PORT MACQUARIE HASTINGS

Drinking Water Management System

Annual Report 2021/22

Port Macquarie-Hastings Council

Date: October 2022

Version: 1.3

Document control

Document: Drinking Water Management System Annual Report
File No: D2022/339121……..
Date: 13 October 2022
Prepared by: [redacted]
Reviewed by: [redacted] (LPHU)
Approved by: Jeffery Sharp

Revision History:

Version	Date	Change made	Person
1	02/09/22	First Draft	[redacted]
1.1	06/09/22	Second Draft	
1.2	07/09/22	Third Draft	
1.3	07/10/22	Final Version	
2	13/10/22	Final Approval	Jeffery Sharp

Executive Summary

The NSW Guidelines for Drinking Water Management Systems (NSW Ministry of Health 2013) provide guidance on the implementation of a Drinking Water Management System, in accordance with the Public Health Act 2010, Public Health Regulation 2012. The NSW Guidelines are based on the Framework for Management of Drinking Water Quality, as outlined in the Australian Drinking Water Guidelines (ADWG 2011).

Port Macquarie-Hastings council manages five (5) water supply systems, supplying drinking water to the region.

This report has been prepared to address the guideline requirements for continuous evaluation and review of Council's Drinking Water Management System (DWMS) and provides an annual review of the performance of its water supply systems, for the reporting period 1 July 2021 to 30 June 2022.

Water quality performance is monitored through operational and laboratory testing. Exceptions in water quality are measured as performance against the Australian Drinking Water Guideline (ADWG) limits and Critical Control Points for each supply system that are based on the ADWG limits.
The table below summarises the water quality performance for all supplies systems council manage.

Supply System	Volume of Water Supplied (ML) and the percentage it accounts for in the entire council supply system	CCP Exceedances	ADWG Exceedances
Port Macquarie - Camden Haven	5164 (81%)	5	14
Wauchope	1115 (18%)	5	2
Comboyne	13.7 (0.22%)	0	0
Long Flat	7.9 (0.12%)	0	0
Telegraph Point	23.9 (0.38%)	0	1

A continuous improvement plan was developed as part of the DWMS and all improvement actions identified during risk assessments as well as subsequent reviews of the DWMS have been documented. Council has continued to implement these improvement actions, with a total of 58 actions completed or ongoing since the last time continuous improvement plant was reviewed in 2014. A total of 24 tasks remain to be implemented, with none of them being classified as a high priority.

Table of Contents

1 Report purpose

This report is designed to address the reporting (Element 10), evaluation (Element 11) and review and continual improvement (Element 12) requirements of the Port Macquarie-Hastings Council Drinking Water Management System (DWMS), as prescribed under The Public Health Act 2010 (NSW 2010). The NSW Guidelines for Drinking Water Management Systems (2013) provide guidance on the implementation of a Drinking Water Management System, in accordance with the Public Health Act 2010 and the Public Health Regulation 2012. The NSW Guidelines are based on the Framework for Management of Drinking Water Quality, as outlined in the Australian Drinking Water Guidelines (ADWG 2011) and any amendments thereafter.

The NSW Guidelines for Drinking Water Management Systems (2013) recommends review of the following areas:

- Performance of critical control points
- Water quality review (raw, treated and distribution water quality including verification monitoring in the NSW Health Drinking Water Database)
- Levels of Service (including consumer complaints)
- Incident and emergencies (including follow up)
- Drinking Water Management System implementation
- Continuous Improvement Plan implementation

Review of system performance are measured against ADWG, levels of service, NSW Water Supply and Sewerage Performance Monitoring Reports and other regulatory requirements (Element 1). Shortcomings are captured in the Improvement Plan (Element 12).

Port Macquarie-Hastings Council has developed this report to provide an annual review of the performance of its water supply systems for the reporting period 01 July 2021 to 30 June 2022. This report addresses the guideline requirements for continuous evaluation and review for Council's DWMS and the water supply systems.

2 Scheme Summary

Port Macquarie-Hasting Council (PMHC) is located on the mid north coast of NSW, covering an area of 3,686 km^2, the area is located adjacent to the Hastings River, the Pacific Highway, the Oxley Highway and the North Coast railway line. The areas major population centre is Port Macquarie, and includes smaller townships such as Wauchope, Camden Haven, Long Flat, Telegraph Point and Comboyne.

PMHC manages a total of five (5) water supplies that supply drinking water to the region - Port Macquarie - Camden Haven, Wauchope, Telegraph Point, Comboyne and Long Flat. There are two (2) major water storage reservoirs that supply the Port Macquarie - Camden Haven region, Port Macquarie Dam and Cowarra Dam. Raw water is pumped from the Hastings River at Koree Island to store, treat and supply residents via Port Dam and Cowarra Dam.

Table 2-1 below provides the summary for Port Macquarie - Camden Haven water supply system. Wauchope, Comboyne, Long Flat and Telegraph Point have their own water supplies which are pumped directly from Hastings River (Koree Island Pump stations), Thone River, Hastings River and Wilson River respectively, and are treated and filtered before being supplied to residents. Table 2-2, 2-3, 2-4 and 2-5 provides the summary of the Wauchope, Comboyne, Long Flat and Telegraph Point supply system respectively.

Table 2-1 Summary of Port Macquarie - Camden Haven Water Supply System

Water supply system name	Port Macquarie-Camden Haven Water Supply
Water source	Hastings River (Through Koree Island Pump Station 2 & 3), water transferred to and stored in Port Dam and Cowarra Dam where it is pumped into the Port Macquarie, Bonny Hills, Kew, Kendall and Camden Haven reticulation systems.
Treatment unit processes	Lime and CO2 dosing for increasing alkalinity & pH correction, Hypochlorite disinfection (at Wauchope Treatment Plant & Port Macquarie Dam), Fluoride Dosing.
Treatment capacity (ML/day)	100 ML/day
Towns supplied	Port Macquarie, Bonny Hills, Lake Cathie, Camden Haven
System upgrades/improvements	None (Council has commenced the concept design for the Cowarra Water Treatment Plant, that will supply filtered water to the Port Macquarie - Camden Haven Water supply system. It is due to be operational by 2027)

Table 2-2 Summary of Wauchope Water Supply System

Water supply system name	Wauchope Water Supply
Water source	Hastings River (Through Koree Island Pump Station 2 & 3)
Treatment unit processes	Lime and CO2 dosing for increasing alkalinity & pH correction, Hypochlorite disinfection, Fluoride Dosing, Ultrafiltration
Treatment capacity (ML/day)	21 ML/day
Towns supplied	Wauchope, Beechwood, Sancrox, King Creek, Thrumster
System upgrades/improvements	Upgrade from 6 to 21ML/day capacity with the construction of an additional two filtration trains. (Council is in the last stages of concept design for an upgraded chlorination system, converting from Sodium Hypochlorite to Chlorine Gas, due to be completed in 2023)

Table 2-3 Summary of Comboyne Water Supply System

Water supply system name	Comboyne Water Supply
Water source	Thone River
Treatment unit processes	Lime and CO2 dosing for increasing alkalinity & pH correction, Hypochlorite disinfection and Ultrafiltration
Treatment capacity (ML/day)	0.4 ML/day
Towns supplied	Comboyne
System upgrades/improvements	Ultrafiltration membrane are due to be replaced in 2023, as part of a three (3) year program to replace all membranes for council's water treatment plants.

Table 2-4 Summary of Long Flat Water Supply System

Water supply system name	Long Flat Water Supply
Water source	Hastings River
Treatment unit processes	Lime and CO2 dosing for increasing alkalinity & pH correction, Hypochlorite disinfection and Ultrafiltration
Treatment capacity (ML/day)	0.3 ML/day
Towns supplied	Long Flat
System upgrades/improvements	Ultrafiltration membrane are due to be replaced in 2023, as part of a 3 year program to replace all membranes for councils water treatment plants.

Table 2-5 Summary of Telegraph Point Water Supply System

Water supply system name	Telegraph Point Water Supply
Water source	Wilson River
Treatment unit processes	Lime and CO2 dosing for increasing alkalinity & pH correction, Hypochlorite disinfection and Ultrafiltration
Treatment capacity (ML/day)	1 ML/day
Towns supplied	Telegraph Point
System upgrades/improvements	The membranes at Telegraph Point were initially replaced with used membranes and will be replaced with new membranes in 2023, as part of a 3-year program to replace all membranes for our water treatment plants. The membranes became fouled due to continued extraction during high rainfall events, and needed replacement prior to approval to tender for the replacement program. Council were able to use membranes from the Wauchope WTP that were planned to be replaced as part of this program, and not currently used due to the capacity upgrade for Wauchope.

3 DWMS Document Review

Table 3-1Summary of revisions of the Drinking Water Management System

Document	Version	Updates	Submitted to NSW Health and date submitted?
DWMS	1.0	June 2021 updated incorporating structure change	October 2021 at MOU Meeting
CCP Procedures	3.0	June 2021 - review as listed in section 4	October 2021 at MOU Meeting
Implementation Plan (continuous improvement plan)	0.5	September 2022	September 2022 in Annual Report
Risk Assessment	0.4	None	

4 Critical Control Points

A Critical Control Point (CCP) is defined as an “activity, procedure or process at which control can be applied, and which is essential to prevent a hazard or reduce it to an acceptable level” (NSW Ministry of Health 2013). These may be processes such as selective abstraction of raw water, filtration, disinfection or reservoir integrity. For each CCP, a parameter, such as chlorine residual, can be measured to verify the effectiveness of the process or identify when corrective action is required.

Target, alert, shutdown and critical limits are determined for each CCP parameter to identify normal and outside of normal operational conditions. The target limit identifies the normal operational conditions, the alert limit indicates that the parameter is outside the normal conditions and corrective action may be required, and the critical limit, if exceeded, indicates that process control has been lost and safe water quality can no longer be guaranteed. The shutdown limit was recently added to give an indication to operators in consultation with supervisors to be able to shut down certain functions of the system if deemed appropriate.

Operators sample and test the pre and post treated water for all of Councils water supplies, for monitoring CCP parameters and operational performance. Monitoring includes sample collection and analysis using laboratory and field instruments and real-time monitoring using online instrumentation. Council Clear SCADA system also enables operators to remotely monitor the treatment plants and online instrumentation. Where online probes are used for monitoring, laboratory tests, calibration and routine maintenance are undertaken to ensure the online probes are reading correctly.

Operational data is stored in Water Outlook and is accessible at all times to the operators, supervisor and manager. Water Outlook has installed dashboards for visual monitoring of CCP’s through graphs and traffic light warnings. If monitoring data (from both SCADA and Water Outlook) triggers the alert or critical limits for the CCP, the operators undertake corrective actions, as indicated in their CCP procedures, and in consultation with their supervisor. Operators also report these exceptions in Water Outlook using the Incident Report System. The Incident Report provides a record of the reason for the exceptions, the corrective actions undertaken and whether any further actions are required to reduce the likelihood of this exception occurring again.

Summary tables of the CCP’S for each supply systems are shown in Appendix A. Changes to Critical Control Points are summarized in table 4-1 below.

Table 4-1 Summary of CCP Changes

Supply System	CCP Numbers	Changes
Port Macquarie - Camden Haven Supply System	CCP2, CCP3, CCP4	Include winter and summer targets for Chlorine residual levels for the operating target as well as adjustment and shutdown limits
Wauchope Supply System	CCP3	Include winter and summer targets for Chlorine residual levels for the operating target as well as adjustment and shutdown limits
Comboyne Supply System	CCP2	Include winter and summer targets for Chlorine residual levels for the operating target as well as adjustment and shutdown limits

4.1 CCP Performance

Port Macquarie Hastings Council maintains a monitoring system of critical control points (CCP) which includes online analysers as well as physical samples monitoring. Water quality data taken from physical test of samples and online analysers are captured in water outlook where operators can monitor for any CCP exceedances. Critical limit exceedances are summarised for each supply systems in the following sections. CCP trends that have exceedances are shown in Appendix B, CCP trends that contains no exceedances are omitted due to a large number of data points across the entire supply system.

4.1.1 CCP exceedances for Port Macquarie - Camden Haven Supply System

The Port Macquarie - Camden Haven water supply draws its water from the Hastings River through Koree Island pumps stations 2 and 3 via Port Dam and Cowarra Dam. During periods of heavy rains in the summer, CCP exceedances (>30NTU) at our Koree Island Pump stations are common and during this period the pumps are shut down and raw water is not drawn from the Hastings River, to make sure our water quality in the Dams are not compromised. A Graph of CCP trends for raw water turbidity at Koree Island pump station is provided in Appendix B Graph B.1. Due to a large number of exceedances they will not be included in the summary table 4-2 of exceedances for the Port Macquarie - Camden Haven supply system.

Table 4-2 below provides summary of CCP exceedances for Port Macquarie - Camden Haven supply system. There are numerous CCP exceedances for turbidity at reservoirs where the critical limit is 2 NTU and these have not been provided in this table. All individual exceedances of 2NTU in this system's reservoirs have been summarised in Appendix C, Table C.1 and the turbidity trends at these reservoirs are shown in Appendix B. All turbidity exceedances of >5NTU are provided in table 4-2 below.

The Port Macquarie - Camden Haven water supply system is an unfiltered supply system. The unfiltered water at times does exceed best practice of 2 NTU for turbidity. In the process of reviewing the Reservoir CCP exceedances, Council has discovered that the critical limit of 2 NTU for reservoirs in this particular supply system is incorrect. This critical limit should mimic the critical limit of 5 NTU for Dam extraction and the distribution networks, which is also the limit in the ADWG. Council will seek NSW Health approval to change this CCP, to ensure the Target, Adjustment, Operational and Critical Limits mimic the other CCP's for this scheme.

Graphs of turbidity versus cryptosporidium over the last 5 years' period for both the Port Macquarie Dam and Cowarra Dam have been provided in Appendix D. (graphs D.21 and D.22). These graphs demonstrate that over this 5 year period, there was only one detection of Cryptosporidium in the Port Macquarie Dam and none in the Cowarra Dam. During this period both dams experienced higher periods of turbidity when the dams were low and then filled following the 2019 drought. Outside of these fill periods, the turbidity averages around 1 to 1.5 NTU in each Dam.

Council does have a population of deer living around the Port Macquarie Dam, and Local Land Services conducts continuous deer reduction program around the Dam, to manage the risks of contamination from deer.

This data demonstrates that the risk of cryptosporidium contamination is low, despite higher levels of turbidity at times in Councils catchments and reticulation systems. Increasing the turbidity limit to 5 NTU for the reservoirs, to match the other critical limits for this system, should not increase the risk for Cryptosporidium.

The fluoride levels in the Port Macquarie reticulation system are consistently low throughout the reporting period (below the critical limit minimum threshold of 0.9mg/L). Graph B.3 in Appendix B provides a trend of one sample location in our reticulation for the past 12 months.

Water transferred to Cowarra and Port Macquarie Dams contains fluoride that is added to a concentration of 1mg per litre. Until the entire storage area reaches this concentration, the large volume of water in storage at each dam dilutes the fluoride concentration levels to below the required level of 1mg per litre.

In 2019, in consultation with NSW Health, Council paused fluoride dosing when the severe drought resulted in council not being able to draw water from the Hastings River as normal. Fluoride dosing was removed from the usual control sequence as dam levels dropped in order to maximise available extraction opportunities. The pause on fluoride dosing also coincided with a review of environmental considerations around open water storage dams and water distribution network.

Since the drought, Council have replenished our dam levels, but this pause in fluoride dosing for the bulk supply has meant the level of fluoride in the dams has been significantly diluted. Council recommenced fluoride dosing directly to the Wauchope water supply in April 2021. Fluoridation of the Hastings bulk water supply recommenced in September 2021. Fluoride is dosed into the raw water that is pumped to the inlet of the Port Macquarie and Cowarra Dam. Previously it took Council approximately 10 years to reach a fluoride level of 0.8 mg/L in Cowarra Dam, as it is a large storage, and hence, has a low turnover of water. It is anticipated that it will again take up to 10 years for the Cowarra Dam water to reach the required1 mg/L of fluoride in the stored water.

The Port Macquarie Dam is much smaller than Cowarra Dam and hence turns over water supply at a much quicker rate than Cowarra Dam. When the Port Macquarie Dam is filled directly from the Kooree pumps (Hasting River) it is able to build up the levels of fluoride at a quicker rate. Unfortunately, there are times when we have to pump to Port Macquarie Dam from Cowarra Dam, when the river conditions do not allow extraction. Filling from Cowarra Dam then dilutes the level of fluoride in the Port Macquarie Dam. This will continue to inhibit Councils ability to achieve a level of 1 mg/l in the Port Macquarie Dam.

Table 4-2 Summary of CCP exceedances for Port Macquarie- Camden Haven Supply System

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value	Reason	Immediate Corrective Action	Preventive Action
Port Macquarie	21/06/22	CL (Critical Limit)	Port Base Hospital Distribution Network Sampling	Turbidity	>2NTU	9.6	Fire Service testing near this sample point	Flushing of water mains to reduce turbidity	Council has commenced the design of a water treatment plant to provide filtered water to the Port Macquarie - Camden Haven supply, due to commence supply in 2027. Council also conducts an ongoing mains cleaning and replacement program.
Camden Haven	9/09/2021	CL (Critical Limit)	Kendall Reservoir	Turbidity	>2NTU	5.99	Water main break at bridge across to Kendall	Flushing of reticulation networks	Council has commenced the design of a water treatment plant to provide filtered water to the Port Macquarie - Camden Haven supply, due to commence supply in 2027. Council also conducts an ongoing mains cleaning and replacement program.
Camden Haven	9/09/2021	CL (Critical Limit)	Kendall Reservoir	Turbidity	>2NTU	8.62	Water main break at bridge across to Kendall	Flushing of reticulation networks	Council has commenced the design of a water treatment plant to provide filtered water to the Port Macquarie - Camden Haven supply, due to commence supply in 2027. Council also conducts an ongoing mains cleaning and replacement program.
Camden Haven	11/09/2021	CL (Critical Limit)	Kendall Reservoir	Turbidity	>2NTU	6.89	Water main break at bridge across to Kendall	Flushing of reticulation networks	Council has commenced the design of a water treatment plant to provide filtered water to the Port Macquarie - Camden Haven supply, due to commence supply in 2027. Council also conducts an ongoing mains cleaning and replacement program.
Camden Haven	13/09/2021	CL (Critical Limit)	Kendall Reservoir	Turbidity	>2NTU	3.7	Water main break at bridge across to Kendall	Flushing of reticulation networks	Council has commenced the design of a water treatment plant to provide filtered water to the Port Macquarie - Camden Haven supply, due to commence supply in 2027. Council also conducts an ongoing mains cleaning and replacement program.

4.1.2 CCP exceedances for Wauchope Supply System

The Wauchope supply system encountered the same exceedances as the Port Macquarie - Camden Haven system with regards to high turbidity in raw water, as it has the same water source (Hastings River through Koree Island Pump Station 2 & 3). This was during periods of heavy rain over the summer of this reporting period. Refer to Appendix B Graph B.1 for the raw water turbidity level. During periods of high turbidity (above 30NTU) Koree Island Pump Stations are shut off. Due to a large number of exceedances they will not be included in the summary table 4-3 of exceedances for the Wauchope supply system. The table 4-3 below shows the CCP exceedances for the Wauchope Water supply system.

Table 4-3 Summary of CCP exceedances for Wauchope Supply System

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value	Reason	Immediate Corrective Action	Preventive Action
Wauchope	14/09/21 - 19/09/21	CL (Critical Limit)	Rosewood Resevoir 1	Fluoride levels	<0.9mg/L for 24 hours or ≥1.5	<0.9mg/L, Shown on Graph in appendix B graph B.2	In September council conducted cleaning procedures of the fluoride dosing system where we pumped raw water into the fluoride storage tank and diluting the concentration of the fluoride solution by 50%. The dosing rate is not adjusted as it is too complicated and thus the fluoride level drops in water to about 50% of the target concentration.	Reported to LPHU and commence dosing immediately following works	N/A
Wauchope	02/03/22 - 18/04/22	CL (Critical Limit)	Rosewood Reservoir 1	Fluoride levels	<0.9mg/L for 24 hours or ≥1.5	<0.9mg/L, Shown on Graph in appendix B graph B.2	From March to April 2022 there are two dips in the level of fluoride in Rosewood 1 reservoir. This is because during this time due to heavy rain events the turbidity at koree Island was extremely high (above 30NTU) for large parts of the 2 months. During this time Council was required to backfeed from Cowarra Dam where the water has low fluoride levels and this leads to a drop in concentration levels of the fluoride.	Reported to LPHU	N/A
Wauchope	24/06/22 onwards	CL (Critical Limit)	Rosewood Reservoir 1	Fluoride levels	<0.9mg/L for 24 hours or ≥1.5	<0.9mg/L, Shown on Graph in appendix B graph B.2	The Koree 2 Rising Main Flowmeter was faulty and as such we were unable to dose fluoride until the flowmeter was replaced.	Reported to LPHU	Improve preventative maintenance procedure
Wauchope	01/12/2021	CL (Critical Limit)	Beechwood Reservoir	Chlorine Residual	<0.2mg/L or >5mg/L	0.07mg/L	Beechwood Reservoir is at the end of the water main from Wauchope Treatment Plant which feeds numerous private residences before reaching the reservoir. As such it is expected that the chlorine residual level will be lower in the reservoir than in the reticulation which had a minimum CL residual level of 0.83mg/L during the year.	Sodium Hypochlorite pills are added into the reservoir	Supply scheme is being upgraded, new mains constructed to supply directly from WTP without needing Beechwood reservoir
Wauchope	09/12/2021	CL (Critical Limit)	Beechwood Reservoir	Chlorine Residual	<0.2mg/L or >5mg/L	0.17mg/L	Beechwood Reservoir is at the end of the water main from Wauchope Treatment Plant which feeds numerous private residences before reaching the reservoir. As such it is expected that the chlorine residual level will be lower in the reservoir than in the reticulation which had a minimum CL residual level of 0.83mg/L during the year.	Sodium Hypochlorite pills are added into the reservoir	

4.1.3 CCP exceedances for Comboyne Supply System

There were no CCP exceedances the for Comboyne water supply system. This water supply system is not fluoridated.

4.1.4 CCP exceedances for Long Flats Supply System

There were no CCP exceedances for the Long Flat water supply system. This water supply system is not fluoridated

4.1.5 CCP exceedances for Telegraph Point Water Supply System

There were no CCP exceedances for the Long Flat water supply system. This water supply system is not fluoridated

5 ADWG Water Quality

The Australian Drinking Water Guidelines (NHMRC 2011) provide an authoritative reference that defines what is safe and good water quality and how this can be achieved and assured, using the latest and best available scientific evidence. The ADWG provide detailed information on the measurable characteristics of drinking water, including microbiological, physical and chemical aspects, and these are grouped into two different guidelines:

- A health guideline value – which is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption;
- An aesthetic guideline value – which is the concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, such as, appearance, taste and odour.

Reticulation monitoring is undertaken on a routine basis to ensure that Councils customers receive safe and acceptable water quality, which complies with the Australian Drinking Water Guidelines (ADWG) guideline limits. Council's Water Process Operators collect samples from each water supply reticulation system and these are sent to the Port Macquarie Hastings Environmental Laboratory. Additional chemical samples are also taken by the operators and these are sent to the NSW Health Laboratory (FASS). Samples from both laboratories are entered into NSW Health Laboratory Testing Database. Chemical sample test results from NSW Health Laboratory are shown in appendix E.

Trends of water quality results are shown in Appendix D for reference, due to the large set of data from more than 50 sample points across the entire water supply system, certain trends of water quality characteristic that are within the health and aesthetic guidelines have not be shown and only those that have exceeded the guideline values have been presented.

5.1 Data Collection

Raw water, treated water and reticulated water samples are collected from numerous sites around the five (5) water supply networks. The reticulated samples are used for monitoring compliance against the ADWG. A summary of non-compliant data for each supply system is provided in section 5.2. Turbidity is monitored in accordance with Councils CCP's, so exceedances for these are not included in this section.

5.2 Non-compliant data

The sections below provide a summary of the non-compliant data for each supply system.

5.2.1 Summary of non-compliant data for the Port Macquarie - Camden Haven system

There are 24 sample sites in the reticulation network in Port Macquarie and 18 sample sites in the reticulation in the Camden Haven area. There were a total of five (5) exceedances for Total Coliforms and 9 exceedances for pH, with a total of 14 exceedances for this system. A summary of non-complaint water quality is shown in the table 5-1 below.

Council also collects 12 samples per year that are sent to the NSW Health Laboratory for detailed chemical analysis. There were no exceedances of the ADWG for any of the chemical parameters tested, with 100% compliance with the ADWG requirements.

Table 5-1 Summary of Non-Complaint Water Quality for Port Macquarie - Camden Haven System

Date	Location	Parameter	ADWG Limit	Unit	WQ Value
26/07/2021	Lakewood SPS 13	Total Coliforms	0	MPN/100ml	1
5/01/2022	Chestnut Road (SPS18)	Total Coliforms	0	MPN/100ml	1
8/03/2022	Green Meadows (SPS 72)	Total Coliforms	0	MPN/100ml	2
4/04/2022	Seawind Chase (SPS 13)	Total Coliforms	0	MPN/100ml	201
7/12/2021	Ascot Park	Total Coliforms	0	MPN/100ml	1
18/10/2021	Herons Creek	pH	6.5 - 8.5		8.56
17/01/2022	Kew - Visitor Info Centre	pH	6.5 - 8.5		8.79
7/02/2022	Herons Creek	pH	6.5 - 8.5		8.79
7/02/2022	Seawind Chase (SPS 13)	pH	6.5 - 8.5		8.6
14/02/2022	Kew - Visitor Info Centre	pH	6.5 - 8.5		8.57
17/05/2022	Lady Nelson Drive (SPS 29)	pH	6.5 - 8.5		8.51
6/06/2022	Kew - Visitor Info Centre	pH	6.5 - 8.5		8.51
7/06/2022	St Columba School	pH	6.5 - 8.5		8.75
27/06/2022	Lakewood SPS 13	pH	6.5 - 8.5		8.67

5.2.2 Summary of non-compliant data for the Wauchope system

There are 11 sample sites in the reticulation network for the Wauchope Water supply. There were two (2) non-compliant results for the Wauchope Water Supply. A summary of non-complaint water quality is shown in the table 5-2 below.

Council also collects 12 samples per year that are sent to the NSW Health Laboratory for detailed chemical analysis. There were no exceedances of the ADWG for any of the chemical parameters tested, with 100% compliance with the ADWG requirements.

Table 5-2 Summary of Non-Complaint Water Quality for Wauchope Supply System

Date	Location	Parameter	ADWG Limit	Unit	WQ Value
21/07/21	Sarah's Creek	Total Coliforms	-	MPN/100ml	15
14/12/2021	River Breeze Estate	Free Chlorine	0.2 - 5	mg/L	0.19

5.2.3 Summary of non-compliant data for the Long Flats system

There is a single (1) sample site in the reticulation network for the Long Flat Water supply. Samples from this site are collected fortnightly. There were no non-compliant results from this water supply system.

Council also collects two (2) samples per year that are sent to the NSW Health Laboratory for chemical analysis. There were no exceedances of the ADWG for any of the chemical parameters tested, with 100% compliance with the ADWG requirements.

5.2.4 Summary of non-compliant data for the Comboyne system

There is a single (1) sample site in the reticulation network for the Comboyne Water supply. Samples from this site are collected fortnightly. There were no non-compliant samples from this water supply system.

Council also collects two (2) samples per year that are sent to the NSW Health Laboratory for chemical analysis. There were no exceedances of the ADWG for any of the chemical parameters, with 100% compliance with the ADWG requirements.

5.2.5 Summary of non-compliant data for the Telegraph Point system

There is a single (1) sample site in the reticulation network for the Telegraph Point Water supply. Samples from this site are collected weekly. There was one (1) non-compliant samples from this water supply system. Summary of non-complaint water quality is shown in the table 5-3 below.

Council also collects two (2) samples per year that are sent to the NSW Health Laboratory for chemical analysis. There were no exceedances of the ADWG for any of the chemical parameters tested, with 100% compliance with the ADWG requirements.

Table 5-3 Summary of Non-Complaint Water Quality for Telegraph Point Supply System

Date	Location	Parameter	ADWG Limit	Unit	WQ Value
30/03/2022	Telegraph Point School Tap	Total Coliforms	-	MPN/100ml	27

5.3 Water Quality Discussion

The Port Macquarie-Camden Haven water supply is an unfiltered water supply. The unfiltered water at times will exceed best practice of 2 NTU for turbidity and the ADWG guidelines of 5 NTU. Sediment can accumulate over time in the reticulation system and this is managed by regular flushing and cleaning of the mains. Increased turbidity can also impact the effectiveness of chlorine, turbidity levels above 1 NTU and at times if chlorine residual is low in the reticulation, we may detect total coliforms. Total Coliforms do not have a health limit in the ADWG, however normal practice is for Council to re-sample and implement flushing if there are two samples that detect the presence of Total Coliforms.

The majority of the samples that have detected Total coliforms are collected in the Port Macquarie-Camden Haven scheme are at Sewer Pump Stations. There is an increased risk of contamination of the sample at these locations due to the environment. It is recommended that staff review the procedures for sampling to

ensure extra care is taken when sampling in these locations. Council will also consider setting up a separate sample point in these locations that can be covered, to prevent contamination or alternatively finding an alternative sample location. In addition, if well washers are not installed at these SPS, then water use can be very low and this could cause increased pH, low chlorine and bacterial growth in the pipework as the water ages. On 4 April 2022 Council had a high total coliform count of 201. There was no detection of *E. coli* and re-sampling detected no Total Coliforms.

In Wauchope and Telegraph point, there was one (1) total coliform detection of 15MPN/100ml and 27 MPN/100ml respectively. There was no detection of *E. coli* and re-sampling detected no Total Coliforms. Both sample sites are in a location where there is a long detention time in the reticulation, potentially impacting the chlorine levels and increasing the risk of detecting Total Toliforms.

The high pH in the reticulation are generally in areas that are at the end points of the reticulation network and low use sites. the high pH incidences in the Camden Haven areas are due to the long retention times of the water as it travels down to the Camden Haven area. The pH of the water will increase as it ages and can also increase due to the extraction of calcium from cement lined pipework and reservoirs. High pH is managed through flushing to increase turnover of the water supply at that point. The council has also planned a construction of the Southern Arm Truck trunk main which is expected to be completed in 2024 and this will reduce the travel time for drinking water to the Camden Haven area and hopefully reduce the water age and hence higher pH experienced in the reticulation.

Further investigations were undertaken to see determine the efficiency of chlorine disinfection process in these high pH sample sites. An analysis of free chlorine versus total chlorine data is provided in Graphs in Appendix D. The graphs show that free chlorine levels are only slightly lower than total chlorine, averaging around 6.5% lower, and that the concentration of free chlorine residual is always higher than 0.05mg/l (councils minimum critical limit for free chlorine residual in reticulation) which suggests that the effectiveness of chlorine to disinfect is not compromised.

The single detect of low chlorine in the Wauchope supply was just below the ADWG, and there was no continued trend for low chlorine. For this reason, no action was required.

5.4 Algae Monitoring in Dams

Cyanobacteria, Methylisoborneol (MIB) and Geosmin (MIB and Geosmin are naturally occurring compounds that have an earthy taste and odour) samples are collected by Council on a weekly basis, in both the Port Macquarie and Cowarra Dams. Council utilises an alert level freamework as documented in *WQRA Research Report 74: Management Strategies for Cyanobacteria (blue-green algae) - A Guide for Water Utilities for the management of cyanobacteria in the Dams*. Samples are sent to the Port Macquarie Hastings Environmental Laboratory, for analysis.

The identification of the cyanobacteria species is important as it enables a targeted response and a more accurate assessment of the potential toxicity. If toxin tests are deemed necessary the sample will be sent by PMHC Environmental Laboratory to another laboratory, for analysis. Toxin testing may be done on both raw and treated water samples.

Operationally it is difficult for Council to respond to the cyanobacteria blooms as there is no means to bypass the Dams, given the system is an unfiltered supply. Toxin monitoring and taste and odour monitoring are key to the management of algae blooms, with the ability to notify our customers of the issues when required.

Biovolume results indicates that cyanobacteria levels were mostly within the Below alert level and Detection Level (Low Alert) levels for both the Port Macquarie and Cowarra Dam. There were a number of short periods during the past 12 months where levels spiked into the Alert Level 1, however these were short and at low levels below 0.4mm3/L for both Dams. There were only a few complaints for Taste and odour and no concerns with Geosmin or MIB levels were noted through the testing.

A number of graphs showing cyanobacterial cell numbers and Bio Volume in the Port Macquarie and Cowarra Dam are included in Appendix D.

6 Customer Complaints

Customer Complaints are received by Council's Customer Service section. Customer complaints are recorded and saved on the Customer Request Management system which automatically notifies the water operator/technical officer who delegates responsibilities as appropriate. Where appropriate, a Water Operator will contact the customer, attend the location, undertake sampling and testing and provide feedback to the customer on the results. The operator will then coordinate a response to these results as appropriate to ensure that the drinking water continues to meet the ADWG guidelines.

The table below 6-1 shows the summary of the complaints for the reporting period

Table 6-1 Summary of Complaints for the Reporting Period

Supply System	Dirty	Air or Cloudy	Taste & Odour	Illness	Leaks	Loss of supply	other	Annual Total
Port Macquarie/Camden Haven	137	2	5	2	11	29	52	238
Wauchope	4	0	0	0	3	1	7	15
Comboyne	1	0	0	0	0	0	0	1
Telegraph Point	0	0	0	0	0	0	0	0
Long Flats	0	0	0	0	0	0	0	0

Council experienced a total of 142 complaints for dirty water during the reporting period which accounts for majority of the complaints. Investigations were carried out for every complaint. Out of all the complaints for dirty water, around 75% were due to reasons unknown and the issue seems to resolve itself after a period of flushing of the mains. Around 8% and 15% were due to internal plumbing, scheduled maintenance issues and following the mains cleaning program

Most of the dirty water and taste and odour complaints were from the Port Macquarie - Camden Haven supply system which is an unfiltered supply. The unfiltered water at times will exceed best practice of 2 NTU for turbidity and the ADWG guidelines of 5 NTU. Sediment can accumulate over time in the reticulation system and this is managed by regular flushing and cleaning of the mains

There were a number of other isolated water enquiries that were recorded that did not indicate any wider issues in the reticulation system. These included enquiries about loss of supply, low pressure, issues with water meter readings. faulty mains and sink holes and other water quality issues. On all occasions, testing indicated that the water complied with the ADWG. On a couple of occasions, the causes were determined to be internal plumbing issues. Council also received two (2) complaints regarding the Port Macquarie Water Supply system not being fluoridated.

7 Water Quality Incidents or Emergency

A water quality incident or emergency, is an event where a controlled response is required to ensure that Council continues to protect public health. Although preventative strategies, such as CCP procedures, have been developed by Council, some events cannot be anticipated or controlled. These events need a managed response to ensure the incident is responded to adequately, investigated following the event, and preventative actions are implemented to reduce the risk of the event re-occurring.

Water quality incidents are recorded in water outlook which automatically notifies supervisors to allow the investigation to commence. Table 7-1 below provides a summary of water incidents in the reporting period

Table 7-1 Summary of Incidents Recorded in the Reporting Period

Details of incident/emergency	Investigation recommendations	Preventive action undertaken
High Turbidity for samples from Port Base Hospital in Port Macquarie	Hospital maintenance team was contacted, reasons for high turbidity are due to annual fire system tests that were performed on the day as well as the day before. Reservoir and dosing system is checked and everything is fine	Immediate flushing of the mains

8 Staff Development and Training

The council's water infrastructure department includes the operations as well as the planning team. The operations team is comprised of well-trained water operators in the process, maintenance and construction team and the planning team includes qualified engineers in the process and hydraulics team. Out of all the staff that are currently involved in the water team, which adds up to more than 30 people, around 70% have Cert II or Cert III in water operations, which they obtained in 2021.

Council employs seven (7) water treatment operators and two (2) supporting trades staff whom are qualified for fluoride dosing. Table 8-1 below shows the list of council staff whom have fluoride dosing qualifications. Council has four (4) further supporting trades staff in the process of completing the qualification

Table 8-1 Present Qualified Fluoride Operators

Water Treatment Operators	Mechanical Fitters	Electrical / Telemetry
[redacted]	[redacted]	[redacted]

9 Continuous Improvement Plan

Council's Improvement Plan (IP) was developed as part of the DWMS to document the improvement actions identified during the detailed risk assessment of the drinking water supplies. The Improvement Plan encompasses Element 12 of the DWMS and demonstrates Council's commitment to continual improvement of its water supply services from a quality and safety perspective.

The IP has been reviewed as part of the development of this Annual report, however prior to this it was last reviewed in 2017. From the 2022 review there were in total there were 82 action items, of these 58 have been completed or removed (closed), and a total of 24 remain either incomplete or ongoing since 2012, with none of them being classified as high priority. The review in 2022 identified a total of 11 actions that were completed and 1 action that was no longer required to be undertaken. A number of the actions in the IP date back to 2012 and appear to be out of date. Council will complete an external review of the DWMS Risk Assessment and it is recommended that some of the actions in the IP are to be reviewed as part of the Risk Assessment Review. As a result of this report investigation Council have also added four more action items (items ID are 087,088,089 and 090) into the IP in Appendix F.

A summary of the ongoing actions in the DWMS Implementation Plan has been included in Appendix F. The updated plan indicates the status of tasks and comments on the progress. It also indicates the dates where tasks have been added and references the reason for the tasks addition to or removal from the plan.

10 Review of DWMS Implementation

An internal review of the DWMS was undertaken in June 2021. This included a review of the DWMS, CCP, and the regulatory and stakeholder registers. No external review of the DWMS of the Risk Register has been undertaken since 2016. This will be undertaken in 2023, as part of Council regulatory requirements. The Improvement Plan has been reviewed internally in June 2022. A number of actions that have not been completed are to be reviewed during the risk register review to determine whether they are still appropriate.

11 Reservoir Inspections

Reservoir integrity is included as a critical control point for each of Council's water supplies, as this is the last point of contact with the water, prior to distribution. Maintaining reservoir integrity is critical to a water supply system, to ensure that no contaminants, such as vermin, stormwater and bird faeces, can freely access the stored water. Cleaning and inspection of the reservoirs are crucial to ensuring the water quality is not contaminated or sediments are not disturbed.

Monthly inspections if each reservoir are undertaken by operational staff and results are recorded in water outlook, which automatically notifies Headwork's Technical Officer whom delegates tasks to appropriate people. Due to the large amount of data captured from the inspections only issues are captured in appendix G, inspections that pass will be omitted. The council also source the service of external contractors to inspect integrity of reservoirs however the latest round of external contractor's inspection was conducted prior to this reporting period and as such will not be captured in this report.

Table G-1 in Appendix G shows the issues that was raised from reservoir inspection and the corrective actions taken.

In the process of reviewing the reservoir inspections for this report, council has identified some problems with keeping track of issues that have been rectified or still needs to be attended to. Therefore, the reporting structure on water outlook will be modified to allow for a "repairs undertaken" section, this will enable better tracking of outstanding repair works and those that are closed off.

The summary of the reservoir inspections for this reporting period is provided in Appendix G. The main integrity issues that have been identified and fixed include security issues with fencing and gates, holes in bird proofing, vegetation clearing and roof replacement required. Where required the issues have been identified for capital works forward programming for example Widderson Reservoir roof is part of the upcoming capital works program.

12 References

NHMRC (2011) *Australian Drinking Water Guidelines,* National Water Quality Management Strategy, National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

NSW Ministry of Health (2013), *NSW Guidelines for Drinking Water Management Systems*, NSW Ministry of Health, 2013

NSW Government (2010), *Public Health Act 2010,* NSW Government Parliamentary Counsel's Office.

NSW Government (2012), *Public Health Regulation 2012,* NSW Government Parliamentary Counsel's Office

Water Directorate (2014), *Blue-Green Algae Management Protocols 2014,* Water Directorate, 2014

WQRA Research Report 74: *Management Strategies for Cyanobacteria (blue-green algae): a Guide for Water Utilities*

Appendix A Summary of CCP's for each supply systems

A.1 Port Macquarie - Camden Haven Water Supply System

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Operating Target	Adjustment Limit	Shutdown Limit	Critical Limit
Port Macquarie - Camden Haven Water Supply	CCP1	Koree Island Water Extraction	All Pthogens	Turbidity	<5 NTU	>5 - <10 NTU	>10 NTU	≥20 NTU
	CCP1	Koree Island Water Extraction	Nitrogen Levels	TN	<0.3 mg/L TN	>0.3 mg/L TN		≥0.3 mg/L TN
	CCP1	Koree Island Water Extraction	Phosphorous Levels	TP	<30 µg/L TP		≥30 µg/L TP	≥30 µg/L TP
	CCP1	Koree Island Water Extraction	Algal Growth, taste and odour organisms, toxins	Cyanobacteria	No filamentous cyanobacteria detected	No filamentous cyanobacteria detected	Filamentous cyanobacteria detected	Filamentous cyanobacteria detected
	CCP1	Port Macquarie Dam Water Extraction	All Pathogens	Turbidity	<2 NTU	>2 - <4 NTU	≥4 NTU	≥5 NTU
	CCP1	Port Macquarie Dam Water Extraction	Faecal Contamination	Total Coliforms + E. coli	E. coli < 1/100mL Total coliforms < 100MPN/100mL	E. coli < 5/100mL Total Coliforms < 500MPN/100mL	E. coli > 5/100mL Total Coliforms > 500MPN/100mL	E. coli ≥ 5/100mL Total Coliforms ≥ 1000MPN/100mL
	CCP1	Port Macquarie Dam, Cowarra Dam Water Extraction	Algal Grwoth, taste and odour organisms, toxins	Cyanobacteria	<2000 cells/mL *Microcystis aeruginosa* Cyanobacteria biovolume <0.2mm^3/L	≥2,000 and <6,500 cells/mL *Microcystis aeruginosa* Cyanobacteria biovolume ≥	≥6,500 and <65,000 cells/mL *Microcystis aeruginosa*	>65,000 cells/mL *Microcystis aeruginosa*

						0.2mm^{3}L and <0.6 mm^3/L	Cyanobacteria biovolume ≥0.6mm3/L and <6mm3/L	Cyanobacteria biovolume ≥6 mm3/L
	CCP2	Disinfection dosing station at water reservoirs	Chlorine Sensitive Pathogens	Free Chlorine residual	1.5mg/L (Winter), 2.0mg/L(Summer)	<1.35mg/L or >1.65mg/L (Winter), <1.5mg/L or >2.5mg/L (Summer)	<1.2mg/L or >3.0mg/L	<0.6mg/L or > 5.0mg/L
	CCP3	Water Reservoirs	Pathogens	Reservoir Integrity	No breach of integrity	Signs of Integrity Breach, Items not properly maintained	Signs of Integrity Breach, items not properly maintained	Evidence of Contamination
	CCP3	Water Reservoirs	Chlorine Sensitive Pathogens	Free Chlorine residual	>0.6mg/L -1.8 mg/L (Winter), >0.6mg/L -2.5 mg/L (Summer)	<0.6mg/L or >1.8 mg/L (Winter), <0.6mg/L or >2.5 mg/L (Summer)	<0.3mg/L or >2.5mg/L	<0.2mg/L or >5.0 mg/L
	CCP3	Water Reservoirs	All Pathogens	Turbidity	<0.5 NTU	>0.5 NTU	≥1 NTU	≥2 NTU
	CCP3	Water Reservoirs		Fluoridation	1mg/L	<0.95 mg/L for 12 hours or >1.05 mg/L	<0.90 mg/L for 24 hours or >1.10 mg/L	<0.9 mg/L for 72 hours or ≥1.5 mg/L
	CCP4	Distribution Networks	Chlorine Sensitive Pathogens	Free Chlorine residual	>0.4mg/L <1.8 mg/L (Winter), >0.4mg/L -2.5 mg/L (Summer)	<0.4mg/L or >1.8 mg/L (Winter), <0.4mg/L or >2.5 mg/L (Summer)	<0.3mg/L or >2.5mg/L	<0.05mg/L or >5.0 mg/L
	CCP4	Distribution Networks	All Pathogens	Turbidity	<2 NTU	>2 - <4 NTU	>4 NTU	≥5 NTU

A.2 Wauchope Water Supply System

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Operating Target	Adjustment Limit	Shutdown Limit	Critical Limit
Wauchope Water Supply	CCP1	Koree Island Water Extraction	All Pathogens	Turbidity	<5 NTU	>5 and <10 NTU	>10 NTU (river supply mode auto4), >30 NTU (dirty river mode auto9)	>30 and <50 NTU
	CCP2	Fluoridation	-	Fluoride Concentration	1mg/L	<0.95 mg/L for 12 hours or >1.05 mg/L	<0.90 mg/L for 24 hours or >1.10 mg/L	<0.9 mg/L for 72 hours or ≥1.5 mg/L
	CCP3	Disinfection dosing station at Rosewood 1 water reservoir	Chlorine Sensitive Pathogens	Free Chlorine residual	1.8mg/L (winter), 2.5mg/L (summer)	<1.35mg/L or >2.2 mg/L (Winter), <1.85mg/L or >3.1 mg/L (Summer)	<0.5mg/L instant shutdown after initial start-up inhibit, <1.2 mg/L or >2.6mg/L delayed shutdown	<0.2mg/L or >5.0 mg/L
	CCP3	Disinfection dosing station at Rosewood 1 water reservoir	Effectiveness of Chlorine disinfection	pH	7.8 - 8.0	<7.8 or >8.0	≤7.0 or ≥8.5	≤5.5 or ≥9.0
	CCP4	Membrane Filtration	All Pathogens	Turbidity	<0.15NTU	>0.15NTU for 5 minutes	>0.2 NTU for 2 minutes	>0.5NTU
	CCP4	Membrane Filtration	Membrane Failure	Transmembrane Pressure	<70kPa	>70kPa and <80kPa	>80kPa and <120kPa	>120kPa
	CCP5	Water Reservoirs	Pathogens	Reservoir Integrity	No breach of integrity	Signs of Integrity Breach, Items not properly maintained	Signs of Integrity Breach, items not properly maintained	Evidence of Contamination
	CCP5	Water Reservoirs	Chlorine Sensitive Pathogens	Free Chlorine residual	0.6mg/L-1.8mg/L (winter), 0.6mg/L-2.5mg/L (winter)	<0.6mg/L or >1.8mg/L (winter), <0.6mg/L or >2.5mg/L (summer)	<0.3mg/L or >2.5mg/L	<0.2mg/L or >5.0mg/L
	CCP5	Water Reservoirs	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU
	CCP 6	Distribution Network	Chlorine Sensitive Pathogens	Free Chlorine residual	0.4mg/L-1.8mg/L (winter), 0.4mg/L-2.5mg/L (winter)	<0.4mg/L or >1.8mg/L (winter), <0.4mg/L or >2.5mg/L (summer)	<0.3mg/L or >2.5mg/L	<0.05mg/L or >5.0mg/L
	CCP 6	Distribution Network	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU

A.3 Comboyne Water Supply System

System	CCP ID	Critical Control Point	Hazard	Control Parameter	Operating Target	Adjustment Limit	Shutdown Limit	Critical Limit
Comboyne Water Supply	CCP1	River Water Extraction	All Pathogens	Turbidity	<10 NTU	>10 and <15 NTU	>15 NTU (river supply mode), >30NTU (dirty river mode)	>30 and <50 NTU
	CCP2	Disinfection Dosing System	Chlorine Sensitive Pathogens	Free Chlorine residual	1.8mg/L (winter), 2.5mg/L (summer)	<1.35mg/L or >2.2 mg/L (Winter), <1.85mg/L or >3.1 mg/L (Summer)	<0.5mg/L instant shutdown after initial start-up inhibit, <1.2 mg/L or >2.6mg/L delayed shutdown (winter), <1.2 mg/L or >3.6mg/L delayed shutdown (summer)	<0.2mg/L or >5.0mg/L
	CCP2	Disinfection Dosing System	Effectiveness of Chlorine disinfection	pH	6.5 - 7.5	<6.5 or >7.5	≤6.0 or ≥8.5	≤5.5 or ≥9.0
	CCP3	Membrane Filtration	All Pathogens	Turbidity	<0.15NTU	>0.15NTU for 5 minutes	>0.2 NTU for 2 minutes	>0.5NTU
	CCP3	Membrane Filtration	Membrane Failure	Transmembrane Pressure	<70kPa	>70kPa and <80kPa	>80kPa and <120kPa	>120kPa
	CCP4	Water Reservoirs	Pathogens	Reservoir Integrity	No breach of integrity	Signs of Integrity Breach, Items not properly maintained	Signs of Integrity Breach, items not properly maintained	Evidence of Contamination
	CCP4	Water Reservoirs	Chlorine Sensitive Pathogens	Free Chlorine residual	0.6mg/L-1.8mg/L (winter), 0.6mg/L-2.5mg/L (winter)	<0.6mg/L or >1.8mg/L (winter), <0.6mg/L or >2.5mg/L (summer)	<0.3mg/L or >2.5mg/L	<0.2mg/L or >5.0mg/L
	CCP4	Water Reservoirs	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU
	CCP5	Distribution Networks	Chlorine Sensitive Pathogens	Free Chlorine residual	0.4mg/L-1.8mg/L (winter), 0.4mg/L-2.5mg/L (winter)	<0.4mg/L or >1.8mg/L (winter), <0.4mg/L or >2.5mg/L (summer)	<0.3mg/L or >2.5mg/L	<0.05mg/L or >5.0mg/L
	CCP5	Distribution Networks	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU

A.4 Long Flat Water Supply System

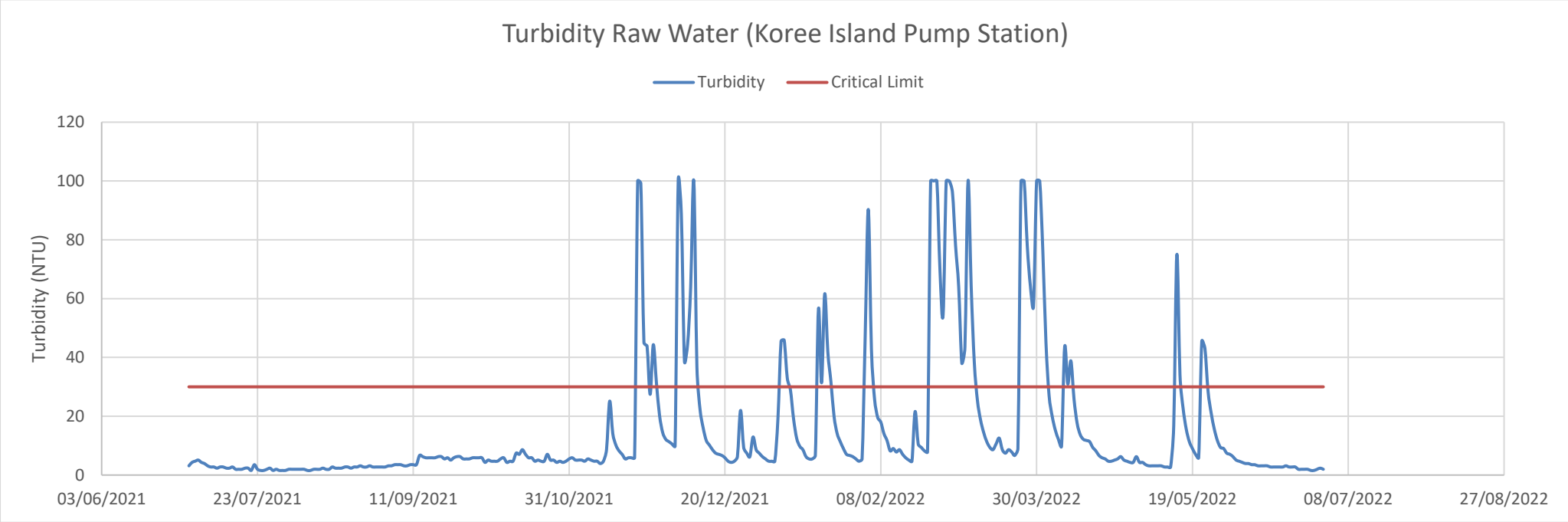
System	CCP ID	Critical Control Point	Hazard	Control Parameter	Operating Target	Adjustment Limit	Shutdown Limit	Critical Limit
Long Flat Water Supply	CCP1	River Water Extraction	All Pathogens	Turbidity	<10 NTU	>10 and <15 NTU	>15 NTU (river supply mode), >30NTU (dirty river mode)	>30 and <50 NTU
	CCP2	Disinfection Dosing System	Chlorine Sensitive Pathogens	Free Chlorine residual	3.5mg/L	<3.1mg/L or >3.9 mg/L	<0.5mg/L instant shutdown after initial start-up inhibit, <2.5 mg/L or >4.2mg/L delayed shutdown	<0.2mg/L or >5.0mg/L
	CCP2	Disinfection Dosing System	Effectiveness of Chlorine disinfection	pH	7.5 - 8.5	<7.5 or >8.5	≤6.5 or ≥8.5	≤6 or ≥9.0
	CCP3	Membrane Filtration	All Pathogens	Turbidity	<0.15NTU	>0.15NTU for 5 minutes	>0.2 NTU for 2 minutes	>0.5NTU
	CCP3	Membrane Filtration	Membrane Failure	Transmembrane Pressure	<70kPa	>70kPa and <80kPa	>80kPa and <120kPa	>120kPa
	CCP4	Water Reservoirs	Pathogens	Reservoir Integrity	No breach of integrity	Signs of Integrity Breach, Items not properly maintained	Signs of Integrity Breach, items not properly maintained	Evidence of Contamination
	CCP4	Water Reservoirs	Chlorine Sensitive Pathogens	Free Chlorine residual	0.6mg/L-1.8mg/L	<0.6mg/L or >1.8mg/L	<0.3mg/L or >2.5mg/L	<0.2mg/L or >5.0mg/L
	CCP4	Water Reservoirs	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU
	CCP5	Distribution Networks	Chlorine Sensitive Pathogens	Free Chlorine residual	0.4mg/L-1.8mg/L	<0.4mg/L or >1.8mg/L	<0.3mg/L or >2.5mg/L	<0.05mg/L or >5.0mg/L
	CCP5	Distribution Networks	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU

A.5 Telegraph Point Water Supply System

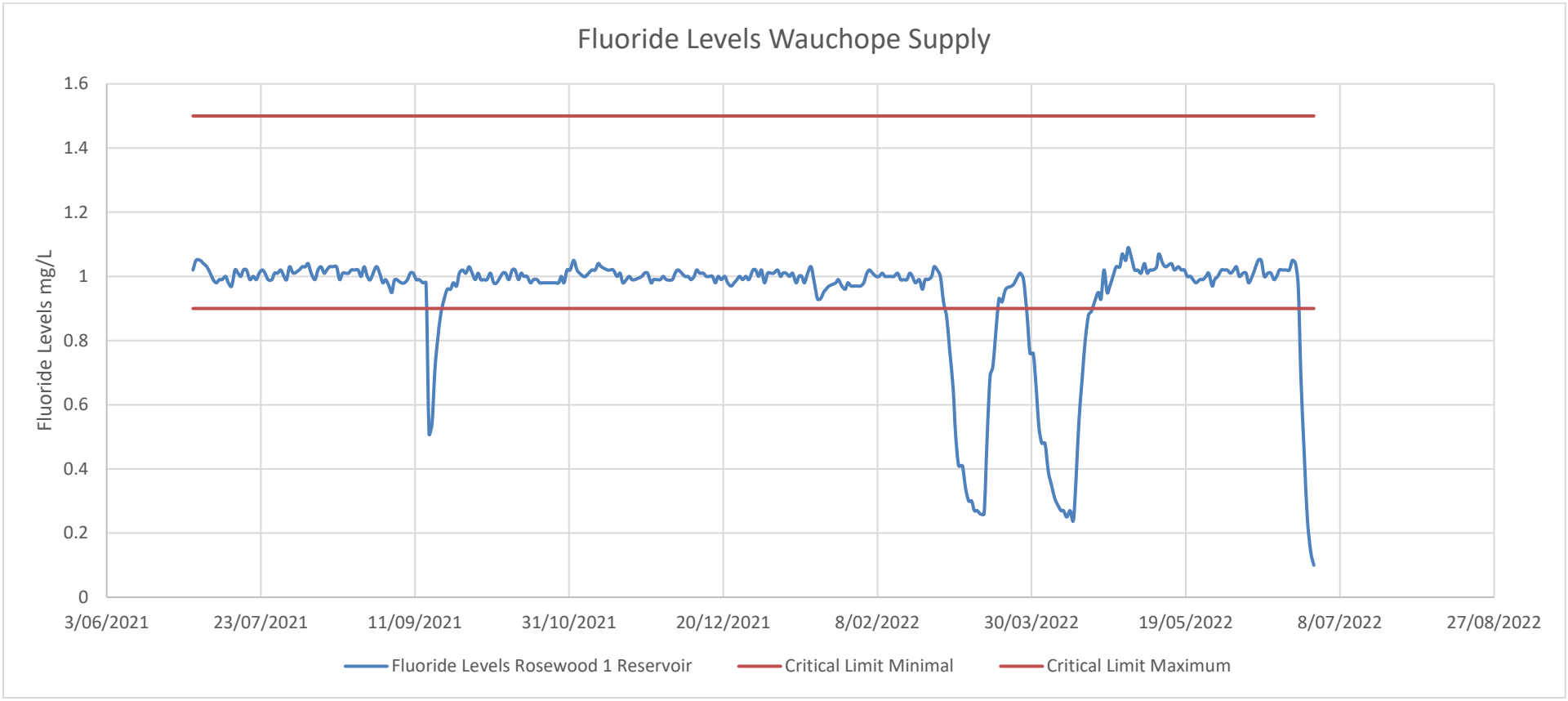
System	CCP ID	Critical Control Point	Hazard	Control Parameter	Operating Target	Adjustment Limit	Shutdown Limit	Critical Limit
Telegraph Point Water Supply	CCP1	River Water Extraction	All Pathogens	Turbidity	<5 NTU	>5 and <10 NTU	>10 NTU (river supply mode), >30NTU (dirty river mode)	>30 and <50 NTU
	CCP2	Disinfection Dosing System	Chlorine Sensitive Pathogens	Free Chlorine residual	3.0mg/L	<2.7mg/L or >3.3 mg/L	<0.5mg/L instant shutdown after initial start-up inhibit, <2.0 mg/L or >3.6mg/L delayed shutdown	<0.2mg/L or >5.0mg/L
	CCP2	Disinfection Dosing System	Effectiveness of Chlorine disinfection	pH	6.8 - 7.8	<6.8 or >7.8	≤6.5 or ≥8.5	≤6 or ≥9.0
	CCP3	Membrane Filtration	All Pathogens	Turbidity	<0.15NTU	>0.15NTU for 5 minutes	>0.2 NTU for 2 minutes	>0.5NTU
	CCP3	Membrane Filtration	Membrane Failure	Transmembrane Pressure	<70kPa	>70kPa and <80kPa	>80kPa and <120kPa	>120kPa
	CCP4	Water Reservoirs	Pathogens	Reservoir Integrity	No breach of integrity	Signs of Integrity Breach, Items not properly maintained	Signs of Integrity Breach, items not properly maintained	Evidence of Contamination
	CCP4	Water Reservoirs	Chlorine Sensitive Pathogens	Free Chlorine residual	0.6mg/L-1.8mg/L	<0.6mg/L or >1.8mg/L	<0.3mg/L or >2.5mg/L	<0.2mg/L or >5.0mg/L
	CCP4	Water Reservoirs	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU
	CCP5	Distribution Networks	Chlorine Sensitive Pathogens	Free Chlorine residual	0.4mg/L-1.8mg/L	<0.4mg/L or >1.8mg/L	<0.3mg/L or >2.5mg/L	<0.05mg/L or >5.0mg/L
	CCP5	Distribution Networks	All Pathogens	Turbidity	<0.5NTU	>0.5NTU and <1.0NTU	>1.0NTU and <2.0NTU	>2.0NTU

Appendix B CCP Trends

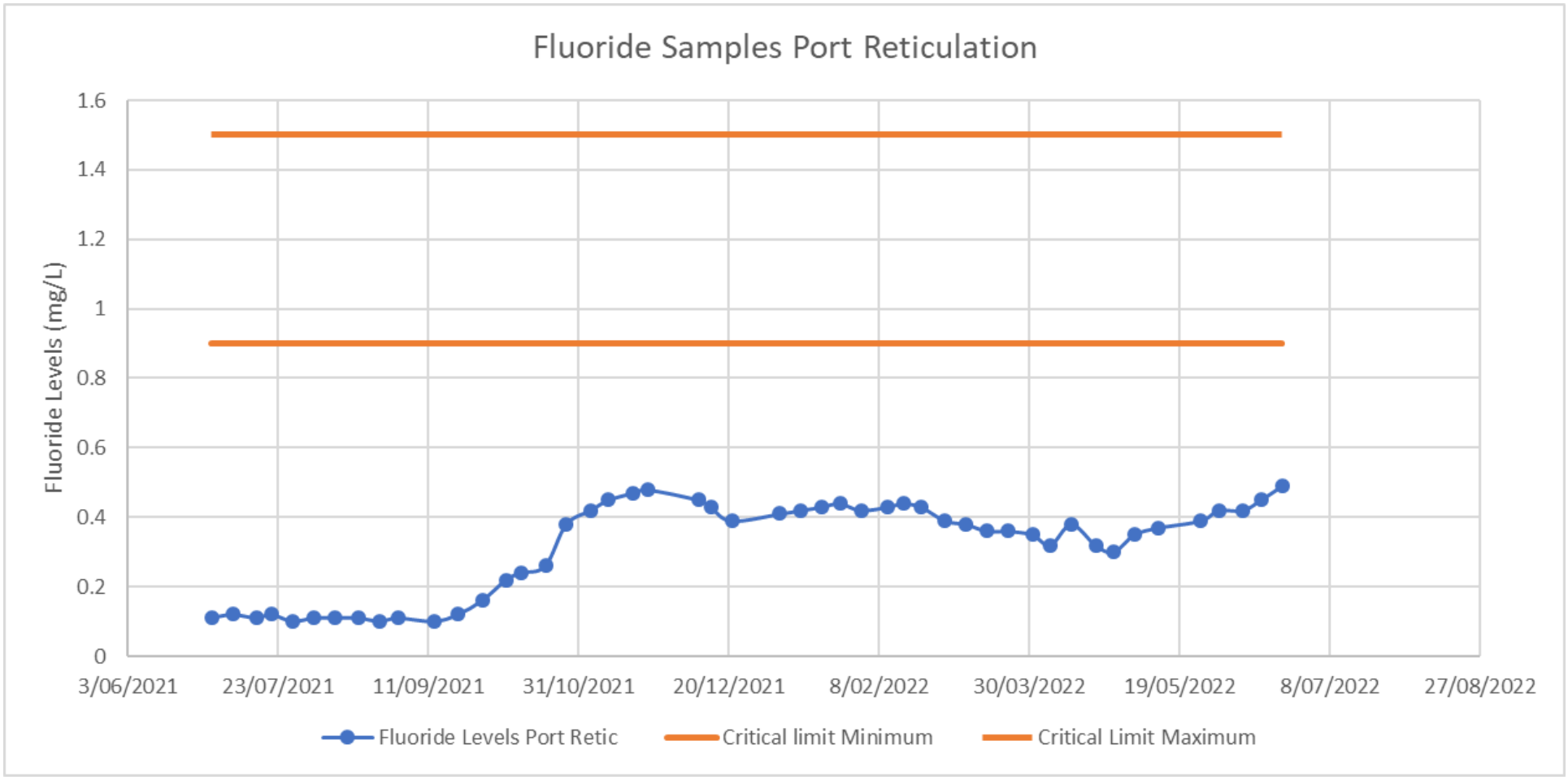
B.1 Turbidity Trends Raw Water at Koree Island Pump Station



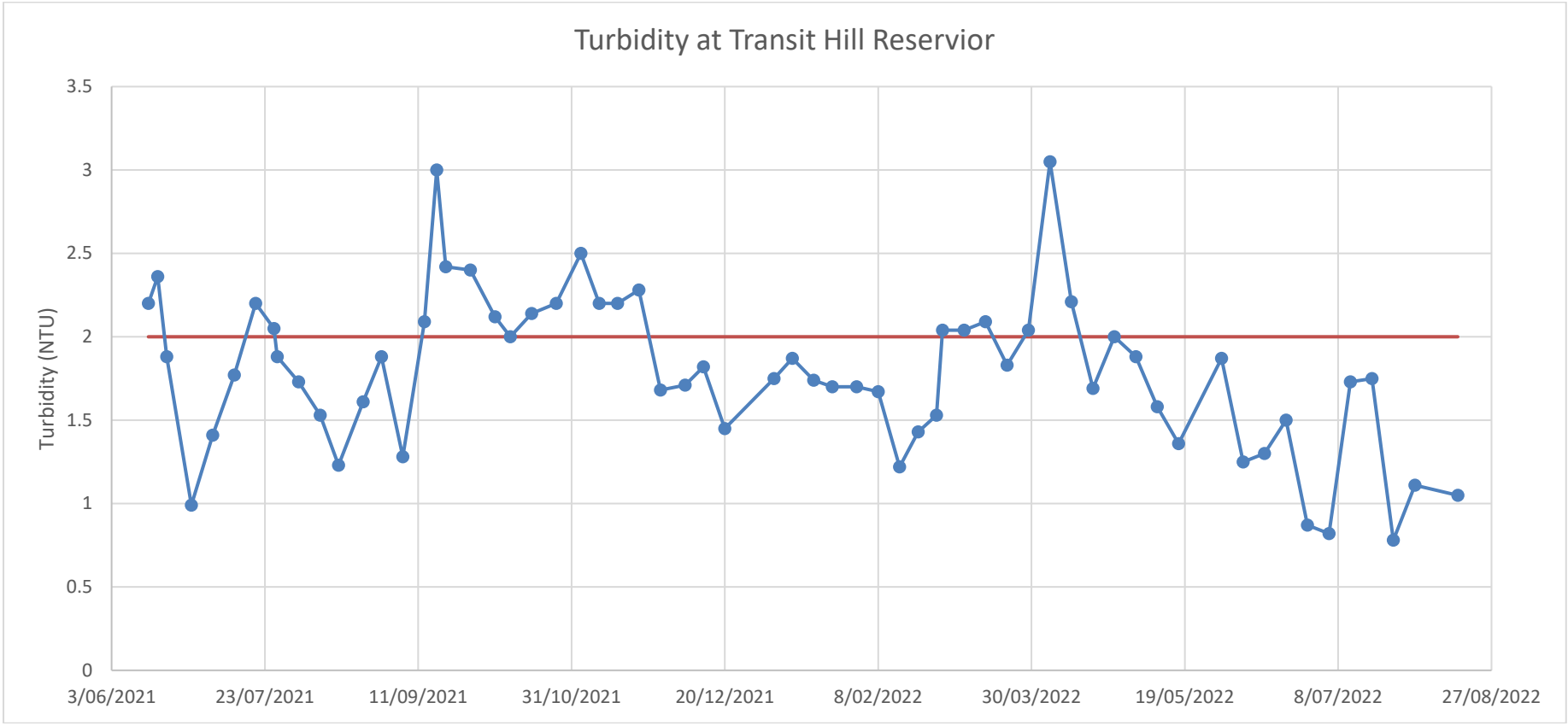
B.2 Fluoride Levels of Wauchope Supply System



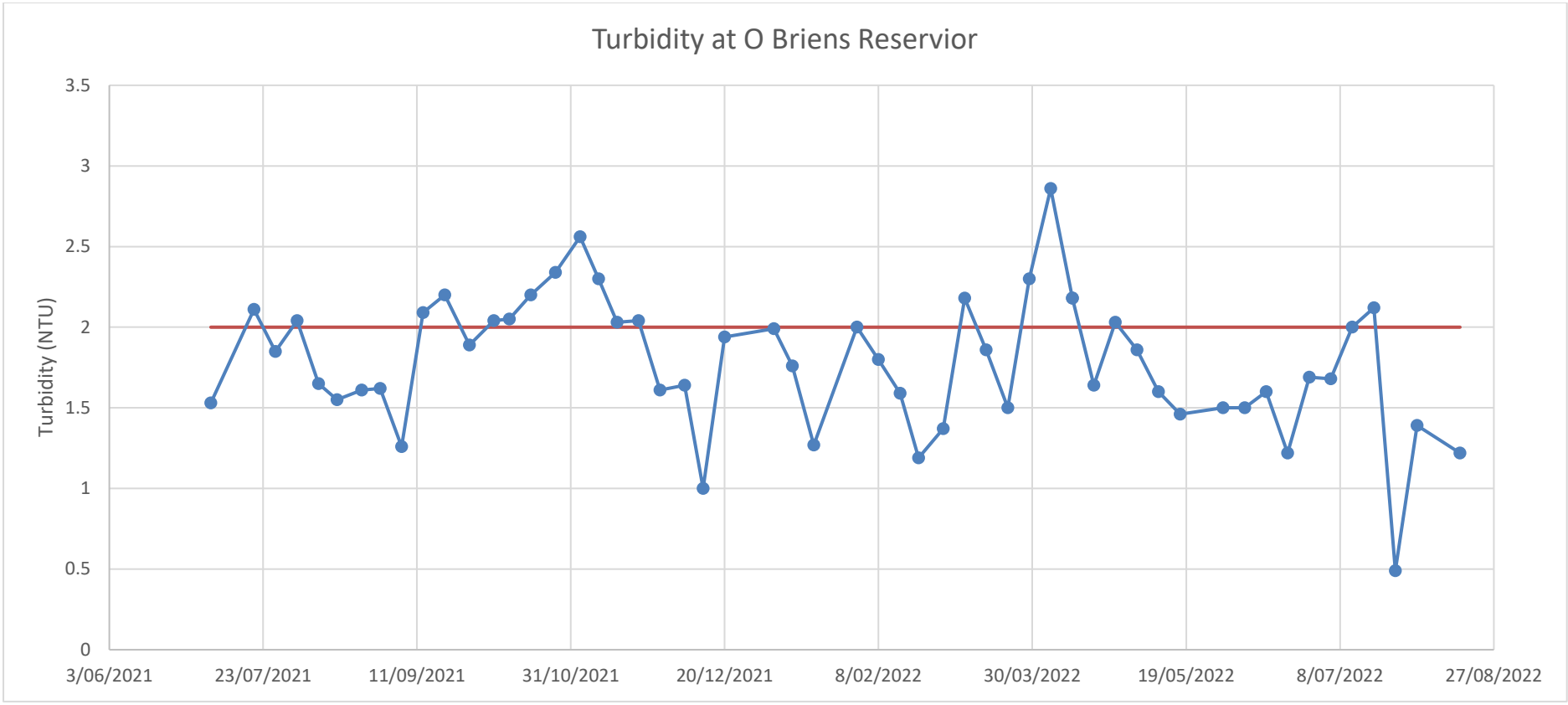
B.3 Fluoride Samples at Port Reticulation



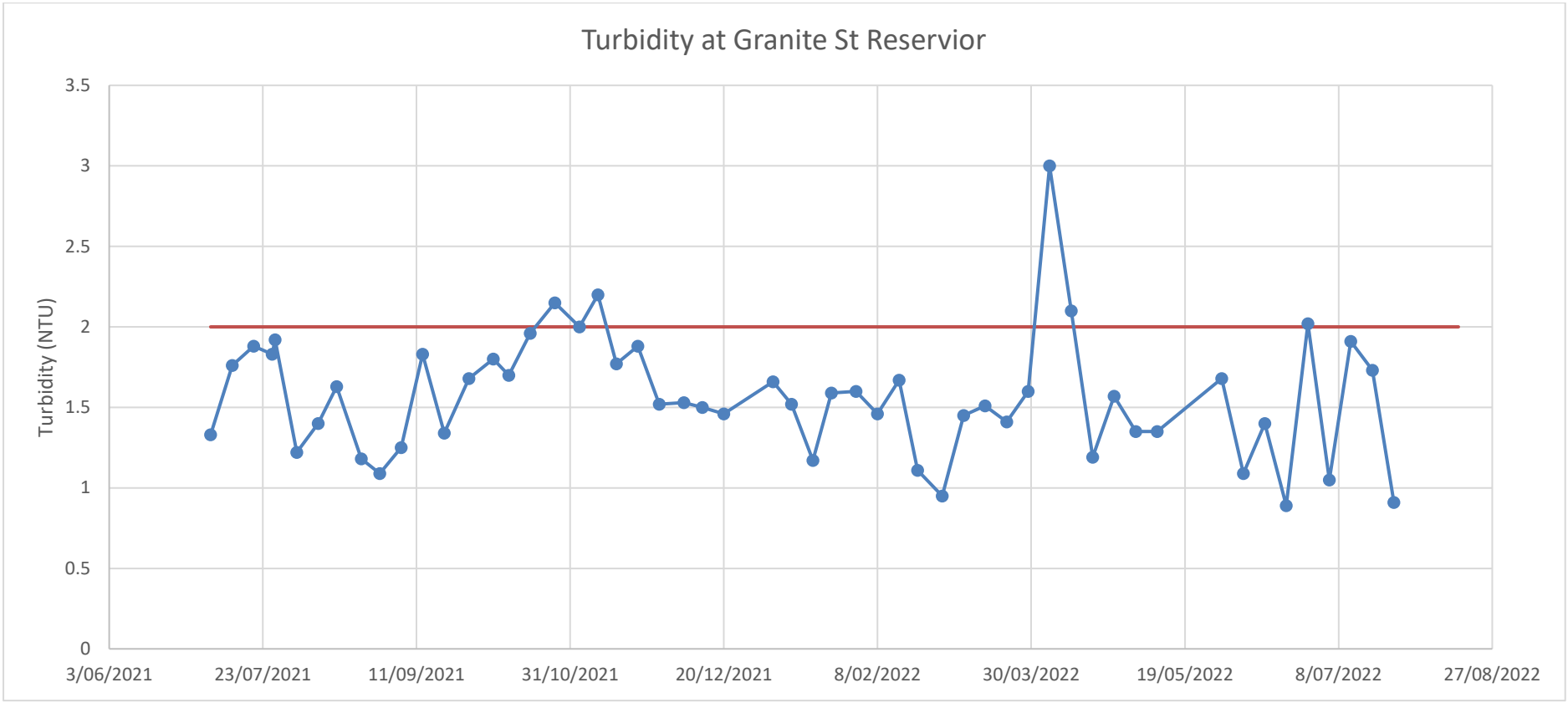
B.4 Turbidity Trends at Transit Hill Reservoir, Port Macquarie - Camden Haven Supply System



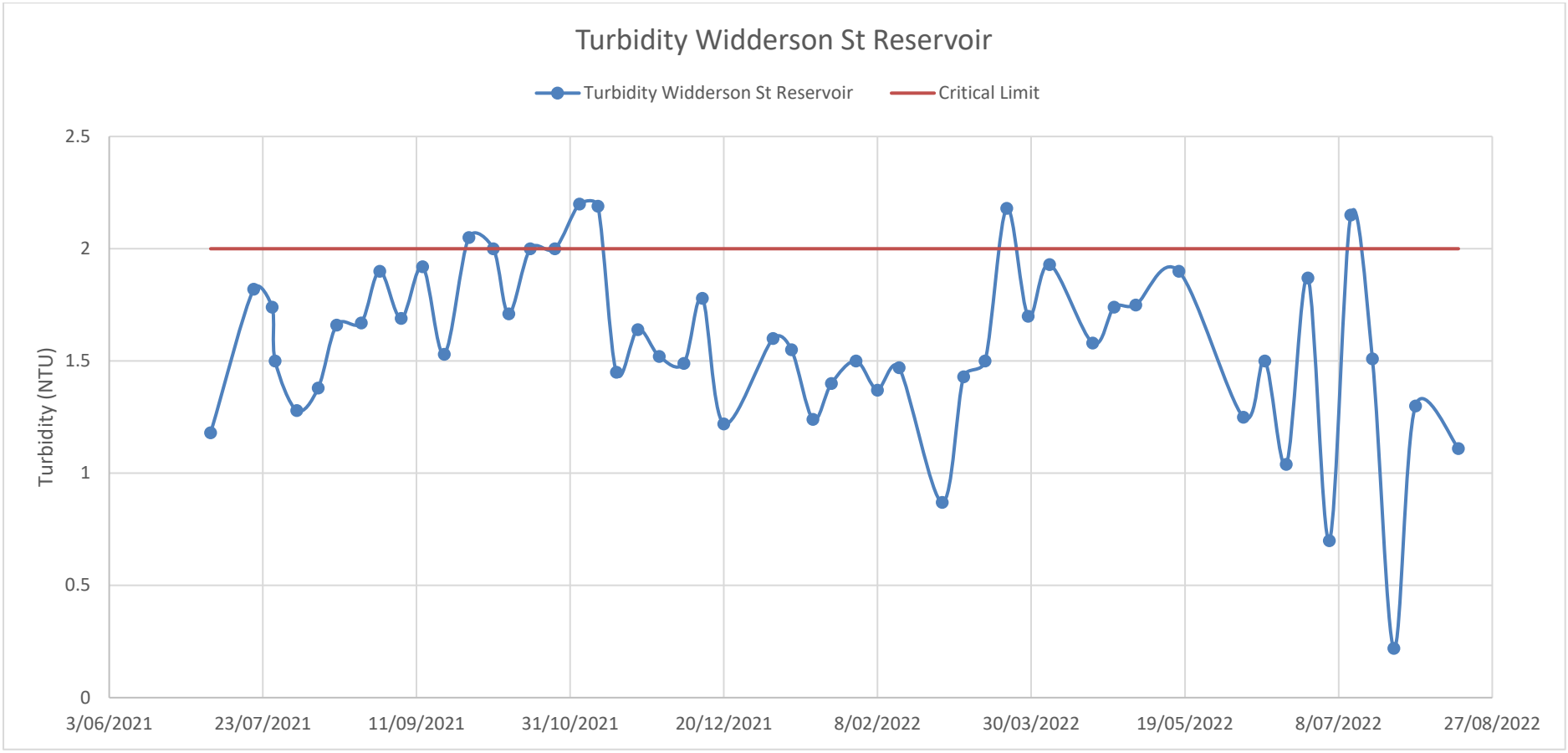
B.5 Turbidity Trends at O'Briens Reservoir, Port Macquarie - Camden Haven Supply System



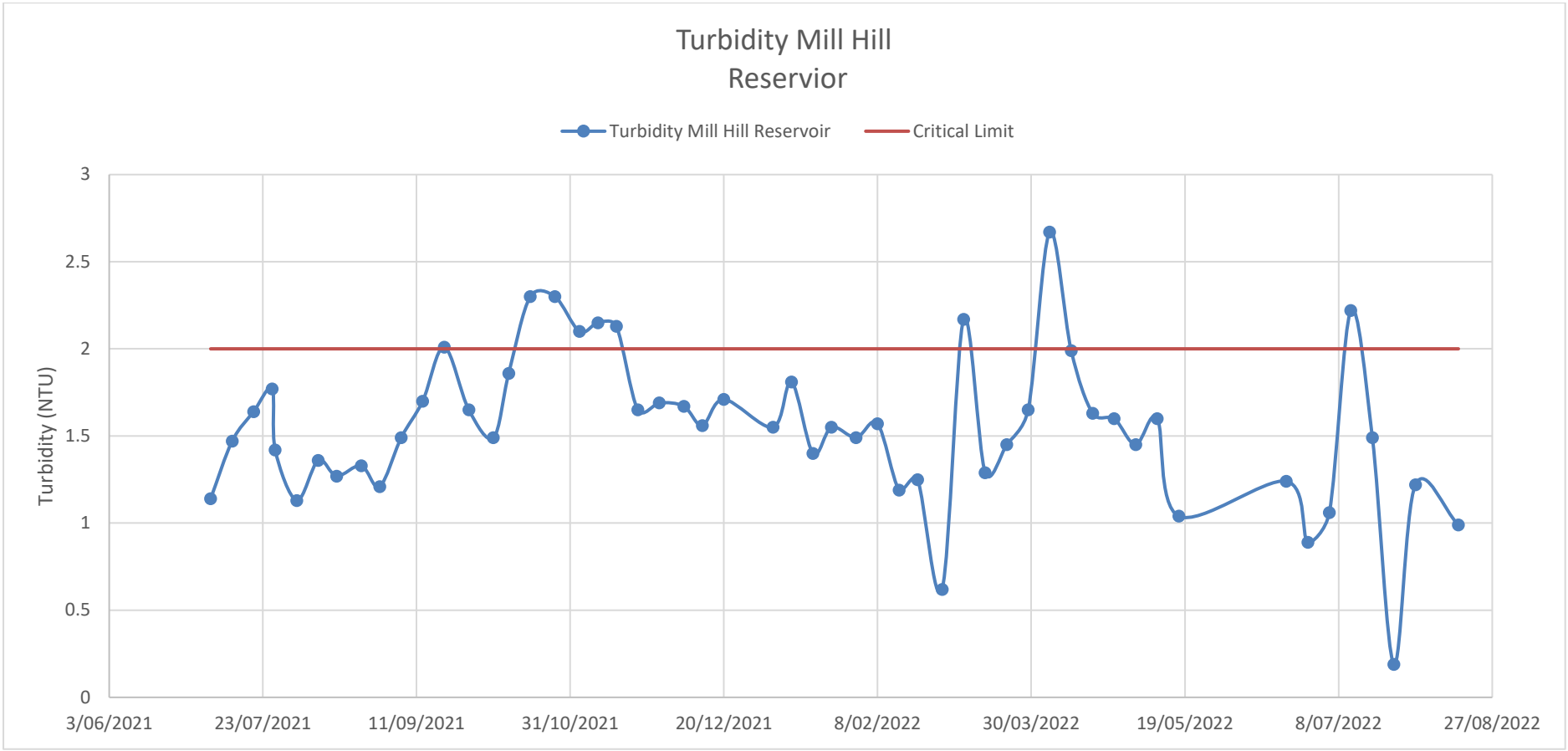
B.6 Turbidity Trends at Granite St Reservior, Port Macquarie - Camden Haven Supply System



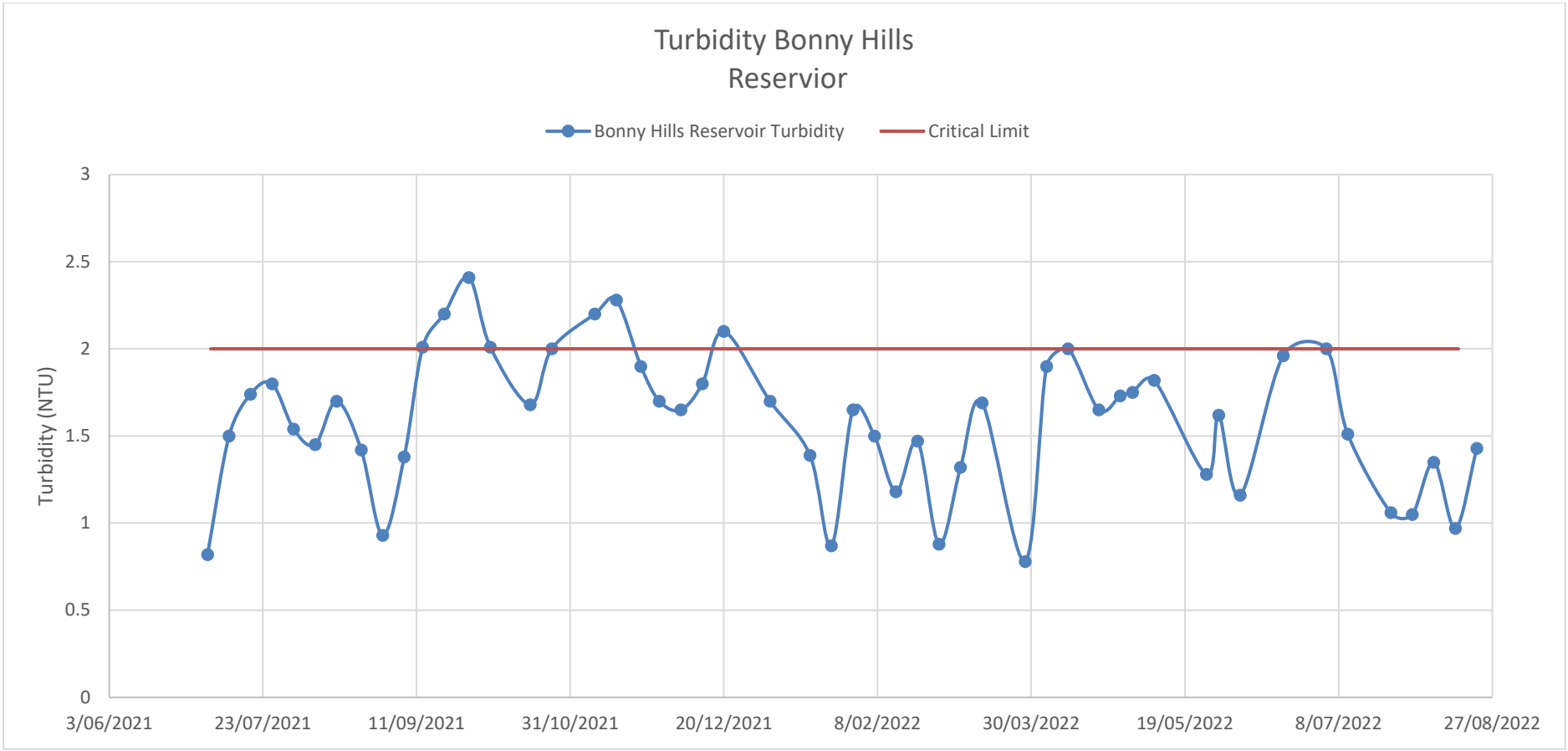
B.7 Turbidity Trends at Widderson St Reservoir, Port Macquarie - Camden Haven Supply System



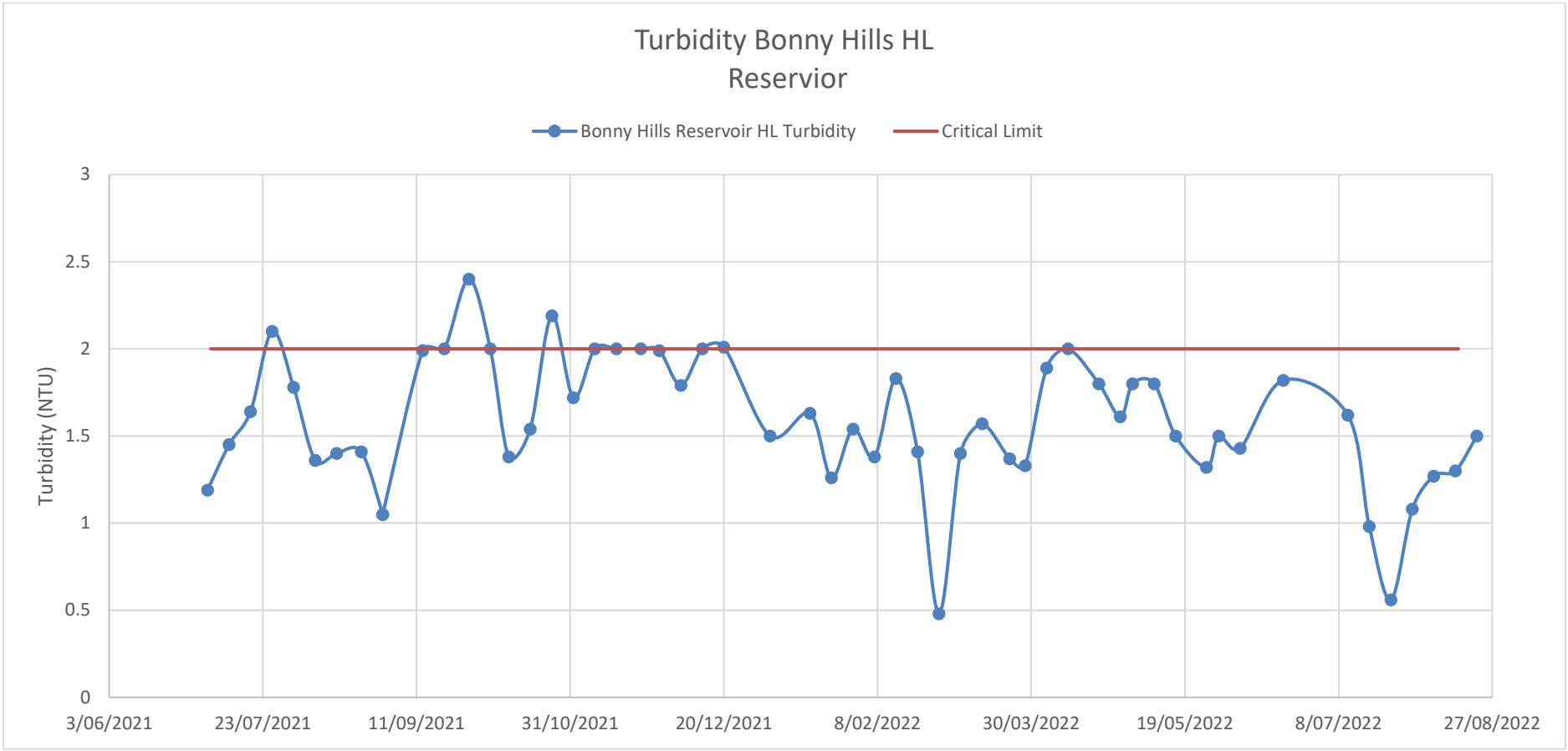
B.8 Turbidity Trends at Mill Hill Reservoir, Port Macquarie - Camden Haven Supply System



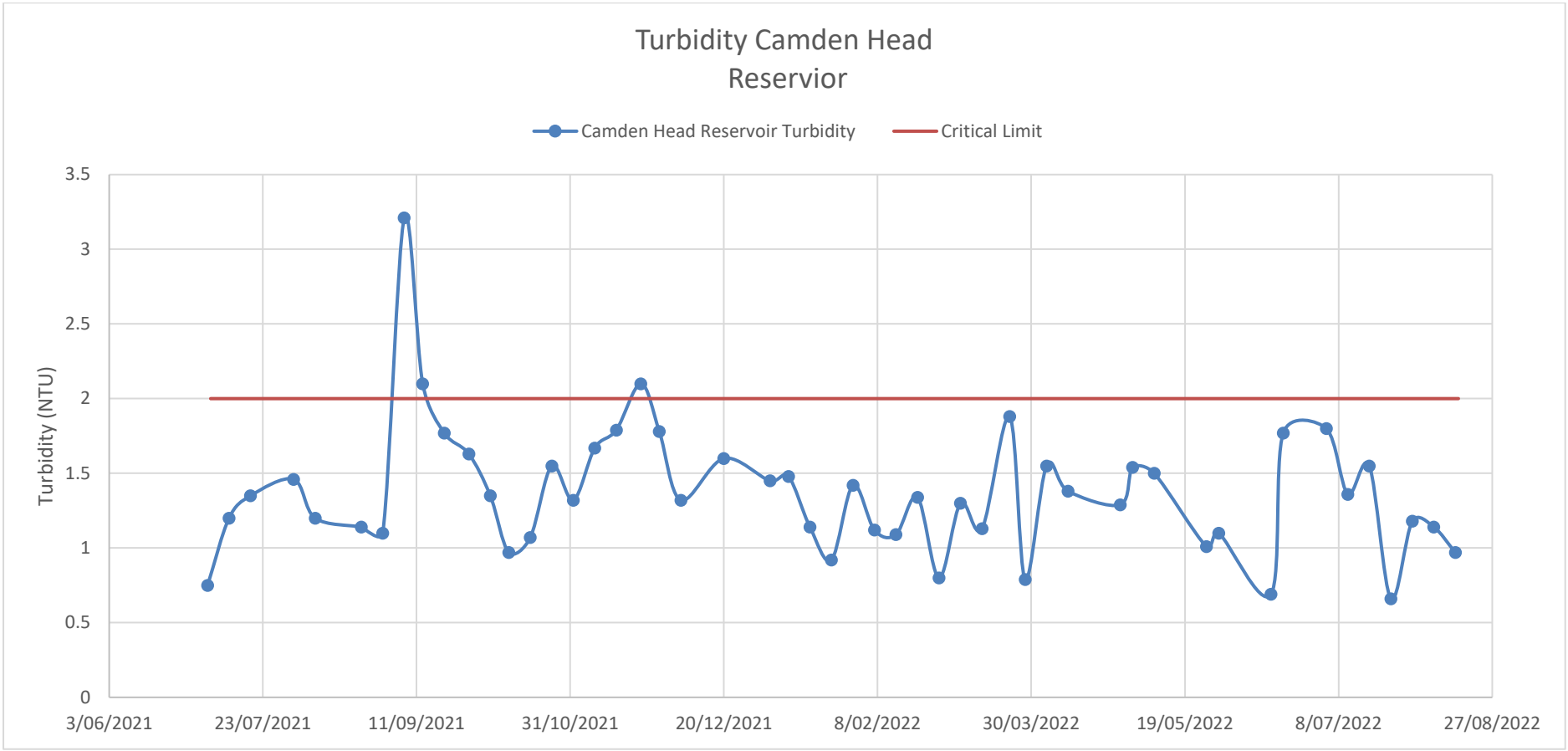
B.9 Turbidity Trends at Bonny Hills Reservoir, Port Macquarie - Camden Haven Supply System



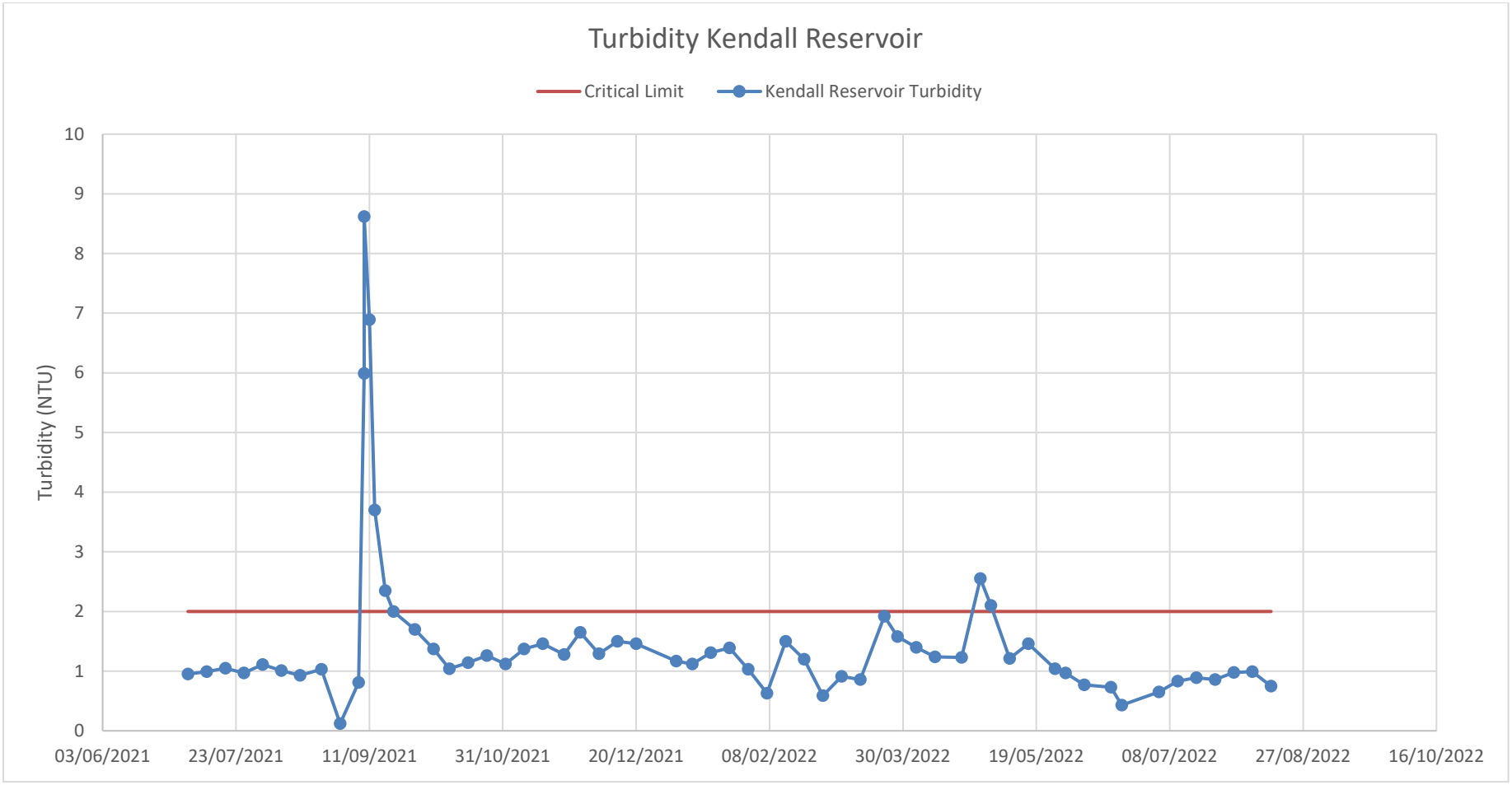
B.10 Turbidity Trends at Bonny Hills HL Reservoir, Port Macquarie - Camden Haven Supply System



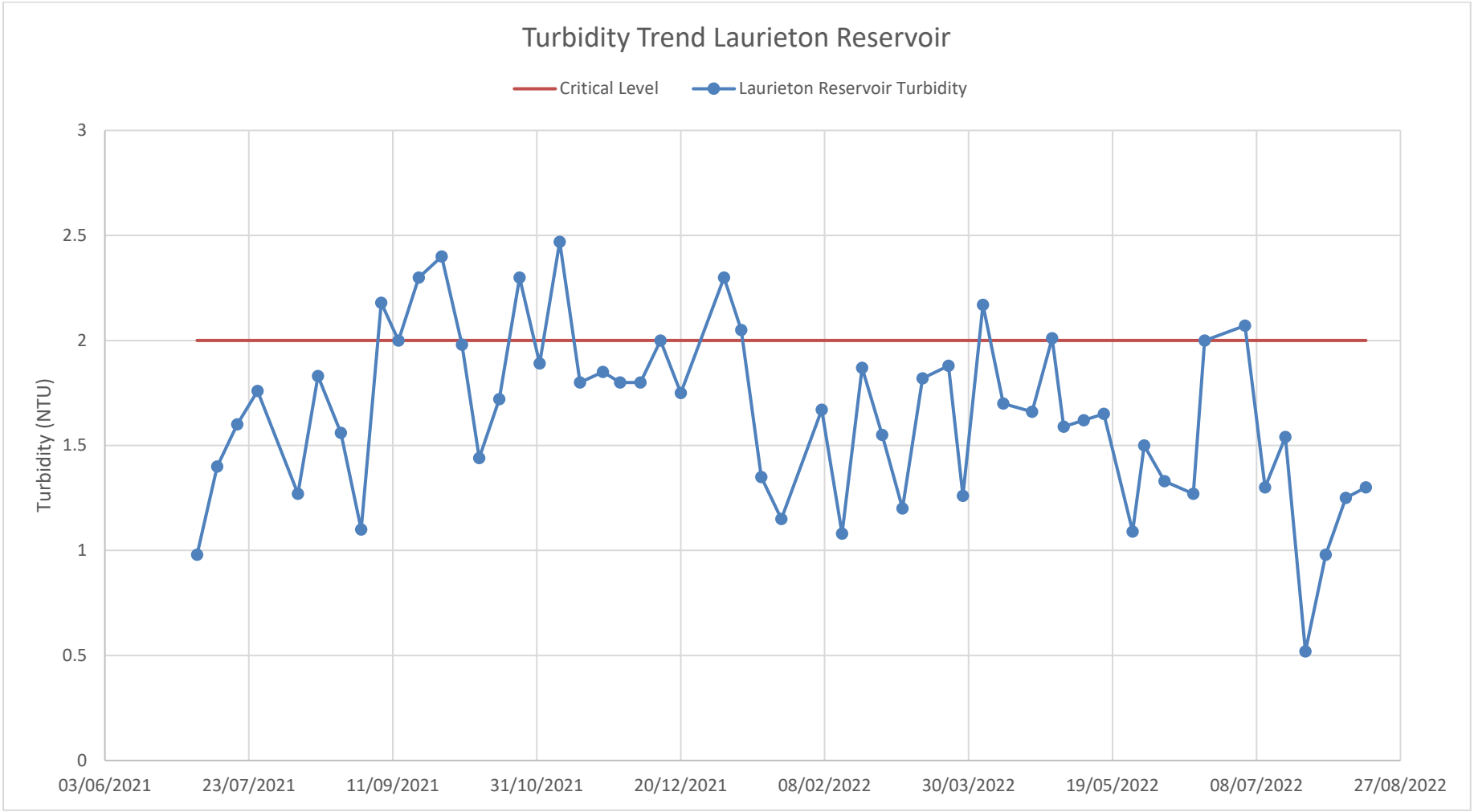
B.11 Turbidity Trends at Camden Head Reservoir, Port Macquarie - Camden Haven Supply System



B.12 Turbidity Trends at Kendall Reservoir, Port Macquarie - Camden Haven Supply System



B.13 Turbidity Trends at Laurieton Reservoir, Port Macquarie - Camden Haven Supply System



Appendix C CCP Exceedances in Reservoir for Port Macquarie - Camden Haven Supply

C.1 CCP Exceedances for Turbidity >2NTU of Reservoirs in Port Macquarie - Camden Haven System

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	20/07/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	26/07/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.05
Port Macquarie	13/09/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.09
Port Macquarie	13/09/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.09
Port Macquarie	17/09/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	3

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	20/09/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.42
Port Macquarie	28/09/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.4
Port Macquarie	06/10/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.12
Port Macquarie	18/10/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.14
Port Macquarie	26/10/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	03/11/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.5
Port Macquarie	09/11/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.2

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	15/11/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	22/11/2021	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.28
Port Macquarie	01/03/2022	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.04
Port Macquarie	08/03/2022	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.04
Port Macquarie	15/03/2022	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.09
Port Macquarie	29/03/2022	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.04
Port Macquarie	05/04/2022	CL	Transit Hill Reservoir	Turbidity	>2NTU	3.05

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	12/04/2022	CL	Transit Hill Reservoir	Turbidity	>2NTU	2.21
Port Macquarie	20/07/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.11
Port Macquarie	3/08/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.04
Port Macquarie	13/09/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.09
Port Macquarie	20/09/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	6/10/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.04
Port Macquarie	11/10/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.05

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	18/10/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	26/10/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.34
Port Macquarie	3/11/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.56
Port Macquarie	9/11/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.3
Port Macquarie	15/11/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.03
Port Macquarie	22/11/2021	CL	O Brien's Reservoir	Turbidity	>2NTU	2.04
Port Macquarie	8/03/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.18

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	29/03/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.3
Port Macquarie	5/04/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.86
Port Macquarie	12/04/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.18
Port Macquarie	12/04/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.18
Port Macquarie	26/04/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.03
Port Macquarie	19/07/2022	CL	O Brien's Reservoir	Turbidity	>2NTU	2.12
Port Macquarie	26/10/2021	CL	Granite St Reservoir	Turbidity	>2NTU	2.15

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	9/11/2021	CL	Granite St Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	5/04/2022	CL	Granite St Reservoir	Turbidity	>2NTU	3
Port Macquarie	12/04/2022	CL	Granite St Reservoir	Turbidity	>2NTU	2.1
Port Macquarie	28/06/2022	CL	Granite St Reservoir	Turbidity	>2NTU	2.02
Port Macquarie	28/09/2021	CL	Widderson St Reservoir	Turbidity	>2NTU	2.05
Port Macquarie	3/11/2021	CL	Widderson St Reservoir	Turbidity	>2NTU	2.2
Port Macquarie	9/11/2021	CL	Widderson St Reservoir	Turbidity	>2NTU	2.19

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	22/03/2022	CL	Widderson St Reservoir	Turbidity	>2NTU	2.18
Port Macquarie	12/07/2022	CL	Widderson St Reservoir	Turbidity	>2NTU	2.15
Port Macquarie	20/09/2021	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.01
Port Macquarie	18/10/2021	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.3
Port Macquarie	26/10/2021	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.3
Port Macquarie	3/11/2021	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.1
Port Macquarie	9/11/2021	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.15

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Port Macquarie	15/11/2021	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.13
Port Macquarie	8/03/2022	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.17
Port Macquarie	5/04/2022	CL	Mill Hill Reservoir	Turbidity	>2NTU	2.67
Camden Haven	13/09/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.01
Camden Haven	20/09/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.2
Camden Haven	28/09/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.41
Camden Haven	5/10/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.01

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Camden Haven	8/11/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.2
Camden Haven	15/11/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.28
Camden Haven	20/12/2021	CL	Bonny Hills Reservoir	Turbidity	>2NTU	2.1
Camden Haven	26/07/2021	CL	Bonny Hills Reservoir HL	Turbidity	>2NTU	2.1
Camden Haven	28/09/2021	CL	Bonny Hills Reservoir HL	Turbidity	>2NTU	2.4
Camden Haven	25/10/2021	CL	Bonny Hills Reservoir HL	Turbidity	>2NTU	2.19
Camden Haven	20/12/2021	CL	Bonny Hills Reservoir HL	Turbidity	>2NTU	2.01

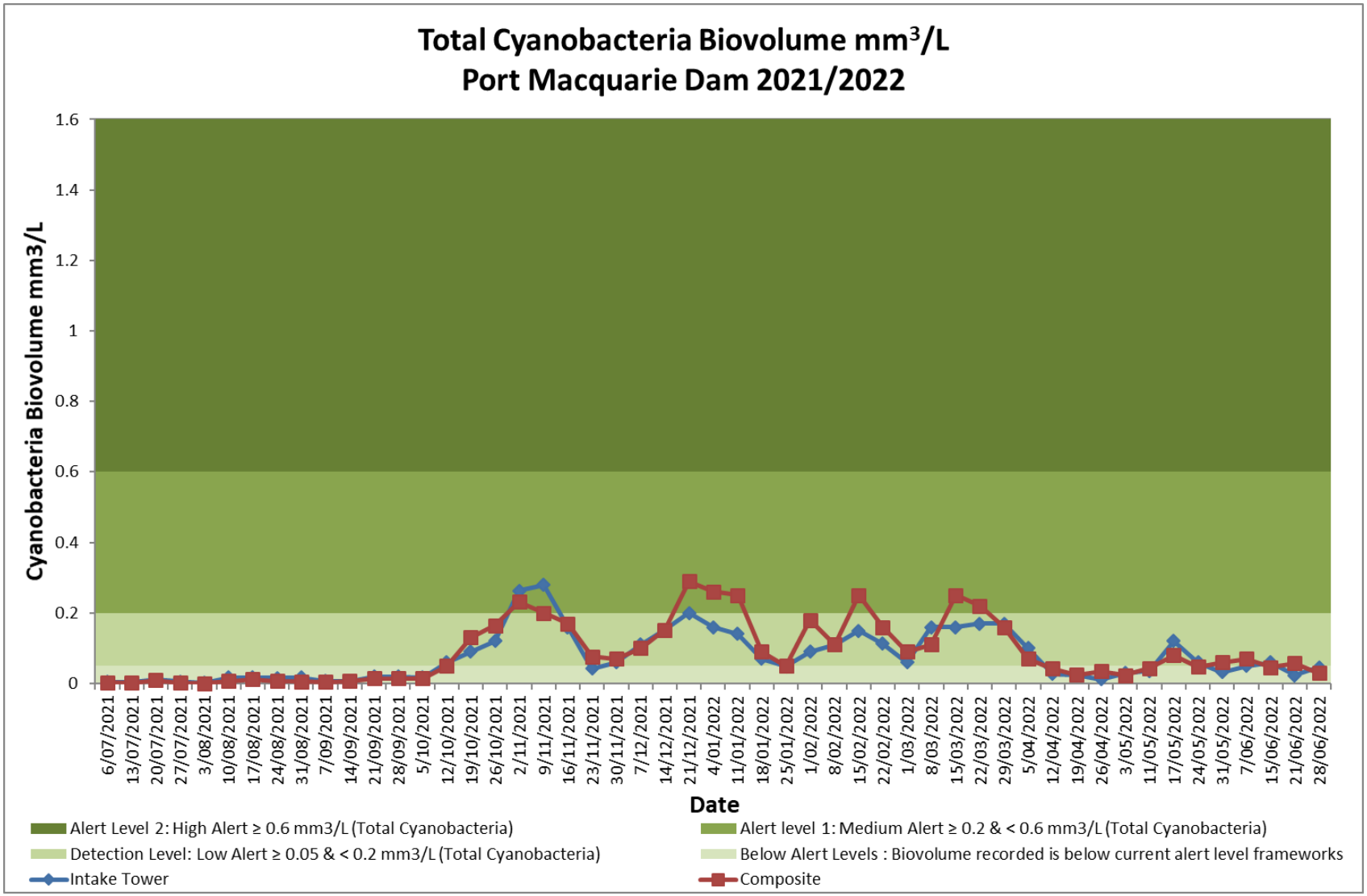
Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Camden Haven	7/09/2021	CL	Camden Head Reservoir	Turbidity	>2NTU	3.21
Camden Haven	13/09/2021	CL	Camden Head Reservoir	Turbidity	>2NTU	2.1
Camden Haven	23/11/2021	CL	Camden Head Reservoir	Turbidity	>2NTU	2.1
Camden Haven	17/09/2021	CL	Kendall Reservoir	Turbidity	>2NTU	2.35
Camden Haven	28/04/2022	CL	Kendall Reservoir	Turbidity	>2NTU	2.55
Camden Haven	2/05/2022	CL	Kendall Reservoir	Turbidity	>2NTU	2.1
Camden Haven	7/09/2021	CL	Laurieton Reservoir	Turbidity	>2NTU	2.18

Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Camden Haven	20/09/2021	CL	Laurieton Reservoir	Turbidity	>2NTU	2.3
Camden Haven	28/09/2021	CL	Laurieton Reservoir	Turbidity	>2NTU	2.4
Camden Haven	25/10/2021	CL	Laurieton Reservoir	Turbidity	>2NTU	2.3
Camden Haven	8/11/2021	CL	Laurieton Reservoir	Turbidity	>2NTU	2.47
Camden Haven	4/01/2022	CL	Laurieton Reservoir	Turbidity	>2NTU	2.3
Camden Haven	10/01/2022	CL	Laurieton Reservoir	Turbidity	>2NTU	2.05
Camden Haven	4/04/2022	CL	Laurieton Reservoir	Turbidity	>2NTU	2.17

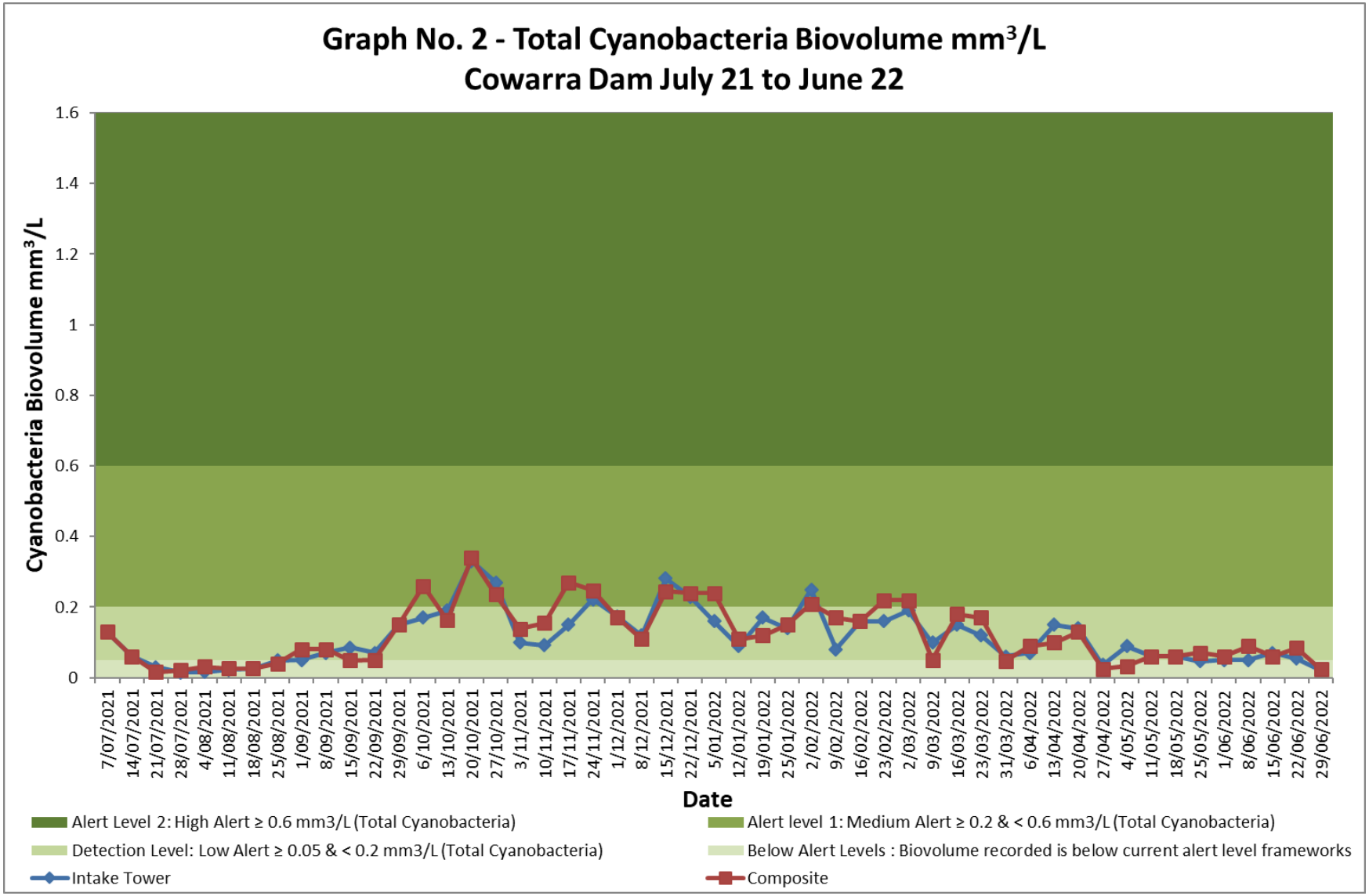
Supply System	Date or Period	Type	Location	Parameter	CCP Limit	Water quality Value
Camden Haven	28/04/2022	CL	Laurieton Reservoir	Turbidity	>2NTU	2.01

Appendix D Water Quality Trends

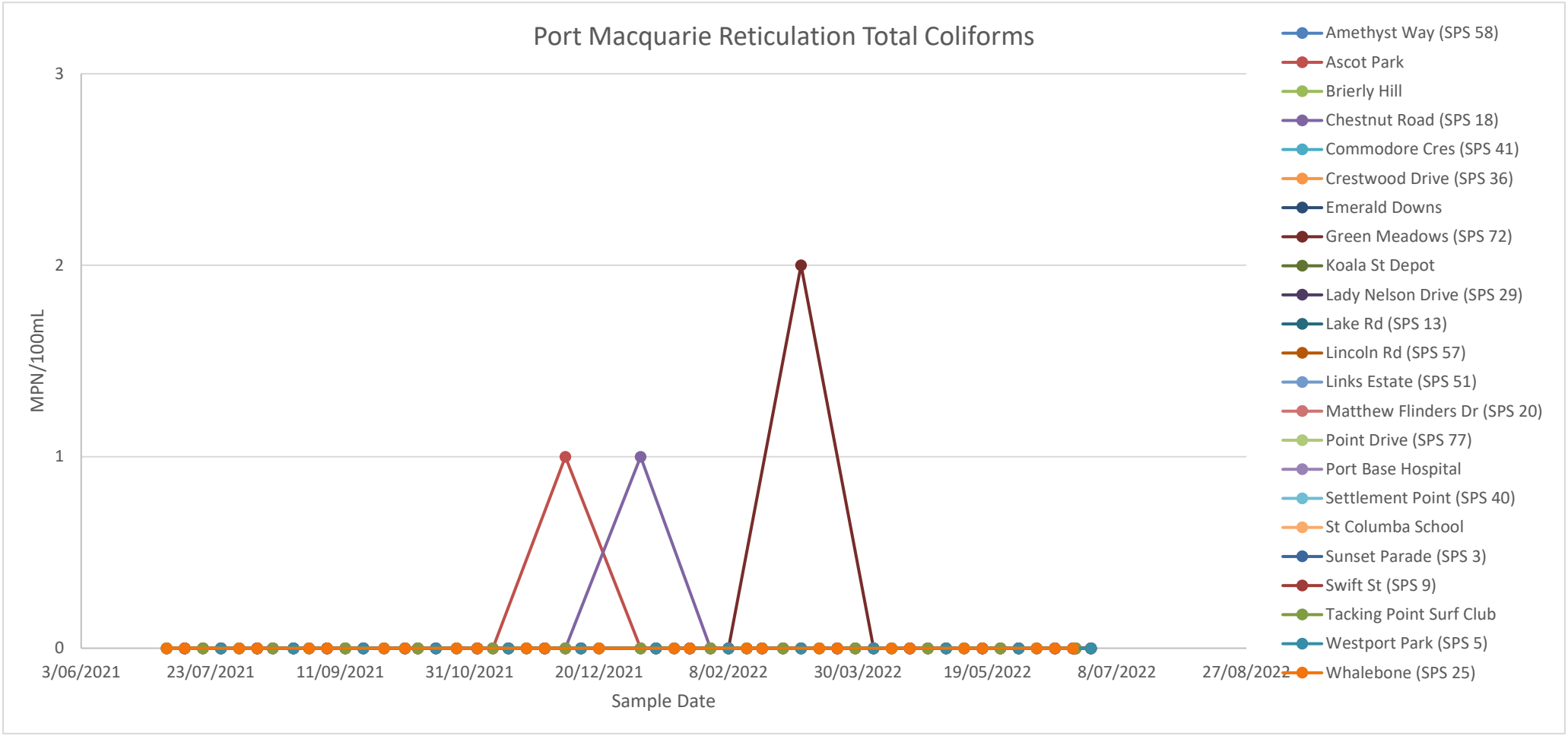
D.1 Cyanobacteria in Port Macquarie Dam



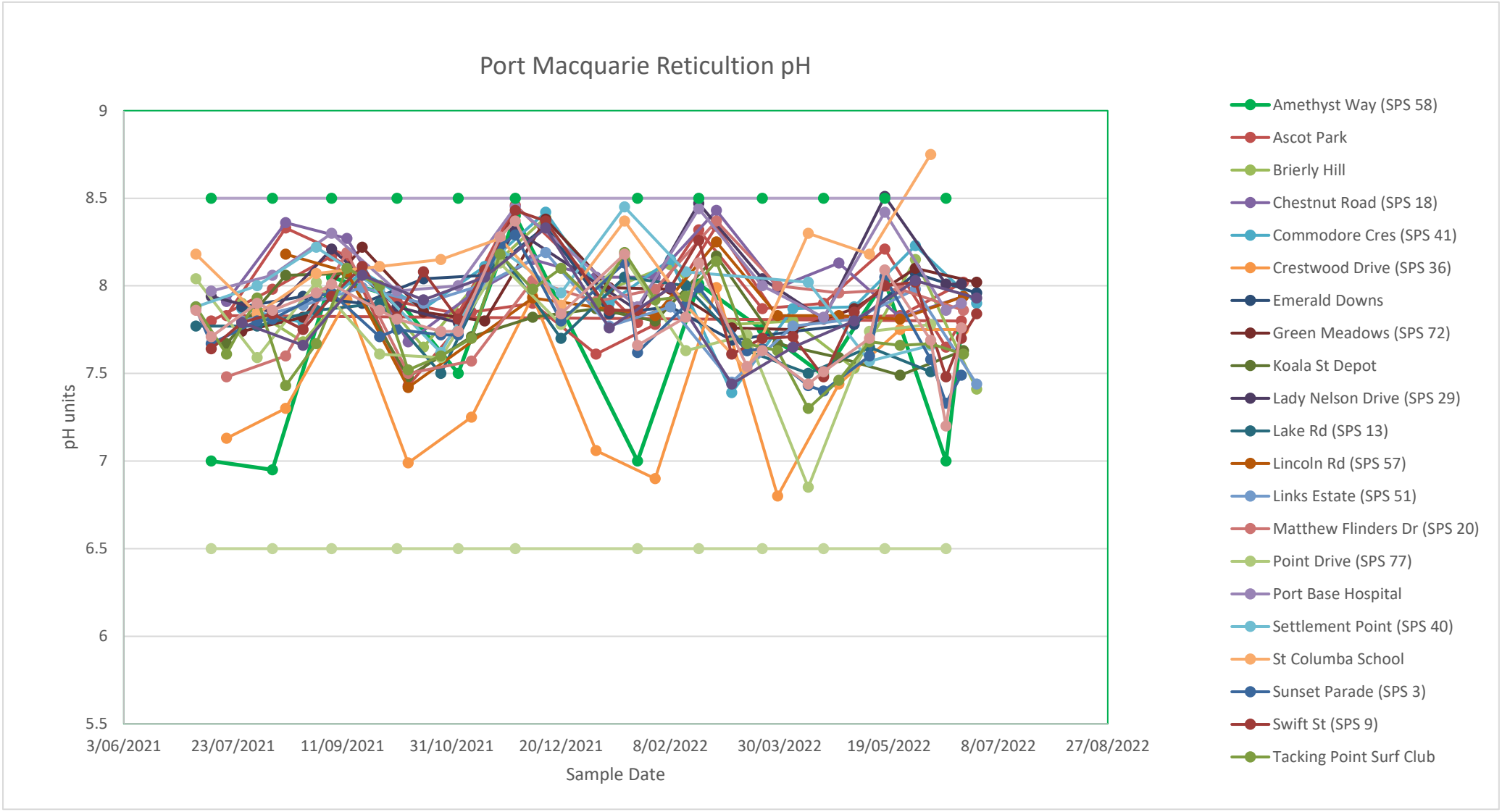
D.2 Cyanobacteria in Cowarra Dam



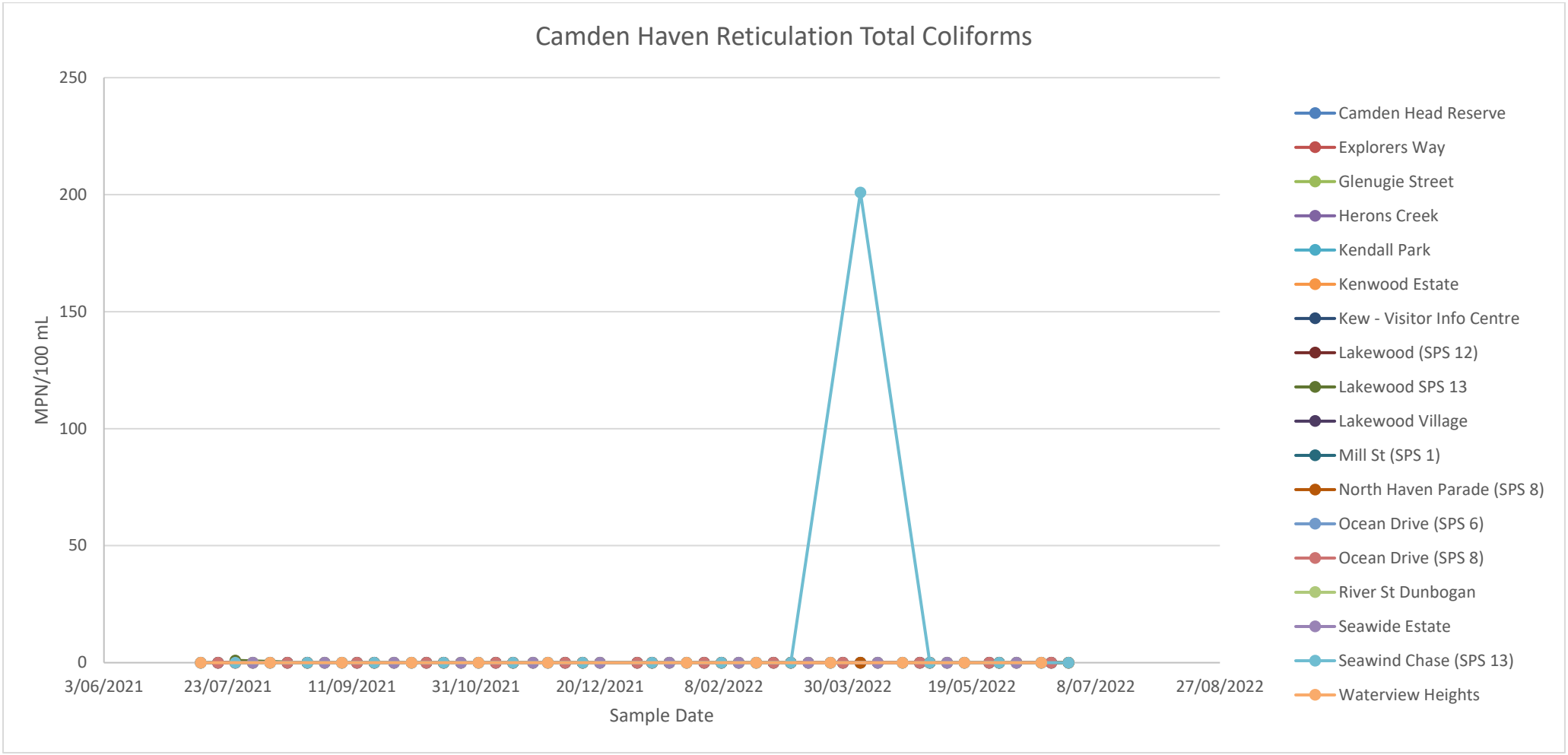
D.3 Port Macquarie Reticulation Total Coliforms Level



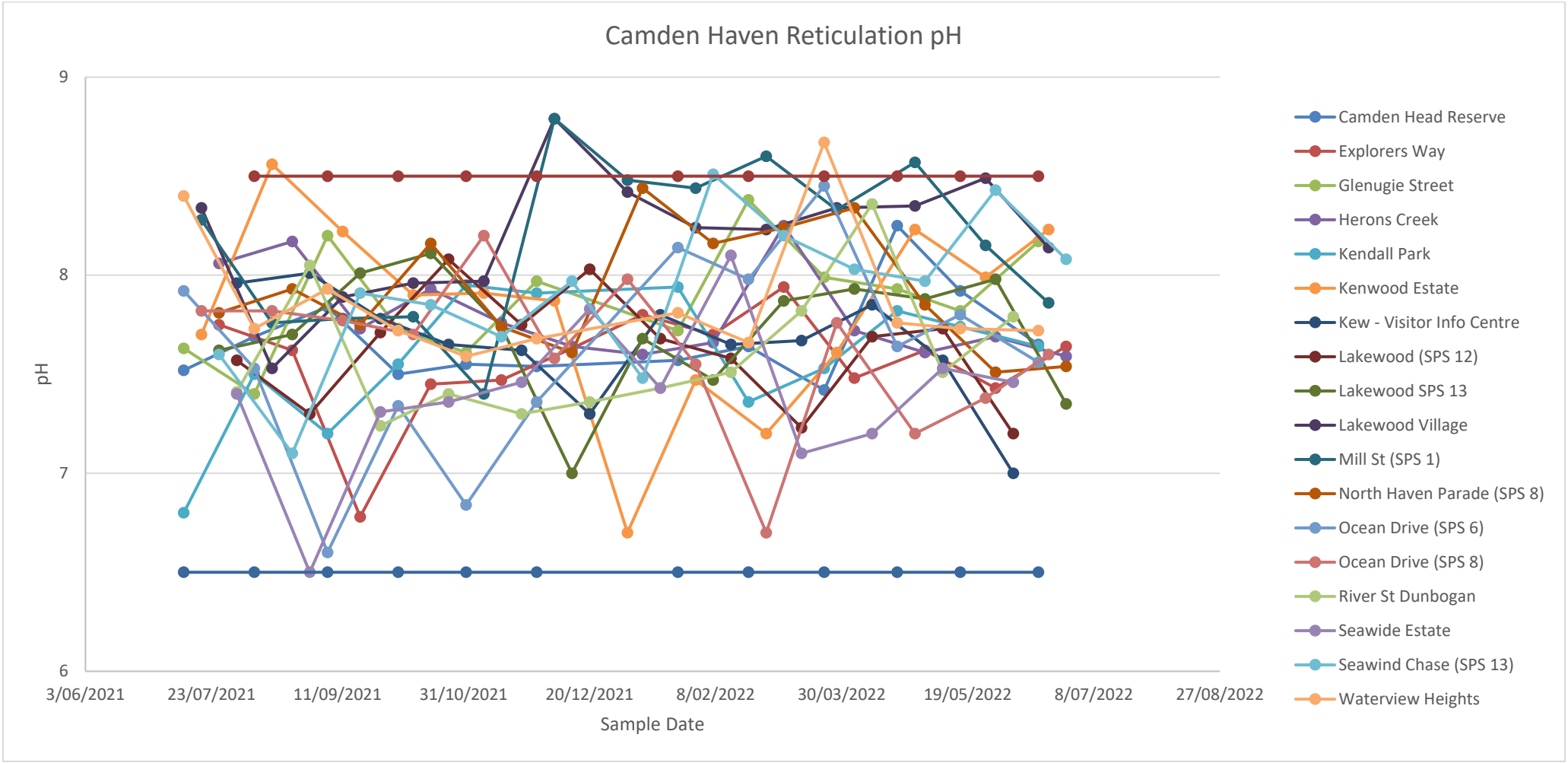
D.4 Port Macquarie Reticulation pH Level



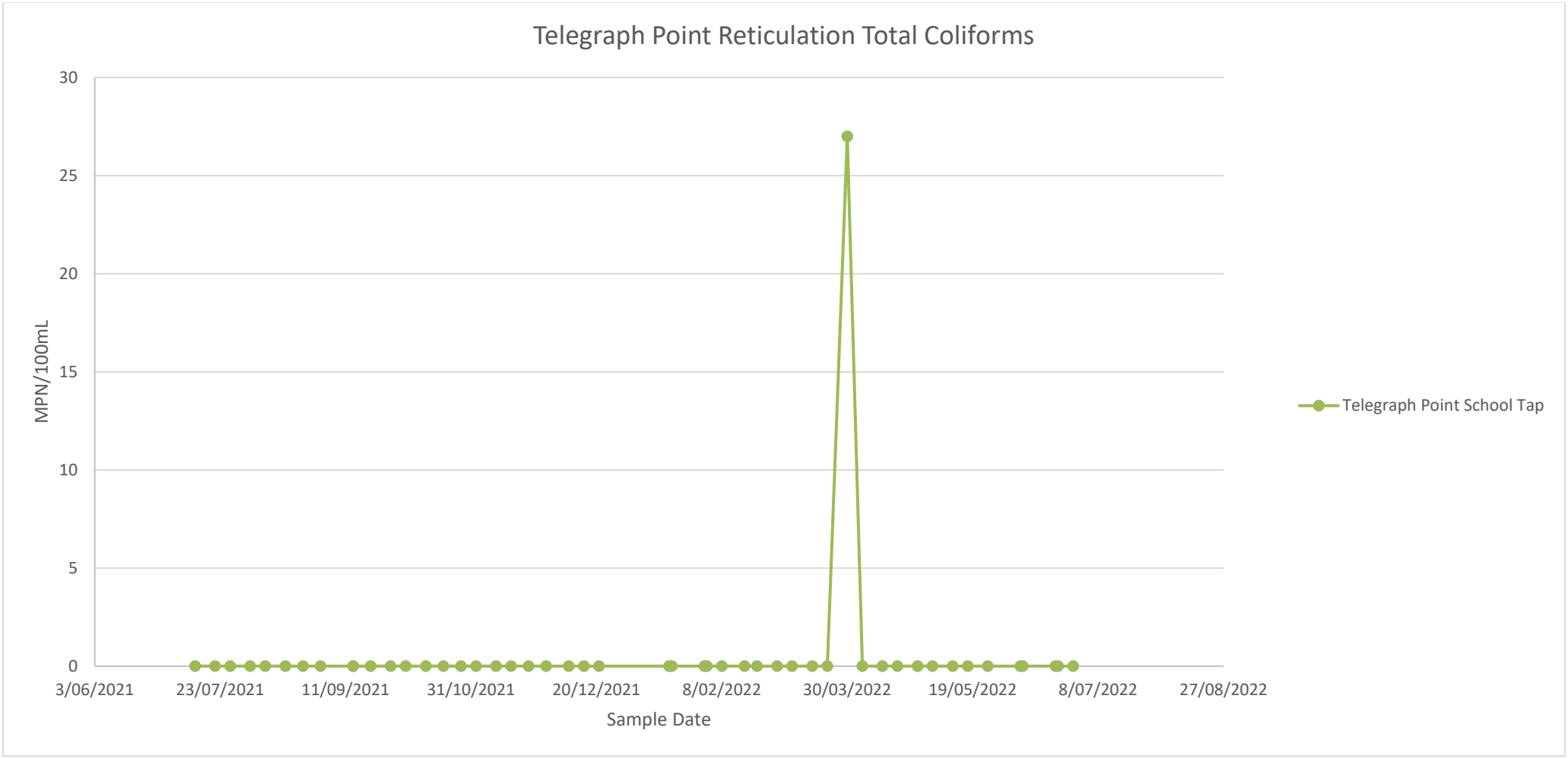
D.5 Camden Haven Reticulation Total Coliforms Level



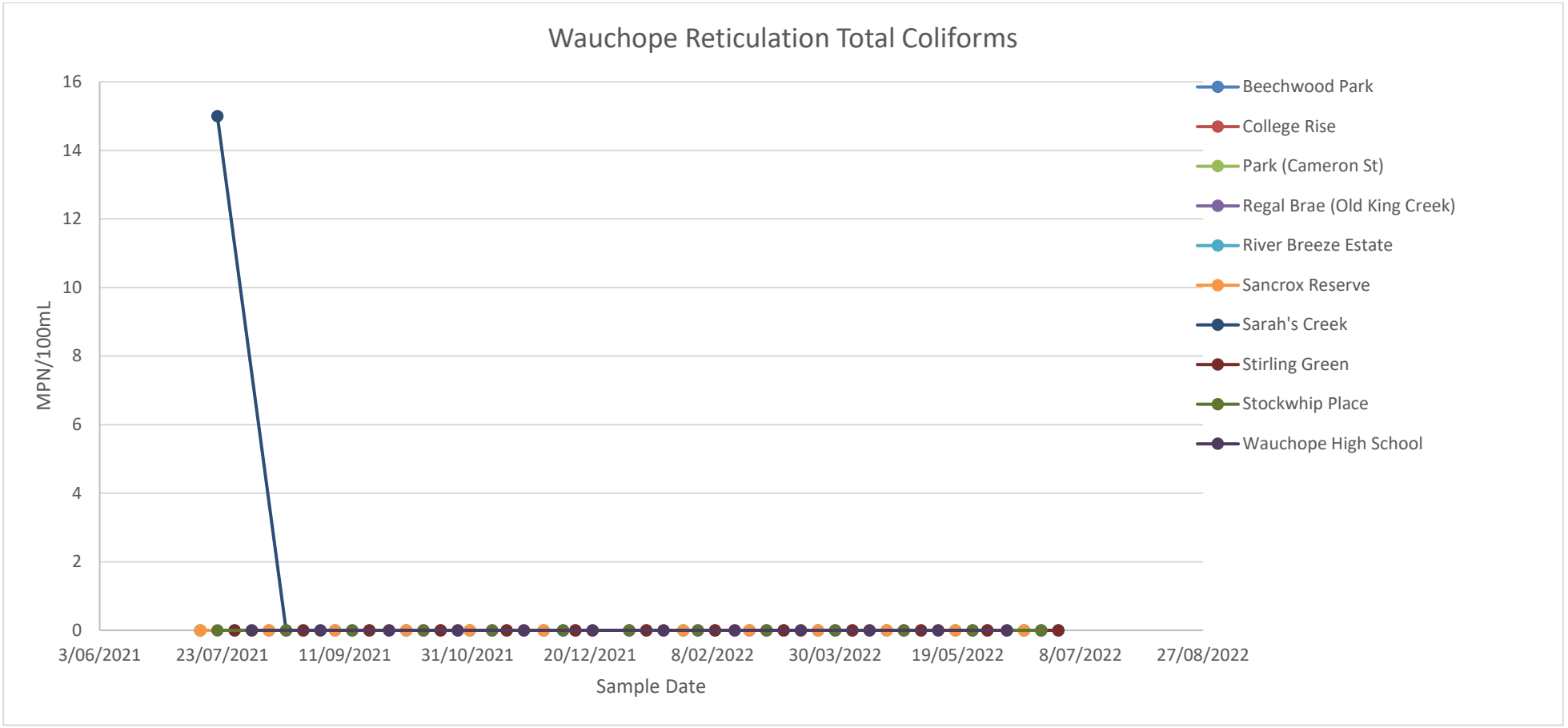
D.6 Camden Haven Reticulation pH Level



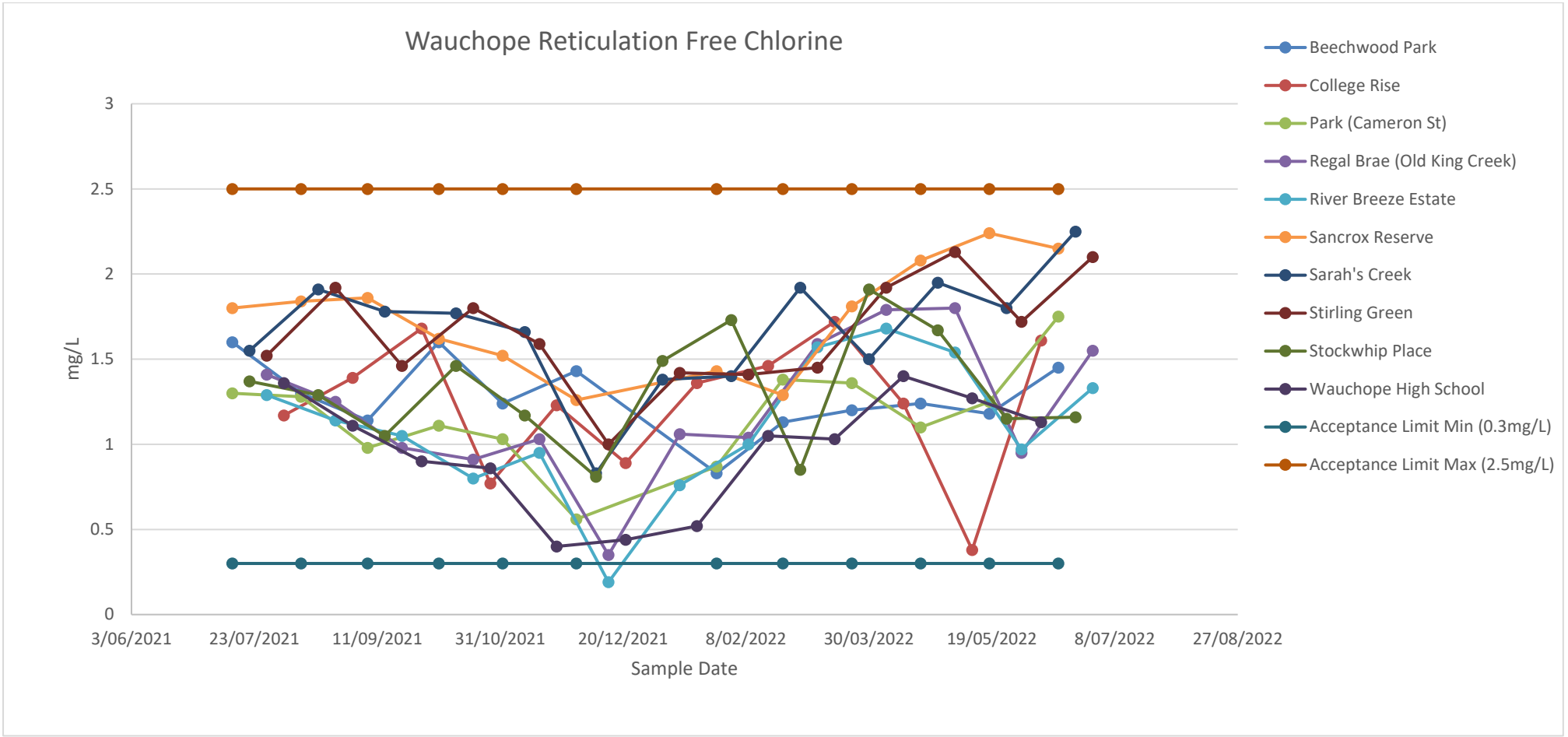
D.7 Telegraph Point Reticulation Total Coliforms Level



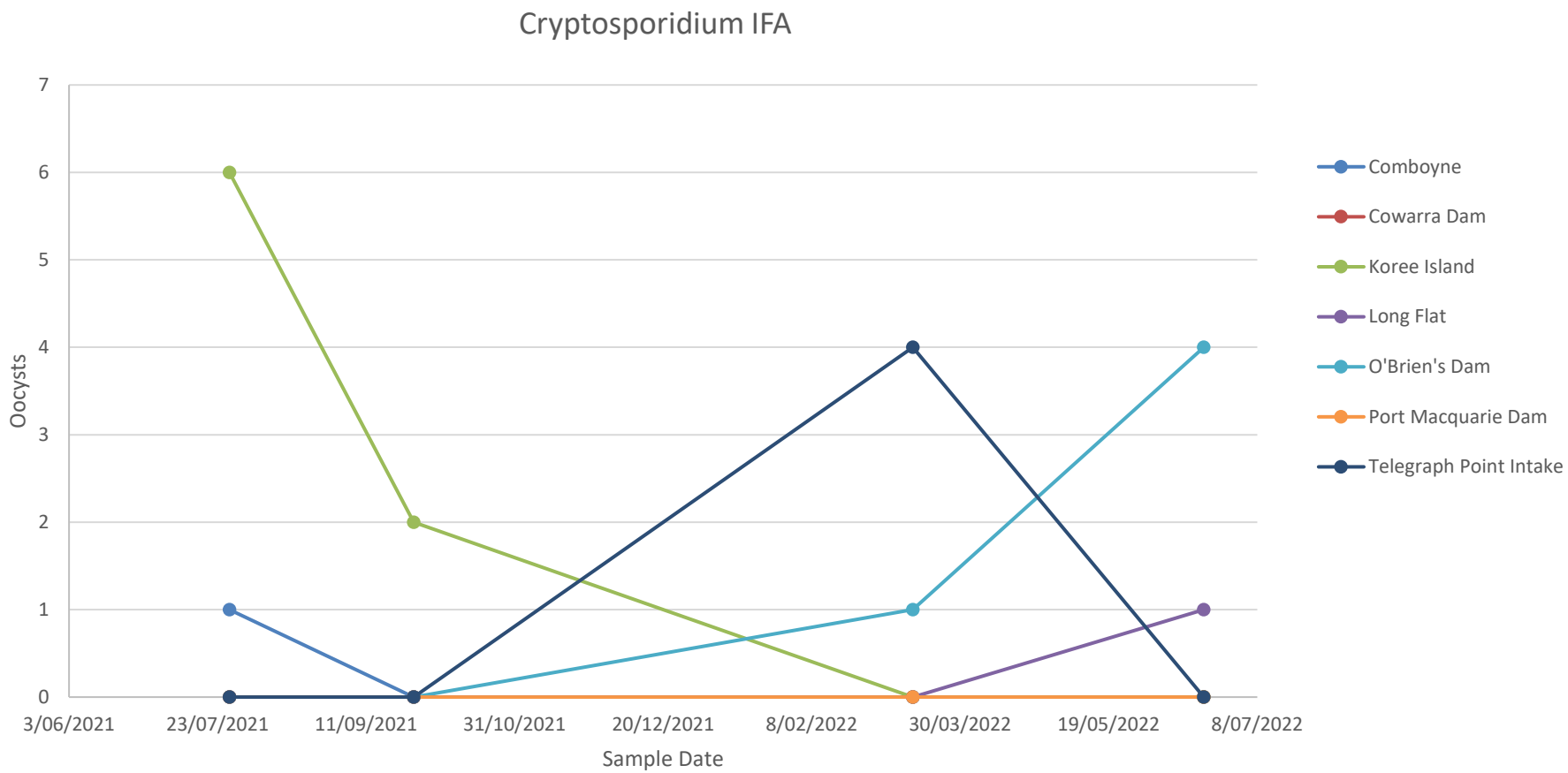
D.8 Wauchope Reticulation Total Coliforms Level



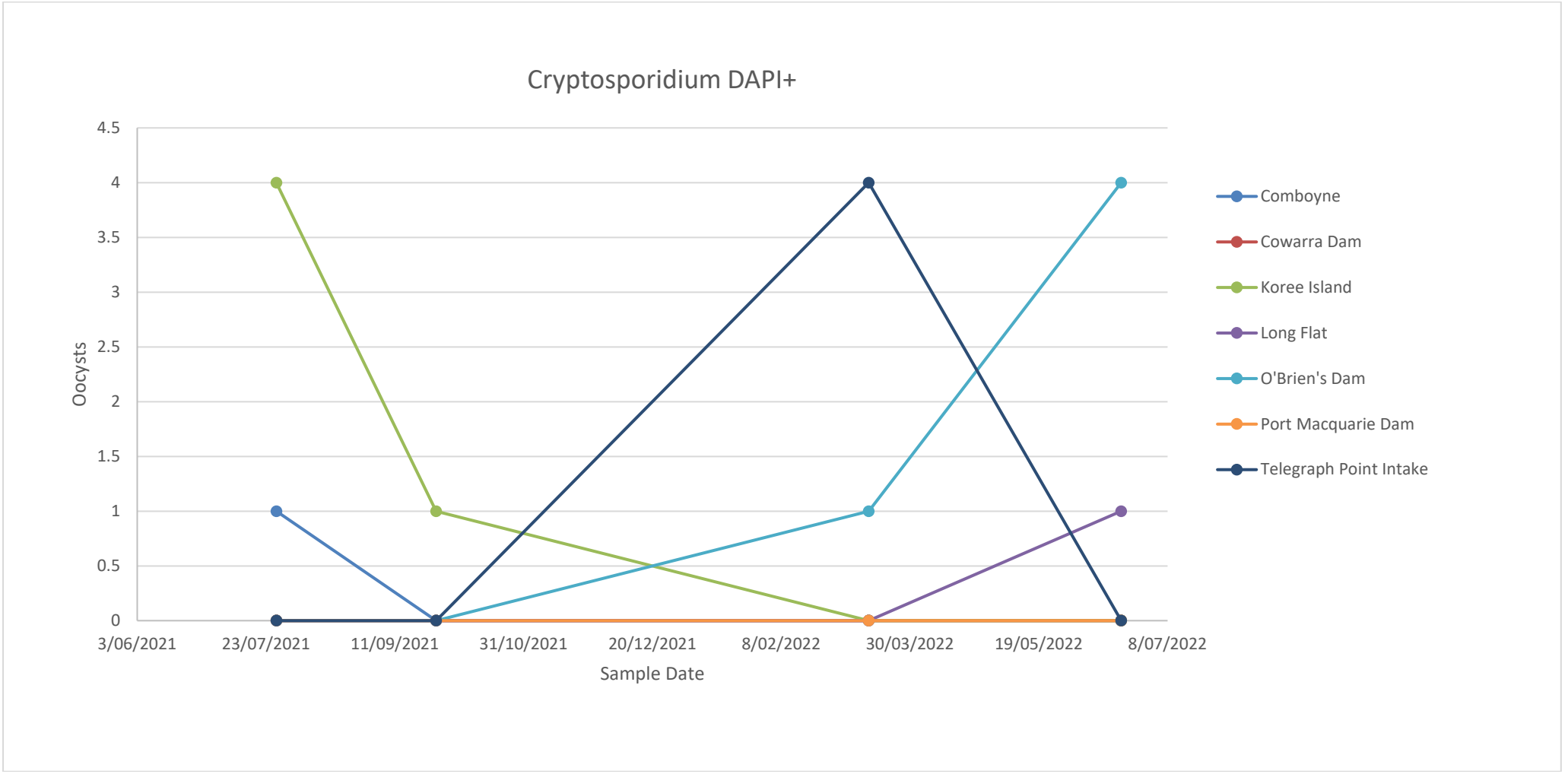
D.9 Wauchope Reticulation Free Chlorine Level



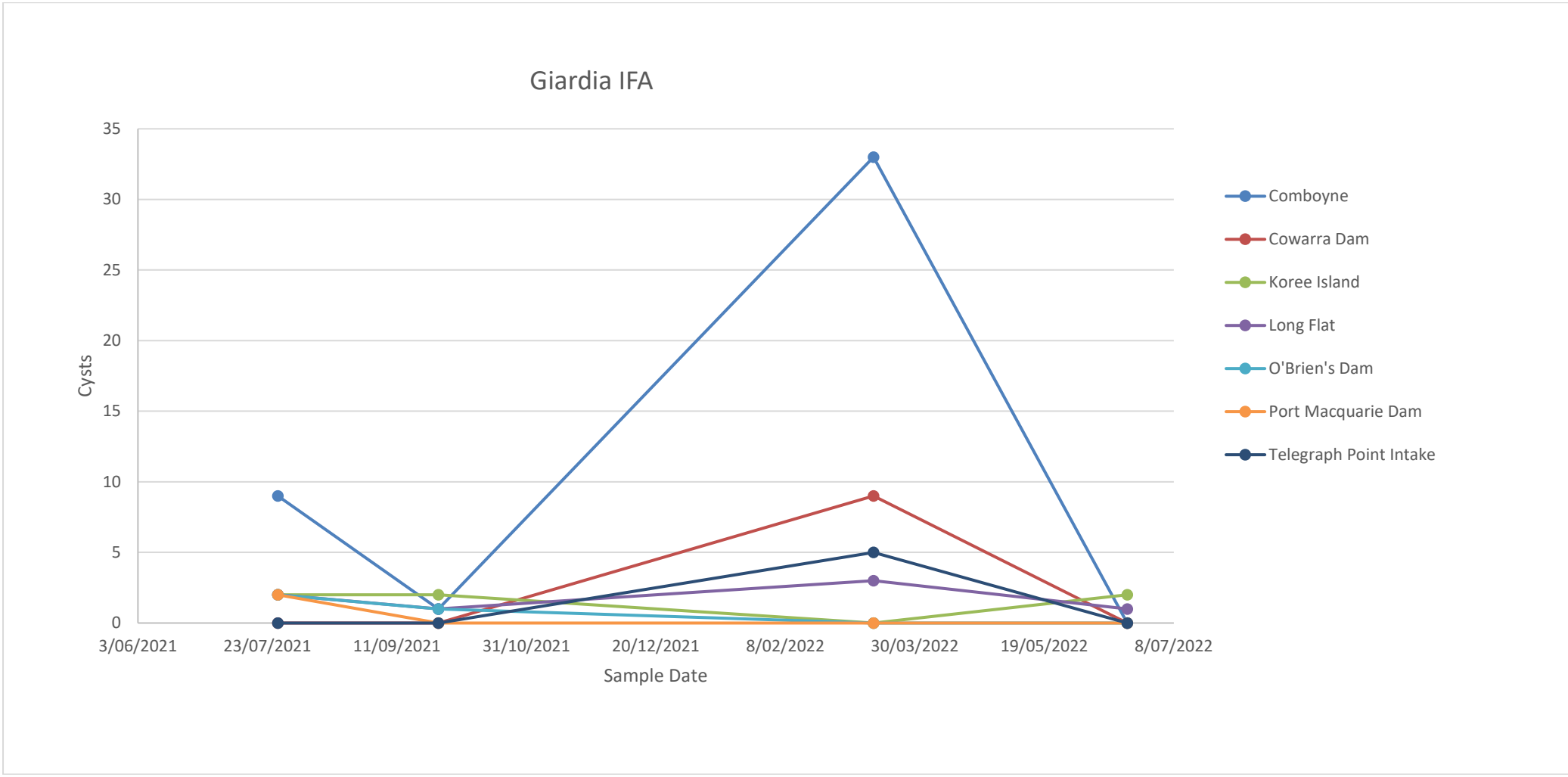
D.10 Cryptosporidium IFA Test Results



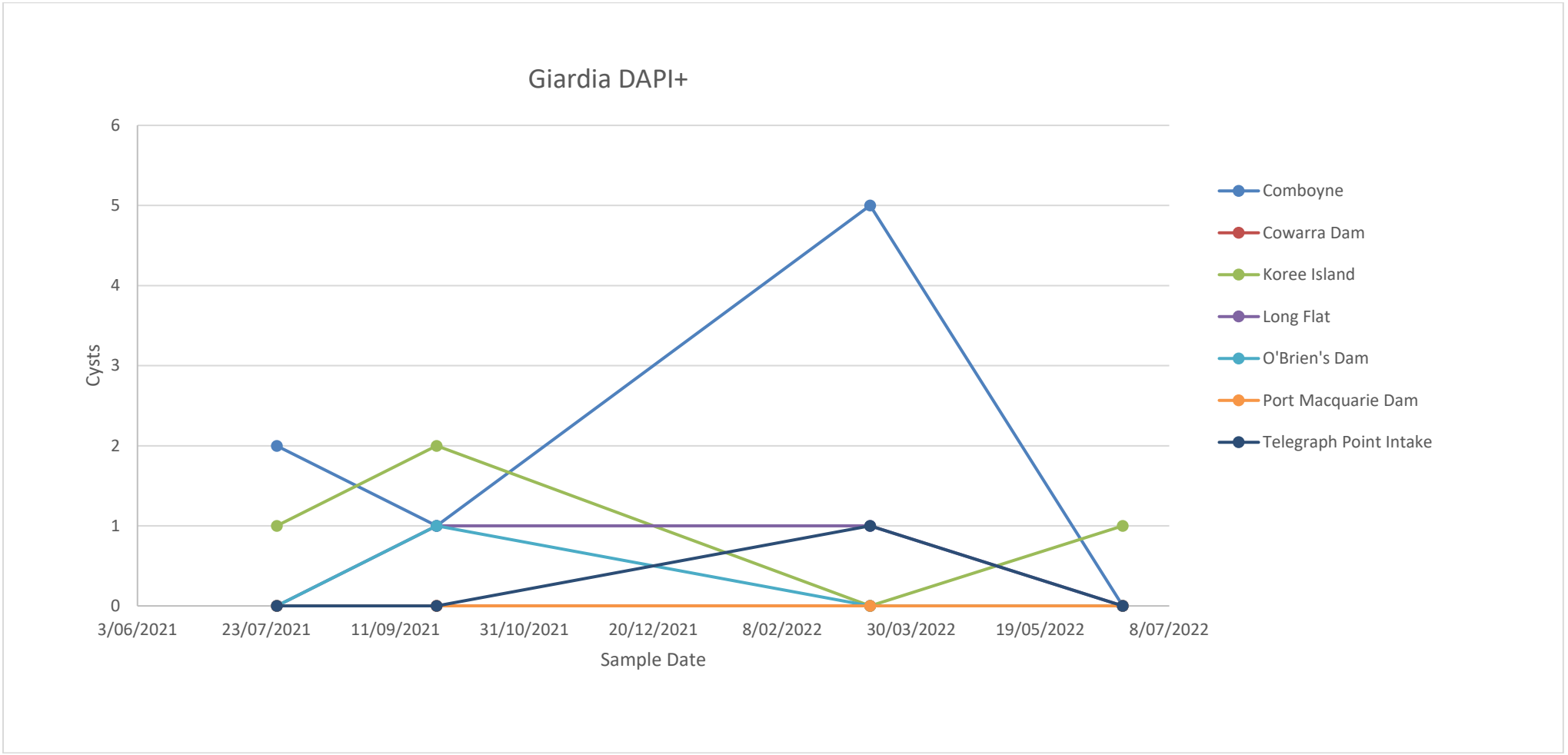
D.11 Cryptosporidium DAPI+ Test Results



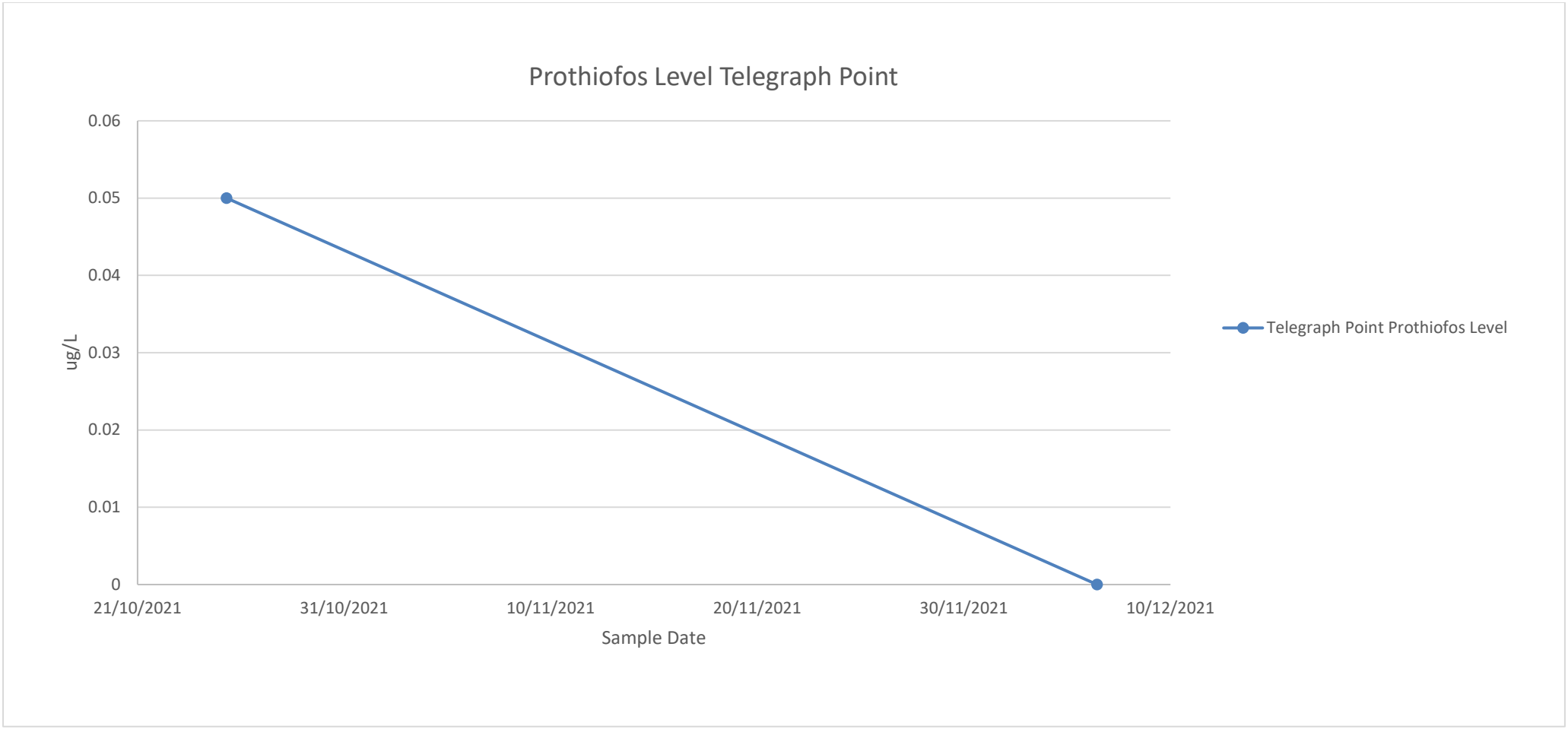
D.12 Giardia IFA Test Results



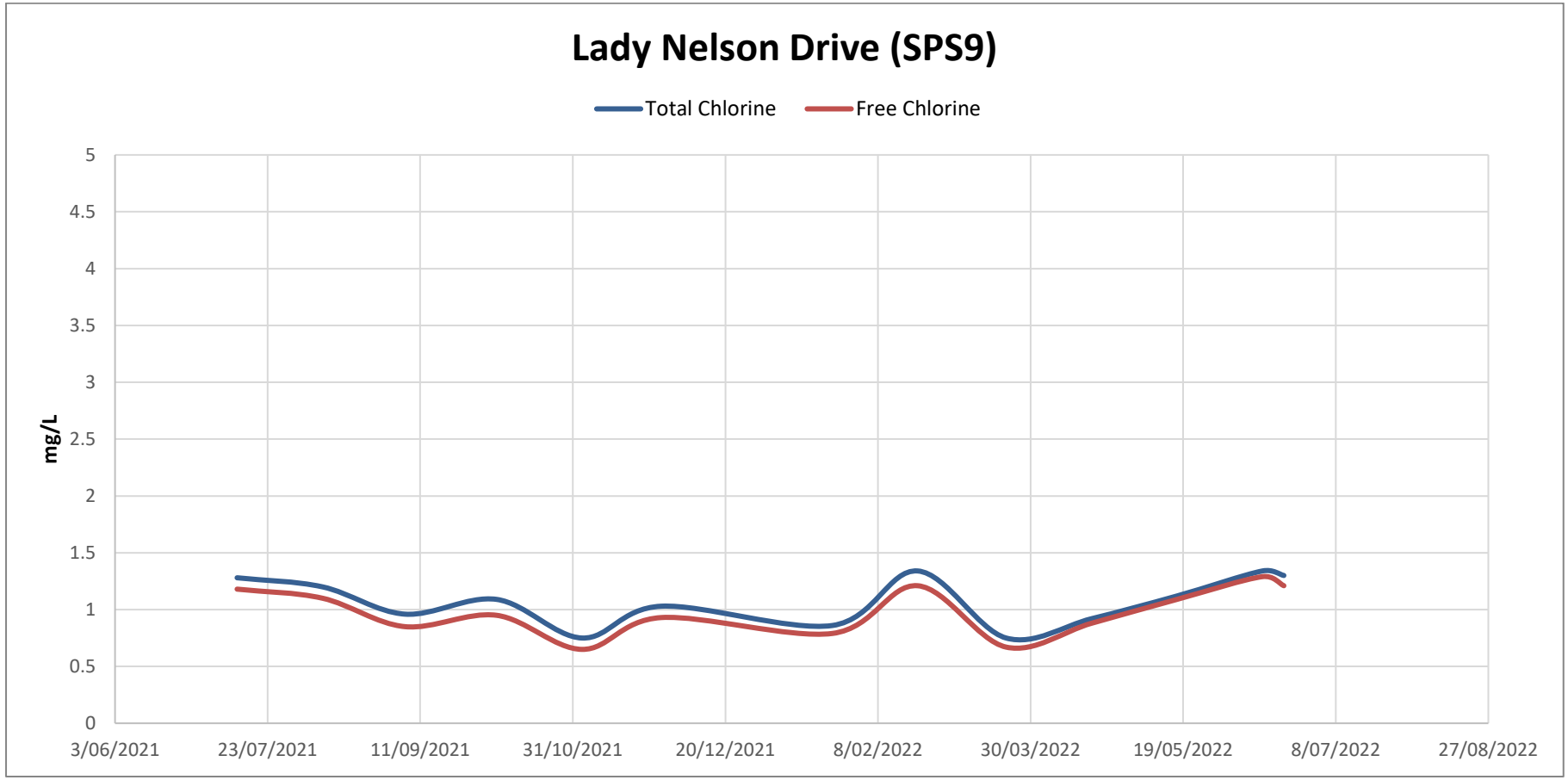
D.13 Giardia DAPI+ Test Results



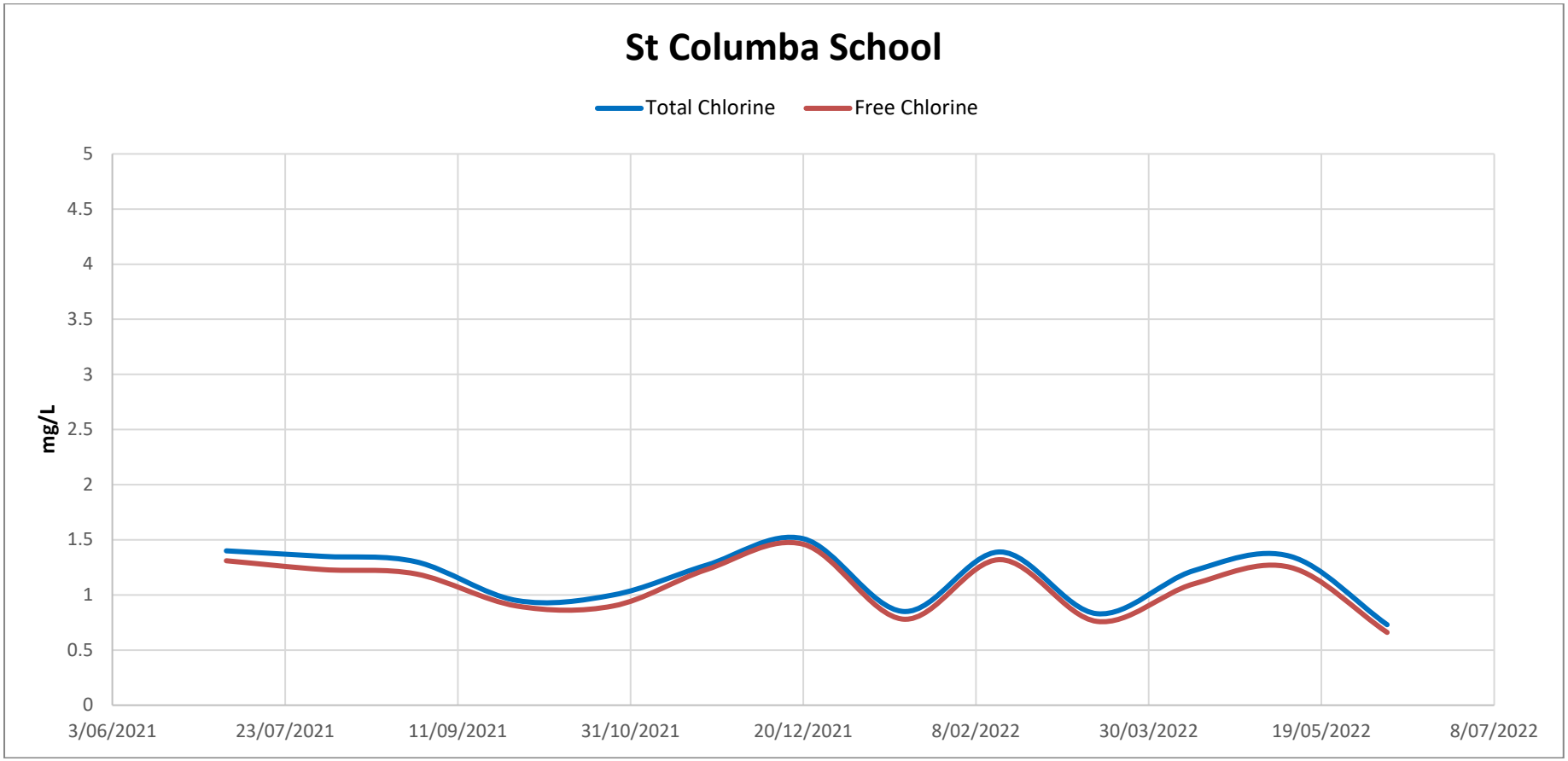
D.14 Prothiofos Level Telegraph Point



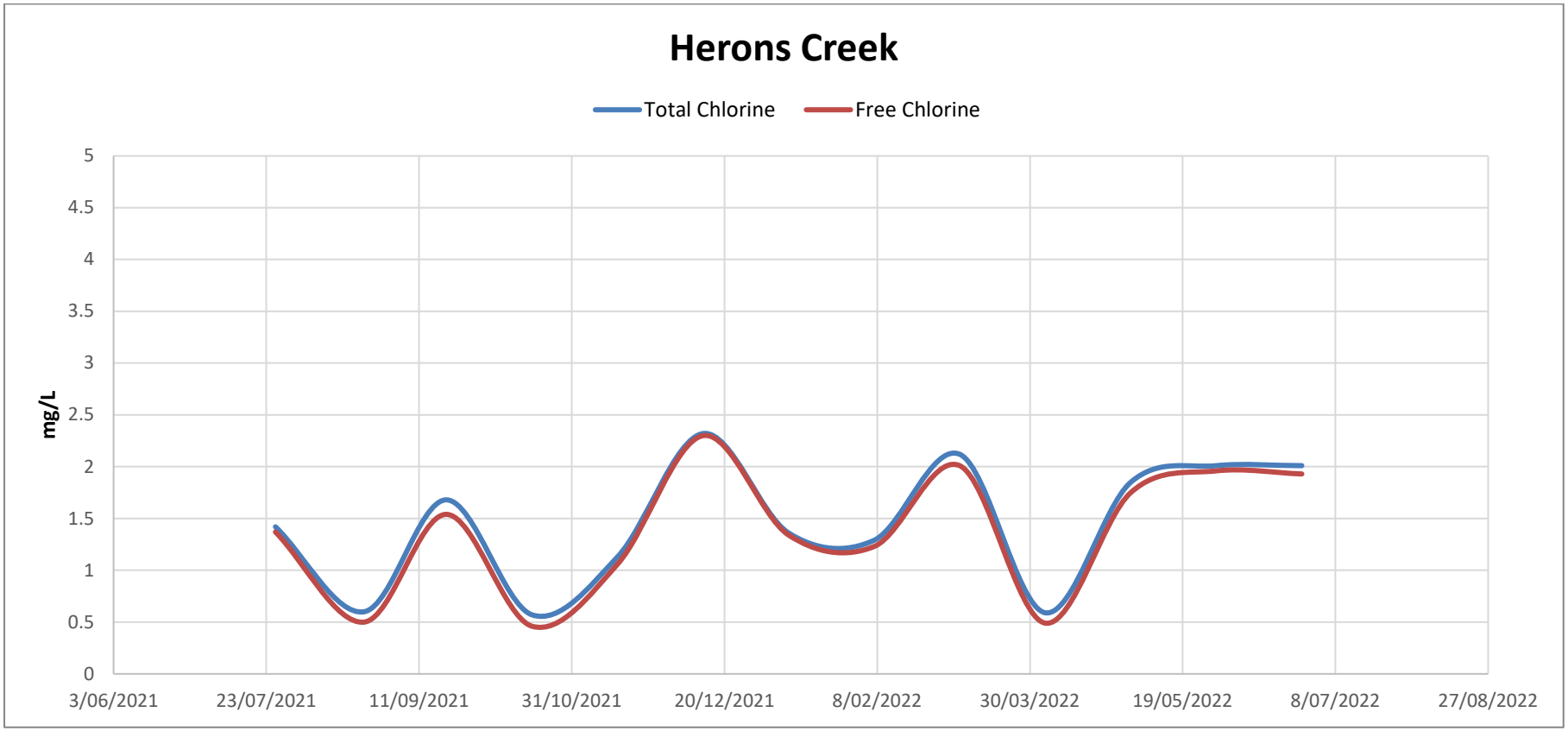
D.15 Graphs of Total Chlorine vs Free Chlorine at Lady Nelson Drive Sample Point



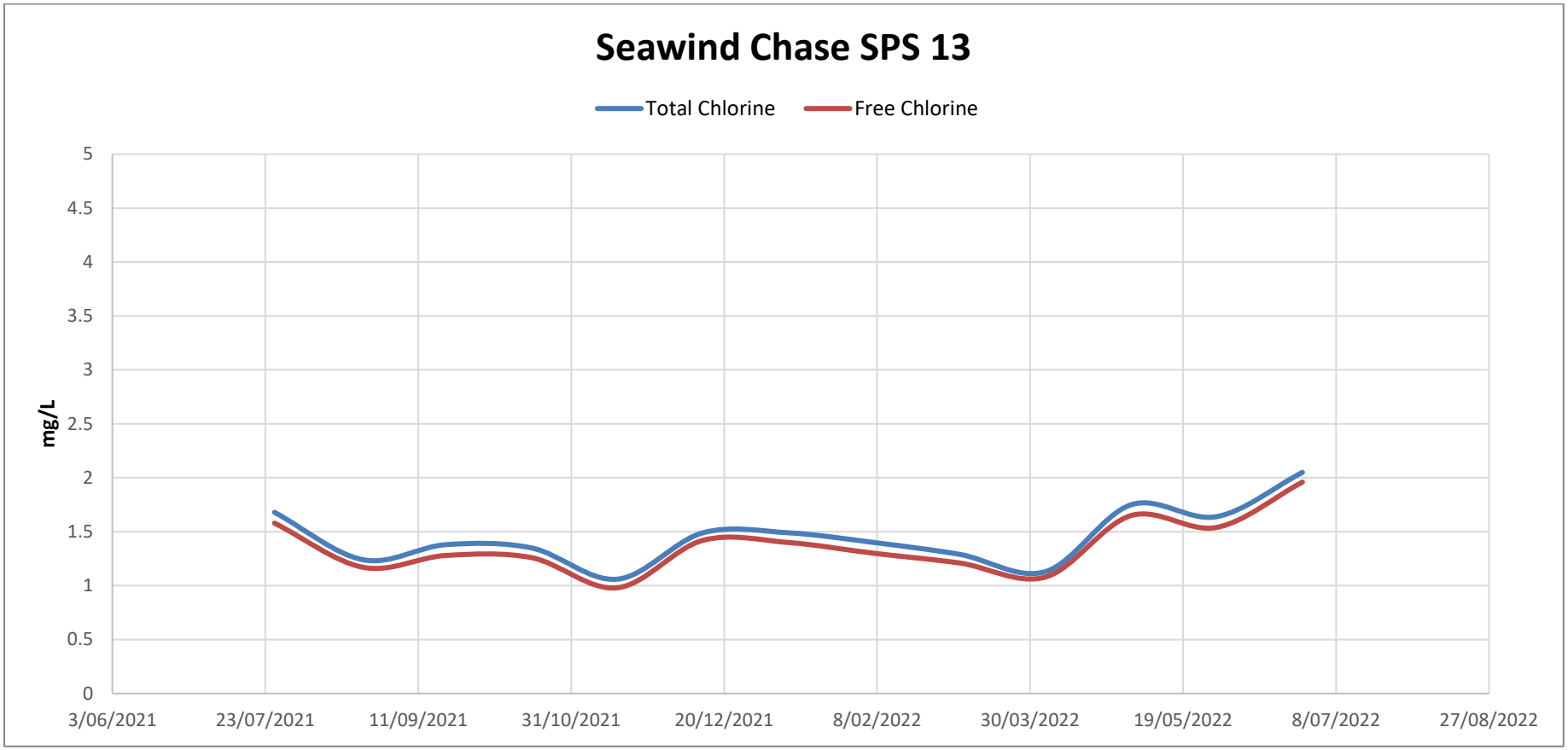
D.16 Graphs of Total Chlorine vs Free Chlorine at St Columba School Sample Point



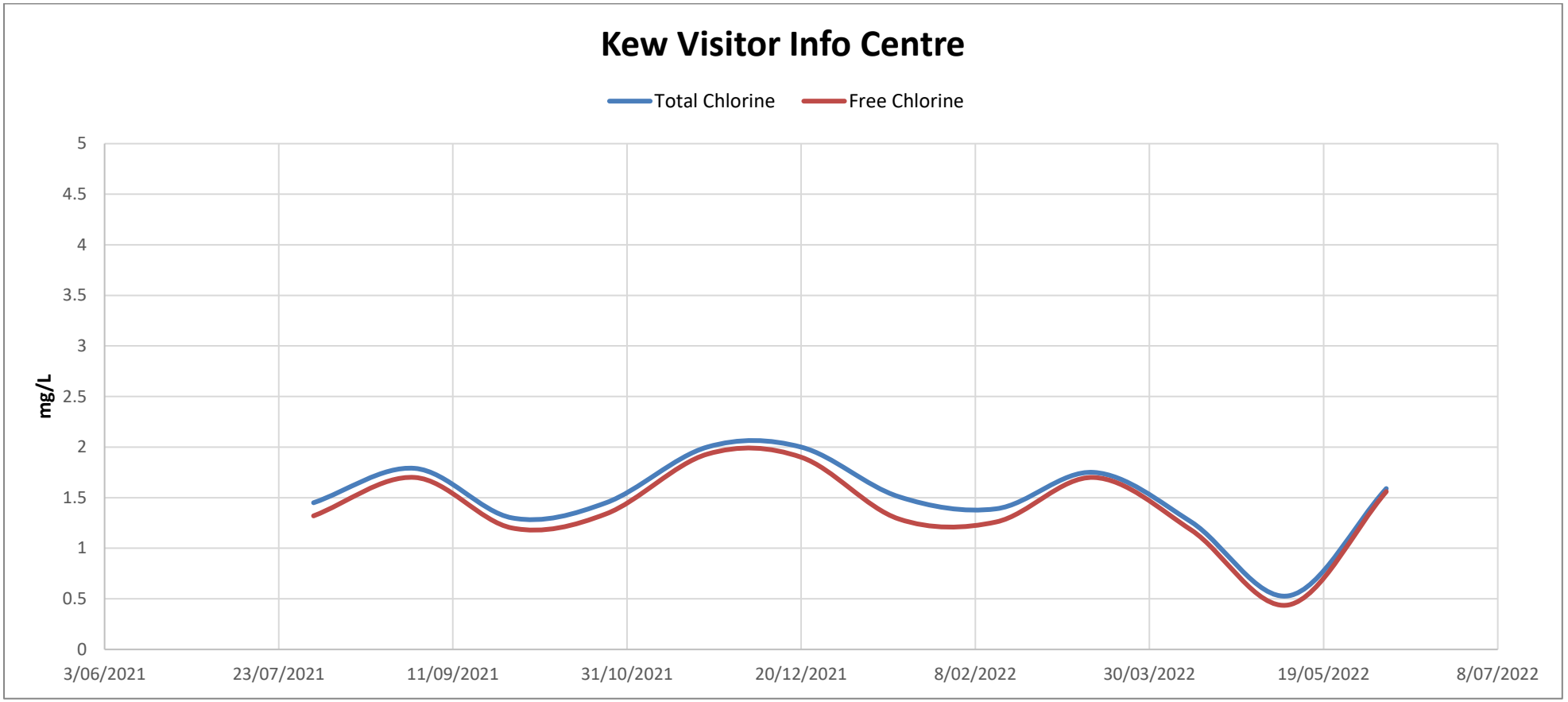
D.17 Graphs of Total Chlorine vs Free Chlorine at Herons Creek Sample Point



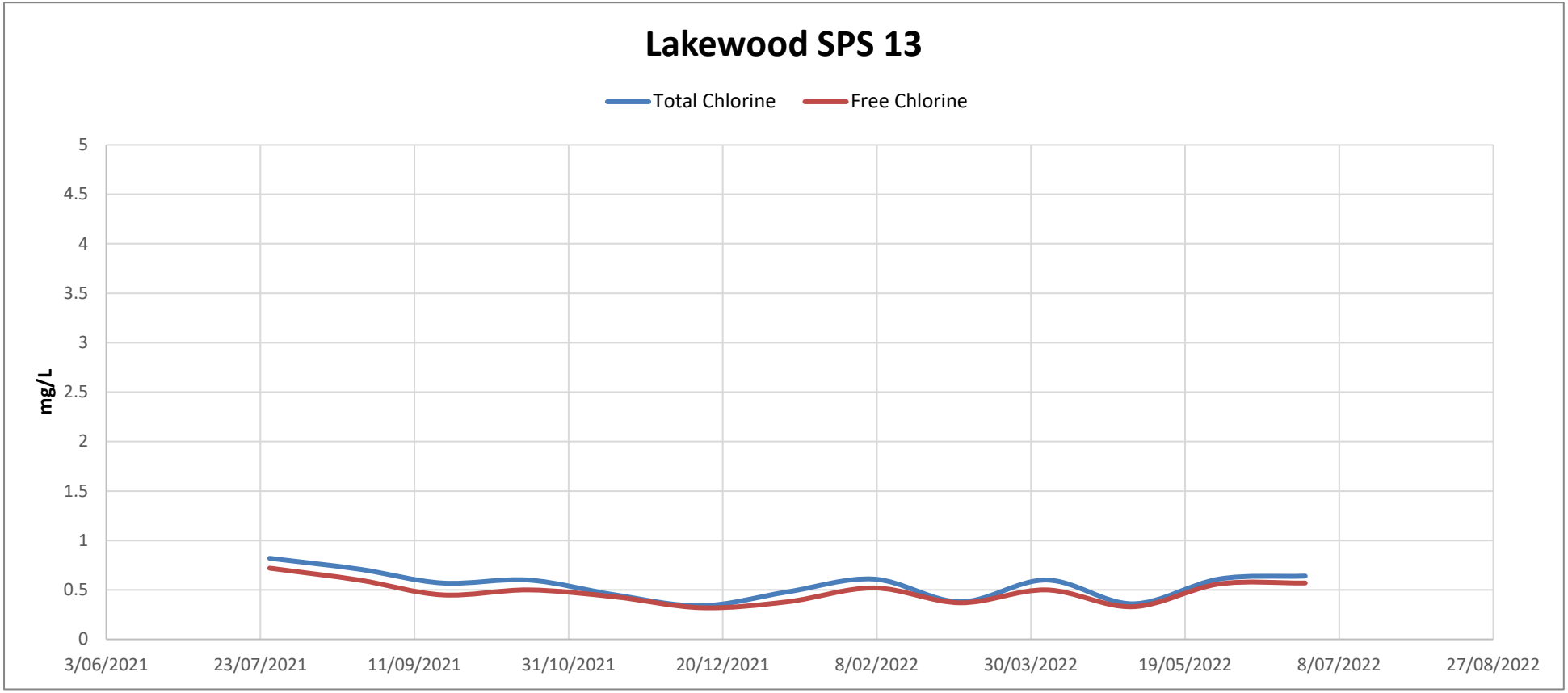
D.18 Graphs of Total Chlorine vs Free Chlorine at Seawind Chase SPS13 Sample Point



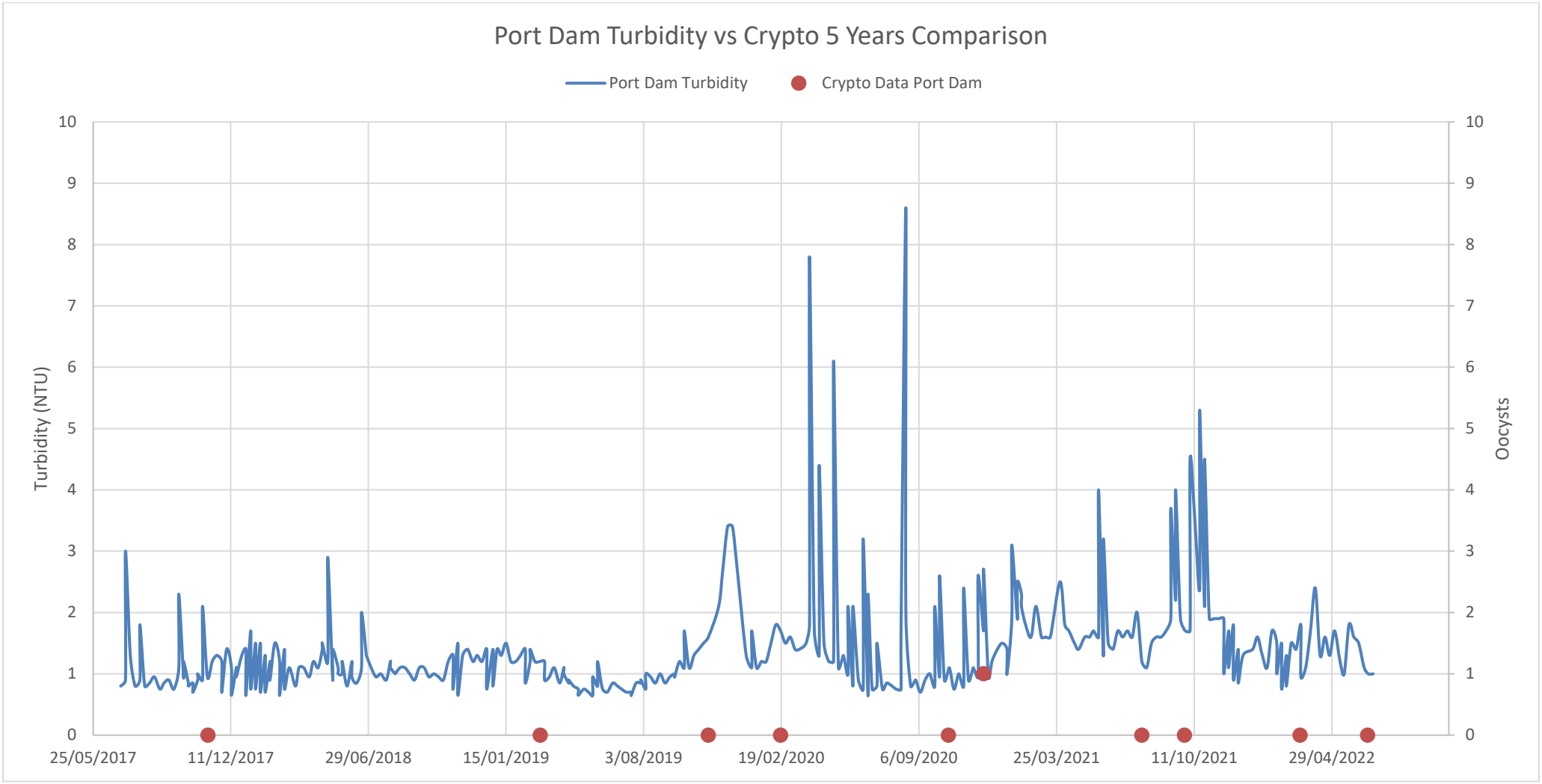
D.19 Graphs of Total Chlorine vs Free Chlorine at Kew Visitor Info Centre Sample Point



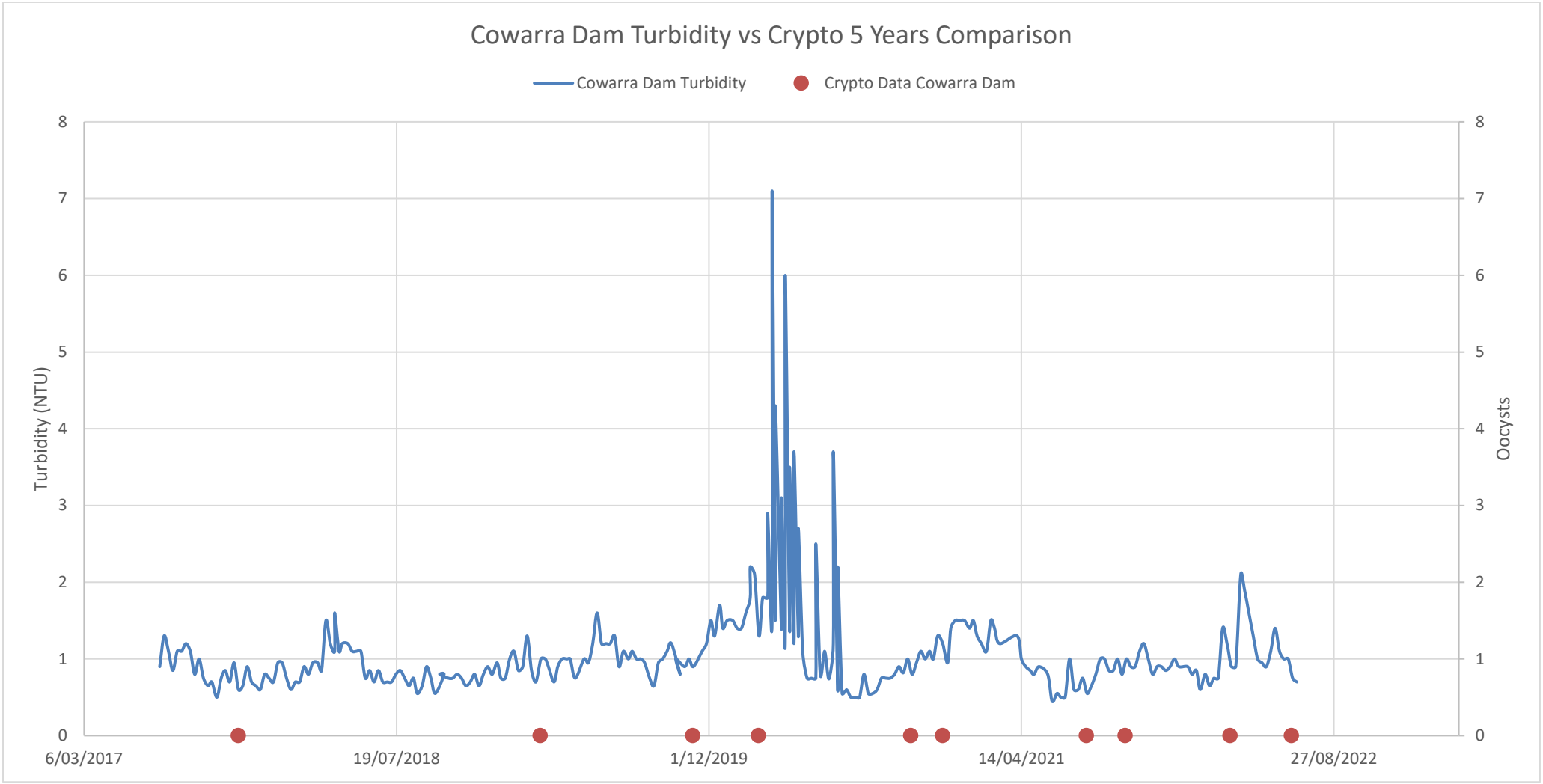
D.20 Graphs of Total Chlorine vs Free Chlorine at Lakewood SPS13 Sample Point



D.21 Graphs of Cryptosporidium VS Turbidity for Port Dam



D.22 Graphs of Cryptosporidium VS Turbidity for Cowarra Dam



Appendix E NSW Health Laboratory Sample Results

E.1 Port Macquarie NSW Health Laboratory Sample Results

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count
Aluminium	0.2000	mg/L	0.0275	0.02	0.05	12	0
Antimony	0.0030	mg/L	0.0001	0.00005	0.0001	12	0
Arsenic	0.0100	mg/L	0.0008	0.0005	0.001	12	0
Barium	2.0000	mg/L	0.0117	0.0104	0.0134	12	0
Boron	4.0000	mg/L	0.0143	0.0121	0.0162	12	0
Cadmium	0.0020	mg/L	0.0001	0.00005	0.00005	12	0
Calcium	10000.0000	mg/L	15.2250	11	18.8	12	0
Chloride	250.0000	mg/L	25.1667	23	28	12	0
Chromium	0.0500	mg/L	0.0005	0.0005	0.0005	12	0
Copper	2.0000	mg/L	0.0383	0.002	0.287	12	0
Fluoride	1.5000	mg/L	0.2933	0.11	0.45	12	0
Fluoride (WU result)	1.5000	mg/L	0.3025	0.11	0.48	12	0
Fluoride Ratio	0.8 - 1.2	mg/L	1.0375	0.92	1.18	12	0
Iodine	0.5000	mg/L	0.0242	0.02	0.04	12	0
Iron	0.3000	mg/L	0.0638	0.005	0.12	12	0
Lead	0.0100	mg/L	0.0005	0.0001	0.0025	12	0
Magnesium	10000.0000	mg/L	4.2217	3.91	4.52	12	0
Manganese	0.5000	mg/L	0.0103	0.0027	0.0208	12	0
Mercury	0.0010	mg/L	0.0004	0.0004	0.0004	12	0
Molybdenum	0.0500	mg/L	0.0002	0.0001	0.0003	12	0
Nickel	0.0200	mg/L	0.0002	0.0002	0.0005	12	0
Nitrate	50.0000	mg/L	0.5000	0.5	0.5	12	0
Nitrite	3.0000	mg/L	0.0500	0.05	0.05	12	0
pH	6.5 - 8.5	mg/L	7.9500	7.6	8.5	12	0
Selenium	0.0100	mg/L	0.0035	0.0035	0.0035	12	0
Silver	0.1000	mg/L	0.0001	0.0001	0.0001	12	0
Sodium	180.0000	mg/L	16.2500	15	18	12	0
Sulfate	500.0000	mg/L	4.3333	4	5	12	0
Total Dissolved Solids (TDS)	10000.0000	mg/L	93.8333	83	100	12	0
Total Hardness as CaCO3	10000.0000	mg/L	55.4083	43.6	63.6	12	0
True Colour	15.0000	Hazen Units (HU)	1.5000	1	2	12	0
Turbidity	5.0000	NTU	0.4875	0.05	1.3	12	0
Uranium	0.0170	mg/L	0.0001	0.00005	0.00005	12	0
Zinc	3.0000	mg/L	0.0246	0.005	0.1	12	0

E.2 Wauchope NSW Health Laboratory Sample Results

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count
Aluminium	0.2000	mg/L	0.0167	0.005	0.03	12	0
Antimony	0.0030	mg/L	0.0001	0.00005	0.0002	12	0
Arsenic	0.0100	mg/L	0.0007	0.0005	0.001	12	0
Barium	2.0000	mg/L	0.0108	0.0089	0.0138	12	0
Boron	4.0000	mg/L	0.0121	0.0092	0.0149	12	0
Cadmium	0.0020	mg/L	0.0001	0.00005	0.00005	12	0
Calcium	10000.0000	mg/L	18.8250	17.2	20.6	12	0
Chloride	250.0000	mg/L	20.0000	16	24	12	0
Chromium	0.0500	mg/L	0.0005	0.0005	0.0005	12	0
Copper	2.0000	mg/L	0.1548	0.002	0.814	12	0
Fluoride	1.5000	mg/L	0.9800	0.76	1.04	12	0
Fluoride (WU result)	1.5000	mg/L	0.9867	0.8	1.03	12	0
Fluoride Ratio	0.8 - 1.2	mg/L	1.0075	0.95	1.07	12	0
Iodine	0.5000	mg/L	0.0108	0.01	0.02	12	0
Iron	0.3000	mg/L	0.0096	0.005	0.02	12	0
Lead	0.0100	mg/L	0.0012	0.0001	0.0057	12	0
Magnesium	10000.0000	mg/L	4.0442	3.06	5.53	12	0
Manganese	0.5000	mg/L	0.0008	0.0003	0.0015	12	0
Mercury	0.0010	mg/L	0.0004	0.0004	0.0004	12	0
Molybdenum	0.0500	mg/L	0.0002	0.0001	0.0002	12	0
Nickel	0.0200	mg/L	0.0006	0.0002	0.0016	12	0
Nitrate	50.0000	mg/L	0.7917	0.5	1	12	0
Nitrite	3.0000	mg/L	0.0500	0.05	0.05	12	0
pH	6.5 - 8.5	mg/L	7.9583	7.8	8.1	12	0
Selenium	0.0100	mg/L	0.0035	0.0035	0.0035	12	0
Silver	0.1000	mg/L	0.0001	0.0001	0.0001	12	0
Sodium	180.0000	mg/L	13.5833	13	15	12	0
Sulfate	500.0000	mg/L	3.9167	3	5	12	0
Total Dissolved Solids (TDS)	10000.0000	mg/L	94.1667	76	108	12	0
Total Hardness as CaCO3	10000.0000	mg/L	63.6667	56.5	71.7	12	0
True Colour	15.0000	Hazen Units (HU)	1.8333	1	4	12	0
Turbidity	5.0000	NTU	0.4375	0.05	2.3	12	0
Uranium	0.0170	mg/L	0.0001	0.00005	0.00005	12	0
Zinc	3.0000	mg/L	0.0604	0.005	0.26	12	0

E.3 Comboyne NSW Health Laboratory Sample Results

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count
Aluminium	0.2000	mg/L	0.0075	0.005	0.01	2	0
Antimony	0.0030	mg/L	0.0001	0.00005	0.00005	2	0
Arsenic	0.0100	mg/L	0.0005	0.0005	0.0005	2	0
Barium	2.0000	mg/L	0.0061	0.0048	0.0073	2	0
Boron	4.0000	mg/L	0.0089	0.007	0.0107	2	0
Cadmium	0.0020	mg/L	0.0001	0.00005	0.00005	2	0
Calcium	10000.0000	mg/L	3.4500	3.3	3.6	2	0
Chloride	250.0000	mg/L	15.0000	15	15	2	0
Chromium	0.0500	mg/L	0.0005	0.0005	0.0005	2	0
Copper	2.0000	mg/L	0.1960	0.058	0.334	2	0
Fluoride	1.5000	mg/L	0.0500	0.05	0.05	2	0
Fluoride (WU result)	1.5000	mg/L	0.0250	0.02	0.03	2	0
Fluoride Ratio	0.8 - 1.2	mg/L	0.2500	0.2	0.3	2	2
Iodine	0.5000	mg/L	0.0100	0.01	0.01	2	0
Iron	0.3000	mg/L	0.0350	0.03	0.04	2	0
Lead	0.0100	mg/L	0.0004	0.0001	0.0007	2	0
Magnesium	10000.0000	mg/L	0.3950	0.29	0.5	2	0
Manganese	0.5000	mg/L	0.0048	0.0024	0.0072	2	0
Mercury	0.0010	mg/L	0.0004	0.0004	0.0004	2	0
Molybdenum	0.0500	mg/L	0.0001	0.00005	0.00005	2	0
Nickel	0.0200	mg/L	0.0002	0.0002	0.0002	2	0
Nitrate	50.0000	mg/L	1.0000	1	1	2	0
Nitrite	3.0000	mg/L	0.0500	0.05	0.05	2	0
pH	6.5 - 8.5	mg/L	7.3000	7.2	7.4	2	0
Selenium	0.0100	mg/L	0.0035	0.0035	0.0035	2	0
Silver	0.1000	mg/L	0.0001	0.0001	0.0001	2	0
Sodium	180.0000	mg/L	10.0000	9	11	2	0
Sulfate	500.0000	mg/L	2.0000	2	2	2	0
Total Dissolved Solids (TDS)	10000.0000	mg/L	40.0000	39	41	2	0
Total Hardness as CaCO3	10000.0000	mg/L	10.2500	10.2	10.3	2	0
True Colour	15.0000	Hazen Units (HU)	1.5000	1	2	2	0
Turbidity	5.0000	NTU	0.0750	0.05	0.1	2	0
Uranium	0.0170	mg/L	0.0001	0.00005	0.00005	2	0
Zinc	3.0000	mg/L	0.0075	0.005	0.01	2	0

E.4 Long Flat NSW Health Laboratory Sample Results

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count
Aluminium	0.2000	mg/L	0.0100	0.01	0.01	2	0
Antimony	0.0030	mg/L	0.0001	0.00005	0.00005	2	0
Arsenic	0.0100	mg/L	0.0005	0.0005	0.0005	2	0
Barium	2.0000	mg/L	0.0076	0.0062	0.009	2	0
Boron	4.0000	mg/L	0.0110	0.0095	0.0124	2	0
Cadmium	0.0020	mg/L	0.0001	0.00005	0.00005	2	0
Calcium	10000.0000	mg/L	8.8500	7.5	10.2	2	0
Chloride	250.0000	mg/L	27.5000	26	29	2	0
Chromium	0.0500	mg/L	0.0005	0.0005	0.0005	2	0
Copper	2.0000	mg/L	0.0360	0.03	0.042	2	0
Fluoride	1.5000	mg/L	0.0500	0.05	0.05	2	0
Fluoride (WU result)	1.5000	mg/L	0.0550	0.05	0.06	2	0
Fluoride Ratio	0.8 - 1.2	mg/L	0.5500	0.5	0.6	2	2
Iodine	0.5000	mg/L	0.0100	0.01	0.01	2	0
Iron	0.3000	mg/L	0.0125	0.005	0.02	2	0
Lead	0.0100	mg/L	0.0003	0.0002	0.0004	2	0
Magnesium	10000.0000	mg/L	4.0200	2.9	5.14	2	0
Manganese	0.5000	mg/L	0.0026	0.0024	0.0027	2	0
Mercury	0.0010	mg/L	0.0004	0.0004	0.0004	2	0
Molybdenum	0.0500	mg/L	0.0001	0.0001	0.0001	2	0
Nickel	0.0200	mg/L	0.0003	0.0002	0.0004	2	0
Nitrate	50.0000	mg/L	0.7500	0.5	1	2	0
Nitrite	3.0000	mg/L	0.0500	0.05	0.05	2	0
pH	6.5 - 8.5	mg/L	7.7500	7.7	7.8	2	0
Selenium	0.0100	mg/L	0.0035	0.0035	0.0035	2	0
Silver	0.1000	mg/L	0.0001	0.0001	0.0001	2	0
Sodium	180.0000	mg/L	19.0000	18	20	2	0
Sulfate	500.0000	mg/L	3.5000	3	4	2	0
Total Dissolved Solids (TDS)	10000.0000	mg/L	85.5000	76	95	2	0
Total Hardness as CaCO3	10000.0000	mg/L	38.6500	30.7	46.6	2	0
True Colour	15.0000	Hazen Units (HU)	0.7500	0.5	1	2	0
Turbidity	5.0000	NTU	0.1250	0.05	0.2	2	0
Uranium	0.0170	mg/L	0.0001	0.00005	0.00005	2	0
Zinc	3.0000	mg/L	0.0075	0.005	0.01	2	0

E.5 Telegraph Point NSW Health Laboratory Sample Results

Characteristic	Guideline Value	Units	Mean	Min	Max	Sample Count	Exception Count
Aluminium	0.2000	mg/L	0.0100	0.01	0.01	2	0
Antimony	0.0030	mg/L	0.0001	0.00005	0.00005	2	0
Arsenic	0.0100	mg/L	0.0008	0.0005	0.001	2	0
Barium	2.0000	mg/L	0.0063	0.0061	0.0065	2	0
Boron	4.0000	mg/L	0.0095	0.0075	0.0114	2	0
Cadmium	0.0020	mg/L	0.0001	0.00005	0.00005	2	0
Calcium	10000.0000	mg/L	6.8500	6.3	7.4	2	0
Chloride	250.0000	mg/L	23.0000	22	24	2	0
Chromium	0.0500	mg/L	0.0005	0.0005	0.0005	2	0
Copper	2.0000	mg/L	0.0055	0.004	0.007	2	0
Fluoride	1.5000	mg/L	0.0500	0.05	0.05	2	0
Fluoride (WU result)	1.5000	mg/L	0.0700	0.07	0.07	2	0
Fluoride Ratio	0.8 - 1.2	mg/L	0.7000	0.7	0.7	2	2
Iodine	0.5000	mg/L	0.0100	0.01	0.01	2	0
Iron	0.3000	mg/L	0.0200	0.02	0.02	2	0
Lead	0.0100	mg/L	0.0005	0.0001	0.0009	2	0
Magnesium	10000.0000	mg/L	0.9450	0.71	1.18	2	0
Manganese	0.5000	mg/L	0.0018	0.0017	0.0018	2	0
Mercury	0.0010	mg/L	0.0004	0.0004	0.0004	2	0
Molybdenum	0.0500	mg/L	0.0002	0.0001	0.0002	2	0
Nickel	0.0200	mg/L	0.0002	0.0002	0.0002	2	0
Nitrate	50.0000	mg/L	0.7500	0.5	1	2	0
Nitrite	3.0000	mg/L	0.0500	0.05	0.05	2	0
pH	6.5 - 8.5	mg/L	7.8500	7.7	8	2	0
Selenium	0.0100	mg/L	0.0035	0.0035	0.0035	2	0
Silver	0.1000	mg/L	0.0001	0.0001	0.0001	2	0
Sodium	180.0000	mg/L	14.5000	14	15	2	0
Sulfate	500.0000	mg/L	3.0000	2	4	2	0
Total Dissolved Solids (TDS)	10000.0000	mg/L	64.5000	63	66	2	0
Total Hardness as CaCO3	10000.0000	mg/L	21.0000	18.7	23.3	2	0
True Colour	15.0000	Hazen Units (HU)	1.0000	1	1	2	0
Turbidity	5.0000	NTU	0.1000	0.1	0.1	2	0
Uranium	0.0170	mg/L	0.0001	0.00005	0.00005	2	0
Zinc	3.0000	mg/L	0.0075	0.005	0.01	2	0

Appendix F Continuous Improvement Program

F.1 Continuous Improvement Program Record

ID	ADWG Ref	ADWG Framework Component	Date Entered	Description	Priority	Responsibility	Status	Date Updated	Reviewing by Whom	Comments
008	1.3	Engaging stakeholders	2/05/2014	Once implemented, ensure that the Stakeholder Register is regularly updated (at the time of DWMS review or more often if appropriate).		Water & Sewer Process Planning Engineer	Ongoing	30-Jun-22	[redacted]	last updated June 2021 and to be further updated following restructure and with development of RWMS

009	2.1	Water supply system analysis	5/12/2012	Review structure of group in line with DWMS requirements. See Risk Register WS15.	Medium	Group Manager, Water & Sewer	Ongoing	30-Jun-22	[redacted]	Responsibilities of Process and Operations section are clearly defined. Water Supply Duty Officers are required to communicate issues. Fortnightly meetings between the Operations/Process and ETS sections are held to discuss any current issues / operational changes that are coming up or have occurred. Changes to structure as of February 2016 include the positions of Process Engineer (formerly Process Coordinator), Headworks Engineer (formerly Headworks Coordinator). The vacant Operations Engineer position is proposed to be recruited by the end of 2015/16. Currency of action to be reviewed in 2023 Risk Register Review
016	2.3	Hazard identification and risk assessment	2/05/2014	Maintain currency of the DWMS Risk Register.	Medium	Water & Sewer Process Manager	Ongoing	30-Jun-22	[redacted]	Risk Register last updated in 2016 and due for an external review in 2023 FY. This has been delayed due to the work required to implement recycled water.
018	3.1	Preventive measures and multiple barriers	5/12/2012	Where applicable, consider signage on valves to prevent accidental connection of	Low	Water & Sewer Manager Headworks	Incomplete			

				raw to treated water. See Risk Register T11.						
022	3.1	Preventive measures and multiple barriers	28/01/2014	Provide sewerage services to Comboyne	Medium		Completed	30-Jun-22	[redacted]	Completion in 2021
023	3.1	Preventive measures and multiple barriers	28/01/2014	Provide sewerage services to Long Flat	Medium		Completed	30-Jun-22	[redacted]	Completion in 2021
024	3.1	Preventive measures and multiple barriers	28/01/2014	Provide sewerage services to Telegraph Point	Medium		Completed	30-Jun-22	[redacted]	Completed in 2020
026	4.1	Operational procedures	5/12/2012	Formalise roles, responsibilities, communication protocols and procedures. See Risk Register WS15.	Low	Water & Sewer Process Planning Engineer	Ongoing	30-Jun-22	[redacted]	Roles and responsibilites register maintained as a separate document in Councils document management system. Will be update in 2022 as per RWMS development
028	4.1	Operational procedures	5/12/2012	Review SWMSs and SOPs for water quality coverage. See Risk Register S6.	Medium	Water & Sewer Process Manager	Ongoing			Several SOP's have been established for water treatment operations. SWMS's were updated and completed in early 2017.
029	4.1	Operational procedures	5/12/2012	Consider doing process map to identify gaps for formalisation of	Low	Water & Sewer Process Manager	Incomplete	30-Jun-22	[redacted]	Currency of this action to be reviewed at 2023 risk workshop update

				procedures. See Risk Register T8 and T9.						
030	4.1	Operational procedures	5/12/2012	Formalise procedures operation of distribution system with regard to low turnover in reservoirs and ensure training. See Risk Register DR3.	Low		Incomplete	30-Jun-22	[redacted]	Currency of this action to be reviewed at 2023 risk workshop update
031	4.1	Operational procedures	5/12/2012	Document procedure for carting water to the villages (by Council or contractors in emergency) including investigating currency of information during the one year period. See Risk Register DR5 and D1.	Low		Incomplete	30-Jun-22	[redacted]	Currency of this action to be reviewed at 2023 risk workshop update

033	4.2	Operational monitoring	5/12/2012	For Port Macquarie and Cowarra Dams, consider validating turbidity levels in normal operating window. See Risk Register C10.	Low		Completed	30-Jun-22	[redacted]	Online monitoring of turbidity in both dams to provide 24 hr water quality data. Design of filtration plant for Cowarra dam in progress for completion of construction in 2027.
034	4.2	Operational monitoring	5/12/2012	Review water quality monitoring program and consider more proactive benthic monitoring. See Risk Register S8.	Medium	Laboratory Manager & Manager Water Process	Incomplete	30-Jun-22	[redacted]	A Cyanobacteria management plan has been drafted. Responses to algal levels are in line with CCP monitoring requirements. Council currently follows Report 74, through Laboratory monitoring, with the lab flagging incidents as required. Council needs to review the draft Protocol and document this process in line with newer guidelines, such as NHRMC and formalise protocols with up to date practices in Australia.
037	4.2	Operational monitoring	28/01/2014	Install online fluoride monitoring at Rosewood Road Reservoir Outlet	Medium		Completed	30-Jun-22	[redacted]	Installed at Rosewood Reservoir 1

038	4.2	Operational monitoring	28/01/2014	Install online fluoride monitoring at Port Dam	Medium		Closed	30-Jun-22	[redacted]	No longer required. Fluoride is raw dosed and still at low levels in Port Macquarie. In 2027 council will complete construction of a Filtration Plant at Cowarra dam which will include treated water fluoridation and online monitoring of fluoride levels
039	4.2	Operational monitoring	28/01/2014	Install online chlorine analysers at Council reservoirs	Low		Incomplete	30-Jun-22	[redacted]	90% complete - still to do upgrades at Long Flat, Comboyne & Laurieton - switchboard upgrade, fencing etc required and then chlorine analyser can be installed. Beachwood reservoir to be decommissioned.
045	4.4	Equipment capability and maintenance	5/12/2012	Review and maintain mains renewal priorities. See Risk Register D4.	Low		Completed	30-Jun-22	[redacted]	This is a recurring capital works item that is managed by the Water & Sewer Operations group.
046	4.4	Equipment capability and maintenance	5/12/2012	Review meter renewal program. See Risk Register D11.	Low		Completed	30-Jun-22	[redacted]	This is a recurring capital works item that is managed by the Water & Sewer Operations group.
047	4.4	Equipment capability and maintenance	5/12/2012	Review third party calibration of key equipment. See Risk Register WS8.	Low		Completed	30-Jun-22	[redacted]	Calibration of equipment undertaken by council ETS group. This is well documented through the MEX asset management system.

053	6.2	Incident and emergency response protocols	5/12/2012	Prepare SOP for alternative water delivery, such as during rain events following bushfires. See Risk Register C13.	Medium		Incomplete	30-Jun-22	[redacted]	Secure yield study and IWCM Planning currently underway and to be completed in 15/16. Currency of this action to be reviewed at 2023 risk workshop update
054	6.2	Incident and emergency response protocols	5/12/2012	Review operational monitoring for rain events following extensive bushfires. See Risk Register C13.	Low		Incomplete	30-Jun-22	[redacted]	Currency of this action to be reviewed at 2023 risk workshop update
058	7.1	Employee awareness and involvement	5/12/2012	Consider team meetings to share knowledge from NOW update courses etc. See Risk Register WS10.	Low		Completed	30-Jun-22	[redacted]	Weekly Water Operator team meetings are coordinated by the Technical Officer. Information sharing is undertaken at these meetings.

060	7.1	Employee awareness and involvement	5/12/2012	Formalise water quality awareness for contractors and field staff (e.g. induction from an experienced operator). See Risk Register S6 and WS11.	Low	Group Manager, Water & Sewer Operations	Incomplete	30-Jun-22	[redacted]	Water quality awareness training provided to all Water staff via WIOA training course in August 2017. Regular training to be implemented on a 2 yearly basis.All staff undertook key Cert 111 training in Water operations in 2021 Improved Contractor induction to be considered - using WIOA developed water and Sewer work induction tools
061	7.2	Employee training	5/12/2012	Consider reviewing sample collection competency of field staff using the lab competency procedures. See Risk Register C1.	Low	Laboratory Manager & Manager Water Process	Incomplete	30-Jun-22	[redacted]	Council to implement an annual laboratory refresher training program covering sampling, completing of COC, correct handling + storage of samples with Council Laboratory
064	7.2	Employee training	5/12/2012	Consider training for administration staff regarding metering. See Risk Register D11.	Low	Group Manager, Water & Sewer Operations	Incomplete			
068	8.2	Communication	5/12/2012	Review local resident awareness program in relation to reporting of suspicious	Low	Group Manager, Water & Sewer Operations	Incomplete	30-Jun-22	[redacted]	Councils education team undertake regular tours of the Dam to build community awareness.

				activities. See Risk Register S3.						
069	9.1	Investigative studies and research monitoring	5/12/2012	Review outcomes from secure yield and water quality analysis. See Risk Register C9.	Medium	Group manager Water & Sewer Planning	Completed	30-Jun-22	[redacted]	Secure yield report (Jacobs) due Q2 2016. IWCM plan to determine future water treatment requirements and water infrastructure for secure supply. Design of filtration plant for Cowarra dam in progress for completion of construction in 2027. investigations ongoing for secure supply including considerations for Recycled water and desalination
071	9.1	Investigative studies and research monitoring	5/12/2012	Keep watch on what is happening nationally with respect to increased levels of organisms in dam and benthic samples causing taste and odour issues. See Risk Register S8.	Medium	Laboratory Manager & Manager Water Process	Ongoing	30-Jun-22	[redacted]	NATA accredited lab continuously monitors the algae and cyanobacteria in Councils water supply. Lab Manager is expert in this field and maintains current information through research and attendance at relevant conferences. Review of Cyanobacteria Management protocol will also incorporate this.

072	9.1	Investigative studies and research monitoring	5/12/2012	Keep watching brief on potentially toxic cyanobactiera in storages. See Risk Register S8.	Medium	Laboratory Manager & Manager Water Process	Ongoing	30-Jun-22	[redacted]	NATA accredited lab continuously monitors cyanobacteria in Councils water supply. Lab Manager is expert in this field and maintains current information through research and attendance at relevant conferences.Review of Cyanobacteria Management protocol will also incorporate this.
073	9.1	Investigative studies and research monitoring	5/12/2012	Look at Bago Reservoir (and others) inlet pipework to increase mixing. See Risk Register DR2.	Low	Water & Sewer Manager Headworks	Incomplete	30-Jun-22	[redacted]	Jet nozzles installed on the inlets to new reservoirs. Jet nozzles to be retrofitted to old reservoirs on an as needs basis but at low priority. Chlorine levels monitored and adjusted to ensure that residual levels are maintained throughout the reticulation system. Currency of this action to be reviewed at 2023 risk workshop update
075	9.2	Validation of processes	5/12/2012	Review operation of distribution system with regard to low turnover in reservoirs. See Risk Register DR3.	Low	Water & Sewer Manager Headworks	Ongoing	30-Jun-22	[redacted]	Currency of this action to be reviewed at 2023 risk workshop update

076	9.2	Validation of processes	5/12/2012	Review noxious weeds program in relation to the risk of illegal dumping and accidents leading to breach of guideline values for chemicals. See Risk Register C12.	Low	Group Manager, Water & Sewer Operations	Incomplete	30-Jun-22	[redacted]	Currency of this action to be reviewed at 2023 risk workshop update
080	9.2	Validation of processes	2/05/2014	Confirm adequate disinfection Ct in all systems.	High	Water & Sewer Manager Headworks	Ongoing			Ct calculations completed for several storage reservoirs.
082	9.2	Validation of processes	5/12/2012	Review operation of McManus valve with view to using manual valves to isolate and follow up training. See Risk Register T11.	Low	Water & Sewer Manager Headworks	Completed	30-Jun-22	[redacted]	Double isolation installed for this valve
087	3.1	Preventative measures and multiple barriers	27/09/22	Apply to NSW Health for an intensive pesticides monitoring program for Spring Summer 2023 if approved by NSW Health	Medium	W&S Process Planning Engineer	Incomplete			

088	3.1	Preventive measures and multiple barriers	27/09/22	Update the Risk Matrix, Review CCP and DWMS in 2023, using external consultants. Apply to NSW Health for support	Medium	W&S Process Planning Engineer	Incomplete			
089	4.4	Equipment capability and maintenance	07/10/22	Improve maintenance frequency of online turbidity analysers in 2023	Low	Headworks Coordinator & Water Process Coordinator	Incomplete			

Appendix G Reservoir Inspection Report

G.1 Reservoir Inspection Report

Date	Reservoirs	Issue	Findings	Corrective Actions
29/07/21	Bonny Hills Reservoir	OH&S Security Structures	First Aid Kit not available on-site Fences Damaged Reservoir Roofs are loose, water ingress into valve pits	First Aid kit not available Fences Repaired Roofs Re-screwed, Drained Water out of Pits
29/07/21	Bonnyview Reservoir	Structures	Tears in Roof Sheets	Reservoir not in operation
02/08/21	Camden Head Reservoir	OH&S Security	Missing Confined Space Sign Western Gate rusted	Confined space sign are due to be put in Gate Fixed
02/08/21	Lakewood Res	OH&S	Missing 2 confined space signs	Confined space signs are due to be put in
16/08/21	O'Briens Rd Reservoir	OH&S	Confined Space Sign missing on top hatch	Confined space signs are due to be put in
16/08/21	Widderson St Reservoir	Security OH&S	Damaged Fences Western Side Hand Railing not on top or Reservoir Roof Screws Missing Vegetation in Gutters	Fences Replaced Reservoir roof to be replaced next year Roof Screws replaced Vegetation Cleared
16/08/21	Granite St Res	Security OH&S Structures	Locks was cut off Fencing around switchboard and ladder damaged Confined space signs have been	Locks Replaced. Fence repaired. Confined space signs are due to be put in

			spray painted over valve pits Bird Proofing Missing	No work done on bird proofing
26/08/21	Comboyne Res 1	OH&S	No confined space signage on top or reservoir	Confined space signs are due to be put in
26/08/21	Beechwood Reservoir	Security	Confined Space on Hatch missing Slight leak at base on Northern Side	Confined space signs are due to be put in Contractor engaged to repair
26/08/21	Rosewood 3 Reservoir	OH&S	Confined Space Signs need replacing	Confined space signs are due to be put in
26/08/21	Bago Reservoir	Security	Barbed wire on back fence came down	Barbed wire not repaired
28/10/21	Lakewood Reservoir	Security	Fence in NorthWest Corner needs repair	Fence repaired
28/10/21	Laurieton Reservoir	Security	Fenced was cut to access reservoir to paint graffiti	Repaired. Also whole site fence being replaced next year with high security fencing
29/10/21	O'Briens Road Reservoir	Security	Lock missing from one of the lids	Lock Replaced
29/10/21	Granite St Reservoir	Security	Barbed Wire damaged Door Latch damaged Flashing and Screws deteriorate	Barbed wire repaired Door Latch welded Flashing and Screws Replaced
02/11/21	Widderson St Reservoir	Security OH&S Structures	Perimeter fence damaged No Hand railing on top of reservoir and no anchor point for harness Bird Proofing around hatches damaged and	Fence Repaired Reservoir roof to be replaced next year Bird Proofing not fixed waiting for contractors

			screws missing in roof	
16/11/21	Bonny Hills Reservoir	General	Valve pits had water in them	Pits pumped out
18/11/21	Grants Head Reservoir	Structures	Bird Proofing needs repair	Not done - currently being quoted
19/11/21	Laurieton Reservoir	Safety	Holes was cut on fence Line	Fence repaired
22/11/21	Bago Reservoir	Structure	Flashing Damaged	Flashing Fixed
26/11/21	Sancrox Reservoir	Structure	Bird Proofing on roof ventilation needs repair	Bird Proofing Repaired
26/11/21	Rosewood Reservoir 3	Structure	Roof Screws Missing around walkway and in roof joins	Repaired
26/11/21	Rosewood Reservoir 2	Structure	Bird Proofing needs attention	Bird Proofing still needs fixing
03/12/21	Lakewood Reservoir	Structure	Roof Ventilation on reservoirs not moving	Roof Ventilation on reservoirs still needs fixing
06/12/21	Granite St	Structure Safety	Roof Flashing needs Fixing Safety Rail missing	Roof flashing repaired Safety rail still missing
08/12/21	Cowarra Balance Tank	Structure Safety	Hole in Fence Loose flashing around platform	Hole repaired Flashing Screwed
16/12/21	Bonnyview Reservoir	Structure	Sections of Roof Sheetings have crease	Reservoir not in operation
16/12/21	Bonny Hills Reservoir	Structure Security	Piece of Roofing damaged Fencing (south western side) needs attention	Roofing repaired Fence Repaired
17/12/21	Laurieton Reservoir	Structure Security	Roofs screws missing in Flashing Holes in Fencing	Roofs screws missing have been replaced Holes patched, fencing repaired

17/12/21	Grants Head Reservoir	Structure	Bird Proofing needs fixing Concrete Patching on side on reservoir	Currently being quoted Not done
20/12/21	Telegraph Point Balance Tank	Structure	Roof Ventilation does not spin	Not done
20/12/21	Bago Reservoir	Structure	1 Piece of Flashing requires fixing	Flashing Repaired
06/01/22	Mill Hill Reservoir	Security Grounds Maintenance	Hinge on valve pit needs repair Tree work needed Whirlwind needs repair	Not done Tree work completed Whirlwind not fixed
10/01/22	Comboyne Reservoir	Structure	Hole in roof sheetings	Roof Repaired
14/01/22	Grands Head Reservoir	Structure	Tap at southern valve pit was run into and bent	Repaired. Bollards installed
20/01/22	Sancrox Reservoir	Structure	Flashing needs repair	Not done
21/01/22	Rosewood Reservoir 3	Structure Grounds Maintenance	Tree on northern side of reservoir needs pruning Flashing on northern sides needs refixing	Complete Flashing Repaired
31/01/22	Granite St Reservoir	Safety	Latch on telemetry cabinet is broken Barbed wire damaged by vandles	Latch Fixed Barbed wire Repaired
04/02/22	Transit Hill Reservoir	Structure	Centre flashing needs replacing	Not done
10/02/22	Bonny Hills HL Reservoir	Other	One of the valve pits were full of water	Pit pumped out
17/02/22	Sutherland St Reservoir	OH&S	Hand Railing needs repair	Not done
07/03/22	Comboyne Reservoir 1	Structure	Roofs needs some repair works	Roofs Repaired
11/03/22	Grants Head Reservoir	Safety	Fence needs repairing	Fence repaired

11/03/22	Laurieton Reservoir	Safety	Fence needs repairing	Fence repaired
18/03/22	Widderson St Reservoir	Structure Safety	Lock to switchboard broken Gutters need cleaning	Lock Replaced Gutters not cleaned
0/06/22	Telegarph Point Balance Tank Reservoir	Safety	South Western Corner of Fencing needs repair	Fencing Repaired

PORT MACQUARIE
HASTINGS