	
20.0	300	300	
30.0	450	450	
M 40.0	600	650	
50.0	800	850	
60.0	900	1000	
70.0	850	1050	
80.0	700	800	
D 90.0	200	200	

Table 3: Seabed scour depth adjacent exposed pipe

The exposed inshore pipeline section (position 'C') commences at approximately 32.2M below the MHWL (B) at a water depth of 2.5M, and extends approximately 90M to a water depth of 7.5M.

Over the past year (between the 2023 to 2024 Inspections) the area has experienced frequent southerly swells. While severe events have been rare, the slight to moderate swell conditions that have prevailed, result in increased scour adjacent the exposed pipeline section; with erosion of sand and fine gravels from the well-defined scour channels.

While neither the length of exposed pipe nor the maximum scour depth have increased, the average scour depth over the length was found to be greater.

Due to the nature of this coastline and its exposure to severe southerly storms: wave action and strong currents will inevitably continue to result in erosion and aggregate migration along the shoreline and tidal shallow water reaches. This coupled with the shallow depth of burial of the inshore pipeline's transition from land to sea, determines that scour adjacent to the pipe will always remain active and a factor requiring monitoring.

The exposed length of pipeline has remained relatively constant throughout the years since inspection and monitoring commenced.
Over the period between the 2023 to 2024 annual inspections, exposed pipe length has remained constant, and maximum scour depth adjacent to the pipeline remains stable; however, the average scour depth within the 'M' to 'D' positional zone has increased over the period.
The occurrence of scour being predominately due to the cyclic effect of repetitive southerly sea states, resulting in sand and light gravel deposit migration within the shallows and along the shoreline.

Figure 4: Zone C – shoreward position at which pipe exposure commences

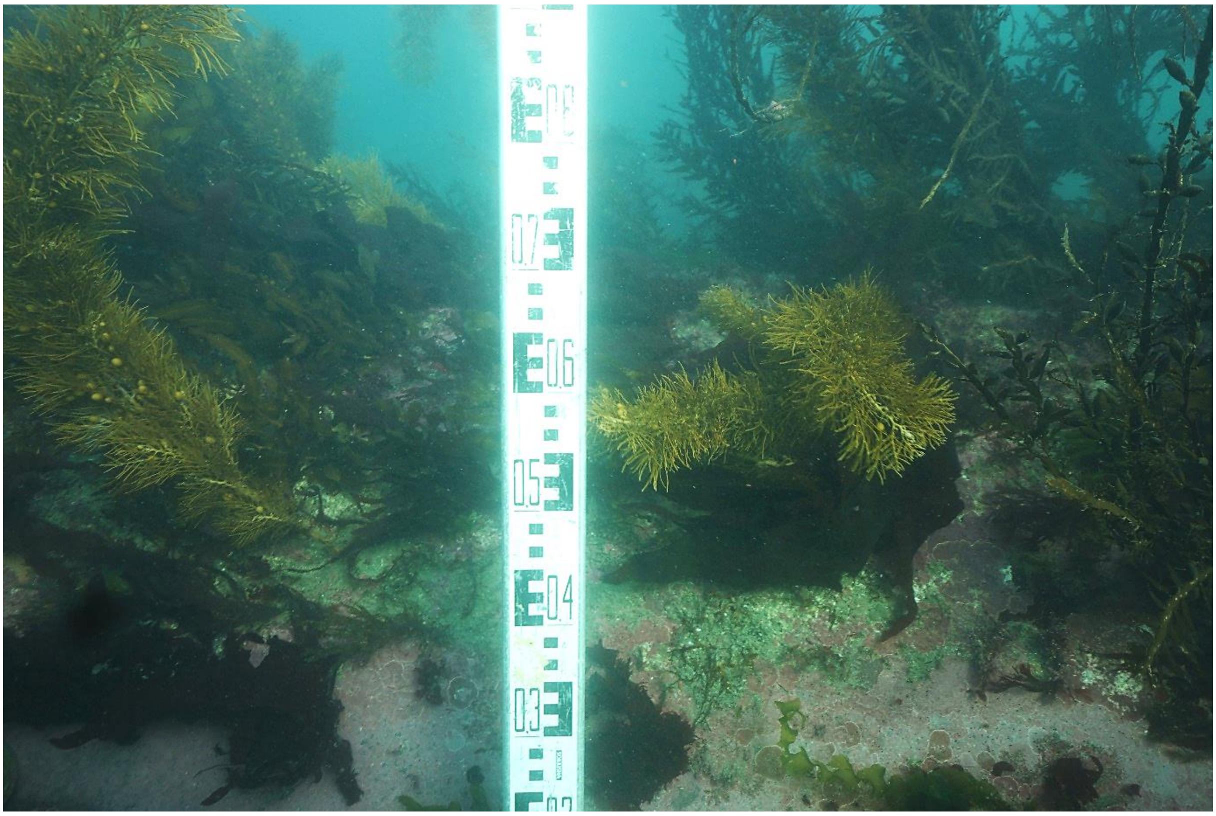


Figure 5: Position M – shoreward end of zone M to D

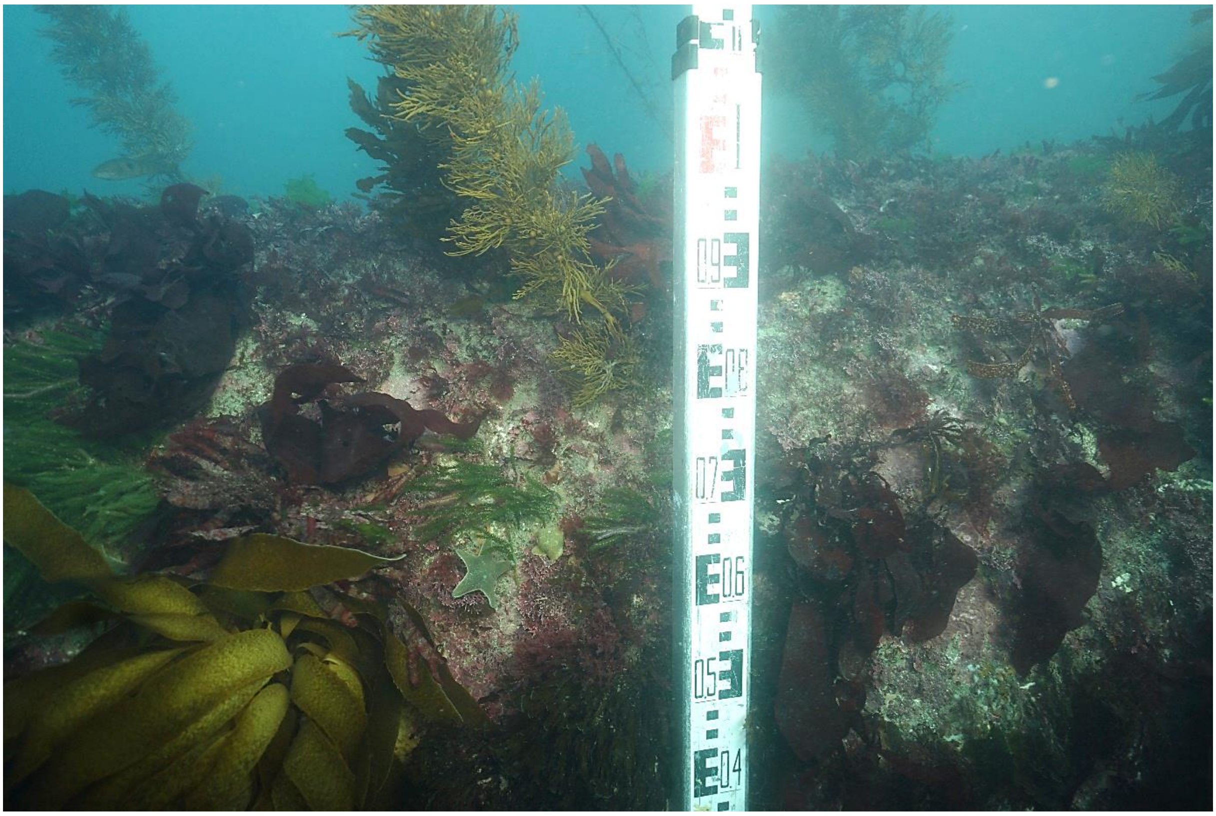


Figure 6: Zone M to D – 60m position

Figure 7: Zone M to D – 80m position

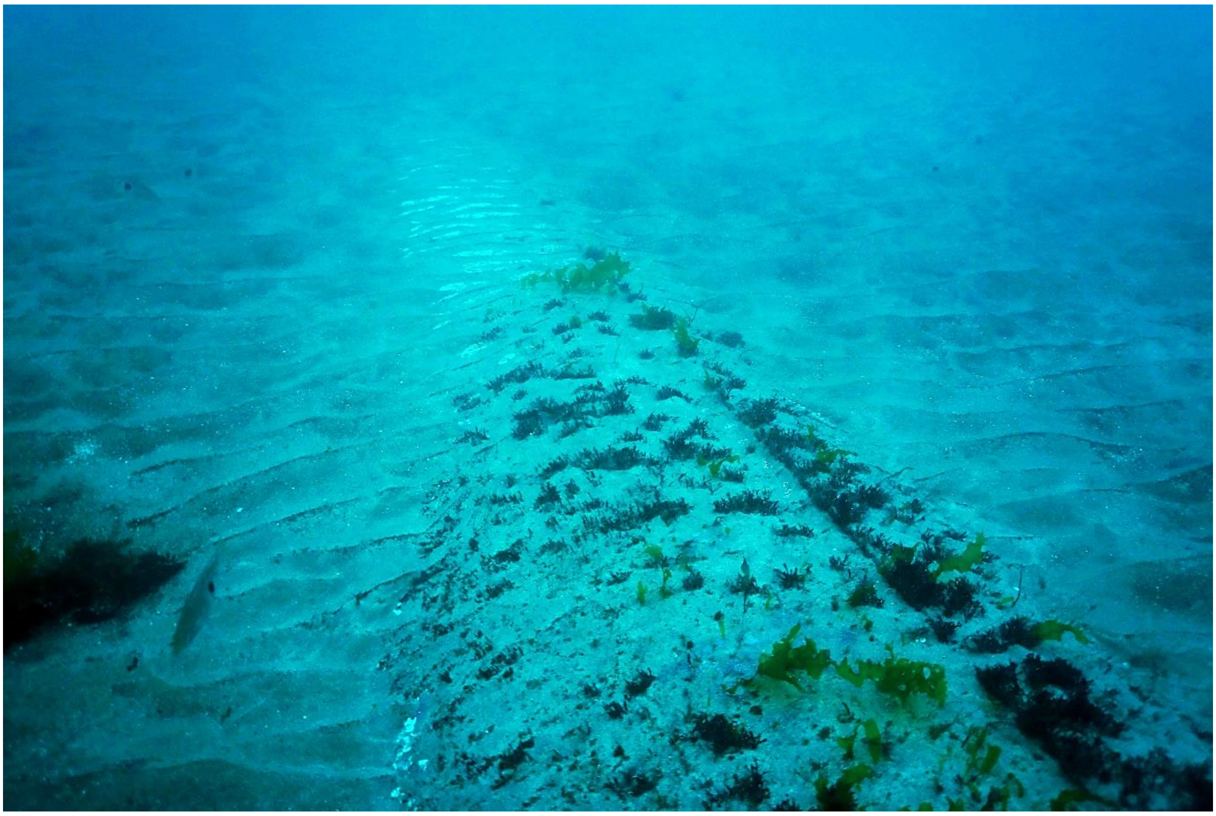


Figure 8: Position D – seaward position of pipeline departure back below seabed

Buried Pipeline Outfall Route & Seabed

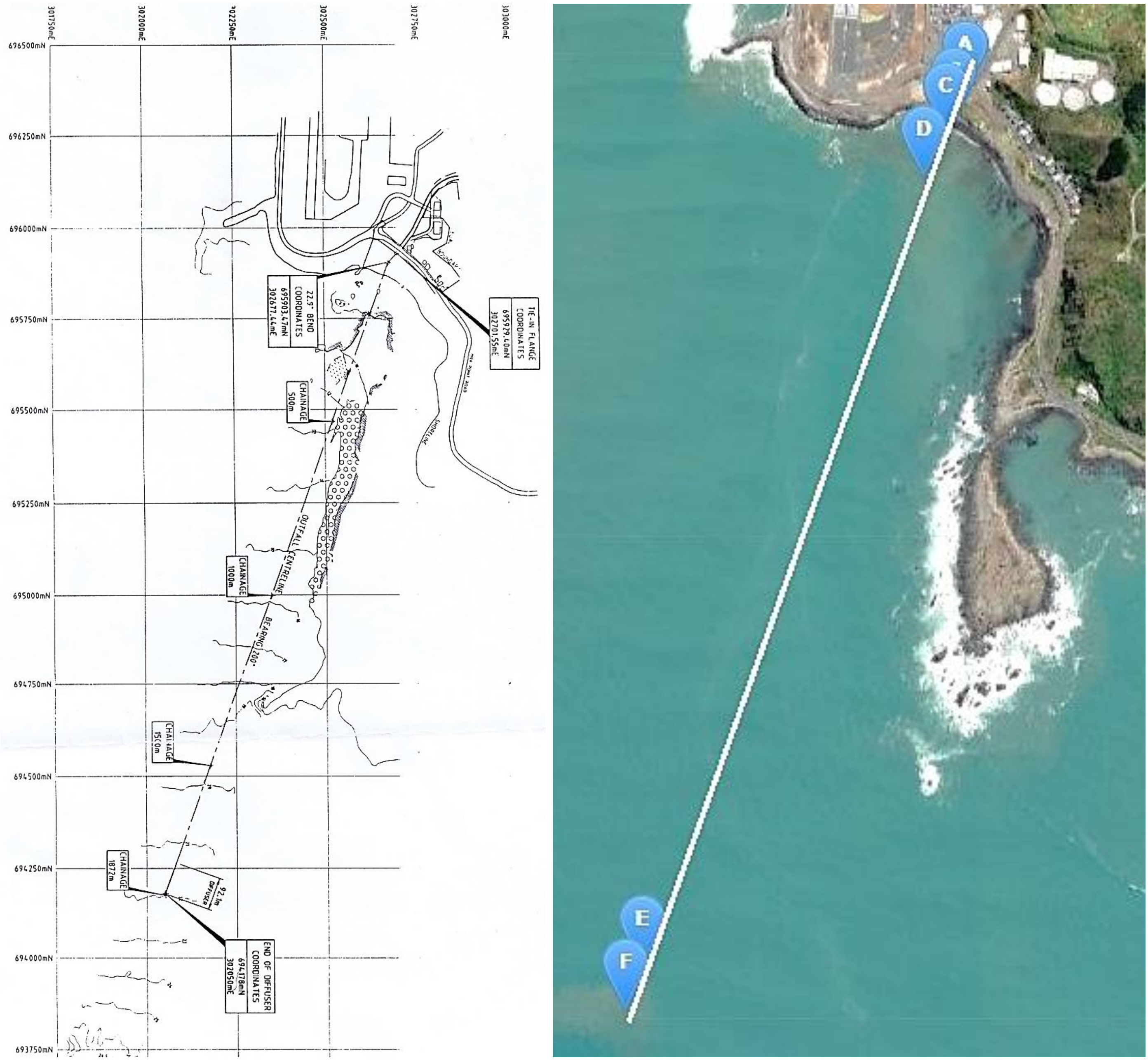


Figure 9: Pipeline route

Using the drop line marker deployed at Diffuser # 1, the Inspection Diver equipped with a DPV (Diver Propelled Vehicle) descended to the seafloor at position 'F', and then set both the Diver's underwater computer compass and the DPV compass on a Heading of 18.5º East of True North. The Diver then travelled from position 'F'/Diffuser # 1 along the diffuser section to position 'E'/Diffuser # 18, where inspection of the buried pipeline route commenced. Travelling the pipeline route from position 'E' shoreward to position 'D'.

Travelling just above the seabed along the pipeline route, the Diver kept observation for any exposed pipeline sections, or evidence of fouling or other notable detail.

Due to swell common wave heights of 1.0m at the diffusers, and increasing in height to 1.5m closer inshore, visibility along the route was fair; ranging from 2.0 to 3.5 metres.

The diver made no observations of exposed pipe, nor any evidence of fouling by foreign objects.

The offshore seabed, consisting of rocks, and coarse gravels and sand, forms a profile of undulating peaks and depressions of +/- 300mm.

The inner route seabed, consisting of coarse sand and gravels forms a profile of undulating peaks and depressions of +/- 150mm.

Seafloor deposits of gravel and sand in the form of undulating peaks and depressions that mirror wave direction are typical and commonplace in this type of coastal environment.

The result of the underwater inspection of the pipeline route being; no areas of concern observed.

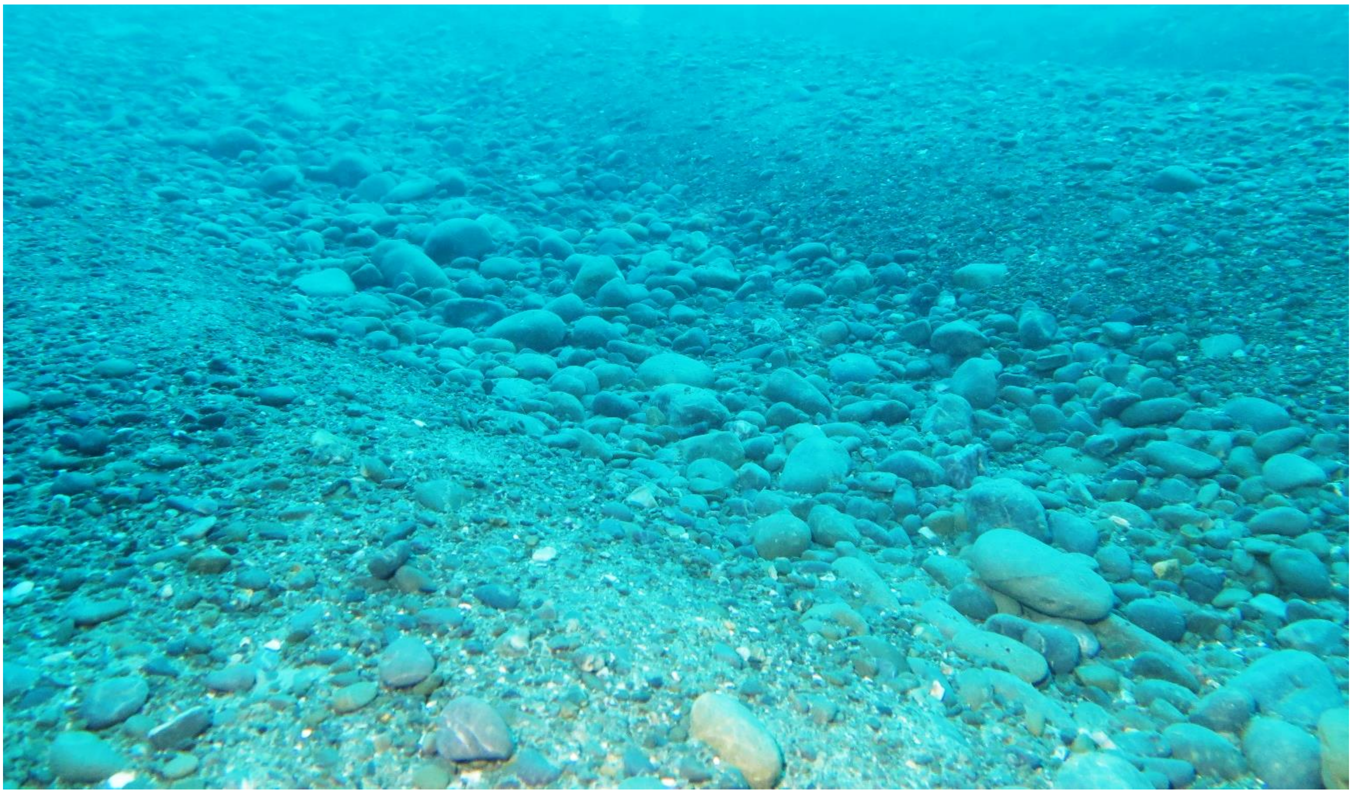


Figure 10: Typical seafloor profile and aggregate composition at seaward end of pipeline route.
Approaching closer to position 'D' the aggregate sizing reduces, primarily to small gravel and coarse sand. Then returns to a combination of rocky outcrops, small to large boulders, and coarse gravels through the shallower shoreline surf zone.

Offshore Diffuser Section – General Survey

Divers inspected the general condition of diffusers, measuring scour depths around riser pipes, and checking for any evidence of fouling, damage, defect, or deterioration.

The inspection commenced at the seaward most diffuser, this being position ‘F’/Diffuser # 1, and finished at the shoreward most diffuser, this being position ‘E’/Diffuser # 18.

Visual investigations were completed around the diffusers that exhibited the greatest scour depths to ensure that none of the bed stabilisation mats were exposed. No exposed erosion control mat material was observed.
With reference to the ‘as built’ drawings, it should be noted that at the specified design depth, several of the current recorded reduced scour depths are below the specified depth of the erosion stabilisation matting; however, no stabilisation matting material is evident.
Visibility ranging between 3.5 – 6.0 metres was satisfactory, during the underwater inspection of the wastewater pipeline Diffuser section.

All 18 diffusers had their height of exposure measured using the current reduced seabed level as a datum. All heights ranged between 1300 to 1750 mm.

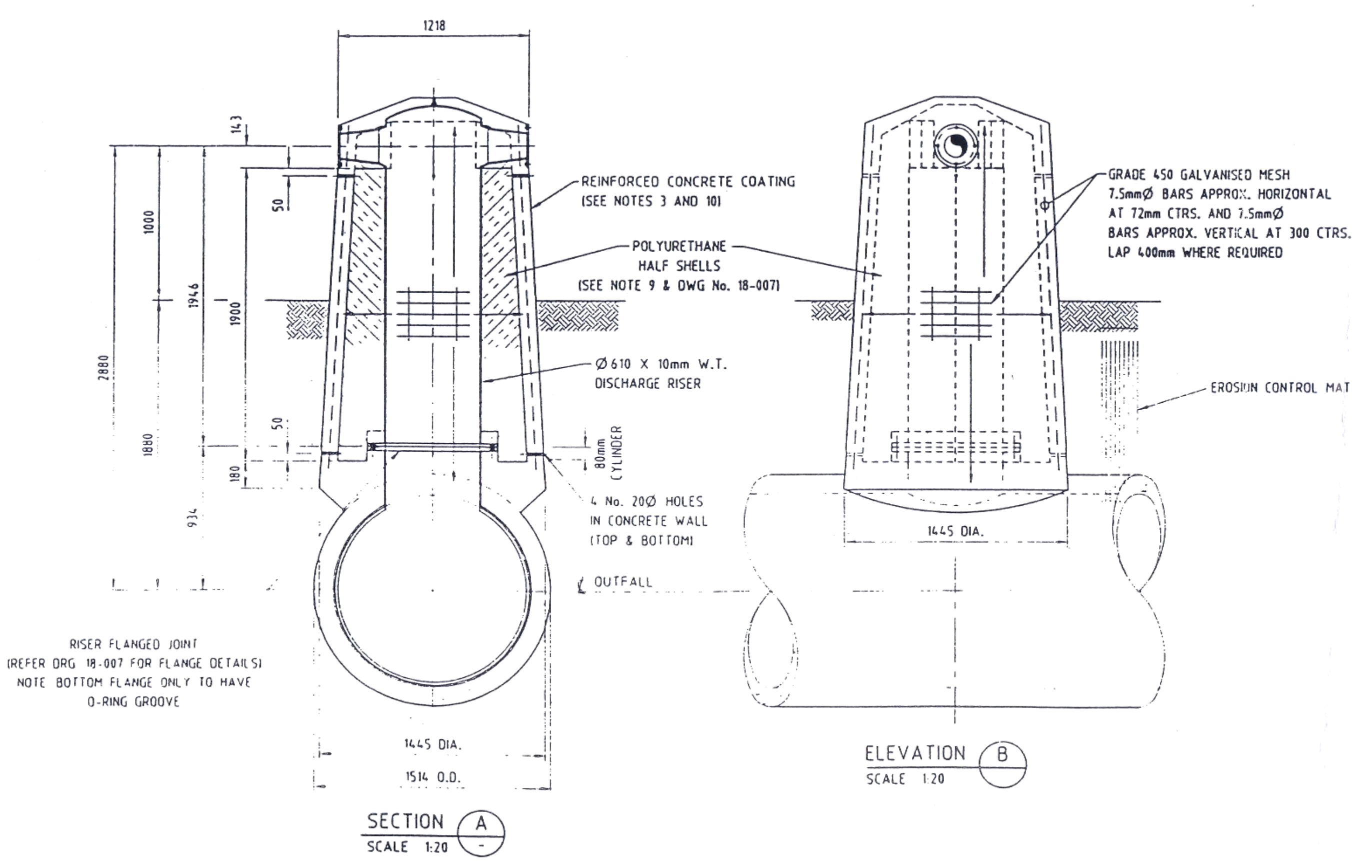


Figure 10: Diffuser ‘as built’ Cross-section

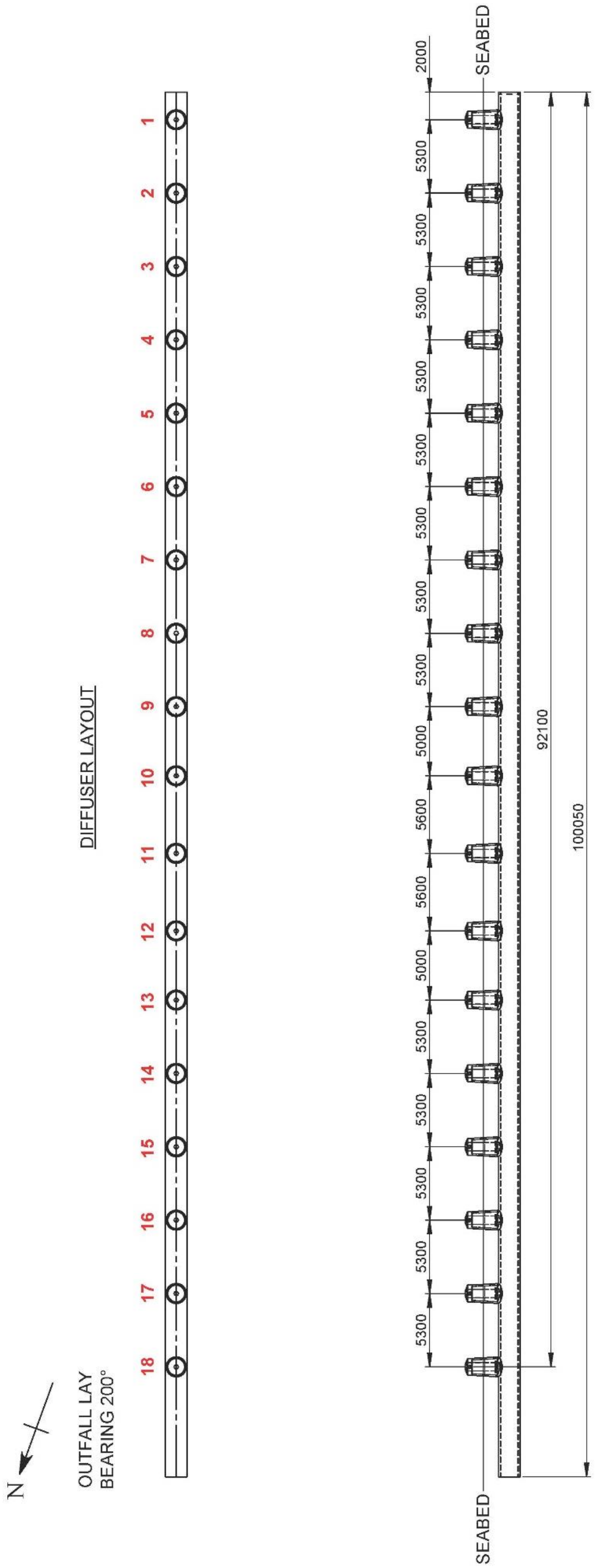


Figure 11: Diffuser section layout

Diffuser # from seaward to shoreward	Diffuser Exposed Height out of Seabed (mm)		Open Ports X	
	North face	South face	West	East
1	1600	1600	X	X
2	1600	1600	X	X
3	1650	1600	X	X
4	1650	1600	X	X
5	1600	1600	X	X
6	1600	1550	X	X
7	1650	1600	X	X
8	1750	1700	X	X
9	1700	1700		X
10	1750	1650	X	
11	1700	1600		X
12	1600	1600	X	
13	1650	1500		X
14	1600	1500	X	
15	1550	1400		X
16	1400	1400	X	
17	1400	1300		X
18	1300	1300	X	

Table 4: Exposed heights of diffusers (seabed scour around diffuser positions)
X – Open diffuser ports

No evidence was observed of any damage or deterioration to any of the 18 diffuser assemblies. About the diffuser positions, seafloor deposits of rocks, course gravels and sand form undulating peaks and depressions traversing the seafloor in west / east orientation, typically of +/- 300mm in height and mirroring wave direction.

Figure 12: Typical seafloor profile and aggregate composition around the Diffuser section

Figures 13 & 14: Diffusers in operation

Note: Also view video footage – Diffuser in operation 2024.

Diffuser Section Cathodic Potential Survey

CP Design Arrangement

The sacrificial anode cathodic protection system consists of 26 x WZ18 zinc alloy sacrificial anodes.

- Anode Type: WZ18
- Nett Mass: 17.0 Kg
- Gross Mass: 18.3 Kg
- Material: Zinc Base Alloy
- Specification: AS 2239 Designation ZI

The anodes are located on the pipeline in 13 sets of two. The anodes in each set are diametrically opposed. The spacing between each anode set is 150 ± 15 metres.
Each anode is embedded longitudinally in the concrete weight coating, with the outer face exposed end flush with the concrete external surface. Each anode is in electrical contact with the pipeline by two studs at the appropriate height and spacing centres. Each stud is attached to the pipe surface by means of weld process. Anodes are electrically isolated from all weight coating steel reinforcement.
The design also includes provision of a test point at the shore end of the pipeline to facilitate the retrofitting of a future impressed current cathodic protection system.

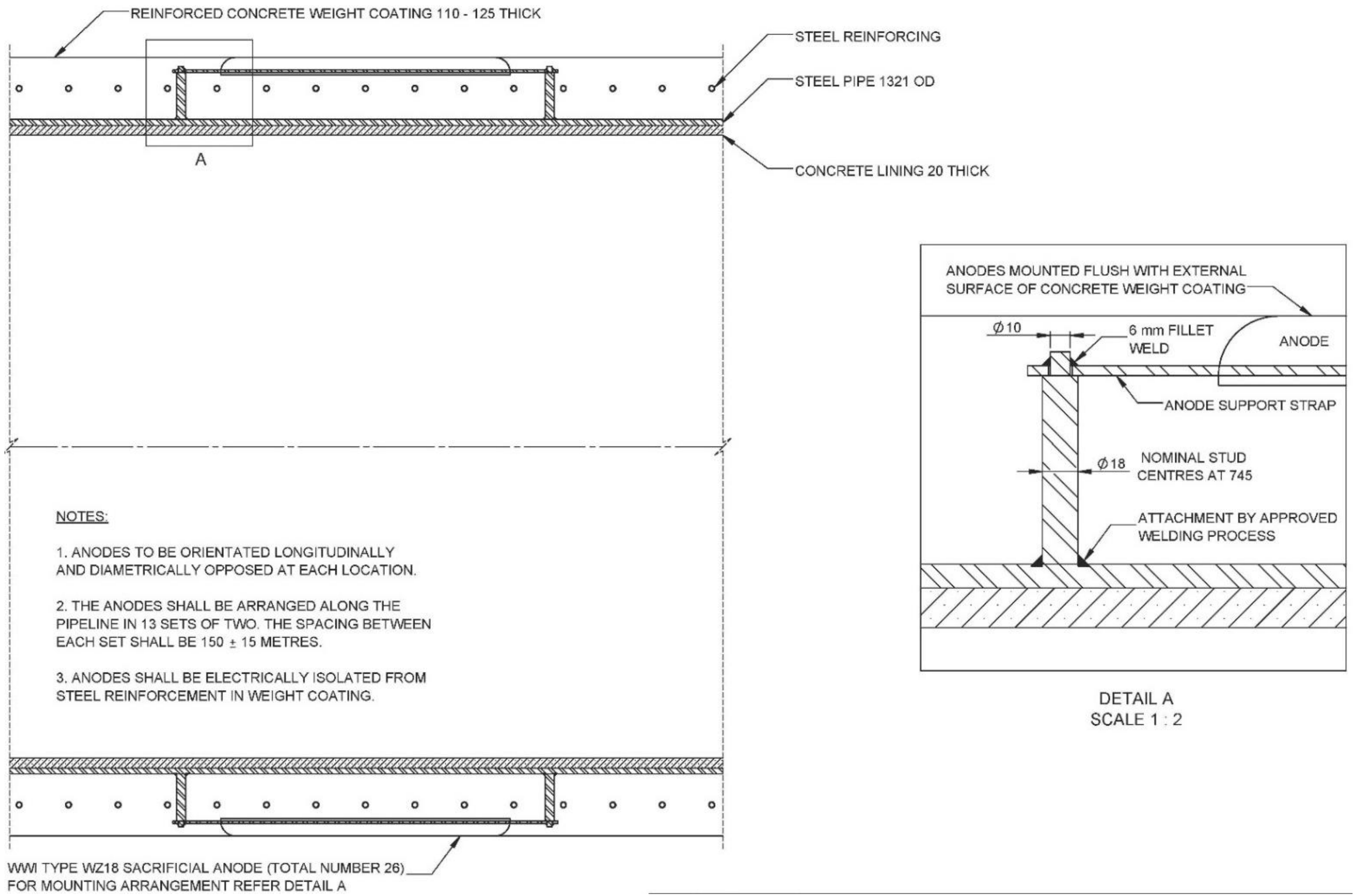


Figure 15: CP Sacrificial Anode Design Arrangement

Pre & Post Dive CP Meter Calibration Checks

On the surface pre-dive, the BathyCorrometer Instrument (BCM) calibration is checked with a Cal-Checker Pro'. The display reading was -1.901V; this being within the manufacturer's specification range of -1.900V (±0.002V).
Once on the seafloor adjacent Diffuser #1, the Inspection Diver again checked the BCM calibration against a certified (Zinc) Test Block. The BCM display value provided in this instance was -1.048V. Following obtaining Cathodic Potential values from contact with several of the Diffuser discharge nozzles, and prior to returning to the surface, the Inspection Diver again obtained a 'close-off' value from the Zinc Test Block; in this instance the value was -1.047V.

The specialised Cathodic Potential Instrument used to extrapolate data was:

- BUCKLEYS BathyCorrometer (BCM), Serial No. BUC587.
  Certificate of Calibration: S.41610, Det Norske Veritas (D.N.V.)

As standard procedure with the use of this type of instrument; prior to taking Cathodic Potential readings a calibration check is carried-out using a Zinc (Zn) test block; against the BCM Silver / Silver Chloride (Ag/AgCl) electrode.

- BUCKLEYS BCM Cal-Checker Pro, Serial No. 59630/10.
  Certificate No. BUC48680.

- BUCKLEYS Zinc Test Block
  Certificate of Analysis:

Anode	:	ZM3303
Type	:	Zinc Alloy
Batch No.	:	M07720
Buckley's Ref.	:	P46540

ANALYSES

% Al	% Cd	% Fe	% Cu	% Pb	% Zn
0.33	0.0567	<0.00026	<0.0002	0.00053	99.6

Note: Analysed by Spark Spectrometry.

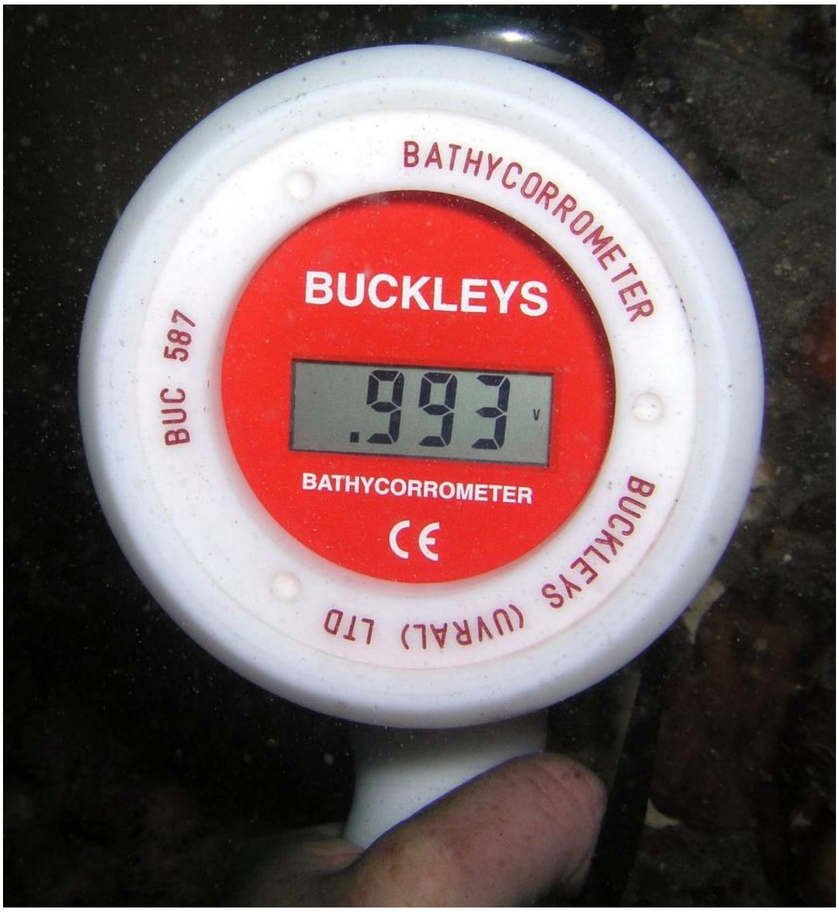


Figure 16: BCM (Cathodic Potential Meter) in operation

<u>Methodology</u>

Using SCUBA kitted with a light-weight Divator positive pressure mask designed for exposure to contaminated water, and a Nitrox 40 (40% O^2 / 60% N^2) breathing gas, the Inspection Diver descends a drop line to the seafloor adjacent to Diffuser # 1, the southern-most (seaward) of the 18 Diffusers.

Following performing and recording a BCM instrument calibration check against a certified test block, the Inspection Diver takes Cathodic Potential values from a number of the Diffuser discharge nozzles. This process always includes Diffusers # 1 & 18, and a few in between to ensure electrical passage continuity throughout the Diffuser section.

Upon completion of gathering Cathodic Potential values, the Inspection Diver takes a further value from the test block prior to returning to the surface.

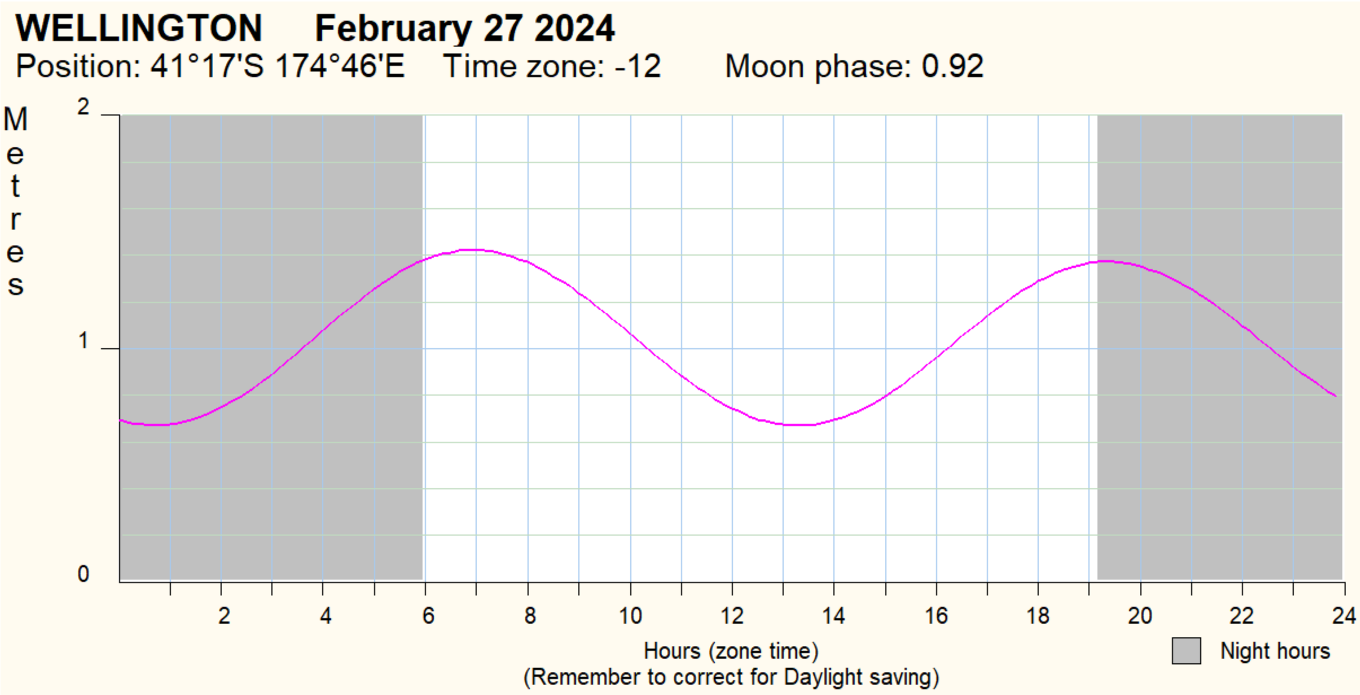
Cathodic Potential Data

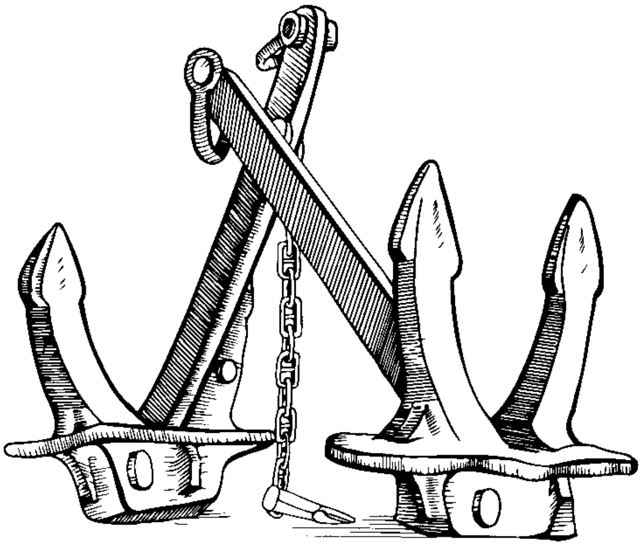
MOA POINT WASTE WATER OUTFALL PIPELINE OFFSHORE DIFFUSER SECTION CATHODIC PROTECTION TESTING 27th February 2024			
CP Instrument		**Calibration Check Values** Against Zinc Alloy Test Block	
Buckleys BCM (Cathodic Potential Meter) Reference Electrode: Ag/AgCl		Prior -1.048V	Post -1.047V
Diffuser #	**Discharge Nozzle**	**Pipe Potential verses Ag/AgCl reference**	**Time: (NZDST)** approx. only
1	West	-0.993mV	10.05
	East	-0.993mV	10.07
6	East	-0.995mV	10.12
10	West	-0.988mV	10.16
14	West	-0.992mV	10.19
18	West	-0.991mV	10.24

Table 5: Pipe Potential values

Wellington Tide Table for 27th February

27	0040	0.7
Tue	0700	1.4
	1320	0.7
	1920	1.4





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Veolia Water Services (ANZ) Pty Ltd

AMBIENT MICROBE MONITORING OF THE MOA POINT WASTEWATER TREATMENT PLANT, APRIL 2024

Issue

April 2024

Veolia Water Services (ANZ) Pty Ltd

AMBIENT MICROBE MONITORING OF THE MOA POINT WASTEWATER TREATMENT PLANT, APRIL 2024

Issue

April 2024

Source Testing New Zealand Ltd
PO Box 32 017
Maungaraki
Lower Hutt 5010
Tel: 0275 533 210
Fax: 04 569 4446

Document history and status

Revision	Date issued	Issued by	Reviewed by	Date reviewed	Revision type
Draft	22 April 2024	M. Newby	S. van Soest	23 April 2024	Minor amendments
Issue	23 April 2024	M. Newby			

Approved by

Name	Title	Signature
Matthew Newby, CAQP	Senior Air Quality Scientist	

Distribution of copies

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Author:	M. Newby
Name of organisation:	Veolia Water Services (ANZ) Ltd Pty
Name of project:	Ambient Microbe Monitoring 2024
Name of document:	Ambient Microbe Monitoring of the Moa Point Wastewater Treatment Plant, April 2024
Document version:	Issue
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Contents

Executive Summary

Source Testing New Zealand Limited (STNZ) was commissioned by Veolia Water Services (ANZ) Pty Ltd (Veolia) to undertake ambient microbe monitoring in the vicinity of the Moa Point Wastewater Treatment Plant (WTP). The purpose of this monitoring was to confirm compliance with the Company's Resource Consent (WGN080003[26183]). Condition 7 of the company's resource consent stipulates the following:

"The permit holder shall monitor air quality in the vicinity of the plant to confirm the absence of faecal coliforms and salmonella originating from the plant. Sampling is to be carried out at least once every six months.

"The sampling method and locations are to be agreed with the Manager, Environmental Regulation, Wellington Regional Council within three months of the granting of this permit. Tests are to be carried out at a minimum of three sites down and three sites upwind of the plant, with at least one in the vicinity of the Air New Zealand kitchens and one at a level of Kekerenga Street. The other sites are to be located outside of/and within 100 meters of the site boundary."

The results of the ambient microbe monitoring performed at the Moa Point WTP on 10 April 2024 confirmed the absence of Salmonella and Faecal Coliforms in the vicinity of the plant. The microbiological counts at all sites were all within the guidelines for a wastewater treatment plant (Biodet Data Base) with no *Aspergillus Fumigatus,* Gram-negative, or Enterococci identified at any of the sites.

The results are higher than measured in September 2023 but are generally similar to the samples collected in March 2023. The results for Sites 4 and 6 were approximately double those observed at the other sites. For Site 4 this was most likely due to recent earth works on the golf course. For Site 6, the new neighbour has several chickens along the fence line and while the sampling location was moved to the opposite side of the property, it is likely the presence of the chickens has increased the levels of ambient microbes.

Table 1 Moa Point Wastewater Treatment Plant Ambient Microbe Monitoring, 10 April 2024

Site	Total Count (CFU/m³)[1]	Filter 1 Breakdown of Total Count					Filter 2		Filter 3		
		Total Bacteria (CFU/m³)[a]	Total Actinomycetes (CFU /m³)[a]	Total Fungi[b] (CFU /m³)[a]	Total Yeasts (CFU/m³)[a]	*Aspergillus Fumigatus* [c] (CFU /m³)[a]	Gram Negative (CFU/m³)[a]	Enterococci (CFU /m³)[a]	Salmonella Present/Absent	Total Coliforms Present/Absent	Faecal Coliforms Present/Absent
Site 1	575	49	3	520	3	<3	<3	<3	Absent	Absent	Absent
Site 2	436	19	17	400	<2	<2	<3	<3	Absent	Absent	Absent
Site 3	530	18	2	510	<2	<2	<2	<2	Absent	Absent	Absent
Site 4	1,140	21	19	1,100	<3	<3	<2	<2	Absent	Absent	Absent
Site 5	369	2	7	360	<2	<2	<2	<2	Absent	Absent	Absent
Site 6	1,869	28	36	1,800	5	<3	<2	<2	Absent	Absent	Absent

a. CFU/m^3 = Colony forming units per cubic meter of air at actual temperature and pressure
b. F/Fungi = Filamentous Fungi
c. Aspergillus fumigatus count is included in the Total Fungi count

1. Introduction

Source Testing New Zealand Limited (STNZ) was commissioned by Veolia Water Services (ANZ) Pty Ltd (Veolia) to undertake ambient microbe monitoring in the vicinity of the Moa Point Wastewater Treatment Plant (WTP). The purpose of this monitoring was to confirm compliance with the Company's Resource Consent (WGN080003[26183]). Condition 7 of the company's resource consent stipulates the following:

"The permit holder shall monitor air quality in the vicinity of the plant to confirm the absence of faecal coliforms and salmonella originating from the plant. Sampling is to be carried out at least once every six months"

"The sampling method and locations are to be agreed with the Manager, Environmental Regulation, Wellington Regional Council within three months of the granting of this permit. Tests are to be carried out at a minimum of three sites down and three sites upwind of the plant, with at least one in the vicinity of the Air New Zealand kitchens and one at a level of Kekerenga Street. The other sites are to be located outside of/and within 100 meters of the site boundary."

Matthew Newby, Senior Air Quality Scientist performed the monitoring on 10 April 2024. Matthew has 25 year's air quality monitoring and consulting experience and is designated as a Key Technical Person under STNZ's IANZ accreditation. Matthew is also a Certified Air Quality Professional (CAQP) under the Clean Air Society of Australia and New Zealand (CASANZ) certification programme. This report presents the sampling methodology, meteorological conditions on the day of sampling and the results of the ambient microbe monitoring.

2. Sampling Methodologies

Sampling for ambient microbes was performed at a total of six monitoring sites in the vicinity of the Moa Pt WTP. The sampling locations were approved by the Wellington Regional Council are depicted in Figures 1 through 6 with Appendix A detailing their locations within the landfill. A series of three gelatine filters were collected from each site and analysed for the following microbes.

- Total Coliforms.
- Faecal Coliforms.
- Salmonella.
- Total Bacteria.
- Total Actinomycetes,
- Total Filamentous Fungi
- Total Yeasts,
- Aspergillus Fumigatus,
- Gram Negative,
- Total Yeasts, and
- Enterococci.

Samples were collected in accordance with NIOSH Method 0500 "Particulates Not Otherwise Regulated, Total" which determines the total aerosol mass. The samples were collected on a series of three specially prepared gelatine filters per site at a sampling rate of 1.5 to 2.5 L/min for a period of 6 to 7 hours. Due to the limited stability of salmonella and faecal coliforms on filter paper, the filter for these species was placed in a sterilised broth immediately following sampling. Samples were couriered on ice to the laboratory on the day of sample collection. Biodet Services Ltd, Auckland supplied the filters and performed the analysis.

Please note that for Site 6 the new neighbours have several chickens along the fence line where the original sample site was located. Hence, the samples were collected from the opposite boundary.

- **Figure 1: Site 1 Monitoring Equipment**

- **Figure 2: Site 2 Monitoring Equipment**

- **Figure 3: Site 3 Monitoring Equipment**

- **Figure 4: Site 4 Monitoring Equipment**

- **Figure 5: Site 5 Monitoring Equipment**

- **Figure 6: Site 6 Monitoring Equipment**

3. Meteorological Conditions

In order to assess potential sources of the airborne microbes measured in the vicinity of the Moa Pt WTP, the wind speed and direction data was recorded at each of the monitoring sites for the duration of the monitoring using a handheld anemometer and compass. Tables 2 through 7 present the meteorological data recorded at each of the monitoring sites.

On 10 April 2024, the wind conditions consisted of light to moderate northerlies resulting in Sites 1 and 2 having the greatest potential to be impacted by emissions from the Moa Pt WTP.

- **Table 2: Moa Point WTP Site 1, 10 April 2024**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:20	3.4	310	18.8	102.24
10:21	1.6	300	22.0	
11:45	3.0	300	22.9	
12:41	2.3	300	22.1	
13:41	1.9	300	22.0	
14:20	1.7	300	22.2	

- **Table 3: Moa Point WTP Site 2, 10 April 2024**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:05	0.9	320	18.2	101.88
09:49	1.7	340	21.8	
11:29	2.8	340	21.5	
12:42	1.1	340	22.3	
14:20	1.8	340	22.8	
15:01	0.5	360	22.7	

- **Table 4: Moa Point WTP Site 3, 10 April 2024**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
09:40	0.8	360	21.2	102.65
11:12	1.6	360	23.3	
12:33	2.3	360	22.1	
14:00	2.6	350	23.2	
16:00	1.0	340	21.3	

Table 5: Moa Point WTP Site 4, 10 April 2024

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
09:35	0.9	340	20.0	102.20
11:12	1.6	360	23.3	
12:30	2.3	360	22.3	
14:00	2.0	350	15.2	
16:00	0.9	360	21.3	

Table 6: Moa Point WTP Site 5, 10 April 2024

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:40	0.7	340	19.9	102.06
10:32	0.4	340	21.9	
11:57	1.5	330	22.3	
13:00	1.0	340	22.0	
14:35	2.3	350	22.2	
15:15	0.8	360	22.2	

Table 7: Moa Point WTP Site 6, 10 April 2024

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:58	0.9	80	20.0	101.37
10:55	0.3	Calm	21.4	
12:20	0.8	80	22.0	
13:21	0.3	Calm	22.6	
15:31	0.5	Calm	21.5	

4. Ambient Microbe Monitoring Results

4.1 Ambient Microbe Monitoring Results

The results of the ambient microbe monitoring performed at the Moa Point WTP on 10 April 2024 are presented below. Table 8 presents the results of the ambient microbe monitoring with the raw sampling data presented in Appendix B and the Biodet analytical report presented in Appendix C.

Table 8: Moa Point Wastewater Treatment Plant Ambient Microbe Monitoring Results, 10 April 2024

Site	Total Count (CFU/m^3)[1]	Filter 1 Breakdown of Total Count					Filter 2		Filter 3		
		Total Bacteria (CFU/m^3)[1]	Total Actinomycettes (CFU/m^3)[1]	Total F/Fungi[2] (CFU/m^3)[1]	Total Yeasts (CFU/m^3)[1]	*Aspergillus Fumigatus*[3] (CFU/m^3)[1]	Gram Negative (CFU/m^3)[1]	Enterococci (CFU/m^3)[1]	Salmonella Present/Absent	Total Coliforms Present/Absent	Faecal Coliforms Present/Absent
Site 1	575	49	3	520	3	<3	<3	<3	Absent	Absent	Absent
Site 2	436	19	17	400	<2	<2	<3	<3	Absent	Absent	Absent
Site 3	530	18	2	510	<2	<2	<2	<2	Absent	Absent	Absent
Site 4	1,140	21	19	1,100	<3	<3	<2	<2	Absent	Absent	Absent
Site 5	369	2	7	360	<2	<2	<2	<2	Absent	Absent	Absent
Site 6	1,869	28	36	1,800	5	<3	<2	<2	Absent	Absent	Absent

1. CFU/m^3 = Colony forming units per cubic meter of air at actual temperature and pressure
2. F/Fungi = Filamentous Fungi
3. Aspergillus fumigatus count is included in the Total Fungi count

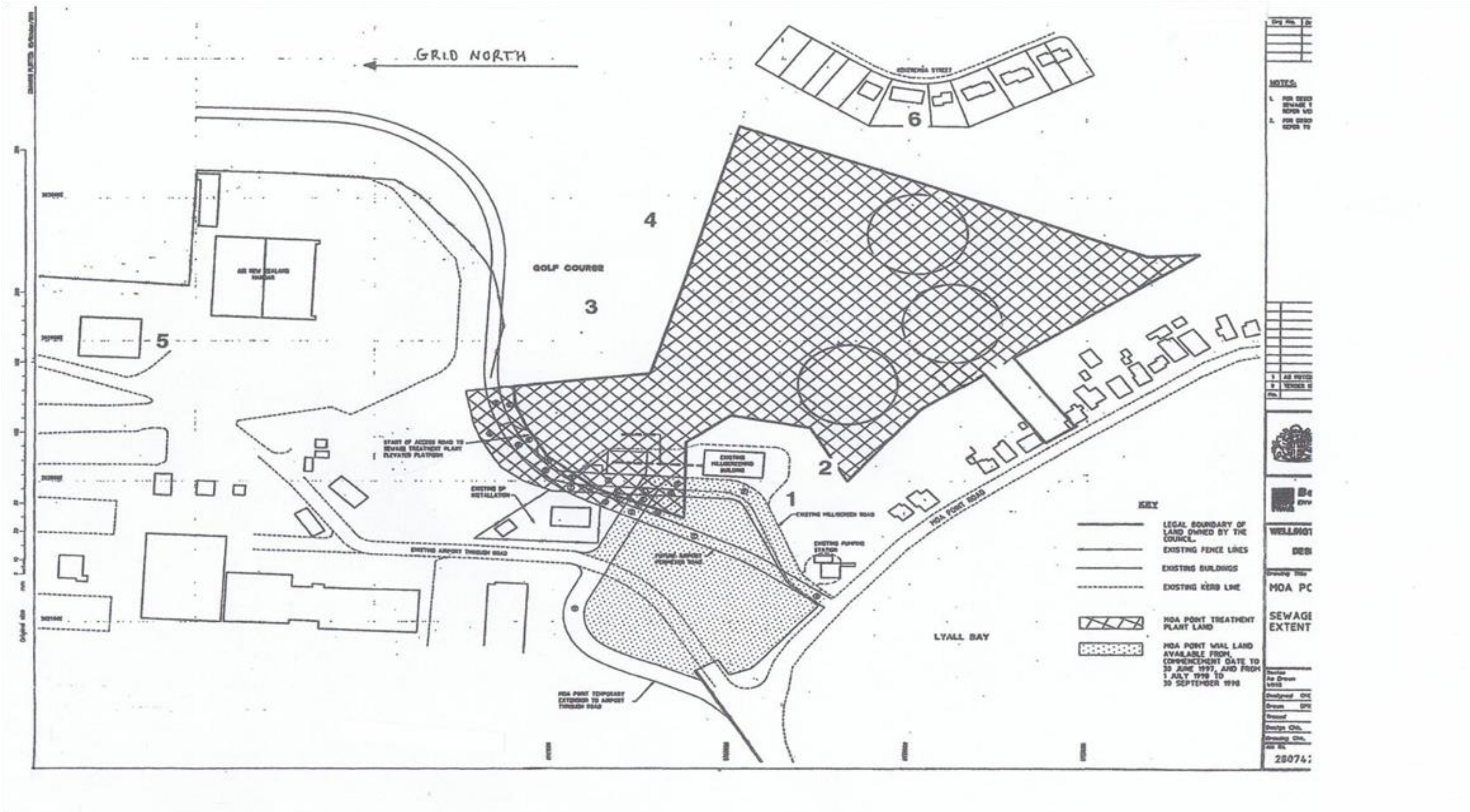
4.2 Summary

The results of the ambient microbe monitoring performed at the Moa Point WTP on 10 April 2024 confirmed the absence of Salmonella and Faecal Coliforms in the vicinity of the plant. The microbiological counts at all sites were all within the guidelines for a wastewater treatment plant (Biodet Data Base) with no *Aspergillus Fumigatus*, Gram-negative, or Enterococci identified at any of the sites.

The results are higher than measured in September 2023 but are generally similar to the samples collected in March 2023. The results for Sites 4 and 6 were approximately double those observed at the other sites. For Site 4 this was most likely due to recent earth works on the golf course. For Site 6, the new neighbour has several chickens along the fence line and while the sampling location was moved to the opposite side of the property, it is likely the presence of the chickens has increased the levels of ambient microbes.

Appendix A Site Plan

This Appendix contains 2 pages including cover


GRID NORTH
6
4
GOLF COURSE
3
5
2
1
MOA POINT ROAD
LYALL BAY
KEY
LEGAL BOUNDARY OF LAND OWNED BY THE COUNCIL.
EXISTING FENCE LINES
EXISTING BUILDINGS
EXISTING KERB LINE
MOA POINT TREATMENT PLANT LAND
MOA POINT WIAL LAND AVAILABLE FROM, COMMENCEMENT DATE TO 30 JUNE 1997, AND FROM 1 JULY 1998 TO 30 SEPTEMBER 1998
MOA PC
SEWAGE EXTENT

Appendix B Raw Sampling Data

This Appendix contains 2 pages including cover.

Ambient Microbe Monitoring Data, Moa Point WTP, 10 March 2024

Sample Description	Sample ID	Sampling Date	Sampling Period	Sample Duration (min)	Initial Flow (L/min)	Final Flow (L/min)	Ave Flow (L/min)	Sample Vol (m^3)
Moa Pt Site 1 Filter 1	ST1188/01	10/04/024	8:19 - 16:30	491	1.55	1.45	1.50	0.737
Moa Pt Site 1 Filter 2	ST1188/02	10/04/024	8:19 - 16:30	491	1.45	1.50	1.48	0.724
Moa Pt Site 1 Filter 3	ST1188/03	10/04/024	8:19 - 16:30	491	2.00	2.00	2.00	0.982
Moa Pt Site 2 Filter 1	ST1188/04	10/04/024	8:57 - 15:00	423	2.00	1.95	1.98	0.835
Moa Pt Site 2 Filter 2	ST1188/05	10/04/024	8:57 - 15:00	423	1.95	1.80	1.88	0.793
Moa Pt Site 2 Filter 3	ST1188/06	10/04/024	8:57 - 15:00	423	2.10	2.10	2.10	0.888
Moa Pt Site 3 Filter 1	ST1188/07	10/04/024	9:38 - 16:04	402	2.10	2.25	2.18	0.874
Moa Pt Site 3 Filter 2	ST1188/08	10/04/024	9:38 - 16:04	402	2.10	2.25	2.18	0.874
Moa Pt Site 3 Filter 3	ST1188/09	10/04/024	9:38 - 16:04	402	2.15	2.30	2.23	0.894
Moa Pt Site 4 Filter 1	ST1188/10	10/04/024	9:37 - 15:59	387	1.95	1.90	1.93	0.745
Moa Pt Site 4 Filter 2	ST1188/11	10/04/024	9:37 - 15:59	387	2.10	2.05	2.08	0.803
Moa Pt Site 4 Filter 3	ST1188/12	10/04/024	9:37 - 15:59	387	2.05	2.00	2.03	0.784
Moa Pt Site 5 Filter 1	ST1188/13	10/04/024	8:37 - 15:14	397	2.20	2.20	2.20	0.873
Moa Pt Site 5 Filter 2	ST1188/14	10/04/024	8:37 - 15:14	397	2.15	2.15	2.15	0.854
Moa Pt Site 5 Filter 3	ST1188/15	10/04/024	8:37 - 15:14	397	2.10	2.00	2.05	0.814
Moa Pt Site 6 Filter 1	ST1188/16	10/04/024	8:58 - 15:32	393	1.95	2.00	1.98	0.776
Moa Pt Site 6 Filter 2	ST1188/17	10/04/024	8:58 - 15:32	393	2.05	2.05	2.05	0.806
Moa Pt Site 6 Filter 3	ST1188/18	10/04/024	8:58 - 15:32	393	2.00	2.05	2.03	0.796

Appendix C Laboratory Reports

This Appendix contains 3 pages including cover.

Biodet Services Ltd
Consulting Industrial Microbiologists

Unit K, 383 Khyber Pass Road, PO Box 99010, Newmarket, Auckland 1149. Phone: 09-529-1563, E-mail: office@biodet.co.nz, www.biodet.co.nz

CULTURABLE AIRBORNE MICROBIAL REPORT

DATE OF REPORT:	**17 April 2024**	**CLIENT:**	**Source Testing New Zealand** **PO Box 32-017** **Maungaraki** **LOWER HUTT 5010**
SITE:	**Veolia Moa Pt**		
DATE OF SAMPLING:	**10 April 2024**		
DATE SAMPLES RECEIVED:	**11 April 2024**		
CLIENT REF NO:	**ST1188**		
BIODET REF NO:	**24/51885**	**ATTN:**	**Matthew Newby**

METHOD: **In-house gelatin filter method (available on request.)**

Volumes Sampled:

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Filter 1	737L	835L	874L	745L	873L	776L
Filter 2	724L	793L	874L	803L	854L	806L
Filter 3	982L	888L	894L	784L	814L	796L

LABORATORY NUMBER	TOTAL COUNT	FILTER 1 - BREAKDOWN OF TOTAL COUNT					FILTER 2		FILTER 3		
	TOTAL COUNT CFU/M³	TOTAL BACTERIA CFU/M³	TOTAL ACTINOMYCETES CFU/M³	TOTAL F/FUNGI CFU/M³	TOTAL YEASTS CFU/M³	*Aspergillus fumigatus* CFU/M³	GRAM NEGATIVE CFU/M³	ENTEROCOCCI CFU/M³	*SALMONELLA* Present/Absent	TOTAL COLIFORMS Present/Absent	FAECAL COLIFORMS Present/Absent
51885/1 - Site 1	**575**	49	3	520	3	<3	<3	<3	Absent	Absent	Absent
51885/2 - Site 2	**436**	19	17	400	<2	<2	<3	<3	Absent	Absent	Absent
51885/3 - Site 3	**530**	18	2	510	<2	<2	<2	<2	Absent	Absent	Absent
51885/4 - Site 4	**1140**	21	19	1100	<3	<3	<2	<2	Absent	Absent	Absent
51885/5 - Site 5	**369**	2	7	360	<2	<2	<2	<2	Absent	Absent	Absent
51885-6 - Site 6	**1869**	28	36	1800	5	<3	<2	<2	Absent	Absent	Absent

Limit of detection for quantitative analyses is 2-3 cfu per m^3
F/FUNGI = FILAMENTOUS FUNGI

< = less than
The *Aspergillus fumigatus* count is included in the TOTAL FUNGI count.

INTERPRETATION:

Total coliforms are generally found associated with decaying organic material, so are commonly found in soil and wet environments.
Faecal coliforms and *Salmonella* have a relatively short survival time in aerosols.
Faecal Streptococci, Actinomycetes and *Candida* yeast species have good survival in aerosols and are useful indicators of wastewater aerosol pollution.
Total counts of bacteria and fungi give an indication of air quality.
Actinomycetes are soil microorganisms and may indicate disturbance to the soil
Aspergillus fumigatus is indicative of decomposing plant material and has the potential to cause infection in immunocompromised people.
Actinomycete bacteria are becoming recognised as a significant microorganism in indoor air quality, with some species implicated in hypersensitivity pneumonitis.

Report 51885.xlsx

Biodet Services Ltd
Consulting Industrial Microbiologists

GUIDELINES: *(based on Biodet database)*

	Colony-forming units (cfu) per cubic meter (m^3) of air	
	Bacteria	***Fungi***
Outdoor air	50-100	50-350
Vicinity of waste-water treatment plant	50-500	500-5000

Note: These counts may increase significantly with soil disturbance in the vicinity

CONCLUSIONS:

The microbial counts for all sites sampled were well within the guidelines for a waste water treatment plant.

***Aspergillus fumigatus*, Gram-negative bacteria, Enterococci, *Escherichia coli* and *Salmonella* were not isolated from any of the sites.**

Yours faithfully

Kate Fletcher
B.Sc.
The samples were tested as received.
This report must not be reproduced except in full.
Unless otherwise indicated, sample analysis was performed at Biodet Services, 383 Khyber Pass Road, Newmarket, Auckland.

MEMBER OF NEW ZEALAND ASSOCIATION OF CONSULTING LABORATORIES

Daily Maximum H_2S Concentrations from the Moa Point IPS and WWTP

Day	July 2023		August 2023		September 2023	
	IPS	WWTP	IPS	WWTP	IPS	WWTP
	ppm		ppm		ppm	
1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
3	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
4	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
5	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
6	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001
7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
9	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
10	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001
11	0.0001	0.0002	0.0001	0.0001	0.0000	0.0001
12	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
13	0.0016	0.0001	0.0001	0.0001	0.0000	0.0001
14	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
15	0.0001	0.0001	0.0001	0.0001	0.0000	0.0002
16	0.0001	0.0001	0.0001	0.0002	0.0000	0.0001
17	0.0001	0.0002	0.0001	0.0001	0.0000	0.0001
18	0.0001	0.0001	0.0001	0.0001	0.0000	0.0002
19	0.0001	0.0002	0.0001	0.0001	0.0000	0.0001
20	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
21	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
22	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
23	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
24	0.0001	0.0002	0.0001	0.0001	0.0000	0.0001
25	0.0001	0.0001	0.0001	0.0001	0.0000	0.0002
26	0.0001	0.0002	0.0001	0.0001	0.0000	0.0001
27	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
28	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001
29	0.0001	0.0001	0.0001	0.0002	0.0000	0.0001
30	0.0001	0.0001	0.0001	0.0001	0.0000	0.0002
31	0.0001	0.0001	0.0001	0.0001		
Limit	0.01					

Appendix ii: Ambient Microbe Monitoring

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Veolia Water Services (ANZ) Pty Ltd

AMBIENT MICROBE MONITORING OF THE MOA POINT WASTEWATER TREATMENT PLANT, SEPTEMBER 2023

Isasue

September 2023

Veolia Water Services (ANZ) Pty Ltd

AMBIENT MICROBE MONITORING OF THE MOA POINT WASTEWATER TREATMENT PLANT, SEPTEMBER 2023

Issue

September 2023

Source Testing New Zealand Ltd
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Name	Title	Signature
Matthew Newby, CAQP	Senior Air Quality Scientist	

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Contents

Executive Summary

Source Testing New Zealand Limited (STNZ) was commissioned by Veolia Water Services (ANZ) Pty Ltd (Veolia) to undertake ambient microbe monitoring in the vicinity of the Moa Point Wastewater Treatment Plant (WTP). The purpose of this monitoring was to confirm compliance with the Company's Resource Consent (WGN080003[26183]). Condition 7 of the company's resource consent stipulates the following:

"The permit holder shall monitor air quality in the vicinity of the plant to confirm the absence of faecal coliforms and salmonella originating from the plant. Sampling is to be carried out at least once every six months.

"The sampling method and locations are to be agreed with the Manager, Environmental Regulation, Wellington Regional Council within three months of the granting of this permit. Tests are to be carried out at a minimum of three sites down and three sites upwind of the plant, with at least one in the vicinity of the Air New Zealand kitchens and one at a level of Kekerenga Street. The other sites are to be located outside of/and within 100 meters of the site boundary."

The results of the Ambient Microbe Monitoring performed at the Moa Point WTP on 4 September 2023 confirmed the absence of Salmonella and Faecal Coliforms in the vicinity of the plant. Unfortunately, an issue with the filter preparation and a fault with one of the pumps resulted in the loss of some data for Sites 1 and 4. The microbiological counts were all well within the guidelines for a wastewater treatment plant (Biodet Data Base) and were similar to those observed in August 2022. *Aspergillus Fumigatus,* Gram-negative, and Enterococci were not identified at any of the sites.

Table 1 Moa Point Wastewater Treatment Plant Ambient Microbe Monitoring, 4 September 2023

Site	Total Count (CFU/m^3)[1]	Filter 1 Breakdown of Total Count					Filter 2		Filter 3		
		Total Bacteria (CFU/m^3)[a]	Total Actinomycettes (CFU /m^3)[a]	Total Fungi[b] (CFU /m^3)[a]	Total Yeasts (CFU/m^3)[a]	*Aspergillus Fumigatus* [c] (CFU /m^3)[a]	Gram Negative (CFU/m^3)[a]	Enterococci (CFU /m^3)[a]	Salmonella Present/Absent	Total Coliforms Present/Absent	Faecal Coliforms Present/Absent
Site 1	-	-	-	-	-	-	<2	<2	Absent	Absent	Absent
Site 2	41	<3	<3	41	<3	<3	<4	<4	Absent	Absent	Absent
Site 3	41	<7	<7	41	<7	<7	<2	<2	Absent	Absent	Absent
Site 4	33	<2	<2	33	<2	<2	-	-	Absent	Absent	Absent
Site 5	11	3	<3	8	<3	<3	<3	<3	Absent	Absent	Absent
Site 6	47	3	<3	44	<3	<3	<3	<3	Absent	Absent	Absent

a. CFU/m^3 = Colony forming units per cubic meter of air at actual temperature and pressure
b. F/Fungi = Filamentous Fungi
c. Aspergillus fumigatus count is included in the Total Fungi count

1. Introduction

Source Testing New Zealand Limited (STNZ) was commissioned by Veolia Water Services (ANZ) Pty Ltd (Veolia) to undertake ambient microbe monitoring in the vicinity of the Moa Point Wastewater Treatment Plant (WTP). The purpose of this monitoring was to confirm compliance with the Company's Resource Consent (WGN080003[26183]). Condition 7 of the company's resource consent stipulates the following:

"The permit holder shall monitor air quality in the vicinity of the plant to confirm the absence of faecal coliforms and salmonella originating from the plant. Sampling is to be carried out at least once every six months"

"The sampling method and locations are to be agreed with the Manager, Environmental Regulation, Wellington Regional Council within three months of the granting of this permit. Tests are to be carried out at a minimum of three sites down and three sites upwind of the plant, with at least one in the vicinity of the Air New Zealand kitchens and one at a level of Kekerenga Street. The other sites are to be located outside of/and within 100 meters of the site boundary."

Matthew Newby, Senior Air Quality Scientist performed the monitoring on 27 February 2023. Matthew has 25 year's air quality monitoring and consulting experience and is designated as a Key Technical Person under STNZ's IANZ accreditation. Matthew is also a Certified Air Quality Professional (CAQP) under the Clean Air Society of Australia and New Zealand (CASANZ) certification programme. This report presents the sampling methodology, meteorological conditions on the day of sampling and the results of the ambient microbe monitoring.

2. Sampling Methodologies

A total of six sampling sites have been confirmed with Wellington Regional Council for monitoring the concentration of ambient microbes in the vicinity of the Moa Point WTP. These monitoring sites are depicted in Appendix A. Samples were collected from each site for determination of the following microbes;

- Enterococci;
- Salmonella;
- Total Coliforms;
- Faecal Coliforms;
- Total Bacteria;
- Total Filamentous Fungi;
- Aspergillus Fumigatus; and
- Total Yeasts; and Total Actinomycetes.

Samples were collected in accordance with NIOSH Method 0500 “Particulates Not Otherwise Regulated, Total” which determines the total aerosol mass. Total aerosols were collected on three specially prepared gelatine filters per sampling site. Samples were collected at a rate of between 1 and 2.2 L/min over a 6 to 7 hour period at a height of approximately 1.8 m to represent the breathing zone of an average person. Due to the limited stability of Salmonella and faecal coliforms on filter paper, the filters for these components were placed in a specially prepared sterilised broth immediately following sampling. Samples were couriered on ice to the laboratory on the day of sample collection. Biodet Services Ltd, Auckland supplied the filters and performed the analysis.

Figures 1 through 6 depict the monitoring equipment installed at each of the sampling sites.

- Figure 1: Site 1 Monitoring Equipment

- Figure 2: Site 2 Monitoring Equipment

- Figure 3: Site 3 Monitoring Equipment

- Figure 4: Site 4 Monitoring Equipment

- Figure 5: Site 5 Monitoring Equipment

- Figure 6: Site 6 Monitoring Equipment

3. Meteorological Conditions

To assess potential sources of airborne microbes, wind speed and direction data for the monitoring period was periodically measured using a handheld anemometer and compass at each of the sampling sites. Tables 2 through 7 present the field data collected at each of the monitoring sites. On 4 September 2023, the wind conditions were generally calm resulting in all sites having the potential to be impacted by emissions from the Moa Pt WTP.

- **Table 2: Moa Point WTP Site 1, 4 September 2023**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:08	Calm	Calm	12.2	102.33
09:55	160	1.0	12.7	
11:50	Calm	Calm	17.9	
12:44	Calm	Calm	17.5	
13:41	240	1.1	16.4	
14:32	Calm	Calm	16.9	

- **Table 3: Moa Point WTP Site 2, 4 September 2023**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:23	140	0.9	12.6	102.69
09:50	160	0.5	13.5	
11:45	Calm	Calm	17.6	
12:49	Calm	Calm	17.3	
13:31	240	0.9	16.6	
14:38	Calm	Calm	18.4	

- **Table 4: Moa Point WTP Site 3, 4 September 2023**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:33	160	0.9	12.8	102.65
11:23	170	0.9	15.3	
13:26	100	1.4	16.3	
15:29	160	1.6	15.1	

- **Table 5: Moa Point WTP Site 4, 4 September 2023**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:37	160	1.7	12.7	102.62
11:26	180	1.1	15.4	
13:29	110	1.3	15.9	
15:26	90	0.5	15.2	

- **Table 6: Moa Point WTP Site 5, 4 September 2023**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:35	160	1.4	12.4	102.76
10:53	180	1.5	13.6	
12:52	120	1.6	14.6	
14:48	Calm	Calm	17.4	

- **Table 7: Moa Point WTP Site 6, 4 September 2023**

Time	Wind Speed (m/s)	Wind Direction (from, degrees)	Temp. (°C)	Ambient Pressure (kPa)
08:57	110	0.8	12.8	101.82
11:02	Calm	Calm	15.8	
13:07	Calm	Calm	17.4	
15:05	Calm	Calm	16.6	

4. Ambient Microbe Monitoring Results

4.1 Ambient Microbe Monitoring Results

The results of the ambient microbe monitoring performed at the Moa Point WTP on 4 September 2023 are presented below. Table 8 presents the results of the ambient microbe monitoring with the raw sampling data presented in Appendix B and the Biodet analytical report presented in Appendix C.

- **Table 8: Moa Point Wastewater Treatment Plant Ambient Microbe Monitoring, 4 September 2023**

Site	Total Count (CFU/m^3)[1]	Filter 1 Breakdown of Total Count					Filter 2		Filter 3		
		Total Bacteria (CFU/m^3)[1]	Total Actinomycettes (CFU /m^3)[1]	Total F/Fungi[2] (CFU /m^3)[1]	Total Yeasts (CFU/m^3)[1]	*Aspergillus Fumigatus* [3] (CFU /m^3)[1]	Gram Negative (CFU/m^3)[1]	Enterococci (CFU /m^3)[1]	Salmonella Present/Absent	Total Coliforms Present/Absent	Faecal Coliforms Present/Absent
Site 1	-	-	-	-	-	-	<2	<2	Absent	Absent	Absent
Site 2	41	<3	<3	41	<3	<3	<4	<4	Absent	Absent	Absent
Site 3	41	<7	<7	41	<7	<7	<2	<2	Absent	Absent	Absent
Site 4	33	<2	<2	33	<2	<2	-	-	Absent	Absent	Absent
Site 5	11	3	<3	8	<3	<3	<3	<3	Absent	Absent	Absent
Site 6	47	3	<3	44	<3	<3	<3	<3	Absent	Absent	Absent

1. CFU/m^3 = Colony forming units per cubic meter of air at actual temperature and pressure
2. F/Fungi = Filamentous Fungi
3. Aspergillus fumigatus count is included in the Total Fungi count

4.2 Summary

The results of the Ambient Microbe Monitoring performed at the Moa Point WTP on 4 September 2023 confirmed the absence of Salmonella and Faecal Coliforms in the vicinity of the plant. Unfortunately, an issue with the filter preparation and a fault with one of the pumps resulted in the loss of some data for Sites 1 and 4. The microbiological counts were all well within the guidelines for a wastewater treatment plant (Biodet Data Base) and were similar to those observed in August 2022. *Aspergillus Fumigatus,* Gram-negative, and Enterococci were not identified at any of the sites.

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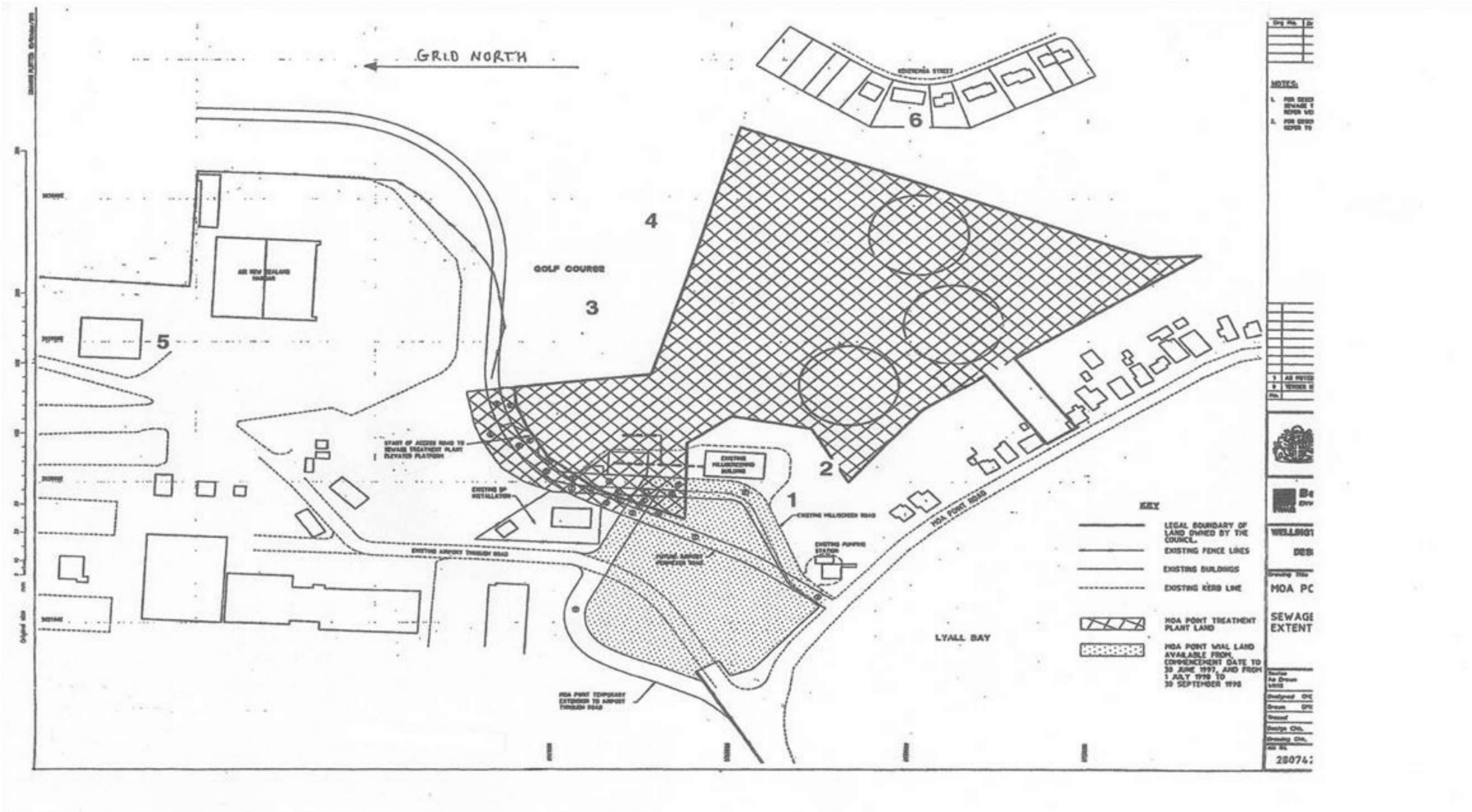
Appendix A Site Plan

This Appendix contains 2 pages including cover


GRID NORTH
GOLF COURSE
1
2
3
4
5
6
LYALL BAY
MOA POINT ROAD
KEY
LEGAL BOUNDARY OF LAND OWNED BY THE COUNCIL.
EXISTING FENCE LINES
EXISTING BUILDINGS
EXISTING KERB LINE
MOA POINT TREATMENT PLANT LAND
MOA POINT WIAL LAND AVAILABLE FROM, COMMENCEMENT DATE TO 30 JUNE 1997, AND FROM 1 JULY 1998 TO 30 SEPTEMBER 1998
NOTES:
MOA PC
SEWAGE EXTENT

Appendix B Raw Sampling Data

This Appendix contains 2 pages including cover.

Ambient Microbe Monitoring Data, Moa Point WTP, September 2023

Sample Description	Sample ID	Sampling Date	Sampling Period	Sample Duration (min)	Initial Flow (L/min)	Final Flow (L/min)	Ave Flow (L/min)	Sample Vol (m^3)
Moa Pt Site 1 Filter 1	ST1144/01	4/09/2023	8:06 - 14:36	390	2.10	2.10	2.10	0.819
Moa Pt Site 1 Filter 2	ST1144/02	4/09/2023	8:06 - 14:36	390	2.10	2.05	2.08	0.809
Moa Pt Site 1 Filter 3	ST1144/03	4/09/2023	8:06 - 14:36	390	2.15	2.10	2.13	0.829
Moa Pt Site 2 Filter 1	ST1144/04	4/09/2023	8:20 - 14:40	380	1.80	1.80	1.80	0.684
Moa Pt Site 2 Filter 2	ST1144/05	4/09/2023	8:20 - 14:40	380	1.50	1.50	1.50	0.570
Moa Pt Site 2 Filter 3	ST1144/06	4/09/2023	8:20 - 14:40	380	2.10	2.05	2.08	0.789
Moa Pt Site 3 Filter 1	ST1144/07	4/09/2023	8:29 - 15:31	422	1.95	2.00	1.98	0.833
Moa Pt Site 3 Filter 2	ST1144/08	4/09/2023	8:29 - 15:31	422	2.05	2.00	2.03	0.855
Moa Pt Site 3 Filter 3	ST1144/09	4/09/2023	8:29 - 15:31	422	1.95	1.95	1.95	0.823
Moa Pt Site 4 Filter 1	ST1144/10	4/09/2023	8:35 - 15:28	413	2.00	2.05	2.03	0.836
Moa Pt Site 4 Filter 2	ST1144/11	4/09/2023	8:35 - 15:28	413	NS	NS		
Moa Pt Site 4 Filter 3	ST1144/12	4/09/2023	8:35 - 15:28	413	1.90	1.95	1.93	0.795
Moa Pt Site 5 Filter 1	ST1144/13	4/09/2023	8:33 - 14:50	377	2.00	2.00	2.00	0.754
Moa Pt Site 5 Filter 2	ST1144/14	4/09/2023	8:33 - 14:50	377	2.00	2.05	2.03	0.763
Moa Pt Site 5 Filter 3	ST1144/15	4/09/2023	8:33 - 14:50	377	2.15	2.10	2.13	0.801
Moa Pt Site 6 Filter 1	ST1144/16	4/09/2023	8:14 - 15:07	373	1.80	1.85	1.83	0.681
Moa Pt Site 6 Filter 2	ST1144/17	4/09/2023	8:14 - 15:07	373	1.85	1.85	1.85	0.690
Moa Pt Site 6 Filter 3	ST1144/18	4/09/2023	8:14 - 15:07	373	2.00	1.95	1.98	0.737

Appendix C Laboratory Reports

This Appendix contains 3 pages including cover.

Biodet Services Ltd
Consulting Industrial Microbiologists

Unit K, 383 Khyber Pass Road, PO Box 99010, Newmarket, Auckland 1149. Phone: 09-529-1563, E-mail: office@biodet.co.nz, www.biodet.co.nz

CULTURABLE AIRBORNE MICROBIAL REPORT

DATE OF REPORT:	**15 September 2023**	**CLIENT:**	**Source Testing New Zealand**
SITE:	**Veolia Moa Pt**		**PO Box 32-017**
DATE OF SAMPLING:	**4 September 2023**		**Maungaraki**
DATE SAMPLES RECEIVED:	**5 September 2023**		**LOWER HUTT 5010**
CLIENT REF NO:	**ST1144**		
BIODET REF NO:	**23/50027**	**ATTN:**	**Matthew Newby**

METHOD: **In-house gelatin filter method (available on request.)**

Volumes Sampled:	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Filter 1	*	684L	833L	836L	754L	681L
Filter 2	809L	570L	855L	*	763L	690L
Filter 3	829L	789L	823L	795L	801L	737L

*** = No sample received**

LABORATORY NUMBER	TOTAL COUNT CFU/M³	FILTER 1 - BREAKDOWN OF TOTAL COUNT					FILTER 2		FILTER 3		
		TOTAL BACTERIA CFU/M³	TOTAL ACTINOMYCETES CFU/M³	TOTAL F/FUNGI CFU/M³	TOTAL YEASTS CFU/M³	*Aspergillus fumigatus* CFU/M³	GRAM NEGATIVE CFU/M³	ENTEROCOCCI CFU/M³	*SALMONELLA* Present/Absent	TOTAL COLIFORMS Present/Absent	FAECAL COLIFORMS Present/Absent
50027/1 - Site 1	-	-	-	-	-	-	<2	<2	Absent	Absent	Absent
50027/2 - Site 2	41	<3	<3	41	<3	<3	<4	<4	Absent	Absent	Absent
50027/3 - Site 3	41	<7	<7	41	<7	<7	<2	<2	Absent	Absent	Absent
50027/4 - Site 4	33	<2	<2	33	<2	<2	-	-	Absent	Absent	Absent
50027/5 - Site 5	11	3	<3	8	<3	<3	<3	<3	Absent	Absent	Absent
50027-6 - Site 6	47	3	<3	44	<3	<3	<3	<3	Absent	Absent	Absent

Limit of detection for quantitative analyses is 2, 3, 4 or 7 cfu per m^3
F/FUNGI = FILAMENTOUS FUNGI

< = less than
The *Aspergillus fumigatus* count is included in the TOTAL FUNGI count.

INTERPRETATION:

Total coliforms are generally found associated with decaying organic material, so are commonly found in soil and wet environments.
Faecal coliforms and *Salmonella* have a relatively short survival time in aerosols.
Faecal Streptococci, Actinomycetes and *Candida* yeast species have good survival in aerosols and are useful indicators of wastewater aerosol pollution.
Total counts of bacteria and fungi give an indication of air quality.
Actinomycetes are soil microorganisms and may indicate disturbance to the soil
Aspergillus fumigatus is indicative of decomposing plant material and has the potential to cause infection in immunocompromised people.
Actinomycete bacteria are becoming recognised as a significant microorganism in indoor air quality, with some species implicated in hypersensitivity pneumonitis.

Report 50027.xlsx 1

Biodet Services Ltd
Consulting Industrial Microbiologists

GUIDELINES: *(based on Biodet database)*

	Colony-forming units (cfu) per cubic meter (m^3) of air	
	Bacteria	***Fungi***
Outdoor air	50-100	50-350
Vicinity of waste-water treatment plant	50-500	500-5000

Note: These counts may increase significantly with soil disturbance in the vicinity

CONCLUSIONS:

The microbial counts for all sites sampled were well within the guidelines for a waste water treatment plant.

***Aspergillus fumigatus*, Gram-negative bacteria, Enterococci, *Escherichia coli* and *Salmonella* were not isolated from any of the sites.**

Yours faithfully

Kate Fletcher
B.Sc.

The samples were tested as received.
This report must not be reproduced except in full.
Unless otherwise indicated, sample analysis was performed at Biodet Services, 383 Khyber Pass Road, Newmarket, Auckland.

Veolia Water Services (ANZ) Pty Ltd

MOA POINT WASTEWATER TREATMENT PLANT ANNUAL SMOKE TESTING, JANAURY 2024

Issue

January 2024

Veolia Water Services (ANZ) Pty Ltd

MOA POINT WASTEWATER TREATMENT PLANT ANNUAL SMOKE TESTING, JANUARY 2024

Issue

January 2024

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Approved by

Name	Title	Signature
Matthew Newby, CAQP	Senior Air Quality Scientist	

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Document version:	Issue
Project number:	ST1183

Contents

1. Executive Summary

Source Testing New Zealand Limited (STNZ) was commissioned by Veolia Water Services (ANZ) Pty Ltd (Veolia) to conduct the annual smoke testing of the Moa Point Wastewater Treatment Plant (Moa Pt WTP), Wellington. The objective of the smoke testing was to demonstrate compliance with the Company's resource consent (26183).

On 26 January 2024, the annual smoke testing of the Moa Pt WTP was carried out and it was found that for the Inlet Pump Station (IPS), that despite the poor condition of the cover seal, there were no visible smoke emissions. This confirmed that the odour control system was providing sufficiently extraction to maintain negative pressure, therefore minimising the potential for any fugitive odour emissions.

Smoke testing of the primary treatment room found no smoke discharges, confirming compliance with Condition 10 of the Company's resource consent. However, the building ventilation rate was calculated to be approximately two room changes per hour, which was lower than measured in November 2022 and below what would normally be considered appropriate for this type of process.

Examination of the extraction duct found the flow control baffle to be severely degraded and in extremely poor condition which could potentially be reducing the effectiveness of the odour control system. Hence, *it is recommended that the primary treatment flow control baffle be replaced, and the associated ducting repaired.*

The smoke testing of the Moa Pt WTP secondary treatment processes did not identify any smoke emissions, confirming the odour control system was providing sufficient extraction to maintain negative pressure within the tanks, thereby minimising the potential for fugitive odour emissions.

However, the visual assessment found the odour containment system to generally be in a poor condition increasing the risk of fugitive odour emissions. Therefore, *it is recommended that the secondary treatment containment system be upgraded to rectify the poor condition of the seal and observed leaks.*

Further examination of the extraction ducting found the flow control baffle for the MBBR tanks and RATs/ SCRTs to be in a poor condition and *it is recommended the MBBR and RATs/SCRTs flow control baffles be repaired or replaced.*

In summary, the smoke testing of the Moa Pt WTP confirmed compliance with Condition 10 of the Company's resource consent Moa Pt WTP with the odour control system providing sufficient extraction to maintain negative pressure and therefore minimising the potential for fugitive odour emissions. However, the containment system is degraded with several components requiring repair increasing the risk of fugitive odour emissions.

2. Introduction

Source Testing New Zealand Limited (STNZ) was commissioned by Veolia Water Services (ANZ) Pty Ltd (Veolia) to conduct the annual smoke testing of the Moa Point Wastewater Treatment Plant (Moa Pt WTP), Wellington. The objective of the smoke testing was to demonstrate compliance with the Company's resource consent (26183). Condition 10 stipulates:

The permit holder shall undertake smoke testing of the Moa Point wastewater treatment plant and ventilation system. The smoke tests are to be carried out on an annual basis between the months of August and November.

The results of the smoke testing shall be submitted to the manager, environmental regulation, Wellington Regional Council within one month of the testing being carried out by the permit holder. A copy of the analysed results shall be provided to the Community Liaison Group, if requested.

The testing involved using an industrial smoke machine to saturate the process area and assessing the containment aspects of the odour control system to identify any potential discharges and in doing so confirming sufficient extraction is being applied to maintain negative pressure, minimising the potential for fugitive odour emissions. For the current assessment, the following process areas were assessed:

- Inlet Pump Station (IPS),
- Primary Treatment Room,
- Secondary Treatment including Moving Bed Bioreactors (MBBR), Re-Aerations Tanks (RAT), and Solids Contact Reaction Tanks (SCRT),

Matthew Newby, Senior Air Quality Scientist with STNZ performed the annual smoke testing of the Moa Pt WTP. Matthew has over 25 year's air quality monitoring and consulting experience and is designated as a Key Technical Person under STNZ's IANZ accreditation. Matthew is also a Certified Air Quality Professional (CAQP) under the Clean Air Society of Australia and New Zealand (CASANZ) certification programme.

The following report presents the results of the annual smoke testing of the Moa PT WTP odour control system conducted on 26 January 2024.

3. Inlet Pump Station Smoke Testing

On 26 January 2024, the annual smoke testing of the Moa Pt WTP IPS was carried out to identify any potential fugitive odour emissions. The outlet from an industrial smoke machine was inserted into an inspection hatch above of one of the wet well (see Figure 1) and allowed to fill the chamber for approximately 30-minutes. Within a few minutes, light smoke was observed exiting the IPS scrubber stack as depicted in Figure 2. Unfortunately, the smoke was very light and was not captured by the photo.

- **Figure 1: Moa Pt IPS Smoke Machine, 26 January 2024**

After approximately 30-minutes, a site walk around was conducted to assess the physical containment aspects of the odour control system. As the IPS is in the process of being decommissioned and incorporated into the new sludge minimise plant, limited preventative maintenance has been performed and as a result all the seals around the pumps power supplies were missing and in poor condition after a recent overhaul of the pumps and wet wells (see Figure 3).

Despite the poor condition of the seal, there were no visible smoke emissions, confirming the IPS odour control system was maintaining negative pressure and therefore minimising the potential for fugitive odour emissions.

- **Figure 2: Moa Pt IPS Scrubber Stack, 25 November 2022**

- **Figure 3: Moa Pt IPS Seals, 26 January 2024**

4. Primary Treatment Room

On 26 January 2024, the annual smoke testing of the Moa Pt WTP primary treatment room was carried out to identify any potential fugitive odour emissions. The industrial smoke machine was placed at the inlet end of the primary treatment room (see Figure 4) and allowed to fill the room for approximately 45-minutes. Once the building was full of smoke, the exterior of the building, including the roof, was observed to identify any discharges of smoke indicative of potential fugitive emissions. The assessment found no smoke discharges, confirming compliance with Condition 10 of the Company's resource consent.

- **Figure 4: Moa Pt Primary Tanks, 26 January 204**

The buildings ventilation rate was estimated by determining the time taken to clear 95 % of the smoke. On 26 January 2024, this took approximately 30-minutes indicating a ventilation rate of two-room changes per hour, which was lower than measured in November 2022 and was low for this type of process with engineering specifications ranging 3 to 5 room changes per hour, up to 10 room changes in cases where workers are required to routinely enter the area.

Examination of the odour control duct found the primary treatment room flow control baffle to be severely degraded with large holes evident (see Figure 5). The extremely poor condition of this baffle has potentially reduced the effective ventilation rate of the primary treatment room. Hence, *it is recommended that the primary treatment flow control baffle be replaced and associated ducting repaired.*

- **Figure 5: Primary Treatment Room Baffle, 26 January 2024**

5. Secondary Treatment Processes

On 26 January 2024, the annual smoke testing of the Moa Pt WTP secondary treatment processes was carried out to identify any potential fugitive odour emissions. The outlet of the industrial smoke machine was placed in one of the hatches of the MBBR tanks (see Figure 6) and allowed to fill the chambers for approximately 30-minutes. The process was then repeated for the RAT with the outlet of the smoke machine inserted into an access hatch as depicted in Figure 7. Within a few minutes, light smoke was observed exiting the main scrubber stack (see Figure 8), however, the smoke was very light and difficult to captured in a photo.

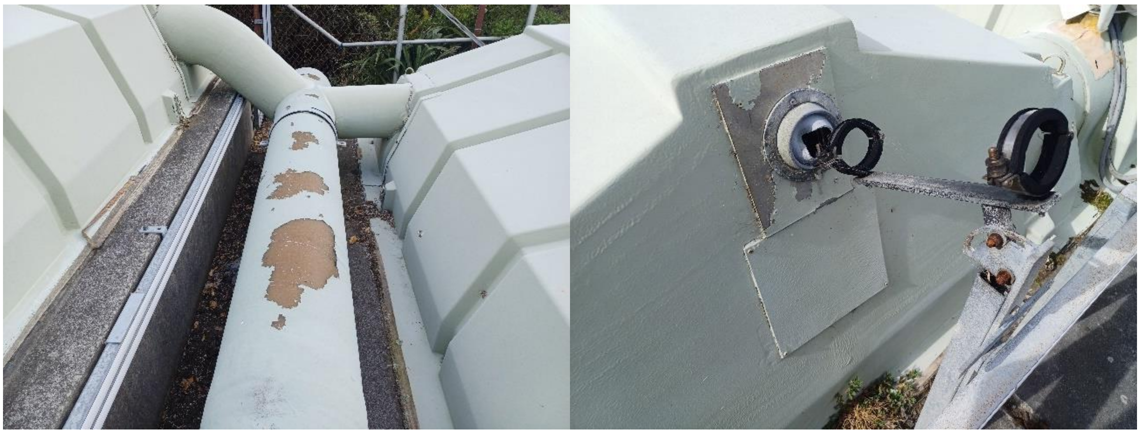
After 30-minites, a visual assessment of the tank covers did not identify any smoke, confirming the odour control system was providing sufficient extraction to minimise the potential for fugitive odour emissions. The lack of visible emissions demonstrates compliance with Condition 10 of the Company’s resource consent.

- **Figure 6: Moa Pt MBBR Tanks Smoke Test, 26 January 2024**

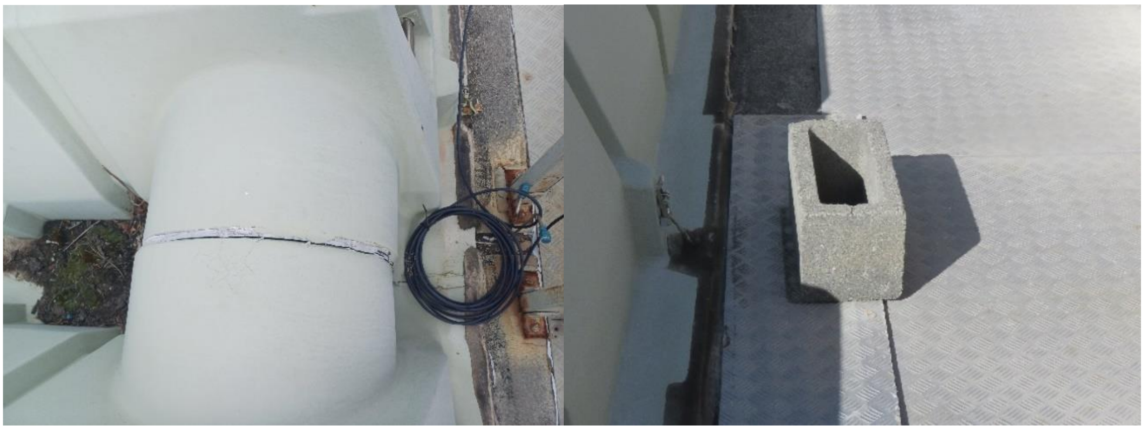
- **Figure 7: Moa Pt RATs Smoke Test, 26 January 2024**

- **Figure 8: Moa Pt Main Scrubber Stack, 26 January 2024**

The visual assessment of the MBBRs, RATs and SCRTs odour containment system found the fibre glass enclosures, ducting and associated seals to be weathered with flaking paint, cracked rubber and numerous gaps (see Figures 9 and 10). Furthermore, the tape used on repairs was also degraded and the overall conditions of the cover seals was poor. While smoke testing showed the system was being maintained under negative pressure, the poor condition of the seals and repairs acts to increase the risk of fugitive odour emissions. Therefore, *it is recommended that the secondary treatment containment system be upgraded to rectify the poor condition of the seal and observed leaks.*



- **Figure 9: Secondary Treatment Enclosure Weather Paint and Holes, 26 January 2024**



- **Figure 10: Secondary Treatment Enclosure Seals, 26 January 2024**

The flow control baffle for the MBBR tanks was found to be highly degraded with significant gaps and holes visible as depicted in Figure 11. The flow control baffle for the RATs and SCRTs extraction ducting was also degraded with substantial rust and the drain line was semi-detached (see Figure 12). Hence, *it is recommended the MBBR and RATs and SCRTs flow control baffles be repaired or replaced.*

- **Figure 11: MBBR Flow Control Baffle, 26 January 2024**

- **Figure 12: Rats & SCRTs Flow Control Baffle, 26 January 2024**

Moa Point Inlet Pump Station: Discharges to Tarakena Bay via the short outfall.

Assessment of Environmental Effects

Stantec

Prepared for:
Wellington Water Ltd

Prepared by:
David Cameron

31 July 2024

Project/File:
310003194

Stantec New Zealand

Moa Point Inlet Pump Station: Discharges to Tarakena Bay through the short outfall

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
0	Draft report	DC	30/7/24	SD	31/7/24	RR	31/7/24

The conclusions in the Report titled Moa Point Inlet Pump Station: Discharges to Tarakena Bay through the short outfall 2024 are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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1 Introduction

1.1 Purpose of this report

Wastewater is received at the Moa Point Inlet Pump Station (IPS) where up to 10 submersible pumps transfer it to the Moa Point Wastewater Treatment Plant (WWTP). In the event that wastewater inflows to the IPS exceed the pumping capacity, the IPS can overflow into a pipeline leading to the short ocean outfall which discharges to Tarakena Bay. The purpose of this report is to characterise these discharges and to provide a high-level assessment of effects on the environment.

1.2 Existing consents

The overflow of wastewater from the IPS is one of over 100 wastewater network overflow points identified in WWL's application to Greater Wellington Regional Council to consent wet weather overflows from Wellington's wastewater collection network. That consent application is in progress and the discharge is currently not consented.

2 Characterisation of short outfall discharges

2.1 Frequency of discharge events

Over the twenty years from June 2004 to June 2024 a total of 16 IPS discharges via the short outfall have been recorded, seven of which are wet weather events driven by high wastewater inflows from the network. Wet weather discharge events have become far more frequent in recent years with six of the seven events occurring after January 2022. The longest duration discharge of nearly 19 hours occurred on 27 September 2023, and the largest volume discharge of 59,911 m^3 occurred on 2nd May 2024.

Table 2-1: Record of short outfall discharge events (June 2004 to June 2024)

Date	Duration (hr:min)	Volume (m^3)	Peak flow (L/s)	Cause
4 January 2005	00hr 05m	22	not stated	Power supply failure
4 January 2005	00hr 06m	167	not stated	Startup issues after power supply failure
31 March 2005	00hr 05m	463	1,600	Equipment control problems
26 August 2006	15hr 20m	24,674	4,283	Wet weather. Influent flows exceeded 3000 L/s
6 May 2013	not stated	not stated	not stated	Pumps turned off while step screens cleared
5 June 2013	5hr 57m	6,229	not stated	Step screens blocked
9 January 2015	00hr 05m	30	not stated	Power supply failure
15 March 2017	2hr 00m	6,000	not stated	Power supply failure
12 February 2022	5hr 00m	323	not stated	Wet weather and high inflows (Cyclone Dovi)
20 February 2022	00hr 41m	97	151	Wet weather and IPS pump fault
19 April 2023	08hr 00m	not stated	not stated	Wet weather and high inflows
16 August 2023	4hr 35m	12,468	1,464	Wet weather and high inflows
27 September 2023	18hr 56m	42,002	1,649	Wet weather and high inflows
30 September 2023	6hr 58m	11,099	1,072	Wet weather and high inflows
12 April 2024	9hr 59m	11,410	1,102	Planned maintenance
2 May 2024	14hr 04m	59,911	3,731	Mechanical failure within WWTP

2.2 Quality of short outfall discharges

The quality of untreated wastewater inflows to Moa Point WWTP determined from daily sampling between 2017 and 2022 is summarised in Table 2-2. Faecal coliform and enteric virus values are from a generic characterisation of wastewater quality of influent to New Zealand WWTPs. It is noted that most overflows from the IPS occur during periods of sustained wet weather when wastewater flows are greatly increased (up to 10-fold) by stormwater and groundwater ingress to the network, and when contaminant concentrations are diluted (also up to 10-fold) below the average concentration.

Table 2-2: Average untreated wastewater quality of flows to Moa Point WWTP (90th percentile values are in brackets)

Determinand	Moa Point WWTP inflow
BOD_5	239 g/m^3 (350 g/m^3)
Total suspended solids (TSS)	398 g/m^3 (617 g/m^3)
Total Nitrogen (n = 17)	36 g/m^3 (46 g/m^3)
Ammoniacal Nitrogen (n = 17)	22 g/m^3 (28 g/m^3)
Total Phosphorus (n = 17)	5.1 g/m^3 (6.5 g/m^3)
Faecal coliform bacteria	10^6 to 10^7 cfu per 100mL
Enteric viruses	10^3 to 10^4 per 100mL

3 Receiving environment

3.1 Ecological value

The short outfall is located within rocky reef habitat at Tarakena Bay on Wellingtons South Coast (Figure 1). It is southeast of Lyall Bay and east of Taputeranga Marine Reserve. That part of the coast is very exposed and can be subject to strong southerly swells and large high energy waves.

James et al (2016) described the marine ecology of the area, observing that rocky reef habitat is found all along the exposed southern Wellington coast, supporting a rich and diverse community of brown, red and green macroalgae which in turn support a rich reef community of a range of fauna including gastropods, paua, kina and rock lobsters. Communities found on the reefs off the southern end of the Wellington Airport runway are typical of those found along the Wellington coastline. Large strap-like canopy-forming macro-algal species (e.g. *Lessonia variegata* and *Macrocystis pyrifera*) were common in most sub-tidal habitats.

3.2 Water quality

GWRC and Wellington City Council collect weekly water samples at popular bathing beaches during the bathing season, from 1 November to 31 March[1]. These samples are tested for enterococci which

[1] It is noted that limited sampling results are available for the 2023-2024 bathing season

is the faecal indicator bacteria most suitable for use in marine waters. The variations in water quality (i.e., the concentration of enterococci) observed at Breaker Bay, Lyall Bay and Princess Bay for the summers of 2020/2021, 2021/2022 and 2022/23 are summarised in Table 3-1. The location of the sites in relation to the short outfall is shown in Figure 3-1.

The Lyall Bay east monitoring site at Tirangi Road had the poorest water quality of the five sites, although a progressive improvement is seen over the last three summers. The highest enterococci concentration recorded at the Tirangi Road site was 2,000 cfu/100ml on 14 July 2021, likely due to a local wastewater network fault or overflow (this site is monitored throughout the year, not just during the bathing season).

Table 3-1: Summary statistics for enterococci (cfu/100ml) monitoring results at bathing beaches close to the short outfall

Site	Distance from short outfall (m)	2020/2021			2021/2022			2022/2023			NRP
		Nr.	95%ile	% >500	Nr.	95%ile	% >500	Nr.	95%ile	% >500	95th%ile
Breaker Bay	2,800	15	22	0	17	23	0	11	98	0	
Lyall Bay (Tirangi)	2,930	29	961	6.9	30	444	6.7	19	188	5.2	
Lyall Bay (Queens Dr)	2,900	11	218	0	31	175	0	11	60	0	≤500
Lyall Bay (Onepu)	2,830	16	173	0	16	129	0	11	34	0	
Princess Bay	3,313	15	64	0	16	26	0	11	4	0	

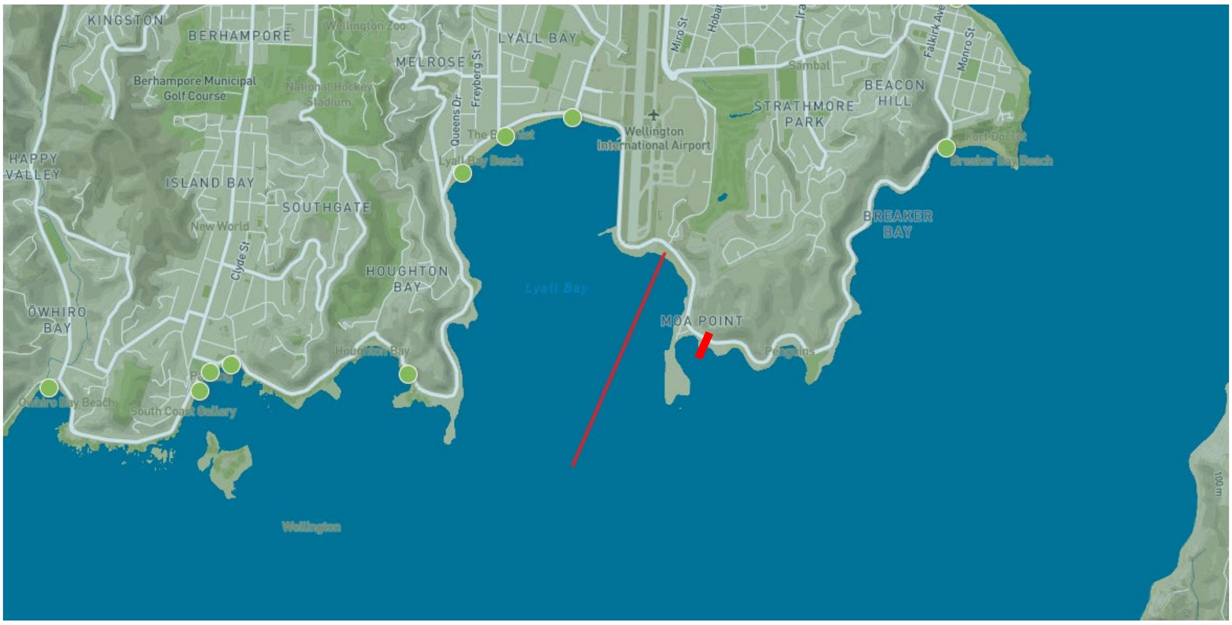

Figure 3-1: Location of bathing beach monitoring sites (green dots) the Moa Point long outfall (long red line) and short outfall (short red line)

4 Assessment of effects

4.1 Dilution of dispersion

The short outfall discharges into the intertidal zone of Tarakena Bay, amongst rocky outcrops, as shown in Figure 4-1. In the absence of a dilution assessment for this site, we have relied on a study conducted by Barter, et al (2004) at Bluff Point for the Seaview WWTP, which also has an exposed south coast aspect, to provide an indicative dilution estimate for the short outfall in Tarakena Bay. The indicative estimated is that a minimum 50-fold dilution would occur at a distance of 400m from the Moa Point short outfall. A 400m radius circle around the Moa Point short outfall is indicated in Figure 4-1.

Figure 4-1: Location of the short outfall shown at centre of a 400m radius mixing zone (red circle)

4.2 Predicted coastal water quality in Tarakena Bay

The effects of an untreated wastewater discharge via the short outfall on receiving water quality in Tarakena Bay can be determined by mass balance calculation. The predicted receiving water contaminant concentration (Cx) at any location x is given by equation 1:

$$Cx = \frac{(Co - Cb)}{TD} + Cb \qquad (1)$$

Where: *Co* = the wastewater concentration of the contaminant.
Cb = the background concentration in the ocean, and
TD = the total dilution.

Table 4-1 summarises the predicted receiving water concentrations of total suspended solids, ammoniacal nitrogen, and faecal coliform bacteria, at 400m from the short outfall during a sustained discharge event. The 400m mixing zone would occupy most of Tarakena Bay. Beyond Tarakena Bay the predominant tidal currents would disperse the discharge plume alternately east and west, parallel with the south coast, while wind could add either an onshore or offshore component to plume movement, potentially pushing dilute plume remnants towards the recreational area of Lyall Bay or out into Cook Strait.

The discharge plume within Tarakena Bay would have roughly twice the suspended solids content of the surrounding seawater and would likely be visible from the shore, but would become less visible as the plume disperses away from the outfall on tidal and wind driven currents.

The discharge would increase receiving concentrations of ammoniacal nitrogen however the predicted concentration at a distance of 400m from the outfall is expected to comply with the ANZG (2018) default guideline value for 99% species protection (<0.5 g/m^3), indicating a low risk of toxicity.

Table 4-1: Predicted water quality during a IPS discharge a distance of 400m from the outfall

Wastewater constituent	Wastewater concentration 90th percentile (C_o; mg/L)	Background seawater concentration (C_b; mg/L)	Minimum dilution (x-fold) (TD)	Predicted concentration 400m from outfall (C_x: mg/L)	Predicted increase (mg/L)
Total suspended solids (g/m^3)	398	10	50	18	8
Ammoniacal-N (g/m^3)	22	0.01	50	0.45	0.44
Enterococci (cfu/100ml)	1,000,000	5	50	20,005	20,000

Faecal coliform concentrations in the dilute wastewater discharge are expected to be extremely elevated. A discharge via the short outfall would increase seawater faecal coliform concentrations within Tarakena Bay by approximately 20,000 cfu/100ml, indicating an unacceptable level of risk for those engaged in full contact activities such as swimming or secondary contact such as fishing in that area. Under onshore wind conditions the discharge plume could move towards the popular recreation area of Lyall Bay but would become increasingly dilute with distance from the outfall.

5 Conclusion

IPS discharges of untreated wastewater to Tarakena Bay through the short outfall have historically been low frequency, low volume events mostly associated with power supply failure or equipment control problems, which likely had very little environmental impact. However, since the beginning of 2022 the frequency of wet weather IPS discharges through the short outfall has increased, as has the volume and duration of those discharges. Over the 30 months from 1 January 2022 to 30 June 2024 a total of eight discharges were recorded, at an average rate 3.2 events per year.

Currently, the risk to marine biota remains low due to the low frequency, low volume, and short duration of short outfall discharges. It is noted however that if the frequency of discharge continued to increase, the risk of adverse effects on the nearshore intertidal and subtidal marine ecology would also increase.

The risk of gastrointestinal infection for recreational users of the near shore waters of Tarakena Bay would be unacceptable if full contact activities such as bathing or snorkelling occurred during or immediately after a discharge event. It is recommended therefore that WWL develop and implement a focused public engagement plan with the objective of preventing recreational use of the area at times of elevated risk.

References

Barter, P., Sneddon, R., & Keeley, N. (2004). *A survey of effluent dilution/dispersion and subtidal marine ecology around the short ocean outfall at Bluff Point.* Cawthron Report No. 887. Prepared for Hutt City Council.

James, M., MacDiarmid, A., Beaumont, J., & Thompson, D. (2016). *Assessment of Ecological Effects of the reclamation and extension to Wellington Airport.* Prepared for Wellington International Airport Ltd.

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Moa Point WWTP

Assessment of environmental effects of non-compliant wastewater discharges from 2020 to 2024

Stantec New Zealand

Prepared for:
Wellington Water

30 July 2024

Prepared by:
Stephanie Davis

Project/File:
310003194

Moa Point WWTP

Assessment of environmental effects of non-compliant wastewater discharges from 2020 to 2024

Rev	Description	Author	Date	Quality Check	Date	Independent Review	Date
0	Draft Report V1	D. Cameron	4/3/2022	B. Mulling	4/3/2022		
1	Final Report	D. Cameron	8/3/2022	D. Cameron	8/3/2022	I. Rautenbach	8/3/2022
2	Update Report	D. Cameron	20/7/2023	D. Cameron	20/7/2023	I. Rautenbach	20/7/2023
3	Updated Final Report	S. Davis	30/7/2024	D. Cameron	30/7/2024	I. Rautenbach	30/7/2024

Moa Point WWTP

Assessment of environmental effects of non-compliant wastewater discharges from 2020 to 2024

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1 Introduction

The Moa Point Wastewater Treatment Plant (WWTP) operates under three discharge permits which authorise:

- A continuous discharge of treated wastewater into the Coastal Marine Area (CMA) via an existing submarine outfall.
- An occasional discharge of mixed disinfected secondary treated and milli-screened wastewater to the CMA via an existing submarine outfall.
- A continuous discharge of contaminants to air (including odour) from the WWTP air ventilation system.

A monitoring and technology review, required by a consent condition of the three discharge permits, was submitted to Greater Wellington Regional Council (GWRC) in 2018 on the 9th year of the 25-year consent duration. The review concluded that, overall, the WWTP has had an exemplary record of compliance with existing consent conditions since 2009 (Stantec, 2018).

Unfortunately, since the middle of 2020, the WWTP discharge moved into a period of non-compliance with condition 10 of the continuous discharge permit which specifies treated wastewater quality standards for $cBOD_5$, suspended solids and faecal coliform bacteria.

Condition 10 states that:
"*The wastewater discharged from the Moa Point Wastewater Treatment Plant to the coastal waters shall comply with the following effluent quality criteria:*

a) $cBOD_5$. The geometric mean of 90 consecutive daily sampling results shall not exceed 20 g/m^3 and no more than 10% of 90 consecutive samples shall exceed 45 g/m^3.

b) Suspended solids. The geometric mean of 90 consecutive daily sampling results shall not exceed 30 g/m^3 and no more than 10% of 90 consecutive samples shall exceed 68 g/m^3.

c) Faecal coliforms. The geometric mean of 90 consecutive daily sampling results shall not exceed 200 colony forming units per 100ml and no more than 10% of 90 consecutive samples shall exceed 950 colony forming units per 100ml.

Compliance with the effluent quality criteria shall be determined from the results of wastewater monitoring undertaken in accordance with conditions (9)(a) and (9)(b) of this permit, with a running geometric mean and ninetieth percentile calculated following each sampling event using the preceding 90 consecutive samples."
Conditions 11 and 14 also specify effluent quality and effects standards and are relevant to this assessment.

Condition 11 states that:
"The permit holder shall at least once every three months obtain a sample of the treated wastewater discharged from the treatment plant to the outfall. This sample shall be analysed for and not exceed the following:

Total arsenic	*0.26 g/m^3*
Total cadmium	*0.08 g/m^3*
Total chromium	*0.48 g/m^3*
Total copper	*0.14 g/m^3*
Total lead	*0.48 g/m^3*
Total mercury	*0.01 g/m^3*
Total nickel	*0.77 g/m^3*
Total zinc	*1.65 g/m^3*
Phenol	*0.80 g/m^3*
Cyanide as CD	*0.10 g/m^3*

This sample shall also be analysed for pH, Ammoniacal nitrogen and Oil & Grease"

Condition 14 states that:
"The discharge shall not result in any of the following effects beyond a 100m radius of the discharge point (described in condition 3 of this permit):

a) The production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials
b) Any conspicuous change in colour or visual clarity
c) Any emission of objectionable odour, or
d) Any significant effects on aquatic life"

The purpose of this report is to review the results of monitoring required by the resource consent, and other relevant information, and to assess the potential adverse effects of non-compliant discharges that occurred during 2020, 2021, 2022, 2023 and part of 2024. This assessment is focused on the ***effects*** of the discharges. A consideration of the ***causes*** of the non-compliance has been addressed elsewhere.

2 Dilution and dispersion

Final treated wastewater is discharged via an ocean outfall and diffuser located south of Lyall Bay. The outfall terminates in a multiport diffuser at the offshore end of a buried pipe running 1,800 m in a southwest direction from the shoreline at Moa Point. Wastewater is discharged from 18 risers spaced at 5m intervals along the 90 m diffuser Figure 2-1. The risers project 1.4 m above the seabed. Each riser has two discharge ports, one of which is blocked off on some of the risers so as to maintain optimal discharge jet velocity. The diffuser is in 21 to 23 m depth of water.

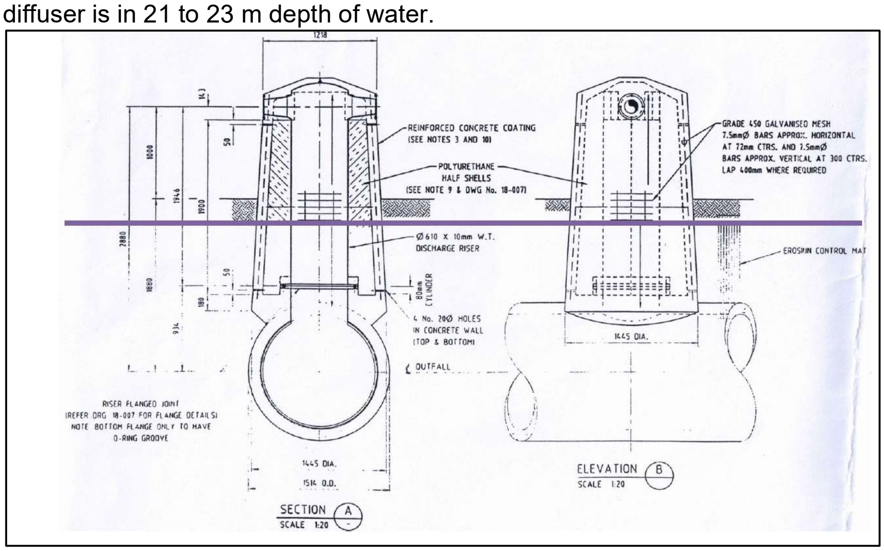

Figure 2-1 Details of diffuser risers (blue line is typical seafloor level)

A dye study and CORMIX hydrodynamic mixing model conducted by Cawthron Institute in 2003, updated in 2007, characterised the initial dilutions achieved for average and peak discharge flow rates (MWH, 2007). At the current average daily flow rate of approximately 800 L/s, a minimum initial dilution of 120-fold is predicted.

3 Recent performance of the WWTP

3.1 Wastewater flow rate

Condition 2 of the continuous discharge consent states that: "*The rate of discharge shall not exceed 260,000 cubic metres per day (m^3/day)*". Figure 3-1 shows a single data point above that limit (red line) on 6 December 2021 when the flow volume was 270,060 m^3. This occurred during a period of sustained heavy rainfall and is the only exceedance on record. Perhaps more importantly, the box plots show that wastewater flows have not increased over the last 20 years despite significant population growth in the wastewater catchment over that period. Note, summary statistic for daily *influent* volumes are presented here because of an historic issue around the accuracy the *effluent* flow monitoring site, but that issue has now been resolved.

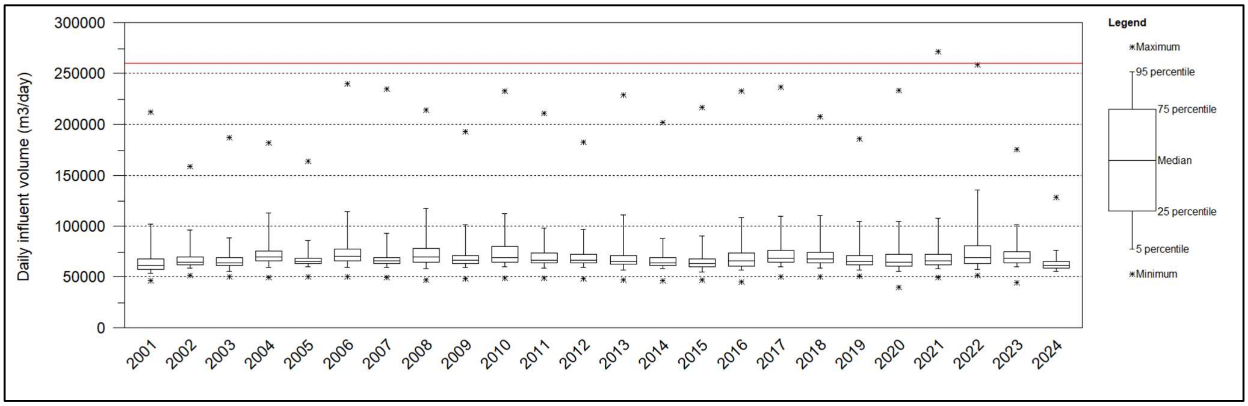

Figure 3-1: Total daily influent flow rate from Moa Point WWTP (maximum permitted flow indicated by red line)

3.2 Assessment against condition 10

3.2.1 $cBOD_5$

Figure 3-2 summarises the daily monitoring results for $cBOD_5$ showing consistently low results until year 2019, followed by a marked increase during 2020 which has been sustained through to 2024. Figure 3-3 focuses on years 2020 to 2024 when the geometric mean and 90th percentile consent limits were exceeded during each spring/summer period. Summary statistics for this period are provided in Table 3-1.

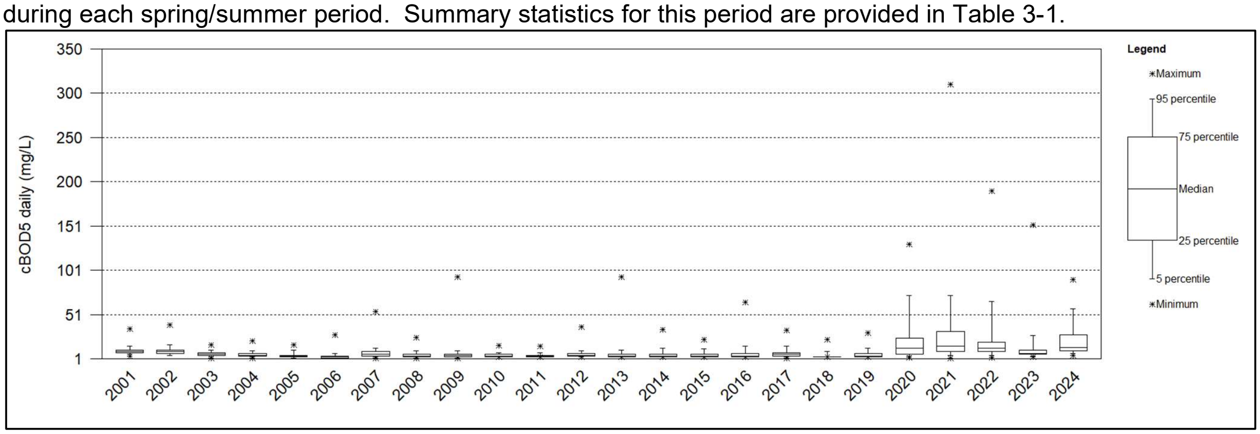

Figure 3-2: Summary of daily treated wastewater $cBOD_5$ (mg/L) by year

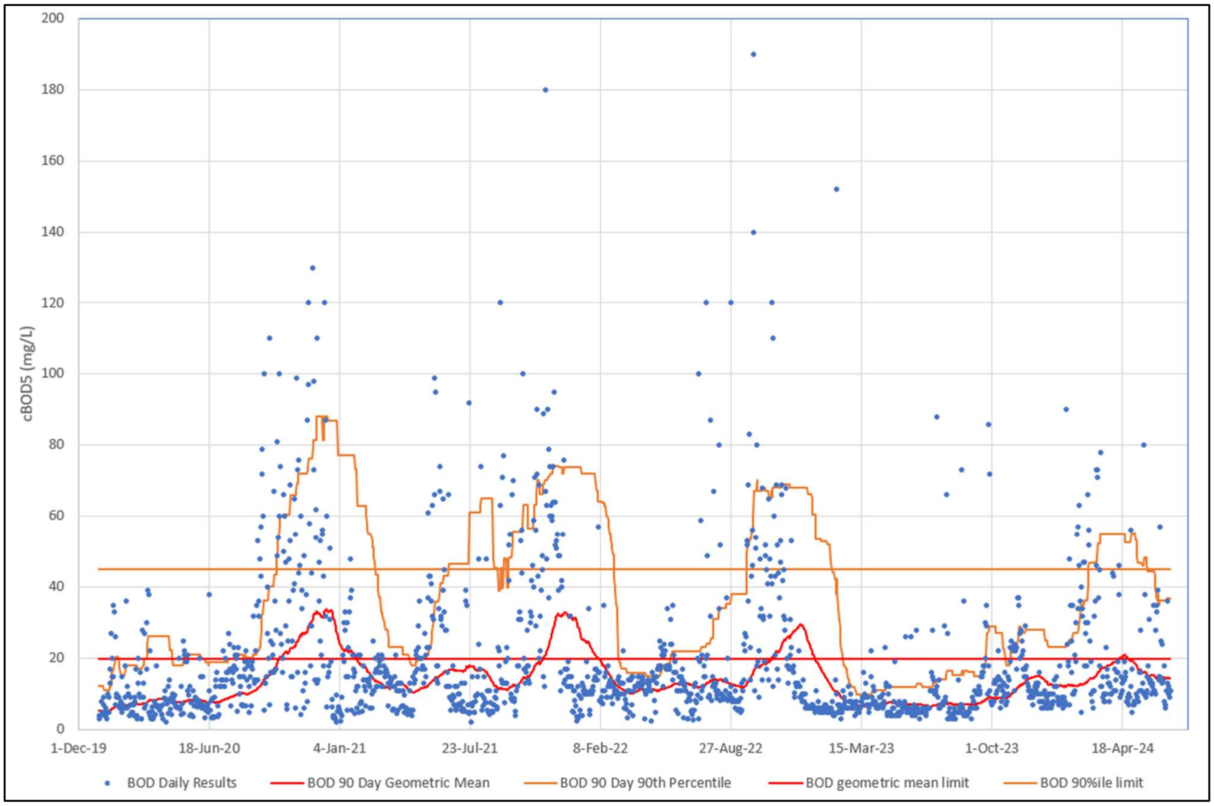

Figure 3-3: Daily treated wastewater $cBOD_5$ (mg/L), 90-day geometric means and 90-day 90^{th} percentiles

Table 3-1: Daily treated wastewater $cBOD_5$ (mg/L) summary statistics for years 2018 to 2024

Year	Sample size	Minimum	Median	95-percentile	maximum	s.d.
2018	365	<3.0	3	9	23	2.35
2019	365	<3.0	4	13	30	4.44
2020	366	2.2	13	72	130	22.84
2021	365	2.1	15	72	310	27.56
2022	365	2.5	13	65	190	22.04
2023	364	3.0	7	27	152	12.57
2024	179	5	14	57	90	17.26

3.2.2 TSS

Figure 3-4 summarises the daily monitoring results for Total Suspended Solids (TSS), showing a similar pattern as observed for BOD, with elevated concentrations recorded during 2020 through to 2024. Figure 3-5 focuses on years 2020 to 2024 when the geometric mean and 90^{th} percentile consent limits were exceeded during each spring/summer period, the magnitude of that exceedance gradually reduced until 2024. Summary statistics for this period are provided in Table 3-2.

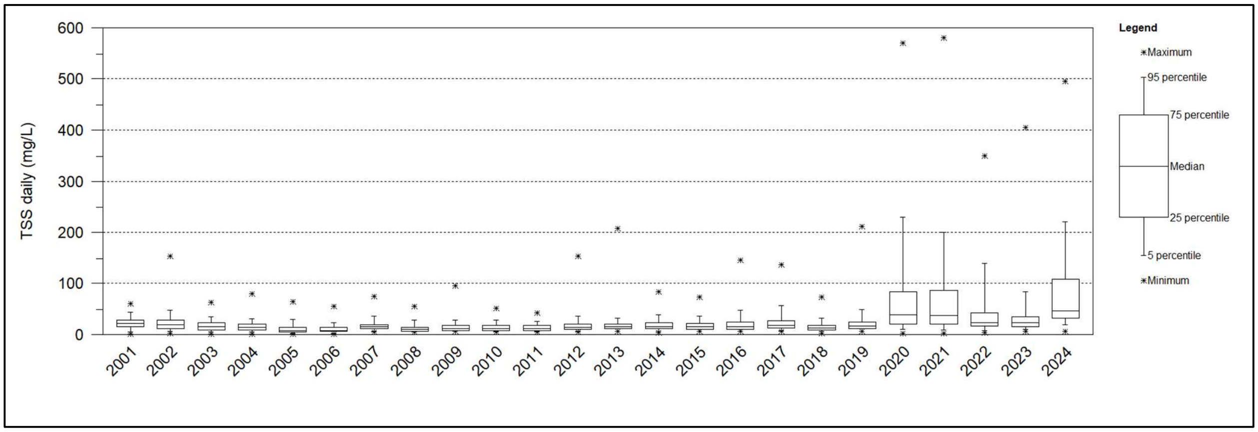

Figure 3-4: Summary of daily TSS (mg/L) monitoring results by year

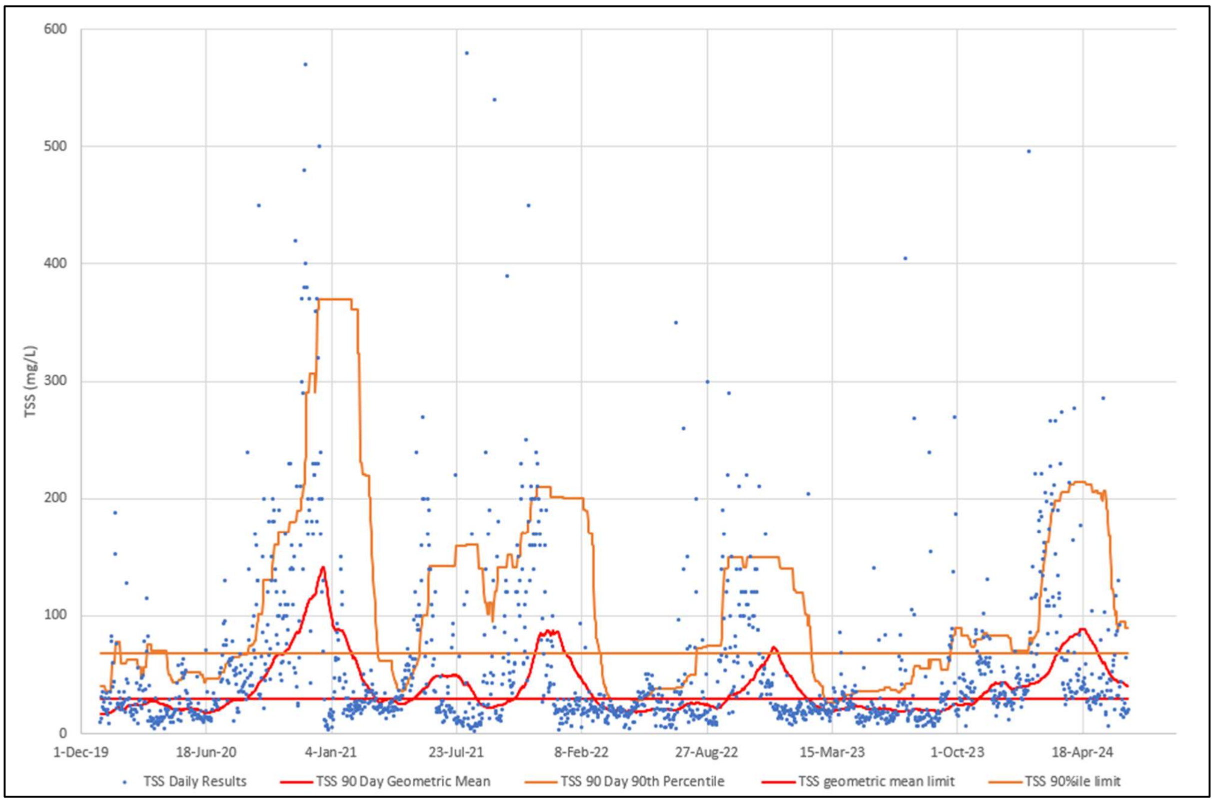

Figure 3-5: Daily treated wastewater TSS (mg/L), 90-day geometric mean and 90-day 90th percentile

Table 3-2: Daily treated wastewater TSS (mg/L) summary statistics for years 2018 to 2024

Year	Sample size	Minimum	Median	95-percentile	Maximum	s.d.
2018	365	3.0	13	32.3	73	9.22
2019	365	6.0	17	48.3	212	18.23
2020	366	3.2	39	230	570	88.62
2021	365	2.0	37	200	580	73.75
2022	365	3.6	23	140	350	48.79
2023	364	6	23	84	405	38.19
2024	181	6	47	221	496	71.27

3.2.3 Faecal coliform bacteria

Figure 3-6 summarises the daily monitoring results for faecal coliforms by year. It shows a progressive increase in upper percentile values during 2020, 2021, and 2022, with a significant jump in 2024. Figure 3-7 shows cyclical exceedances of the geometric mean and 90th percentile consent limits from 2021 to 2024. Summary statistics for this period are provided in
Table 3-3.

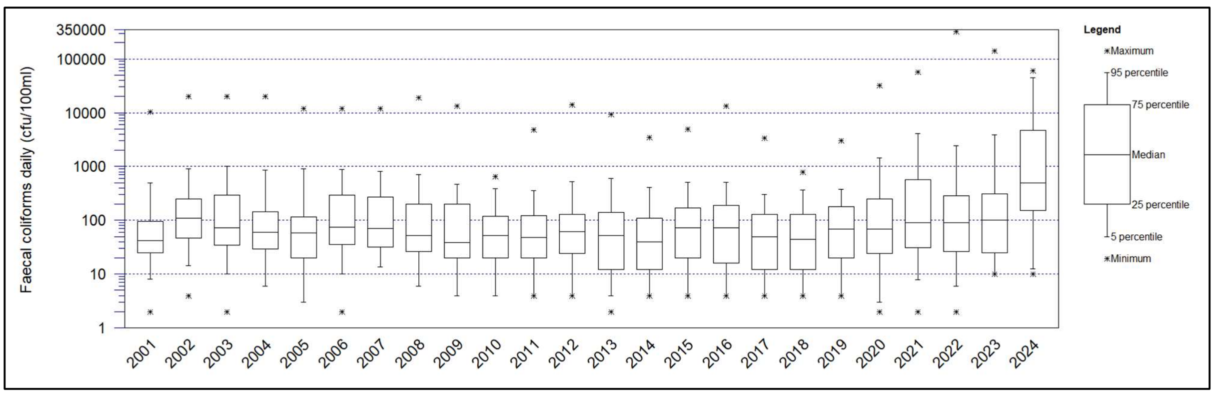

Figure 3-6: Summary of daily treated wastewater faecal coliform concentration per 100ml on a log scale, by year

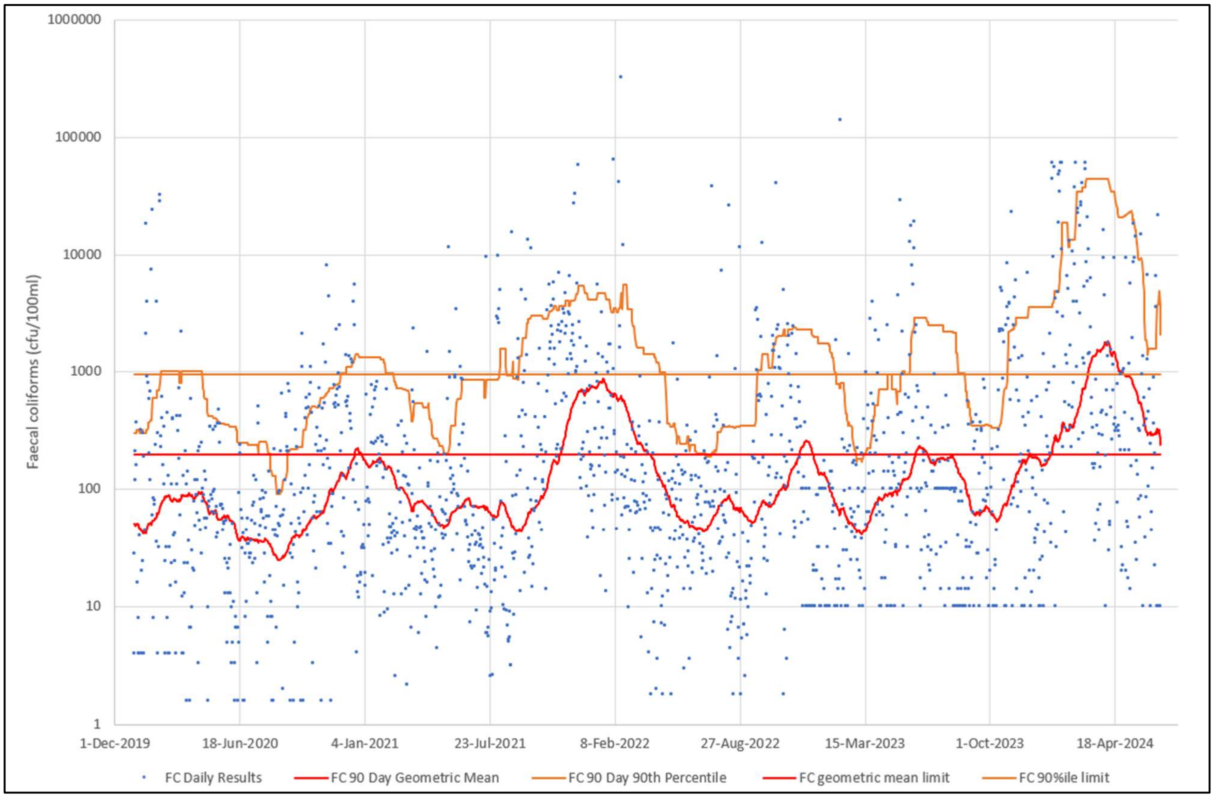

Figure 3-7: Summary of daily treated wastewater faecal coliform results (cfu/100mL) on a log(10) scale

Table 3-3: Daily treated wastewater faecal coliform (cfu/100mL) summary statistics for years 2018 to 2024

Year	Sample size	Minimum	Median	95-percentile	maximum	s.d.
2018	365	<4.0	44	370	800	135
2019	365	<4.0	69	373	3,000	269
2020	366	<2	69	1,449	32,000	2,807
2021	365	2.1	90	4,102	57,297	4,088
2022	364	<2	89	2,458	322,012	17,603
2023	364	10	100	3,771	140,000	7,766
2024	182	10	490	45,222[1]	60,000[2]	13,699

3.3 Assessment against condition 11

Table 3-4 summarises the results of quarterly monitoring from 2020 to 2024 for the contaminants listed in condition 11. It also includes the maximum concentrations permitted by condition 11, and the ANZG (2018) 99% species protection level multiplied by the predicted 120-fold minimum initial dilution. The latter represents a robust trigger value for the protection of marine biota around the outfall. Neither the consent limits nor the ANZG (2018) based trigger values were exceeded in any of the quarterly samples collected during this period, indicating negligible receiving environment risk of toxicity in relation to the condition 11 contaminants.

[1] True value likely higher, as maximum range has been capped at 60,000.
[2] Data range capped at 60,000. True maximum likely higher.

Table 3-4: Summary statistics from quarterly final wastewater monitoring, 2020 to 2024

Variable	Units	Number of samples	Minimum	Mean	Maximum	Consent limit	ANZG (2018) 99%*120
Total arsenic	mg/L	16	<0.0010	0.0013	0.0020	0.2600	0.0960
Total cadmium	mg/L	16	<0.0001	0.0003	0.0010	0.0800	0.0840
Total chromium	mg/L	16	0.0007	0.0016	0.0040	0.4800	0.0168
Total copper	mg/L	16	0.0030	0.0072	0.0260	0.1400	0.0360
Total lead	mg/L	16	<0.0004	0.0009	0.0020	0.4800	0.2640
Total mercury	mg/L	16	<0.0001	0.0003	0.0010	0.0100	0.0120
Total nickel	mg/L	16	0.0005	0.0013	0.0030	0.7700	0.8400
Total zinc	mg/L	16	0.0160	0.0308	0.0490	1.6500	0.3960
Phenol	mg/L	16	<0.0020	0.0053	0.0200	0.8000	32.400
Cyanide as CD	mg/L	16	<0.0050	0.0067	0.0430	0.1000	0.2400
Total nitrogen	mg/L	11	13.0	17.6	30.0	not specified	not specified
Ammoniacal N	mg/L	22	3.74	7.34	14.90	not specified	60
Oil & Grease	mg/L	12	4.0	6.12	13.80	not specified	not specified
pH	-	12	6.70	6.94	7.60	not specified	not specified

3.4 Assessment against condition 14

Condition 14 states that: "*The discharge shall not result in any of the following effects beyond a 100m radius of the discharge point (described in condition 3 of this permit):*

a) The production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials;
b) Any conspicuous change in colour or visual clarity
c) Any emission of objectionable odour, or
d) Any significant effects on aquatic life"

3.4.1 Suspended solids, colour, clarity, oil, grease and odour

The effects of the Moa Point WWTP discharge on receiving water concentrations of total suspended solids can be determined by mass balance calculation. The predicted receiving water contaminant concentration (*Cx*) at any location *x* is given by equation 1:

$$Cx = \frac{(Co - Cb)}{TD} + Cb \qquad (1)$$

Where: *Co* = the wastewater concentration of the contaminant;
Cb = the background concentration in the ocean; and
TD = the total dilution.

Predicted TSS concentrations in surface waters above the diffuser resulting from median and 95-percentile wastewater concentrations during the 2018, 2020, and 2023 years are summarised in Table 3-5.

Table 3-5: Predicted suspended solids concentration after initial mixing (in surface waters above the diffuser)

Year	Statistic	Wastewater concentration (mg/L)	Background seawater concentration (mg/L)	Minimum dilution (x-fold)	Predicted concentration after initial dilution (mg/L)	Predicted increase (mg/L)
2018	Median	13	5	120	5.1	0.1
	95-percentile	33	5	120	5.2	0.2
	Maximum	73	5	120	5.6	0.6
2020	Median	39	5	120	5.3	0.3
	95-percentile	230	5	120	6.9	1.9

	Maximum	570	5	120	9.1	4.1
2023	Median	23	5	120	5.15	0.15
	95-percentile	84	5	120	5.66	0.66
	Maximum	405	5	120	8.33	3.33

Table 3-5 indicates that the high treated wastewater quality achieved during 2018 would have caused a negligible and likely undetectable increase in suspended solids at the point where the discharge plume from the diffuser reaches the seawater surface (i.e., after initial mixing). The poorer quality treated wastewater produced during 2020 to 2023 might, in the worst case, have formed a visible plume in surface waters over the outfall diffuser when viewed from an elevated position, however for the majority of time the plume would have been barely visible.

The maximum wastewater concentration of oil & grease measured in the treated wastewater water (from Table 3-4) is estimated to have caused a worst-case oil and grease concentration of approximately 0.1 mg/L in surface water above the outfall diffuser, which would be barely discernible. Similarly, the discharge would not likely have produced any scum or foam or objectionable odour in surfaces waters near the diffuser.

In summary, because of the high level of dilution achieved by the multiport diffuser, the poor-quality wastewater discharged during 2020 to 2023 might have, in the worst case, caused a visible discharge plume in surface waters above the outfall diffuser, but the formation of a conspicuous oil film, scum, foam, colour or odour is unlikely.

3.4.2 Aquatic life

An ecological survey was conducted around the outfall diffuser by Cawthron marine ecologists on 7 May 2018 (Morrisey, 2018). The ecological survey was conducted in parallel with the annual pipeline condition survey conducted during April and May 2018 by Undersea Construction Ltd (2018). In combination the 2018 survey reports described the condition of the pipeline, the surrounding seabed, and the marine ecology prior to the start of non-compliant discharges, i.e., during a period of normal operation. The Cawthron divers observed that all risers were covered in diverse and apparently healthy fouling assemblages, including sponges, anemones, colonial and solitary ascidians, hydroids, barnacles and red, green and brown algae (Plate 1). Free living organisms included kina, cushion stars, seven armed stars and various gastropods including the large duck's bill limpet and the warty sea slug were also common. The only fish seen during the dives were species of triplefins (family Trypterygiidae). The assemblages were similar to those previously described in an earlier survey by Barter, *et al.*, (2006).

The seabed around the risers consisted of gravels, pebbles and cobbles (up to 30 cm diameter) and small patches of smaller gravel or coarse sand (Plate 2). Disturbance of the sediments by divers showed that there was a small amount of fine, easily suspended material within the matrix of gravel and pebble. Structurally, the bed featured large ripples created by wave action and possibly tidal currents. The lower parts of some risers were not fouled, and this may be the result of abrasion by coarse sediments moved by water currents.

Plate 1: View of a diffuser riser and fouling assemblage, May 2018

Plate 2: Seabed deposits of cobbles, gravel and sands forming undulating peak and depressions around the diffuser position, May 2018

The annual pipeline inspection repeated in February 2021 providing a photographic record of the condition of the pipeline, diffusers, and surrounding seabed during and after a sustained period of sub-optimal discharge quality (Undersea Construction Ltd, 2021). Plates 3 and 4 show the shoreward end of the pipe approximately 30m and 60m from shore. The authors observed that the first 80m of the shoreward section is exposed but beyond that the pipeline is buried under the seabed, except for the risers on the diffuser section at the seaward end.

Plate 5 shows the fouling assemblage on a diffuser riser near the seaward end of the pipeline in February 2021 which appears to be similar to that recorded on a riser in May 2018 (it is not clear whether this is the same riser or an adjacent one), and Plate 6 shows the seabed surrounding a diffuser consisting of cobbles, gravel and sands, which is similar to that recorded in May 2018.

The existence of large ripples in the seabed indicates relatively strong seawater currents capable of transporting sediments away from the diffuser rather than allowing the disposition and accumulation of fine sediment on the seabed. In this type of dispersive receiving environment, the risks associated with an increased contaminant load in the WWTP discharge, such as eutrophication and toxicity, are very much reduced because fine sediment and associated contaminants are not able to accumulate on the seabed.

It is noted that the 2021 pipeline and seabed annual inspection was focused on the physical condition of the pipeline and diffuser and did not include an assessment of the marine ecology. For that reason, the information included in the 2021 report is not sufficient to determine whether ecological changes have occurred compared with the 2018 baseline. Nevertheless, the photographs below suggest that if ecological changes have occurred since 2018, they are likely to be relatively minor.

Plate 3: View of the pipeline 30m from shore, Feb 2021

Plate 4: View of the pipeline 60m from shore, Feb 2021

Plate 5: View of a diffuser riser and fouling assemblage, Feb 2021

Plate 6: Seabed deposits of cobbles, gravel and sands around the diffuser position, Feb 2021.

3.5 Risk to Public Health

Table 3-3 shows that the 95th percentile faecal coliform concentration of the treated wastewater discharge increased by an order of magnitude from 370 cfu/100ml in 2018 to 4,102 cfu/100ml in 2021. Clearly, there is potential for the poorer quality discharge to cause increased faecal indicator bacteria concentrations in coastal waters near the outfall. Predicted faecal coliform concentrations in surface waters after initial dilution during the 2018, 2021/2022, and 2023 years are summarised in Table 3-6.

Table 3-6: Predicted faecal coliform concentration after initial mixing (in surface waters above the diffuser)

Year	Statistic	Wastewater concentration (cfu/100mL)	Background seawater concentration (cfu/100mL)	Minimum dilution (x-fold)	Predicted concentration after initial dilution (cfu/100mL)	Increase (cfu/100mL)
2018	Median	44	2	120	2.4	0.4
	95-percentile	370	2	120	5.1	3.1
	Maximum	800	2	120	8.7	6.7
2021	Median	90	2	120	2.7	0.7
	95-percentile	4,102	2	120	36.2	34.2
	Maximum[1]	322,012	2	120	2,685	2,683
2023	Median	100	2	120	2.82	0.82
	95-percentile	3771	2	120	33.41	31.41
	Maximum	140000	2	120	1168.65	1166.7

[1]The highest faecal coliform value was recorded in 2022

The high-quality wastewater achieved during 2018 is predicted to have caused a negligible increase in receiving water concentrations of faecal coliform bacteria, which would have been barely measurable beyond the 100m mixing zone. The poorer discharge quality in 2020 to 2023 is predicted to have had minimal impact on surface water quality most of the time but might occasionally (for 5% of the time) have caused a receiving water increase of 30 to 40 faecal coliforms per 100 mL, and a rare worst-case increase of 2000 to 3000 per 100mL after initial mixing.

As the discharge plume is carried away from the mixing zone by wind or tide induced currents, faecal indicator bacteria concentrations within the plume are reduced by the combined processes of dilution, dispersion, and die-off, resulting in lower faecal coliform concentrations as the distance from the point of discharge increases.

GWRC and Wellington City Council collect weekly water samples at popular bathing beaches during the bathing season, from 1 November to 31 March. All samples are tested for enterococci which is the faecal indicator bacteria most suitable for use in marine waters. The variations in water quality (i.e., the concentration of enterococci) observed at Breaker Bay, Lyall Bay and Princess Bay for the summers of 2020/2021, 2021/2022, and 2022/2023, are summarised in Table 3-7. The locations of monitoring sites are shown in Figure 3-8. The data for the 2023/2024 summer period was very limited and has not been included in this report. The following summaries and conclusions are therefore based off data gathered until March 2023.

Table 3-7: Summary statistics for enterococci (cfu/100mL) monitoring results at bathing beaches closest to the ocean outfall diffuser (data obtained from WWL)

Site	Distance from outfall diffuser (m)	2020/2021			2021/2022			2022/2023			PNRP
		Nr.	95%ile	% >500	Nr.	95%ile	% >500	Nr.	95%ile	% >500	95%ile
Breaker Bay	4,400	15	22	0	17	23	0	11	98	0	≤500
Lyall Bay (Tirangi)	2,600	29	961	6.9	30	444	6.7	19	188	5.2	
Lyall Bay (Queens Dr)	2,500	11	218	0	31	175	0	11	60	0	

Lyall Bay (Onepu)	2,400	16	173	0	16	129	0	11	34	0	
Princess Bay	1,900	15	64	0	16	26	0	11	4	0	

The Princess Bay bathing beach monitoring site is the closest to the WWTP outfall diffuser, located 1,900 m to the north-west. The three Lyall Bay sites are located 2,400 to 2,600 m north of the outfall diffuser, while the Breaker Bay site is located 4,400 m to the north-east. At Princess Bay the highest enterococci concentration recorded during this period was 80 cfu/100mL on 24 March 2021. The annual 95th percentile values for the 2020/21, 2021/22, and 2022/23 years are 64, 26 and 4 cfu/100mL, respectively, easily achieving the PNRP Objective of ≤500. GWRC gives Princess Bay a ‘long term suitability for swimming grade’ of ‘Good’.

At Breaker Bay the highest enterococci concentration recorded was 120 cfu/100mL on 30 November 2022. The annual 95th percentile values for the 2020/21, 2021/22 and 2022/23 years are 22, 23 and 98 cfu/100mL, respectively, easily achieving the PNRP Objective. GWRC gives Breaker Bay a ‘long term suitability for swimming grade’ of ‘Good’.

There is no indication from routine monitoring data that the Moa Point WWTP discharge from 2020 to 2023 has adversely affected the microbiological water quality at either Princess Bay or Breaker Bay.

The Lyall Bay east monitoring site at Tirangi Road had the poorest water quality of all sites listed in Table 4-1, although a progressive reduction in the 95%ile value is seen over the 2020-2023 summers. The highest enterococci concentration recorded at the Tirangi Road was 2,000 cfu/100mL on 14 July 2021, likely due to a local wastewater network fault or overflow (this site is monitored throughout the year, not just during the bathing season).

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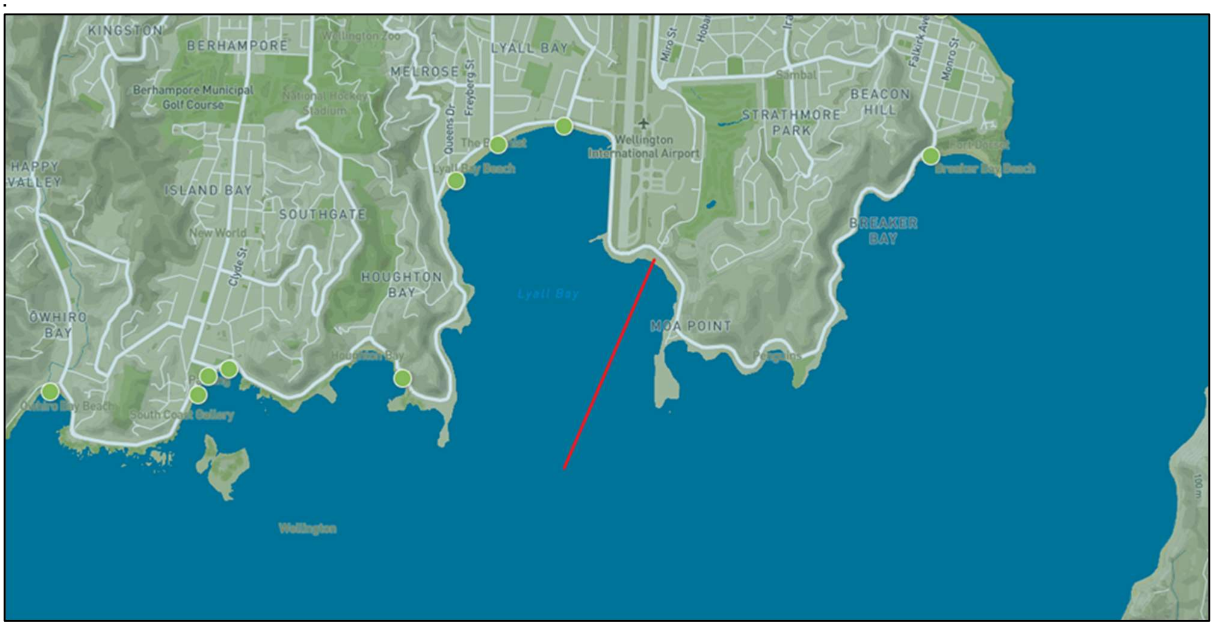

Figure 3-8: Location of bathing beach routine water quality monitoring sites (green dots) and indicative location of Moa Point outfall (red line)

In summary, based on mass balance calculations in combination with the results of routine faecal indicator bacteria monitoring at bathing beaches, the predicted influence of a poorer quality WWTP discharge from 2020/21 to 2022/23 has resulted in a negligible increase in illness risk for those engaged in full contact recreation activities at those locations.

4 Conclusion

The operators of the Moa Point WWTP encountered technical challenges during 2020to 2024 which resulted in a reduced quality of treated wastewater discharged to the CMA, especially in respect of suspended solids, $cBOD_5$, and faecal indicator bacteria. This assessment, based on a review of monitoring data and other readily available information, has reached the following conclusions:

- Increased loads of suspended solids discharged from 2020/21 to 2023/24 might, in the worst case, have formed a visible plume in surface waters over the outfall diffuser when viewed from an elevated position, however for most of the time the plume would have been barely visible.

- The oil & grease content of the discharge remained relatively low and would have been barely discernible in surface waters above the outfall diffuser. The discharge in not likely have produced any scum or foam or objectionable odour in surfaces waters near the diffuser.

- The loads of total metals and total ammonia nitrogen discharged would not have exceeded marine DGV's in receiving waters after initial mixing.

- The information available from annual pipeline condition survey reports, including photographs of the diffuser risers and the surrounding seabed, suggests that if ecological changes have occurred since 2018, they are likely to be relatively minor.

- Increased microbiological loads discharged caused a negligible increase in illness risk for those engaged in full contact recreation activities at Princess Bay, Lyall Bay and Breaker Bay, compared with 2018.

- The long ocean outfall and multiport diffuser have played a critical role in mitigating the adverse effects of poorer quality wastewater by separating the point of discharge from sensitive receptors and by ensuring a high level of initial dilution.

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