St Georges Basin and Sussex Inlet Water Quality and Estuary Health Study

Shoalhaven City Council

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Executive summary

Advisian has been engaged by Shoalhaven City Council (Council) to undertake a Coastal Management Program (CMP) for the St Georges Basin and Sussex Inlet estuary. The CMP is intended to build upon the large body of work that has already been completed in regard to coastal management for this estuary. The purpose of this Water Quality and Estuary Health Study is to provide an up-to-date assessment of estuarine water quality and health to inform the scope and nature of coastal management actions for St Georges Basin and Sussex Inlet during the future stages of Council's CMP development and implementation.

A review of routine water quality monitoring data from the past decade (2010 – 2021) was undertaken for St Georges Basin and Sussex Inlet. Tributaries into St Georges Basin which have sites that are routinely monitored (Wandandian Creek and Tomerong Creek) were also included in the review. The high dilution capacity and nutrient assimilation capacity are likely to have assisted with maintaining good water quality within the basin. Water quality results were compared to the Department of Planning and Environment (DP&E) guideline values for lakes and creeks. Within St Georges Basin and Sussex Inlet, there were occasional exceedances of water quality guidelines with lower pH and higher turbidity values observed. Median dissolved oxygen (DO) was generally within the guideline range or just below and was observed to be lower and more variable during summer and spring. Wandandian and Tomerong Creeks, tributaries of St Georges Basin, are generally of poorer water quality than Sussex Inlet and St Georges Basin, and generally had lower pH, lower DO, higher turbidity and/or higher enterococci values which occasionally exceeded the guidelines. Overall, the review indicates that water quality within Sussex Inlet and St Georges Basin is generally deemed as 'Good' based on the National Health and Medical Research Council (NHMRC) (2008) guidelines.

Recreational water quality within St Georges Basin and Sussex Inlet continues to be highly ranked as "Good" (4-stars out of 4) for swimming and other water-based activities based on the National Health and Medical Research Council (NHMRC) (2008) guidelines. There are sources of faecal contamination identified, including runoff from urban and rural areas in the upstream sites of the main tributaries, Wandandian Creek and Tomerong Creek, and within Sussex Inlet Canals. However, faecal contamination is diluted within the creek, and lower values have been monitored at downstream sites in these tributaries and at drainage points into the St Georges Basin. The microbial monitoring demonstrates that the high dilution capacity of the basin is sufficient to maintain 'Very Good' recreational quality within Sussex Inlet and St Georges Basin.

The NSW DP&E undertook an estuarine health assessment for St Georges Basin and Sussex Inlet during 2020 – 2021 using key water quality indicators of turbidity and chlorophyll–*a* following the NSW Monitoring, Evaluation and Reporting Strategy (MER) methodology. They reported an overall estuary health grade of A (Excellent), which, despite the bushfires affecting the surrounding catchment in 2019-20, is consistent with historical assessments. DP&E reported DO results just below the expected range during 2020 - 2021. Total nitrogen and total phosphorous were within the DP&E MER guidelines, and ammonia was above guidelines on two occasions. Following the February 2020 flood, there was low DO (<72%) and high turbidity (up to 39 NTU) observed within the middle of St Georges Basin which may have been influenced by sediments, ash and debris runoff from the bushfires in conjunction with urban stormwater and agricultural runoff

The findings of this water quality study are consistent with previous reports by Council and other relevant agencies (including DP&E) that conclude water quality within St Georges Basin and Sussex Inlet is generally good and that there is poorer water quality associated within inflows from the main tributaries Wandandian Creek and Tomerong Creek. The likely contributors of poor water quality within these tributaries are urban stormwater, foreshore and urban developments, bank erosion, agricultural runoff and sewage effluent from sewage treatment plants (STPs), all of which can impact on water clarity and health of macrophytes (seagrasses, saltmarsh and mangrove) and associated dependent ecological communities including fish and endangered birds. Release of pollutants (nutrients and pathogens) were typically exacerbated following periods of flooding and inundation over cleared/developed areas.

Issues that have been raised regarding water quality and estuary health in this report, previous reports and during the community consultation undertaken as part of the CMP include:

- Poor water quality from catchment inflows (Tomerong Creek and Wandandian Creek) associated with catchment pollution sources including bank erosion (including unrestricted access of cattle to foreshores), onsite sewage management, sewage overflows, agriculture, road runoff and urban stormwater.
- Siltation and stormwater runoff around poorly maintained boat ramps within St Georges Basin and retaining wall disrepair along Sussex Inlet.
- Removal of important habitat and associated decline in ecological health as identified in community consultation including:
  - Removal of terrestrial vegetation (for example along Tomerong Creek).
  - Damage to coastal vegetation in Sussex Inlet, dunes and habitats by four-wheel driving and dogs.
  - Damage to seagrasses and saltmarshes within Sussex Inlet Channel associated with boating and canoe storage.
  - Impacts on fisheries within St Georges Basin thought to be associated with illegal and professional fishing and decline in habitat.
  - Impacts on endangered bird species around Sussex Inlet and St Georges Basin thought to be associated with decline in terrestrial and aquatic habitat including from boating potential declines in fisheries as well as dogs and people disturbing shorebird nesting areas.
- Inadequate protection of important ecological zones including wildlife corridors and habitat throughout St Georges Basin.
- Maintenance of Riviera Keys within Sussex Inlet Canals – including bank erosion and inadequate stormwater.
- Flooding and inundation impacts associated with sea level rises.
- Water exchange and entrance management
- Future anticipated climate change impacts.
- Impacts on water quality associated with the 2019/20 bushfire event.

Recommendations were made for an ongoing monitoring program for water quality in terms of sampling sites, frequency, parameters, sampling methodology, limits of reporting (LORs) and applicable trigger values. This is to ensure that the ongoing water quality monitoring program can track improvements towards meeting current water quality objectives.

Acronyms and abbreviations

Acronym/abbreviation	Definition
AFRI	Acute Febrile Respiratory Illness
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines
CMP	Coastal Management Program
CZMP	Coastal Zone Management Plan
DEC	Department of Environment and Conservation
DECCW	Department of Environment, Climate Change and Water
DO	Dissolved oxygen
DPI	Department of Primary Industries
DP&E	Department of Planning and Environment
DPIE	Department of Planning, Infrastructure and Environment
EAC	East Australian Current
FM Act	*Fisheries Management Act 1994*
GI	Gastrointestinal
GIS	Geographic Information System
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
KEFs	Key Ecological Marine Features
LEP	Local Environmental Plan
LGA	Local Government Area
NOAEL	No Observed Effect Level
NSW	New South Wales
NSW EPA	New South Wales Environment Protection Authority
NRMS	National Resource Management Strategy
OEH	Office of Environment and Heritage
SEPP	State Environmental Planning Policy
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids

1 Introduction

The purpose of this Water Quality and Estuary Health Study is to provide an up-to-date assessment of estuarine water quality and health to inform the scope and nature of coastal management actions during the future stages of the Shoalhaven City Council (Council) Coastal Management Plan (CMP) development and implementation.

The St Georges Basin Estuary Management Plan has guided the management of this estuary for many years. It was most recently revised in 2013. Actions not yet complete, or that are ongoing from this plan, should be considered for inclusion within the CMP.

This report presents the following:

- A review of long-term routine estuary water quality monitoring data
- Summary statistics for key water quality parameters across the estuary
- A summary of NSW DP&E's Estuary Health Assessment for the estuary
- A summary of available estuarine macrophyte mapping
- A summary and overall assessment of recreational water quality
- A recommended sampling program for water quality and ecological health.

A desktop review of water quality data was undertaken for Berrara Creek, based on established protocols set out in the:

- NSW Natural Resources Monitoring, Evaluation and Reporting Program (NSW MER program) (DPIE 2016).
- Australian and New Zealand Water Quality Guidelines framework for "Developing a Water Quality Plan" (ANZG 2018),
- National Health and Medical Research Council "Guidelines for Managing Risks in Recreational Waters" (NHMRC 2008).
- Other relevant guidelines as applicable to meet previously identified water quality objectives.

1.1 St Georges Basin

St Georges Basin is located south of Nowra, on the south coast of New South Wales (NSW) within the Shoalhaven Local Government Area (LGA). It covers a surface area of 40.9 km^2, drains a catchment of 315.8 km^2 and has a large estuary volume of 215,00 ML (DP&E 2022a) (Figure 1-1). The St Georges Basin estuary is a wave dominated barrier estuary that discharges through the Sussex Inlet channel to the Pacific Ocean at Bherwerre Beach (Strotz 2012) (Figure 1-2). It is permanently open to the sea via the Sussex Inlet channel, but at times the opening is quite confined by sand shoals which can cause navigational difficulties. The estuary is considered to be in the early stages of infilling with catchment sediments. Whilst most of the land within the catchment is forested, other key land uses include agricultural and urban areas. The main agricultural land use is grazing. Urban areas make up only a small part of the catchment which include Sussex Inlet, Erowal Bay, Sanctuary Point, Pelican Point and Basin View. In the last 30 years the land usage around St Georges Basin has undergone significant changes, from a predominantly rural community to a community with significant areas of urbanisation. The town of Sussex Inlet has grown considerably, mainly due to the development of canal estates which commenced in 1971. It is also a well-known tourist haven, particularly in the summer period. A number of properties surrounding St Georges Basin, Sussex Inlet and its tributaries are low lying and are at particular risk of flooding from catchment flooding as well as coastal inundation, tidal inundation and sea level rise as indicated in the Stage 2 CMP Tidal and Coastal Inundation Study (Advisian 2023), and the St Georges Basin Flood Study (Cardno 2022).

St Georges Basin is considered a healthy waterway with generally good water quality. However, runoff from urban and rural areas is a potential cause of concern. The area has high ecological importance due to its diversity of terrestrial, aquatic and wetland habitats. It includes many endangered ecological communities such as Coastal Saltmarsh and Swamp Oak Floodplain Forest. There are 18 wetlands which are mapped as part of the Coastal Wetlands under the Coastal Management State Environmental Planning Policy (SEPP) within the St Georges Basin catchment (see St Georges and Sussex Inlet Risk Assessment, Advisian 2022a). These are of national significance as habitat for migratory bird species such as waders and shorebirds. Extensive and diverse seagrass meadows are also present, including the endangered *Posidonia australis* within the Sussex Inlet channel. Seagrass provides habitat and nursery areas for fish (including pipefish and dusky flathead), crustaceans and molluscs, has a high capacity for carbon sequestration and helps to stabilise the sediment and regulate nutrient levels and water quality (Gray and Kennelly 2003). A system of artificial reefs deployed by the NSW Department of Primary Industries (DPI) in St Georges Basin also provides habitat for key fish species (DPI 2021).

Figure 1-1 St Georges Basin (Nearmap 2021).

Figure 1-2 Sussex Inlet entering St Georges Basin (DPIE 2021).

St Georges Basin also offers a range of recreational activities including passive recreation, fishing, boating, sailing, kayaking, water-skiing and swimming.

An example of a conceptual model summarising the key processes within wave dominated estuaries is shown in Figure 1-3.

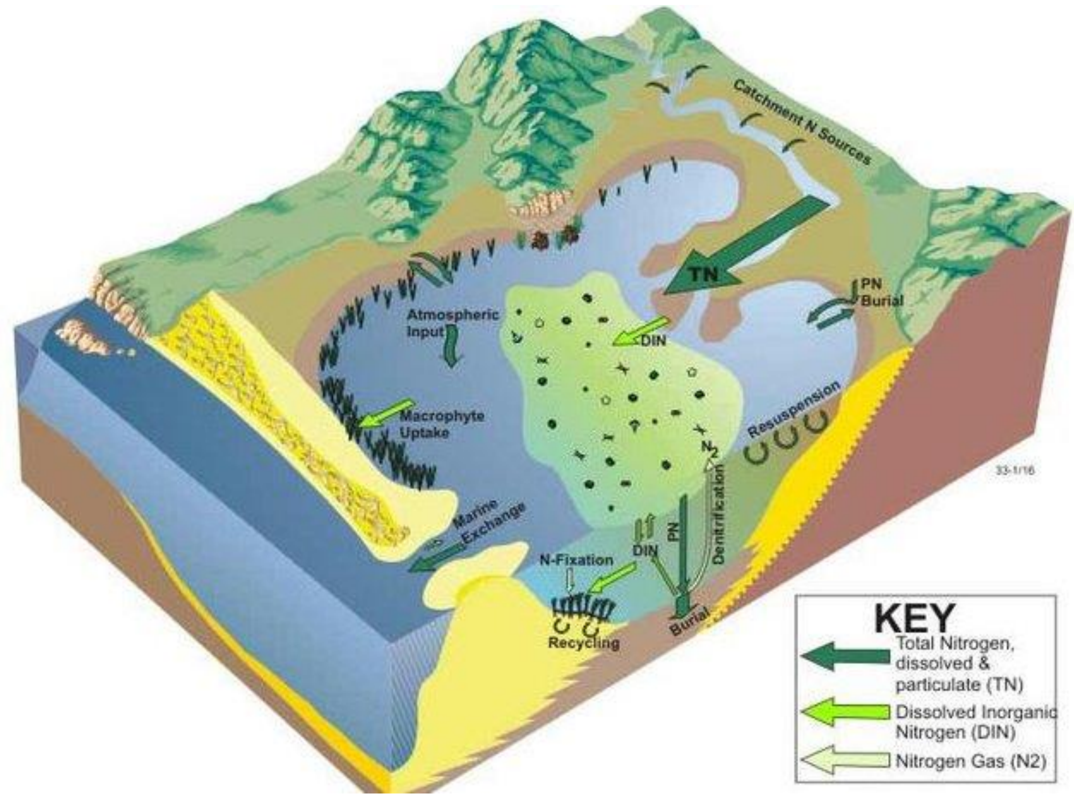


Figure 1-3 Example of estuarine processes in a wave dominated estuary © OzCoasts (Geoscience Australia) 2012.

1.2 Sussex Inlet

Sussex Inlet is a narrow channel which connects St Georges Basin to the Pacific Ocean. The inlet spans a length of 6.5 km, with a width of between 5 m and 300 m (Figure 1-1). The inlet and estuary provide a wide variety of marine habitats including expansive seagrass meadows, shallow subtidal and intertidal reefs, saltmarsh and mangrove areas and soft sediment habitats that provide important habitat for a variety of marine life including the endangered *Posidonia* seagrass, dusky flathead and snapper. Sussex Inlet also offers a range of recreational activities including fishing, boating, sailing, kayaking, stand-up paddle boarding, swimming, walking, cycling, and birdwatching. This region has important cultural and spiritual significance to the local Aboriginal people (NSW NPWS 2021). Land use is largely urban on the eastern and southern sides of the inlet and predominantly natural bushland on the northern and western sides.

1.3 Waterway and Fish Habitat Classification

Under the *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management* (NSW DPI 2013) (Table 2 of the Policy), the waterways of Sussex Inlet and St Georges Basin are considered as *CLASS 1 – Major Key Fish Habitat*, i.e. *"a marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected species or 'critical habitat'"*.

Considering the specific attributes of the habitats present within Sussex Inlet and St Georges Basin, and in accordance with Table 1 of the Policy, the habitat is considered *TYPE 1 - Highly Sensitive Key Fish Habitat* as it contains:

- *Posidonia australis* seagrass (strapweed).
- Zostera, Heterozostera, Halophila and Ruppia species of seagrass beds >5 m^2 in area.
- Coastal saltmarsh >5 m^2 in area.

1.4 Water Quality Objectives

In 1999, the NSW Government introduced Water Quality Objectives as long-term goals for marine waters, estuaries and rivers to identify and protect identified values and uses on waterways through more sustainable and targeted management. The process for setting Water Quality Objectives was previously developed by the Department of Environment and Conservation (DEC 2005) based on the framework outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000, now updated to ANZG 2018).

Water Quality Objectives for the estuaries on the NSW South Coast (DEC 2005) include:

- Protection of aquatic ecosystem health.
- Protection of primary and secondary contact recreational activities.
- Protection of visual amenity.
- Protection of aquatic food and commercial shellfish production.

Water Quality Objectives for rivers on the NSW South Coast (DEC 2005) include:

- Maintain wetland and floodplain inundation.
- Manage groundwater for ecosystems.
- Minimise effects of weirs and other structures.
- Maintain or rehabilitate estuarine processes and habitats.

These Water Quality Objectives are currently under review by DP&E to ensure they reflect the current community values and uses of the waterways (DP&E 2022b).

1.5 Water Quality Issues – St Georges Basin and Sussex Inlet

Poor water quality has previously been identified as an issue throughout Sussex Inlet and St Georges Basin resulting from industrial, agricultural or urban runoff affecting the estuaries ecology and estuarine vegetation, including acid sulfate soil runoff from drained floodplains (Advisian 2019). Current controls include licensing of industrial discharges, urban stormwater treatment, provision of riparian zones and fencing of estuarine foreshores, working with landowners to reduce acid sulphate soil runoff and public education programs.

The key potential issues relevant to water quality within St Georges Basin and Sussex Inlet that have been identified in previous studies and community consultation (Advisian 2022b) include:

- Poor water quality from catchment inflows (Tomerong Creek and Wandandian Creek) associated with catchment pollution sources including bank erosion (i.e. unrestricted access of cattle to foreshores), onsite sewage management, sewage overflows, agriculture, road runoff and urban stormwater (SSC 2013). Community consultation identified that there were several development sites located within the tributaries with insufficient drainage of stormwater that affects the basin water quality (Advisian 2022b).

- Siltation and stormwater runoff around poorly maintained boat ramps including Boathaven Boat Ramp (located at Basin View), in Erowal Bay (due to Tomerong Creek inputs) and Lions Park (Advisian 2022b).
- Retaining wall disrepair along Sussex Inlet.
- Removal of important habitat and associated decline in ecological health as identified in community consultation including:
  - Removal of terrestrial vegetation (for example along Tomerong Creek).
  - Damage to coastal vegetation, dunes and habitats by 4-wheel driving and dogs.
  - Damage to seagrasses and saltmarshes associated with boating and canoe storage along Sussex Inlet Channel.
  - Impacts on fisheries within St Georges Basin associated with illegal and professional fishing and decline in habitat.
  - Impacts on endangered bird species around Sussex Inlet and St Georges Basin thought to be associated with decline in terrestrial and aquatic habitat including from boating and decline in fisheries.
- Inadequate protection of important ecological zones including wildlife corridors and habitat throughout St Georges Basin (identified in community consultation).
- Maintenance of Rivera Keys within Sussex Inlet Canals – including bank erosion and inadequate stormwater management (Advisian 2022b).
- Sea level rises with:
  - Potential changes to hydrodynamics and implications for ecological health via inundation of endangered ecological communities along the foreshore, in particular at Sanctuary Point (Advisian 2022b, SCC 2013).
  - Flooding and inundation which has potential impacts for reduced water quality associated with runoff (rubbish and chemicals) and reduced flushing rates in the estuary.
- Water exchange and entrance management - St Georges Basin is a relatively large estuary with a small opening resulting in slow oceanic water turnover (SCC 2013). The long exchange period could result in buildup of pollutants from catchment sources following wet weather events.
- Impacts on ecological health (in particular seagrasses) from recreational boating activities.
- Impacts on water quality associated with the 2019/20 bushfire event (DP&E currently preparating assessment report).

1.6 Previous Water Quality Assessments

Since 1992, Council has routinely collected water quality data within Sussex Inlet and St Georges Basin. The results are published on the Aquadata portal (https://esdat.net/Aquadata.aspx) and on Council's website.

Generally, monitoring has been undertaken twice per year (generally in autumn, spring or summer) by collecting 1 replicate at all sites for physicochemistry, DO and enterococci (for further detail, refer to Sections 3.1 and 3.3). Selected sites were monitored twice per year for chlorophyll–*a* and nutrients. At times, additional monitoring has been undertaken in response to wet weather or pollution events.

The aim of the monitoring program is to maintain aquatic ecosystem health and ensure that waters are suitable for both primary and secondary recreational activities as defined by the National Health and Medical Research Council (NHMRC) (2008) and below:

- Primary recreational activities – swimming, sailing, waterskiing, windsurfing, kitesurfing, jet skiing and kayaking.
- Secondary recreational activities – boating, fishing, wading and canoeing.

Recreational activities can be classified by the degree of water contact whereby with primary contact activities there is a higher possibility of water being swallowed or inhaled, or coming into contact with the ears, nose or cuts in the skin (NHMRC 2008).

A variety of pressure and stressors indicators are included in Council's routine monitoring program including:

- Physicochemistry – pH, water temperature (°C), salinity (ppt) and turbidity (NTU).
- Dissolved oxygen (DO) (mg/L and % saturation).
- Phytoplankton indicator – chlorophyll-*a* (µg/L).
- Pathogen indicators - faecal coliforms (cfu/100mL) and enterococci (cfu/100mL).
- Nutrients - total nitrogen (TN) (µg/L) and total phosphorous (TP) (µg/L) (selected sites).

Starting in November 2020, the Council has been undertaking more regular monthly sampling to monitor impacts from the 2019 – 2020 bushfires. This includes estuary health parameters (chlorophyll-*a* and turbidity) and nutrients (TN and TP) as well as 3-monthly sampling of Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC). This additional sampling will continue until 2023.

Maintenance of ecological health and maintaining the suitability of Sussex Inlet and St Georges Basin for recreational use are objectives of the program which are highly valued by the community (Shoalhaven City Council 2013). Some threats that would hinder achieving these water quality objectives within the catchment include nutrient enrichment (from tributaries), sedimentation (from erosion within the catchment,input via urban stormwater and limited tidal flushing), pollutants (from urban stormwater and diffuse sources including sediments and nutrients) and invasive species.

A review of historical trends in water quality was undertaken by Council in 2013 as part of the St Georges Basin Revised Estuary Management Plan (Shoalhaven City Council 2013). This review showed that historical water quality was generally good and generally met the default trigger values in the ANZECC Guidelines for Fresh and Marine Water Quality (2000). The tributary creeks that drain into St Georges Basin were subject to occasional spikes of elevated nutrients, elevated chlorophyll-*a* and lower DO. Water quality within St Georges Basin was not significantly influenced by these tributary inputs, which was attributed to high dilution from the large basin volume and nutrient processing capability.

2 Water Quality Guidelines

2.1 Overview

The following guidelines are applicable to St Georges Basin and Sussex Inlet for water quality assessments:

- NSW Department of Environment and Conservation – Marine Water Quality Objectives for NSW Ocean Waters (DEC 2005).
- Assessing Estuary Ecosystem Health: Sampling, Data Analysis and Reporting Protocols. NSW Office of Environment and Heritage, Sydney. P.11 (OEH 2016)
- NSW Natural Resource Monitoring, Evaluation and Reporting (MER) Program Trigger Values, last revised in 2020 (unpublished – provided by DP&E).
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) – Toxicant Default Guideline Values for 95% species protection. http://www.waterquality.gov.au/anz-guidelines.
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) – IMCRA mesoscale bioregions Default Guideline Values for Physical and Chemical Stressors, Batemans Shelf. http://www.waterquality.gov.au/anz-guidelines.
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) – Default Guideline Values for Physical and Chemical Stressors, Southeast Australia.
- National Health and Medical Research Council Water Quality Guidelines for Recreational Users (NHMRC 2008).

2.2 ANZG (2018) Framework

The Australian and New Zealand Water Quality Guidelines (ANZG 2018, previously ANZECC 2000) provide high-level guidance on the management context, ecological descriptions, biological indicator selection and other advice for five of Australia's six marine planning regions. The Great Barrier Reef Marine Park Authority (GBRMPA) provides separate advice for the Great Barrier Reef Marine Park (which represents the inshore portion of the Coral Sea Marine Region).

The ANZECC (2000) guidelines were revised in 2018 into the ANZG (2018) with key changes to ANZECC (2000): Improvements since 2000 (waterquality.gov.au). Some key changes include:

- Transition to an online based platform for guidelines to facilitate more regular updates.
- Revision of the Water Quality Management Framework into a ten-step circular framework with improved guidance including applying to seven common applications including the implementation of a broadscale monitoring program.
- Revision of Default Guideline Values (DGVs) for protection of aquatic systems against toxicants, including revision of the methodology to derive new DGVs, review and update of some existing DGVs (previously listed under ANZECC 2000) and the addition of DGVs for new toxicants.

- In marine waters, physical and chemical stressor DGVs have been derived on a finer scale, using the Integrated Marine and Coastal Regionalisation of Australia (IMCRA 4.0) mesoscale bioregions and divided into seasons. The study site is located within the Batemans Shelf IMCRA bioregion. Some of these guidelines are in different units to those reported by laboratories so may require conversion or may not be applicable.
- In inland waters, physical and chemical stressor DGVs will be divided into finer scale, using drainage divisions. There will also be improved guidance around water quality management for temporary waters. Neither are available at the time of reporting, and therefore default to the ANZECC (2000) guidelines for southeast Australia.
- Improved guidance and emphasis on the development and application of site-specific guidelines, which are to be used in preference to DGVs where established. Site-specific guidelines can be established if there is sufficient monitoring data at appropriate reference locations or using a combination of methods.
- Removal of guidance on recreational waters and drinking water to avoid duplication with the Australian Drinking Water Guidelines (ADWG) (NHMRC 2011) and the Guidelines for Managing Risk in Recreational Waters (NHMRC 2008).

ANZG (2018) sets out a comprehensive systematic framework and guidance for water quality management, including specifically in relation to the assessment of wastewater discharges. The circular nature of the framework highlights the importance of continual improvement and adaptive management in water quality management. A schematic of the ANZG (2018) framework is shown in Figure 2-1.

The ANZG (2018) framework emphasises the importance of a "multiple lines of evidence" approach as shown in Figure 2-2.

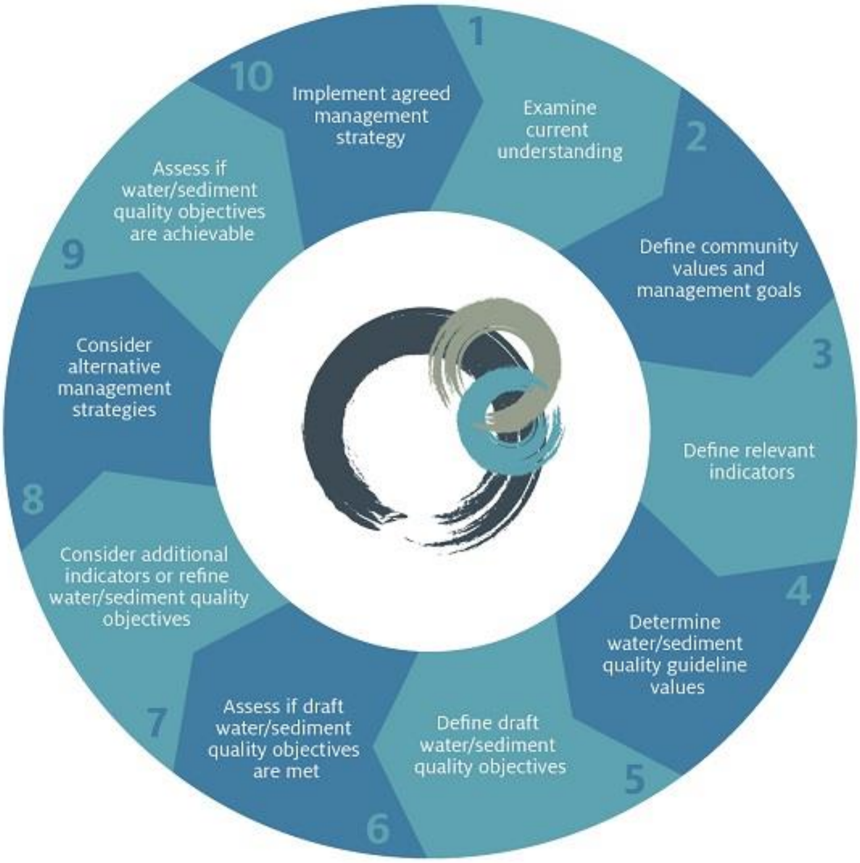


Figure 2-1 ANZG (2018) Water Quality Management Framework.

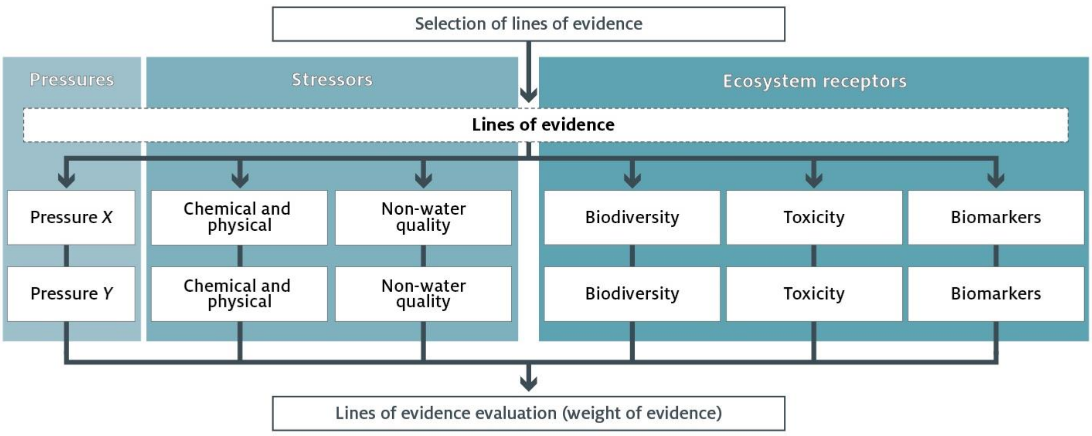


Figure 2-2 Weight of evidence approach across the pressure-stressor-ecosystem pathway (ANZG 2018).

2.3 Monitoring and Evaluation Reporting Program

The NSW Natural Resources Monitoring and Evaluation Program (MER Program) is coordinated by NSW DP&E (formerly OEH) and is generally implemented through Coastal Management Plans (CMPs). This includes standardised protocols for undertaking assessments of estuary ecosystem health including sampling, data analysis and reporting, as outlined in DPIE (2016).

Trigger values are used to comparatively assess whether water quality indicators are outside of the expected range and indicate potential for undesirable ecosystem health. As part of the MER program, DP&E has previously determined trigger values for NSW inland waterways including creeks, lakes and rivers using the ANZECC (2000) and ANZG (2018) approach of calculation of the 80th percentile of all data at appropriate reference locations within NSW in various estuary types. Reference estuaries are generally defined as having minimal impacts on chlorophyll-*a* and turbidity. NSW DP&E updates trigger values periodically as additional data is available.

2.3.1 MER Triggers for Protection of Aquatic Ecosystems

The relevant water quality triggers are based on NSW DP&E MER trigger values, ANZECC 2000 and ANZG 2018 default water quality guidelines, as they apply to protection of aquatic ecosystems. Adopted guidelines are shown in Figure 2-1. The NSW DP&E MER trigger values were last revised in 2020 and provided by DP&E (in preparation).

For the purposes of this assessment, St Georges Basin, Sussex Inlet Channel and Sussex Inlet canals were classified as “Lakes”. This is supported by a water quality analysis that shows strong similarities in physicochemistry and chlorophyll-*a* water quality signature between the areas (**Appendix D**). Wandandian Creek and Tomerong Creek were classified as “Creeks”.

Table 2-1 Relevant NSW DP&E MER Values for inland waters.

Parameter	Lakes	Creeks
Ammonia (mg/L)	0.014	0.021
Total dissolved P (mg/L)	0.009	0.006
Total dissolved N (mg/L)	0.67	0.28
TP (mg/L)	0.024	0.015
TN (mg/L)	0.75	0.36
Chlorophyll-*a* (mg/m^3)	5.3	3.3
Turbidity (NTU)	5.5	1.4
pH upper	9.1	9.1
pH lower	8.1	7.9
DO upper (%)	115	107
DO lower (%)	93	84

2.4 Recreational Water Quality Guidelines

Recreational water quality is assessed using microbial (enterococci) data as an indicator.

Microbial assessment (of enterococci) measures the impact of pollution sources, enables the effectiveness of stormwater and wastewater management practices to be assessed and highlights areas where further work is needed. Swimming sites are graded as Very Good, Good, Fair, Poor or Very Poor in accordance with the National Health and Medical Research Council (NHMRC) 2008 Guidelines for Managing Risks in Recreational Waters. Grades are determined from the most recent 100 water quality results (two to four years' worth of data) and a risk assessment of potential pollution sources.

There are four Microbial Assessment Categories (A to D) and these are determined from the 95th percentile of an enterococci dataset of at least 100 data points. Each category is associated with a risk of illness determined from epidemiological studies (refer to Table 2-2). The risks of illness are the overall risk of illness associated with the 95th percentile of the enterococci dataset.

Table 2-2 Microbial assessment categories and risk of illness (NHMRC 2008).

Category	95th percentile for enterococci per 100mL	Basis of derivation	Estimation of probability
A	≤40	This value is below the NOEAL in most epidemiological studies.	Gastrointestinal (GI) illness risk: <1% Acute febrile respiratory illness (AFRI) risk: <0.3% The 95th%ile of 40/100mL relates to an average probability of less than one case of gastroenteritis in every 100 exposures. The AFRI would be negligible.
B	41-200	The 200 per 100mL value is above the threshold of illness transmission reported in most epidemiological studies.	GI illness risk: 1-5% AFRI risk: 0.3-1.9% The 95th%ile of 200/100mL relates to an average probability of one case of gastroenteritis in every 20 exposures. The AFRI would be ~ 1 in 50 exposures.
C	201-500	A substantial increase in probability of adverse health outcomes for which dose response data is available.	GI illness risk: 5-10% AFRI risk: 1.9-3.9% The 95th%ile of 200/100 mL relates to an average probability of one case of gastroenteritis in every 10-20 exposures. The AFRI would be ~ 1 in 50 to 1 in 25 exposures.
D	>501	Above this level there may be significant risk of high levels of	GI illness risk: >10% AFRI risk: >3.9% The 95th%ile of 200/100mL relates to a greater than 10% change of illness per exposure.

Category	95th percentile for enterococci per 100mL	Basis of derivation	Estimation of probability
		illness transmission.	The AFRI would be ~ 1 in 25 exposures.

AFRI = acute febrile respiratory illness; GI = gastrointestinal, NHMRC = National, Health and Medical Research Council, NOAEL = no observed adverse effect level.

Other relevant NHMRC (2008) guidelines for primary contact recreation are shown in Table 2-3.

Table 2-3 NHMRC (2008) Guidelines for Primary Contact Recreation.

Water Quality Guideline	Parameter	Guideline Value	NSW Water Quality Objective
Primary Contact Recreational – biological (NHMRC 2008)	Faecal coliforms	Median over bathing season of less than 150 faecal coliforms/100 mL.	Median over bathing season of less than 150 faecal coliforms/100 mL with 4 out of 5 samples.
Primary Contact Recreational – physiochemical (NHMRC 2008)	Visual clarity	Natural visual clarity should not be reduced by more than 20%. Horizontal sighting of a 200 mm black disc should exceed 1.6 m.	A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m.
	pH	pH of the water should be within the range of 5.0-9.0 assuming that the buffering capacity of the water is low near the extremes of the pH limits.	--
	Temperature	15-35°C (for prolonged exposure).	--
	Salinity (TDS)	< 1,000,000 µg/L	--
	Surface films	Oil and petrochemicals should not be noticeable as a visible film on the water nor should they be detectable by odour.	--

-- not listed.

At a minimum, microbial monitoring is undertaken as screening to assess suitability of waters for recreational water quality. A detailed assessment would combine microbial monitoring with a sanitary inspection (**Appendix F**) that includes the following:

- Assessment of sewage outfalls and stormwater discharges – present or absent, type of treatment, effectiveness of outfall treatment and location of pumping stations and overflow points.
- Riverine sewage discharges – present or absent, type of treatment, population size and river flow.
- Bathers (i.e. number of bathers and periods of higher use).
- Dilution.
- Any additional information that might affect microbial indicators such as rainfall, wind, tides, currents, water releases and flushing rates.

The combination of microbial monitoring and sanitary inspection would then be used to categorise water quality as per Table 2-4.

A sanitary inspection was not possible, as this is site specific and undertaken at the same time as microbial sampling. Instead, a high-level review of faecal contamination sources within the catchment was undertaken, to provide a combined assessment with microbial monitoring data to provide an assessment of suitability for identified recreational activities.

Table 2-4 NHMRC (2008) classification matrix for faecal pollution of recreational waters.

		Microbial water quality assessment category (95th percentiles — intestinal enterococci/100 mL)				Exceptional circumstances[c]
		A ≤ 40	B 41–200	C 201–500	D > 500	ACTION
Sanitary inspection category (Susceptibility to faecal influence)	Very low	Very good	Very good	Follow up[b]	Follow up[b]	
	Low	Very good	Good	Follow up[b]	Follow up[b]	
	Moderate	Good[a]	Good	Poor	Poor	
	High	Good[a]	Fair[a]	Poor	Very poor	
	Very high	Follow up[a]	Fair[a]	Poor	Very poor	
	Exceptional circumstances[c]	ACTION				

a Indicates possible discontinuous/sporadic contamination (often driven by results such as rainfall). This is most commonly associated with the presence of sewage – contaminated stormwater. These results should be investigated further, and initial follow-up should include verification of the sanitary inspection category and ensuring that samples recorded include 'event' periods. Confirm analytical results, review possible analytical errors.

b Implies nonsewage sources of faecal indicators (eg livestock), which need to be verified.

c Exceptional circumstances are known periods of higher risk such as during an outbreak involving a human or other pathogen that may be waterborne (eg avian botulism — where outbreaks of avian botulism occur, swimming or other aquatic recreational activities should not be permitted), or the rupture of a sewer in a recreational water catchment area etc. Under such circumstances the classification matrix may not fairly represent risk/safety.

* In certain circumstances there may be a risk of transmission of pathogens associated with more severe health effects through recreational water use. The human health risk depends greatly on specific (often local) circumstances. Public health authorities should be engaged in the identification and interpretation of such conditions.

3 Routine Water Quality

3.1 Methodology

Routine water quality monitoring is undertaken by Council in Sussex Inlet and St Georges Basin to assess environmental health of estuarine and coastal waters and impacts from wastewater discharges. This monitoring data is published online on the Aquadata portal (https://www.esdat.net/Aquadata_Web_Based_Water_Quality_Public_Portal.aspx) and includes raw data and mapping capacity for the Shoalhaven (https://webreports.esdat.net/SCC#results-map) (Shoalhaven City Council 2022).

A review of routine water quality monitoring data from the past decade (2010 – 2021) was undertaken for St Georges Basin and Sussex Inlet. This was based on selected monitoring sites and historical data from January 2010 to October 2021 (Table 8-1). Tributaries into St Georges Basin which have sites that are routinely monitored (Wandandian Creek and Tomerong Creek) were also included in the review. There are many other smaller tributaries that drain into the basin including Worrowing Water Way, Tullarwalla Inlet, Cow Creek, Swan Creek, Booroowungan Creek and Bae-Al Creek. However, as there is no consistent or recent (i.e. after 2016) data for these tributaries they were not included in the review.

With the collated raw water quality dataset provided by Council,an initial quality review of the data was undertaken to identify any anomalous values resulting from instrumentation errors, transcription errors or extreme outliers. Extreme outliers were classified as values which were more than four standard deviations from the median and were also outside the possible range that would be expected for that parameter (including pollution events).

Among this review included the removal of:

- pH values below 5.
- Dissolved oxygen above 150%.
- Electrical conductivity values below 100 µS/cm.
- Obvious data entry errors.

No laboratory measured results were required to be removed from the dataset. The final collated,reviewed data, and more detail on the data review process is provided in **Appendix A**.

For turbidity, it is suspected that there may have been overestimation associated with some of the elevated values observed which may be due to:

- Calibration – turbidity meters need to be calibrated to low readings (0-20 NTU) or can result in overestimated readings.
- Instrumentation errors – noting that the turbidity sensor has a rubber cap which needs to be removed prior to monitoring.
- Sampling - turbidity readings taken close to the estuary bed or in areas of current can result in elevated readings.

However, turbidity can also be elevated due to high amounts of suspended particulates in the water column which could be associated with plant and animal decay (in land runoff or directly in water) or suspended solids (from terrestrial runoff, high rainfall, storms, erosion or bushfire events). As there was no way of differentiating between actual and overestimated turbidity, no turbidity values were removed from the dataset. An acceptable method would be to convert using TSS data but a corresponding TSS dataset is not available (with the exception of samples collected during 2020-21).

The final collated and reviewed data (and more detail on the data review process) is provided in **Appendix A**.

Boxplot graphs were prepared in Minitab 16.0 (2010) for key water quality parameters presented by site, area (Sussex Inlet Channel, Sussex Inlet Canals, St Georges Basin, Wandandian Creek or Tomerong Creek) and season as shown in **Appendix C**.

3.2 Location of Monitoring Sites

The location of monitoring sites included in the water quality data review for St Georges Basin and Sussex Inlet are shown in Figure 3-1.

Figure 3-1 Location of selected environmental water quality sites included in the analysis for St Georges Basin and Sussex Inlet.

3.3 Frequency of Monitoring

A summary of the water quality monitoring frequency is provided in **Appendix B**. Water quality monitoring has been undertaken at least twice per year with physicochemistry parameters and enterococci measured at all sites and chlorophyll-*a* and nutrients at selected sites.

3.4 Review of Long Term Water Quality Data

A review of historical long term water quality data was undertaken for Sussex Inlet Canals, Riverina Keys Estate (Sussex Inlet Canals), Sussex Inlet Navigation Channel (Sussex Inlet Channel), St Georges Basin, Wandandian Creek and Tomerong Creek. The focus of the review was to identify any broadscale water quality issues or hotspots.

Key water quality statistics (including average, standard deviation, median, minimum, maximum and count of sample replicates) are included in **Appendix B**. Boxplots of the water quality data by area, site, season and with comparison to any available and applicable water quality guidelines are shown in **Appendix C**.

The key water quality results are as follows:

- **Temperature (°C)** – All monitoring sites in Sussex Inlet and St Georges Basin had low variability in water temperature during summer, autumn and winter, with more variable levels during spring (**Appendix C**). The upstream Wandandian Creek site (E-249) had lower median temperatures during winter and the upstream Tomerong Creek site (E-750) also had lower and more variable temperatures during summer, autumn and spring in comparison to all other sites. With these exceptions, there was little variation between monitoring sites within respective seasons.

- **Dissolved Oxygen (DO) (%saturation)** – During all seasons there were numerous exceedances (above or below) of the respective DP&E MER guideline upper and lower limits (**Appendix C**). However, median values for sites within St Georges Basin were generally within the guideline range or just below. The site north east of St Georges Basin (Site E-241), had more variable and occasional low DO values during summer and spring (**Appendix C**). The lowest DO levels were in the creek sites and during all seasons the median DO values fell well below the lower limit MER guideline value of 84% for DO in creeks (E-25, E-243, E-249 and E-750).

- **pH** – During all seasons the majority of pH values in Sussex Inlet and St Georges Basin sites were within or just below the respective DP&E MER guideline value ranges (**Appendix C**). The Wandandian Creek (E-25 and E-249) and Tomerong Creek (E-243 and E-750) sites had the lowest pH with median values below the DP&E MER lower limit guideline value of 7.9 for creeks.

- **Salinity (ppt) & conductivity (µS/cm)** – All monitoring sites within Sussex Inlet Channel, Sussex Inlet Canals and St Georges Basin were within the typical mid-saline range (of 10 ppt - 25 ppt) or high range (>25 ppt) for estuarine waters (**Appendix C**). The values suggest that there is tidal flushing with oceanic waters. The upstream Wandandian Creek site (E-249) and site E-243 within Tomerong Creek had more variable salinity, reflecting a more brackish nature with freshwater and tidal influence.

- **Turbidity (NTU)** - Monitoring sites within Sussex Inlet Channel, Sussex Inlet Canals and St Georges Basin showed high variability in turbidity with occasional elevated values above the respective DP&E MER guideline values for those areas during summer, autumn and spring (**Appendix C**). Despite this, the median values within Sussex Inlet and St Georges Basin were generally low and below the respective guideline value for lakes. Turbidity in the creek sites was generally elevated and median values were above the guideline value for creeks. In particular, the Tomerong Creek upstream site E-750 had two highly elevated values (255 NTU on 17/4/12 and 112 NTU on 6/9/2010).

Turbidity data may include some overestimated results (either due to calibration, instrumentation errors or sampling methods as outlined in Section 3.1), as elevated values do not always correspond to rainfall periods and the majority of chlorophyll-*a* results are low.

- **Chlorophyll-*a* (mg/m^3)** – The majority of chlorophyll-*a* values at all sites were below the respective DP&E MER guideline values for chlorophyll-*a* in lakes and creeks (**Appendix C**). Slightly elevated outliers (up to 8 mg/m^3) occasionally occurred during summer and spring within St Georges Basin. Only one data value was available for Tomerong Creek (site E-243) on 6/4/2020 which was elevated at 49 mg/m^3 and corresponds with elevated TN (0.05 mg/L) at the same time, which may suggest an algae bloom.

- **Total Nitrogen (mg/L)** – Within the selected sites that are routinely monitored for TN within Sussex Inlet Canals (E-251 and E-331) and St Georges Basin (E-238, E240 and E-29) most values were below the respective DP&E MER guideline values (**Appendix C**). There was little variation between sites. TN is also monitored at the upstream Wandandian Creek site (E-249) with median values above the DP&E guideline value for creeks during summer and autumn.

- **Total Phosphorous (mg/L)** – The same selected sites are monitored for TP as listed above for TN. Concentrations were generally below the respective DP&E MER guideline values or the LOR apart from some exceedances across all areas during winter sampling in Sussex Inlet Canals and St Georges Basin, and in Wandandian Creek site (E-249) (**Appendix C**).

- **Total dissolved solids (mg/L) –** Most monitoring for TDS has been undertaken during spring with variable levels (**Appendix C**).

- **Faecal coliforms and enterococci (cfu/100mL)** – All monitoring sites within the Sussex Inlet Channel, Sussex Inlet Canals and St Georges Basin had median values of faecal coliforms below the NHRMC (2008) guideline value of 150 cfu/100mL and 95th%ile's below the NHMRC (2008) guideline value of 40 cfu/100mL for category A (**Appendix C**).

  The upstream Wandandian Creek site (E-249) and Tomerong Creek site (E-243) had variable levels of faecal coliforms and enterococci, with occasional elevated values (that do not always correlate to periods of heavy rainfall). There was one highly elevated value of enterococci of 1,511 cfu/100ml in Wandanian Creek site (E-249) during summer (15/12/2015). Both sites had 95%iles (295 col/100ml for E-249 and 344 col/100ml for E-243) corresponding to a category C for the NHMRC (2008) microbial assessment trigger.

  Recreational water quality, which uses enterococci data as an indicator, is assessed further in Section 6.1.

Overall, the review shows that water quality within Sussex Inlet and St Georges Basin is generally very good with occasional detections of elevated turbidity, elevated chlorophyll-*a* and low DO. Water inputs from Wandandian and Tomerong Creeks, tributaries of St Georges Basin, are generally of poorer water quality in terms of lower pH, lower DO, higher turbidity (noting that there are some potential data errors for turbidity) and/or higher enterococci values. These findings are consistent with historical results, with historical trends examined in further detail in Section 3.4.

3.5 Water Quality analysis

Analysis of physicochemistry data (temperature, turbidity, DO, pH and salinity) and chlorophyll-*a* for St Georges Basin and Sussex Inlet is presented in **Appendix D**. This analysis was undertaken to understand the patterns in the dataset and interpret whether there are differences in water quality between sites, years or seasons. This information is useful to understand long term trends but also inform future monitoring requirements (in terms of site replication and frequency of sampling required).

The water quality analysis shows:

- There are no apparent differences in physicochemistry between the St Georges Basin area in comparison to the Sussex Inlet Channel (**Appendix D**).
- There are no apparent differences in physicochemistry between individual sites suggesting differences are more related to temporal variation (**Appendix D**).
- Sampling years 2010, 2012 and 2013 show that some samples had a different water quality signature in comparison to all other years. These differences were likely due to warmer water temperatures (2010), higher turbidity (2012 and 2013) and/or lower DO (during 2012 only) (**Appendix D**). There is a seasonal component driving differences with higher turbidity and/or lower DO during these years (2010, 2012 and 2013) occurring in autumn or spring (**Appendix D**).

4 Estuary Health Assessment 2020-2021 (DP&E)

4.1 Post Bushfire Water Quality and Estuary Health 2020 - 2021

NSW DP&E is concurrently assisting Council to undertake an assessment of Councils water quality data for 2020 - 2021 as part of a project looking at the impacts of Bushfires on water quality and estuary health. (DP&E in preparation). This sampling was based on the protocols outlined in the NSW Monitoring, Evaluation and Reporting Strategy (MER) methodology for Assessing Estuary Ecosystem Health: Sampling Data Analysis and Reporting Protocols (OEH (now DP&E) 2016).

The six steps outlined in the NSW MER program include:

1. Calculation of the Non-Compliance Score (NC1) which is the proportion of time that measured values of the indicators are outside the adopted trigger value.
2. Calculation of the Worst Expected Value (WEV) by calculation of the 95th%ile or adoption of those proposed in the MER Program.
3. Calculation of the Distance Score (DSi) from the trigger value whereby DSi = (value – trigger value) / (WEV – trigger value).
4. Calculation of an Indicator Score (ISi) for each zone: ISi = √(NCi x DSi).
5. Calculation of the Zone Score (ZS) whereby ZS = (ISc + ISt) / 2.
6. Grading the zone as A (Very Good/ Excellent), B (Good), C (Fair), D (Poor) or E (Very Poor) (Figure 4-1).

Score Criteria	Rating
4.3 to 5.0	Very Good
3.5 to 4.2	Good
2.7 to 3.4	Fair
1.9 to 2.6	Poor
< 1.8	Very Poor

Figure 4-1 Scoring classes used to assign overall grades of estuary health (Roper et al. 2011).

Normally the relevant temporal scale for the MER Program targets the maximum chlorophyll-*a* period from mid-November to the end of March. A minimum of six samples is recommended from within this period, with more samples providing more statistical confidence.

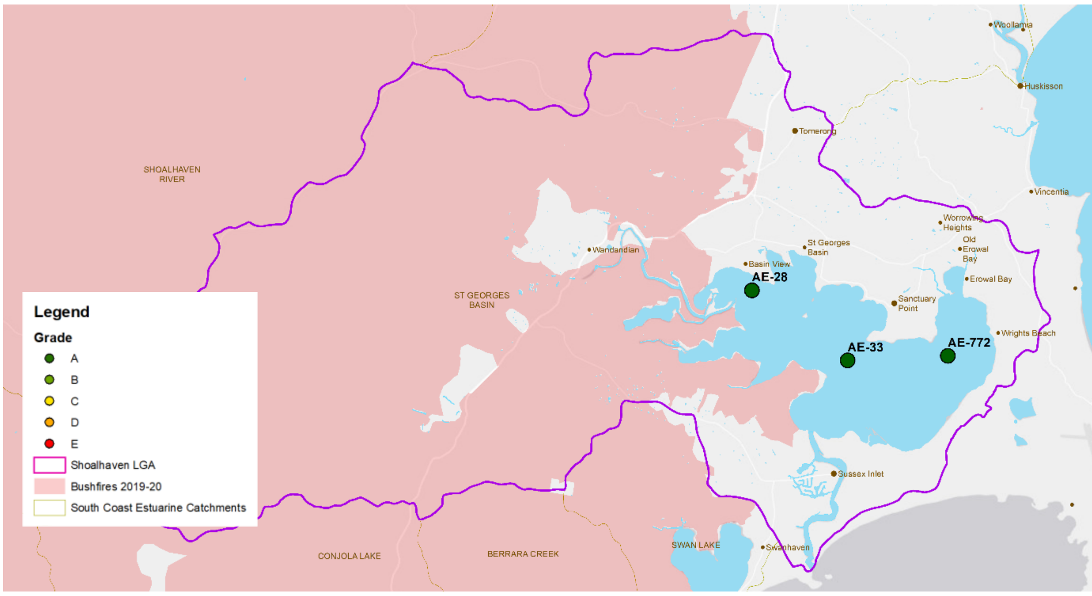
Rather than just sampling over the summer period, Council sampled the St Georges Basin at three locations approximately monthly between November 2020 and November 2021. They sampled estuary health parameters (turbidity and chlorophyll a), standard physical parameters, nutrients, total organic carbon and total dissolved carbon.

Within St Georges Basin, the following sampling sites were included in the 2020/2021 MER assessment:

- E-28 (northwest of basin), E-33 (middle of basin) and E-772 (deep east of basin) (refer to Figure 3-1).

The assessment was undertaken for monthly samples collected between November2020 and June 2021 using routine monitoring data collected by Council at three monitoring sites within St Georges Basin. The sites monitored include E-28 (northwest), E-33 (middle) and E-772 (east) (replicates = 5/site/year for chlorophyll-*a* and 4/site/year for turbidity). For 2020 - 2021, the following assessment findings were reported:

"The health of the St Georges Basin was excellent (A) with low algal levels (chlorophyll-a) and high water clarity (low turbidity) at all sites (Figure 4-2). This result is consistent with those previously reported in 2008 - 2009 (DP&E 2021) and is an improvement from good to excellent compared to Councils results in 2010 - 2011 (SSC, 2011)." (DP&E in preparation).



Site	Description	Algae (Chlorophyll a)	Water Clarity (Turbidity)	Overall Grade
E-772	Middle basin after Sussex on way to Erowal Bay	A	A	A
E-33	Midway between Macleans Point & Kangaroo Pt	A	A	A
E-28	Just off from Basin View	A	A	A
	Overall Estuary Grades	**A**	**A**	**A**

Figure 4-2 St Georges Basin Estuary Health Assessment and monitoring sites (DP&E in preparation).

DP&E's water quality graphs for key health indicators chlorophyll-a and turbidity in 2019 - 2021 are shown below in Figure 4-3.

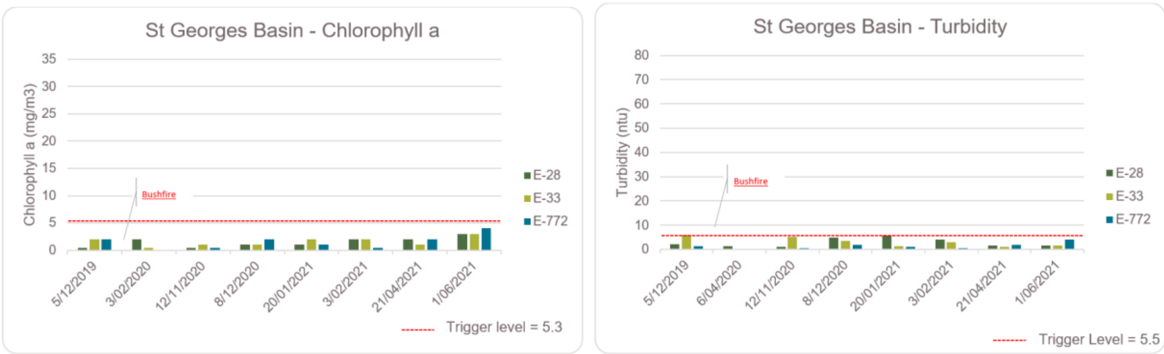


Figure 4-3 DP&E chlorophyll-a and turbidity graphs during 2020-2021 (from DP&E in preparation).

DP&E graphs of other water quality parameters during 2020 - 2021 are provided in **Appendix E**. DP&E reported many DO results were just below the normal expected range during 2020 - 2021, with the lowest results (around 75% saturation in comparison to the lower limit MER guideline of 84%) at E-28 near Basin View during April 2021. TN and TP were within the DP&E MER guidelines, but ammonia was above these at each site on two or three occasions..

4.1.1 Bushfire Event Monitoring

Bushfires can impact on water quality with key changes including increased sediment and nutrient loads (especially Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC)) and increased turbidity, which in turn can generate algae blooms where die off can raise pH and reduce dissolved oxygen (NSW EPA 2020).

During the summer of 2019/20 there was an extreme drought and extensive bushfires throughout the City of Shoalhaven LGA (and large parts of NSW). In NSW an estimated 5.5 million hectares (13,600,000 acres) were burnt (NSW Rural Fire Service 2020), and the bushfires are estimated to have affected over 1 million hectares of land, 47 estuaries and coastal catchments in the Shoalhaven LGA (Shoalhaven City Council 2021b). Around 70% of the St Georges Basin was burnt during the bushfires, with the fires reaching right to the foreshores on the southwestern third of the lake. The high volumes of rainfall that immediately followed the bushfire period are likely to have caused mobilisation of large volumes of soils, sediments and ash into the estuary, raising concern for the potential of impacts on water quality and estuary health.

Council received grant funding from the NSW Government to develop a South-East Catchment and Waterways Bushfire Recovery Plan including water quality and estuary health monitoring within Shoalhaven. Monitoring of TOC, DOC and nutrients commenced in November 2020 and has been collected at 3-monthly intervals. Monitoring of estuary health, nutrients and physiochemical parameters also commenced during November on a monthly basis (ongoing at time of reporting) (Refer to section 5.2 below). Some limited sampling was also conducted by DPE and the EPA during the February 2020 flood even. This was the first flush of floodwaters following the bushfires and contained obvious sediment ash and debris.

A preliminary summary of their findings reported that there appears to be raised concentrations of TOC and DOC in comparison to typical concentrations expected for estuarine waters with initial indications of a decreasing trend over time as less carbon is being washed into the estuary from the surrounding land (DP&E 2022). Following the February 2020 flood, there was low DO (<72%) and high turbidity (up to 39 NTU) (**Appendix E**)

Further analysis of the bushfire monitoring data will be undertaken by NSW DP&E and included in a final report at the end of the grant period in February 2023 (to be prepared by DP&E).

4.2 Comparison to 2008-2009 and 2010-2011 Estuary Health

Estuary health Assessments for St Georges Basin were undertaken by Council and OEH during 2010 – 2011 (Figure 4-4) and by OEH in 2008-2009 (Figure 4-5) (www.environment.nsw.gov.au).

During 2008 – 2009, the overall assessment was excellent with consistently low algae levels and excellent water clarity (Figure 5-4). During 2010 – 2011, the overall assessment was that the health of the estuary was good, with consistently low algae levels and fair water clarity (Figure 4-4).

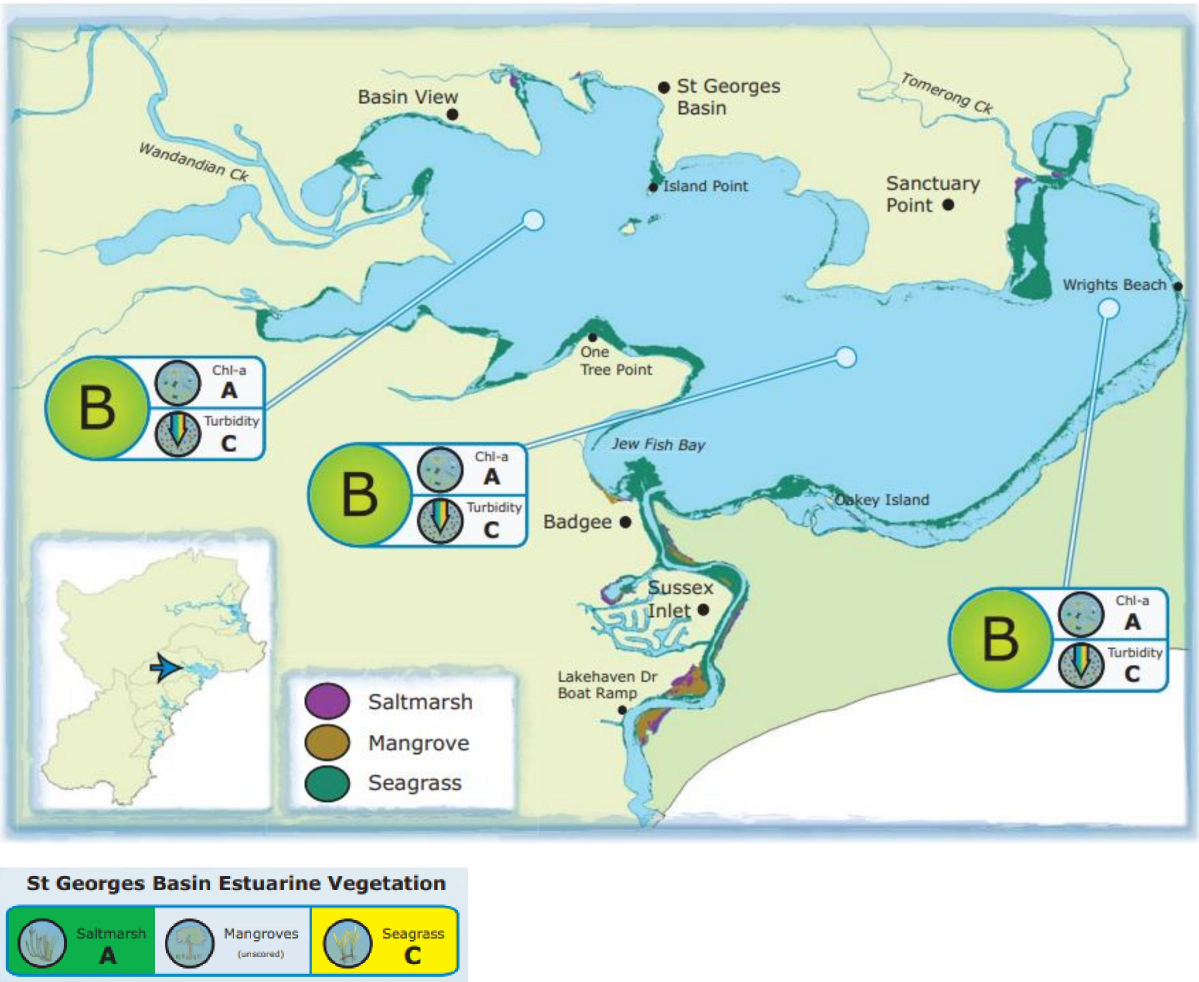


Figure 4-4 OEH 2010-2011 Estuary Health Assessment for St Georges Basin (from Shoalhaven City Council and OEH 2011).

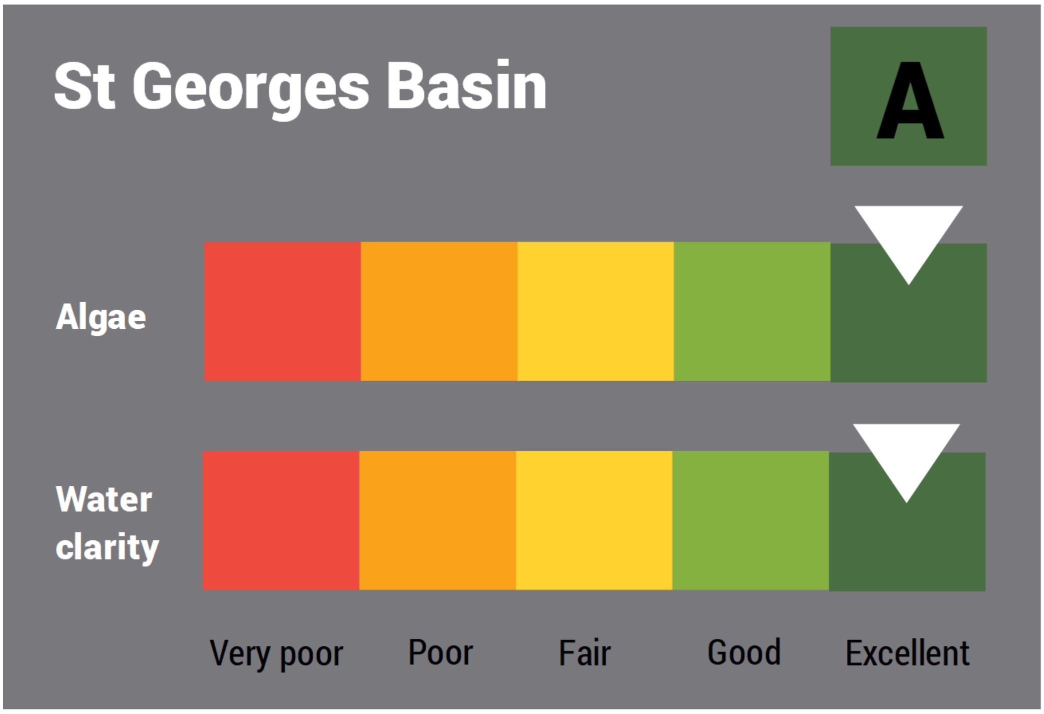


Figure 4-5 2008-2009 Estuary Health Assessment for St Georges Basin (from https://www.environment.nsw.gov.au/topics/water/estuaries/estuaries-of-nsw/st-georges-basin).

4.2.1 Chlorophyll-a

During 2020 - 2021 St Georges Basin received an Excellent (A) rating for chlorophyll-*a* with no samples exceeding guideline values. In 2010 - 2011 the same three sites also received an Excellent (A) rating with 8% of samples just above the guideline value. Of the three sites, two sites exceeded the guideline values 6% of the time, while the sampling site west of Wrights Beach (E-772) exceeded the guideline values 13% of the time. During 2008-2009 the two sites within the centre of St Georges Basin also returned an Excellent (A) chlorophyll-a result.

4.2.2 Turbidity

During 2020 - 2021 St Georges Basin received an Excellent(A) rating for turbidity with only 2.8% of samples exceeding guideline values. The sampling site (E-28), which is located northwest in the basin, exceeded the guideline value 8% of the time. In 2010 - 2011 St Georges Basin received a good (B) rating for turbidity with 12% of total samples significantly exceeding guideline values. The site adjacent to Oakey Island had the greatest percentage of exceedances with 18%. During 2008-2009 the two sites within the centre of St Georges Basin returned an Excellent (A) turbidity (water clarity) result.

5 Estuarine Macrophyte Mapping (NSW DPI)

NSW DPI undertakes macrophyte mapping of most estuarine habitats within NSW using methods developed over decades (Creese et al. 2019; Sainty 2012; West et al. 1985; West and Glasby 2021). Mapping for St Georges Basin has been undertaken in 1982, 2004 and 2020, with the most recent mapping coordinated by Greg West.

Estuarine macrophyte mapping is available via the Estuarine Habitat Dashboard (NSW DPI 2022) which includes the ability to view mapping and undertake a change analysis comparing the percentage of mapped macrophyte area between mapping times.

It is noted that due to differences in mapping techniques, mapping from 1982 generally is an overestimation of the large areas of macrophytes.

5.1 2004 and 2020 Mapping

Updated estuarine macrophyte habitat mapping of St Georges Basin and Sussex Inlet was undertaken by NSW DPI in 2004 and 2020 and are presented in Figure 5-2 and Figure 5-1. Habitat mapping is available via https://nsw-dpi.shinyapps.io/NSW_Estuarine_Habitat/. Estuarine macrophytes in St Georges Basin and Sussex Inlet are widespread and diverse, with numerous seagrass species, saltmarsh and mangroves occurring. The 2020 estuarine macrophyte mapping for this area shows the following:

- The north-eastern, eastern and southern sides of St Georges Basin are characterised by widespread beds of Posidonia and Ruppia seagrass. There are smaller areas of Zostera seagrass, in the north-east, and some small areas of saltmarsh and mangroves occur along the Sanctuary Point foreshore. The north-western side of the basin is characterised by Halophila seagrass interspersed with smaller areas of Zostera and Posidonia seagrass. There are also small areas of saltmarsh and mangroves in the north-west along the foreshore.
- The northern and middle section of Sussex Inlet Channel is lined with large areas of Posidonia seagrass with some small patches of Zostera. Within the deeper parts of the Channel there are no mapped macrophytes. The foreshore along most of the inlet has mixed areas of saltmarsh and mangroves. The southern section of Sussex Inlet has mixed Posidonia and Zostera seagrass beds and larger areas of saltmarsh and mangroves. There are no macrophytes mapped near the mouth of the estuary.
- The Sussex Inlet Canals have areas of Posidonia seagrass near the southern canal entry and Zostera seagrass is also scattered throughout the canals. The northern canal entry opens to a saltmarsh lined lagoon with Ruppia seagrass occurring in the middle of this.

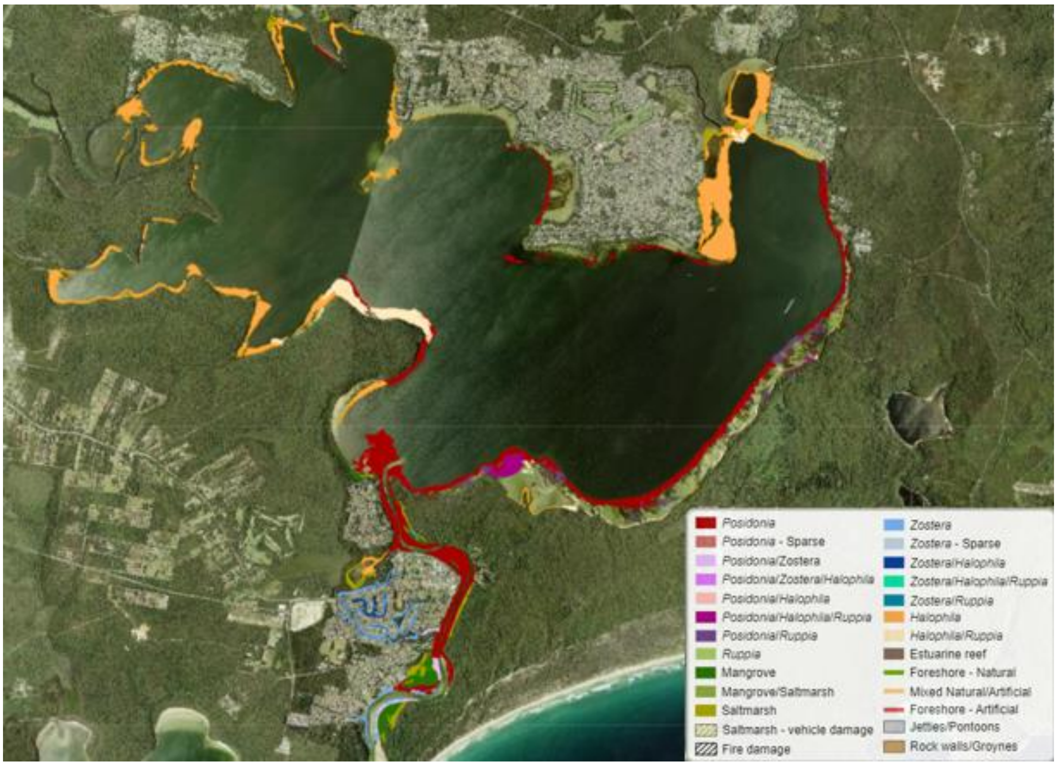


Figure 5-1 NSW DPI estuarine macrophyte mapping for 2004.

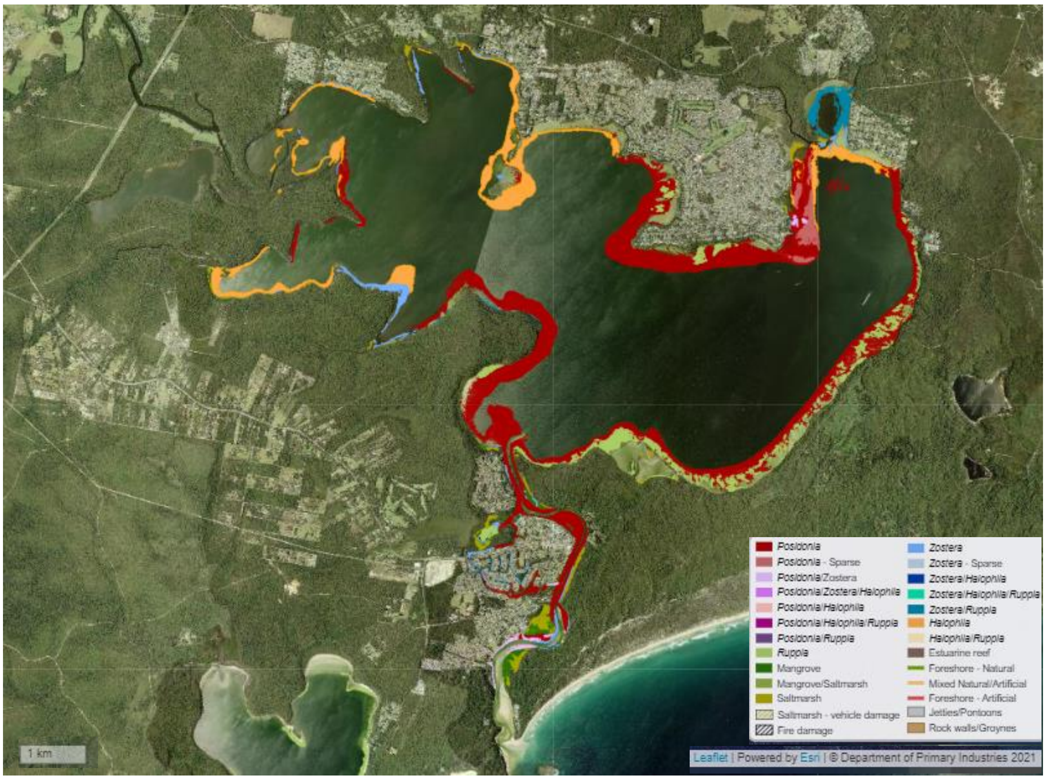


Figure 5-2 NSW DPI estuarine macrophyte mapping for 2020.

5.2 Changes in Macrophytes Over Time

5.2.1 2004 versus 2020

A comparison between the spatial distribution and area of key estuarine macrophyte groups over time (between 2004 and 2020) is available via the NSW DPI Estuarine Habitat Dashboard (NSW DPI 2022) (Figure 5-3, Figure 5-4 and Figure 5-5 NSW DPI estuarine macrophyte mapping change in area (m2) of key macrophyte habitat in St Georges Basin between 2004 in comparison to 2020 (NSW DPI 2022).). The mapping shows that there have been changes over time in the composition of macrophytes within St Georges Basin and Sussex Inlet. The key changes include:

- Overall, the distribution of Posidonia seagrass has significantly increased over time in the St Georges Basin and Sussex Inlet waterway. There was an overall approximate twofold increase in the area of Posidonia mapped , in 2004 ~150 ha was mapped while in 2020 this had increased to ~400 ha. More specifically, there have been large increases in the distribution of Posidonia within St Georges Basin.
- Overall, the area of Zostera seagrass in St Georges Basin and Sussex Inlet remained similar between 2020 and 2004 with around ~5-10 ha in total. More specifically there have been some increases in area within St Georges Basin but decreases within Sussex Inlet.
- Overall, the distribution of Halophila seagrass has decreased by approximately one third in area (from ~180 ha in 2004 to ~120 ha in 2020). There have been decreases seen in the canals and throughout the basin. There were some increases in the north-west of the basin.
- Overall, Ruppia seagrass has increased by approximately one third in area (with ~45 ha mapped in 2020 in comparison to ~70 ha mapped in 2004). There have been increases in both the north-east and eastern sides of the basin.
- Overall, the area of mangroves and saltmarsh were similar between 2020 and 2004. The area of mangroves was ~25 ha in 2004 and ~28 ha in 2020, while saltmarsh area was ~15 ha in 2004 and ~18 ha in 2020.

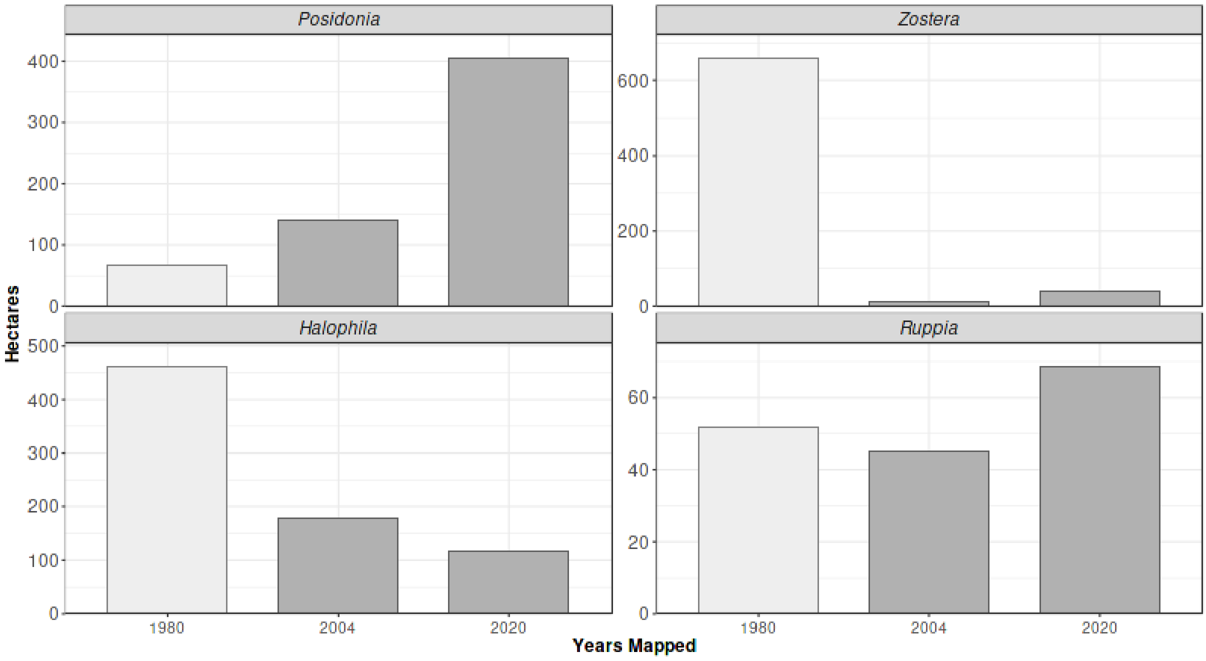


Figure 5-3 NSW DPI estuarine macrophyte mapping – data summary of changes in area (hectares) of seagrasses between 2004 in comparison to 2020 (NSW DPI 2022).

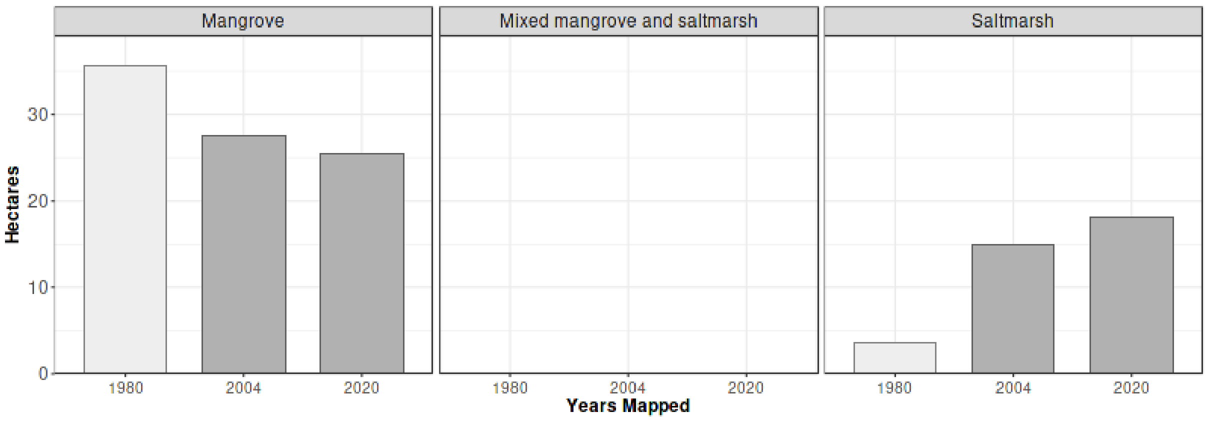


Figure 5-4 NSW DPI estuarine macrophyte mapping – data summary of changes in area (hectares) of mangroves and saltmarshes between 2004 in comparison to 2020 (NSW DPI 2022).

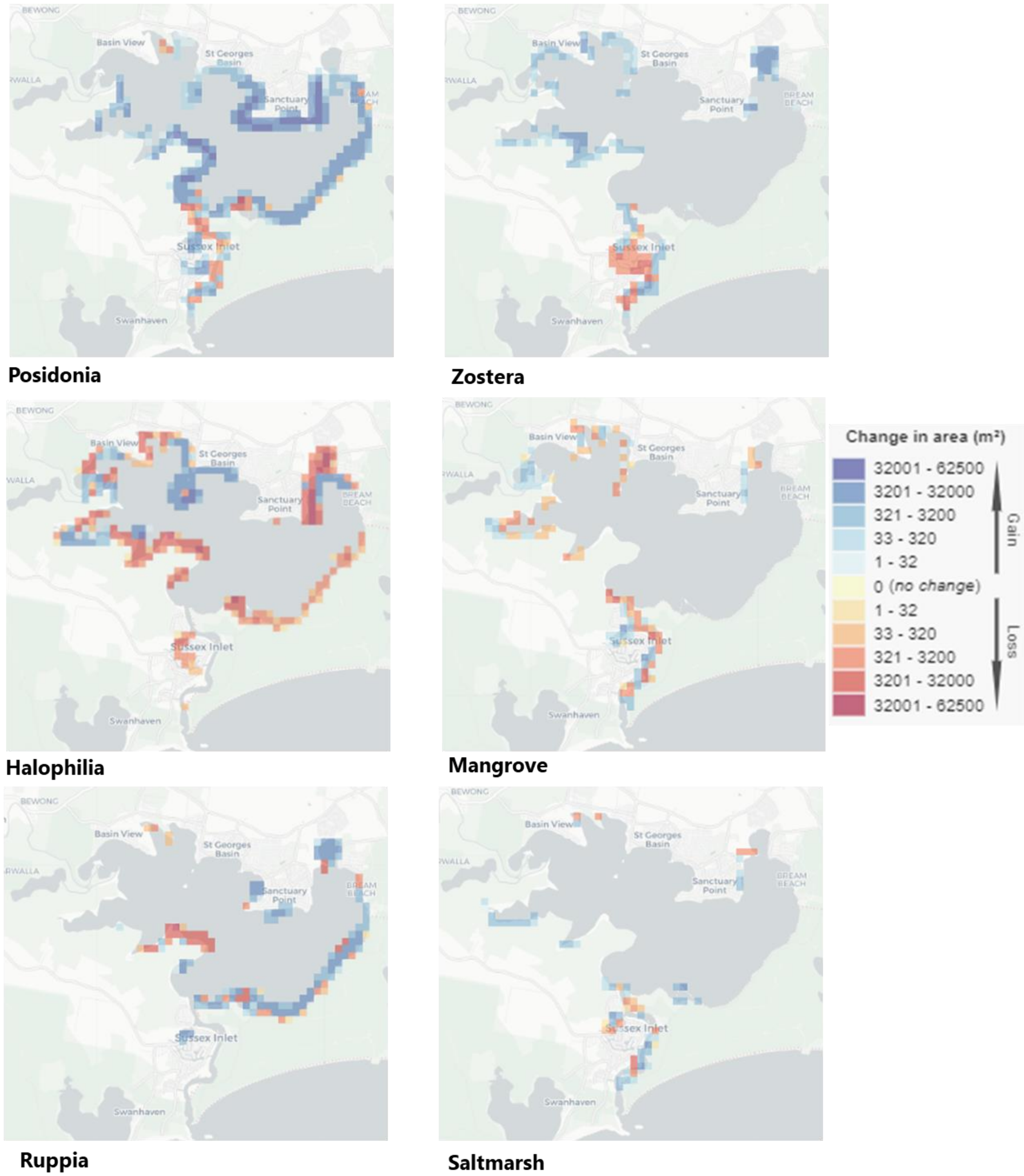


Figure 5-5 NSW DPI estuarine macrophyte mapping change in area (m^2) of key macrophyte habitat in St Georges Basin between 2004 in comparison to 2020 (NSW DPI 2022).

5.2.2 1985 versus 2006

A comparison of changes in estuarine vegetation over time was also included in the 2010 - 2011 assessment of estuary health, which consists of the following assessment (from Council and OEH 2010-11 Estuary Health Report Card):

- *"Seagrasses in St Georges Basin decreased by 23% between 1961 and 1998 and therefore received a grade of fair. This decrease primarily occurred in the near shore immediately east of Island Point and south of Wrights Beach. The loss east of Island Point can be directly attributed to urban development of the foreshore, while loss south of Wrights Beach may be a combination of poor water quality in the past, prior to a reticulated sewerage system and/or natural fluctuations.*
- *Mangroves in St Georges Basin increased by 9% between 1985 and 2006, primarily around the Jew Fish Bay area north of the Badgee township.*
- *Saltmarsh in St Georges Basin increased by 315% between 1985 and 2006 and therefore received a grade of very good. This increase primarily occurred in the Sussex Inlet waterway adjacent to Riverside Caravan Park and opposite Lakehaven Drive Boat Ramp and is a very positive sign for the estuary.*

Note: Analysis of the change in extent of mangrove and saltmarsh was completed using two different aerial photo interpretation methodologies for the 1985 and 2006 surveys. As a result, some of the change observed may be due to the different methodologies, as well as actual losses and gains in vegetation extent."

6 Recreational Water Quality

Recreational water quality is assessed using microbial (enterococci) data as an indicator.

6.1 St Georges Basin / Sussex Inlet

6.1.1 Microbial Monitoring

A comparison of enterococci data from the most recent five years of monitoring (2017, 2018, 2019, 2020 and 2021) to the NHMRC (2008) recreational guideline is summarised in Table 6-1.

Enterococci levels have decreased since 2010 with lower levels measured in the past five years in comparison to 2010 – 2012. Within 2017 – 2021, enterococci have been relatively consistent with exception that one elevated value of 1511 cfu/100ml detected upstream in Wandandian Creek at site E-249, which may have been associated with a heavy rainfall event around the same date.

Table 6-1 Summary of enterococci monitoring.

Area	Site	95th percentile (cfu/100ml)	NHMRC (2008) category	NHMRC (2008) risk of illness
St Georges Basin	E-20	1	A (≤40 cfu/ 100ml)	Gastrointestinal (GI) illness risk: <1% Acute febrile respiratory illness (AFRI) risk: <0.3%
	E-238	1.7		
	E-239	1		
	E-240	1.7		
	E-241	1		
	E-28	1		
	E-29	38		
	E-30	9.4		
	E-32	1		
	E-33	1		
	E-772	1		
	E-773	4.5		
Sussex Inlet Canals	E-251	44.75	B (41-200 cfu/ 100ml)	GI illness risk: 1-5% AFRI risk: 0.3-1.9%
	E-252	2.4	A (≤40 cfu/ 100ml)	GI illness risk: <1% AFRI risk: <0.3%
	E-330	6.1		
	E-331	17.1		
	E-250	22.6		GI illness risk: <1%

Area	Site	95^{th} percentile (cfu/100ml)	NHMRC (2008) category	NHMRC (2008) risk of illness
Sussex Inlet Channel	E-333	4.1	A (≤40 cfu/ 100ml)	AFRI risk: <0.3%
Tomerong Creek	E-243	240	C (201 – 500 cfu/100mL)	GI illness risk: 5 - 10% AFRI risk: 1.9-3.9%
Wandandian Creek	E-249	219		
	E-25	39	A (<40 cfu/100mL)	GI illness risk: <1% AFRI risk: <0.3%

AFRI = acute febrile respiratory illness; GI = gastrointestinal, NHMRC = National, Health and Medical Research Council. Not relevant = sites were not assessed for recreational suitability but were monitored to investigate potential sources of faecal pollution within St Georges Basin.

6.1.2 Review of Pollution Sources within the Catchment

A high-level review was undertaken to assess the potential influence of various faecal pollution sources in the catchment from human versus environmental sources of faecal contamination. Refer to Table 6-2.

Table 6-2 Review of faecal pollution sources within St Georges Basin / Sussex Inlet.

Site Information	
Catchment land use	Relatively low disturbance with 70% forested areas (including parts of Morton National Park, Conjola National Park, Jerrawangala National Park and Booderee National Park), 10% urban, <10% cleared land for grazing (DP&E 2022a).
Type of primary recreational activities	Swimming, kayaking and stand-up paddle boarding.
Type of secondary recreational activities	Fishing, boating, sailing.
Groups likely to use the site	All ages (including infants and elderly which are the vulnerable age groups) are likely to use the site for primary recreation.
Flushing and dilution capacity	High dilution capacity due to the size of the estuary. Less reliance on flushing and high internal capacity for pollutant processing (Shoalhaven City Council 2013). St Georges Basin is a moderate flushed estuary based on 2001 tidal exchange data with an ebb flow of 0.39 10^6m^3 and local tidal range of 0.54 m and a flood flow of 0.3 10^6m^3 and local tidal range of 0.49 m (DNR 2006; DP&E 2022a). The Tidal and Coastal Inundation Study being undertaken as part of the CMP estimated that: • During a 1% annual exceedance probability (AEP) storms the current speed along monitoring sites along Sussex Inlet ranges from 0.2 m/s to 1.5 m/s depending on water levels (Advisian 2022c).

	• During a 5% annual exceedance probability (AEP) storms the current speed along monitoring sites along Sussex Inlet ranges from 0.5 m/s to 1.3 m/s depending on water levels (Advisian 2022c).
Rainfall	Some elevated enterococci values within the Sussex Inlet Canals correspond to periods of minor (i.e. 5-10mm in preceding days) rainfall (120 cfu /100ml at E-243 and 231 cfu /100ml at E-249 on 06/4/2020).
Patterns over time	There were elevated values associated with the upstream tributary sites that do not correlate with periods of rainfall (i.e. <5mm in days preceding) (360 cfu/100ml at E-243 on 21/4/21, 191 cfu/100ml at E-249 on 18/12/18 and 121 cfu/100ml at E-249 on 12/11/20). The source is likely to be upstream agriculture or environmental levels. There have been similar enterococci values in the past five years suggesting that upstream sources remain present at similar magnitude.
Potential Faecal and other Pollution Sources	
Bather shedding (i.e., shed from skin during bathing as source of faecal contamination, sunblock and other chemicals)	The number of bathers can be considered a potential source of faecal contamination via shedding off skin from bathers. This is likely to be a small source in relation to the large size of the basin and inlet. Peak usage is by tourists during school holidays and summer (Dec - Feb).
Toilet facilities	Available at most recreational sites around the basin. The level of risk is likely to be low assuming these facilities are maintained properly and inspected regularly.
Wastewater Treatment Plants	St Georges Basin STP – a small secondary plant with treatment capacity of 16,000 persons and minimum treatment of screening and aeration treatment and small volumes of effluent discharges (>1000 – 5000 ML annual) (EPA EPL 3926; Shoalhaven City Council 2022), although this plant does not discharge into the St Georges Basin catchment area. Sussex Inlet Sewage Treatment Plant (STP) – a very small plant with annual effluent discharge volume of >219 to 1000 ML and treatment capacity of 8000 persons (NSW EPA EPL 3936). Effluent treatment is tertiary with screening, extended aeration and decanting, ponds, chlorination and sand filtration for inflows between 58 and 319 L/sec. Treatment is sand filtration and chlorination for inflows over 320 L/sec. Effluent is reused via irrigation on local sporting grounds or discharged into Sussex Inlet via sand dunes (close to the mouth of ocean). The level of risk of faecal contamination from routine discharges associated with these STPs is likely to be low.
Designated sewage overflows (including network)	There are twenty two Council operated sewage pump stations in the St Georges STP scheme, each containing a flow relief point and storage for emergency flows (Shoalhaven City Council 2013). Overflows can also occur from manholes and boundary risers. As

	part of its Risk Assessment, Risk Minimisation and Incident Management strategy reported in Shoalhaven City Council (2013), Council examined the degree of risk from sewage overflows to adjacent surface water catchments. The portions of the Basin View, Sanctuary Point, St Georges Basin and Old Erowal Bay adjacent to St Georges Basin have been classed as 'medium risk' of overflows. Other portions of the sewerage system were classified as 'low risk'. There were no 'high risk' areas identified. In the Revised Estuary Management Plan (2013), it was identified that St Georges Basin STP was planned to be upgraded with a new 20.6 ML storm water retention pond for consistent wet weather flow management. The level of risk associated with designated sewage overflows is likely to be low-moderate following wet weather depending on the overflow event.
Onsite sewage systems	Numerous private onsite sewage management systems are located throughout the catchment (Shoalhaven City Council 2013). Very few are located near the waterway so the risk is considered to be low.
Wastewater re-use area	Reclaimed water from Sussex Inlet Treatment Plant is used at local sporting ground. Reclaimed water is used for agriculture irrigation on the Shoalhaven River floodplain. Reclaimed water from St Georges Basin STP is used at the St Georges Country Club and the Bay and Basin Leisure Centre. These are located away from waterways and drainage pathways into waterways, so the risk is considered low.
Stormwater & urban runoff	A Stormwater Plan Review in 2003 identified St Georges Basin as vulnerable to stormwater inputs due to the combination of dispersive soils, constricted entrance and moderate proportion of urban land use (Shoalhaven City Council 2013). There is concern from the community that sediment is being washed into the estuary via stormwater drains, particularly from construction sites during rain events.
Boats	There is moderate boating usage within the basin and canals with peak use during school holidays and summer. Boats are a potential source of faecal contamination associated with illegal sewage dumping, the risk is not known. There are also potential human health risks associated with boating for oil and fuel spills, which are listed under NHMRC (2011).
Animals/Environment	A large proportion of the catchment is forested. Faecal contamination from the upper reaches of tributaries could be related to sources of faecal contaminants within the catchment including: ▪ Natural sources (from upstream in catchment), especially following periods of heavy rainfall e.g. bird roosting areas, wildlife breeding areas ▪ Agriculture within upstream tributaries.

	▪ Dogs in the lower catchment (associated with the residential and tourism land uses) are a potential source. Approx. 10% of the catchment is cleared for grazing and potential source within catchment. Erosion of banks – in creeks and foreshores as source of sediment.
Management Controls in place (Pathogens & Pollution)	
Management controls	Environmental Protection License (EPL) on STPs. New onsite sewage systems require approval and Council monitors on a routine basis to ensure compliance. Ongoing enterococci and faecal coliform monitoring. CMP management actions (to be developed). Canal Estate Management Plan (Shoalhaven City Council 2014). Risk Assessment, Risk Minimisation and Incident Management Strategy (Shoalhaven City Council). Multi-faceted programs which respond to overflow events. LLS and other grants for landholders to fence off riparian areas and control stock access.
Management response plan for exceptional events (such as sewage overflows)	Pollution Incident Response Management Plan (PIRMP).

6.1.3 Overall Assessment

Sussex Inlet and St Georges Basin are used for a range of recreational activities including passive recreation, fishing, boating, kayaking, cycling, swimming, walking, and birdwatching.

Recreational water quality within St Georges Basin and Sussex Inlet continues to be highly ranked as "Good" (4-stars out of 4) for swimming and other water-based activities based on the NHMRC (2008) guidelines.

A comparison of enterococci data from the past four years to the NHMRC (2008) recreational guideline is summarised in Table 6-1. Enterococci levels within St Georges Basin and Sussex Inlet have been consistently low and within the NHMRC (2008) Category A for microbial assessments.

Review of enterococci data within the tributaries (Tomerong Creek and Wandandian Creek) shows there are upstream faecal contamination sources. The observed enterococci levels at these sites do not necessarily indicate concern or trigger management actions. It is unclear whether the source of the elevated enterococci is associated with sewage discharges (i.e. Tomerong Creek), natural sources and/or upstream agriculture. However, these results do not indicate a concern for St Georges Basin given they are reduced at downstream creek sites and are not impacting on downstream recreational swimming quality in St Georges Basin. It should be noted that there have been isolated occasions when enterococci values within Tomerong Creek and Wandandian Creek have, on occasion, exceeded the NHMRC (2008) recreational water quality Guidelines for secondary contact recreation (>230 cfu/100mL), Within St Georges Basin, the recreational assessment suggests that the main potential source of faecal pollution is overflows during or following wet weather. However, there are no enterococci values that suggest this may have occurred at the time of monitoring. The Council is recommended to continue to undertake targeted sampling following significant rainfall or overflow events in recreational seasons to confirm suitability (see Section 7.2). The advice from NHMRC (2011) across all estuaries is that swimming and contact recreational activities should be avoided for 3 days following heavy rainfall or upon inspection that shows water pollution (litter, discoloured waters or odours).

7 Summary

7.1 Estuary Health and Water Quality Issues

A summary of estuary health and water quality issues for St Georges Basin and Sussex Inlet and potential implications is provided in Table 7-1. The next stage of the CMP will include development of an action plan to address these identified issues and meet water quality objectives.

Table 7-1 Water quality issues and implications.

Issue	Implication and Indicative Management Responses
Water Quality Program – data maintenance and reporting	
Routine water quality has been collected for St Georges Basin and Sussex Inlet. However, there are some inconsistencies with sampling and data entry including: ▪ Inconsistent seasonal sampling replication (e.g. less sampling has occurred in winter months). ▪ Inconsistent approach to reporting values below the estimated limit of reporting (EQL). ▪ Ambiguous values that were likely related to data entry and/or instrument errors. ▪ Potential overestimation of turbidity. ▪ The Aquadata portal dataset includes both pollution events and routine monitoring data. However, these cannot be identified or separated (apart from reviewing and aligning historical rainfall data). ▪ Inconsistent sampling of turbidity and chlorophyll–*a* makes it difficult to regularly assess estuary health (i.e. need consistent samples at E-28, E-33 and E-772)	Not having consistent and reliable water quality data affects the ability to assess water quality health, whether water quality objectives are being met and thus ability to make management decisions. A lack of similarity / consistency in data collection and therefore in datasets between years restricts the analysis which can be undertaken, for example between seasons, years or events. Errors in water quality data can carry over into reporting issues if not identified (i.e. such as parameters where values are unusually low or high but within possible range such as elevated turbidity throughout dataset). Inconsistencies with reporting values <EQL makes it difficult to compare at later stages. Reduced ability to discriminate between pollution and routine data can affect interpretation of results.
Limited nutrient monitoring data within St Georges Basin, Sussex Inlet and tributaries	
Insufficient sites that are monitored for nutrients and chlorophyll-*a* to assist with understanding trends and linking these to ecological risk. Previously, elevated nutrients were identified as a risk based on comparison to the ANZECC 2000 guidelines. However, in this analysis comparison to the respective DP&E MER guidelines (for creeks, rivers >25 PSU and lakes) showed few exceedances.	Not having an adequate dataset can affect ability to assess water quality health and whether objectives are being met. Nutrient over enrichment (nitrogen and phosphorous, particularly bioavailable forms) can cause excessive nuisance plant and algae growth and lead to low dissolved oxygen and altered pH. In addition, this can lead to human health, amenity and ecological risks. Locally derived guidelines should be referenced in preference of the default ANZECC regional guidelines.
Elevated Turbidity	

<table>
<tr><th>Issue</th><th>Implication and Indicative Management Responses</th></tr>
<tr><td>Elevated turbidity from catchment inputs presents a potential risk to water quality within the basin.

There are several identified sources within the catchments associated with development sites and runoff events following heavy rain which should be further investigated.

Other potential sources are siltation from poorly maintained boat ramps (e.g. Boathaven and Lions Park), seawalls (e.g. retaining walls along Sussex Inlet and revetment around Island within Rivera Keys).

Turbidity values could have been overestimated, and the method could be reviewed.</td><td>Elevated turbidity and reduced dissolved oxygen can results in impacts on ecological functioning which during extreme prolonged events can cause fish kills. Higher turbidity affects light penetration and can reduce DO production by phytoplankton and estuarine plants.

The turbidity, dissolved oxygen and nutrient levels within the basin and inlet are generally good suggesting that the dilution and nutrient assimilation capacity of the basin is sufficient and low risk for impacts.

The occasional elevated turbidity and dissolved oxygen has previously been identified as related to erosion and urban runoff.

There are also challenges from bank and dune erosion due to migration within the channel.</td></tr>
<tr><td colspan="2">Pathogen sources - upstream sites at Wandandian Creek and Tomerong Creek</td></tr>
<tr><td>The upstream sites of Wandandian Creek and Tomerong Creek show that there are upstream pathogen inputs. These sites are located away from recreational areas and are not impacting on downstream swimming recreational quality in the creeks or St Georges Basin.

The recreational microbial water quality within the basin and inlet can be considered very good (Category A) suggesting that the high dilution and flushing rates of the basin are sufficient to maintain recreational water quality despite catchment inputs. However, if ongoing enterococci assessments in St Georges Basin finds elevated values that compromise the recreation assessment, then additional monitoring would be recommended to identify if the upstream sources are associated with human or environmental sources of contamination.</td><td>As the upstream sites of Wandandian Creek and Tomerong Creek are not used for swimming recreational purposes this does not trigger the need for management actions. It is also considered that the downstream sites are more representative to monitor pathogen inputs into St Georges Basin.

The Council should monitor enterococci following heavy rainfall periods or known overflows. They should include signage or educate community that swimming should be avoided for three days following heavy rainfall or if there is visible pollution of waterways (such as litter, leaves, discolouration or odours).

If enterococci within St Georges Basin becomes elevated, then targeted investigations would be recommended to determine whether the source of pathogens in tributaries is environmental, animal or human (i.e. faecal source tracking).</td></tr>
<tr><td colspan="2">Flooding and tidal inundation</td></tr>
<tr><td>Flooding and tidal inundation is a significant challenge, within Sussex Inlet and some of St Georges Basin northern foreshore areas.</td><td>Reductions in water quality following flooding and tidal inundation events:

▪ Through additional inputs from catchments washed into the estuary and impacting on water quality in terms of increased turbidity and reduced DO (from sediments), increased pathogen loads (from potential sewage overflows), and toxic chemicals (from rubbish).</td></tr>
</table>

Issue	Implication and Indicative Management Responses
	▪ Reduced flushing rates associated with the higher water table and higher tides. Bank and dune erosion can impact on infrastructure and navigation for recreational boating.
Loss of important aquatic seagrass and salt marsh habitat	
Damage to seagrass beds from boating activities (e.g. propeller scarring of seagrass), mowing of saltmarsh, provision of sufficient facilities for recreational boating, water quality and build-up of seagrass wrack have all been identified as significant challenges at St Georges Basin and along Sussex Inlet Channel. Within St Georges Basin the overall area of mapped macrophytes is similar between 2004 and 2020, however the composition of seagrass species has significantly changed with higher abundance of Posidonia and lower abundance of Ruppia. Within Sussex Inlet, the mapping shows an overall decrease with lower abundance of Posidonia, Zostera, Halophilia and mangroves but higher abundance of saltmarshes in 2020, compared to 2004. Impacts on seagrasses have specifically been raised for Sussex Inlet during community consultation as resulting from the canoe storage and boating.	For St Georges Basin, although the area of seagrasses in 2020 was similar to 2004, there is a shift in dominant species from Halophila to Posidonia. This has potential implications for changes to ecological communities, including the type of fish species within the basin. Similarly, within Sussex Inlet the transition of seagrasses to more saltmarsh area has potential implications for habitat and water quality. A reduction in seagrass is associated with a loss of essential habitat and abundance of dependent ecological communities (fish and invertebrates). As well as changes to the morphology of the area. Seagrass wrack is part of natural system and cycling including providing important habitat. Buildup of wrack is not generally an issue in natural settings but can create issues if build up is in front of seawalls and decomposes anaerobically, then affecting water quality (reduced DO) and causing odour impacts.
Loss of important coastal terrestrial habitat	
Damage to coastal vegetation, dunes and habitats by four-wheel driving, dogs and illegal clearing. The removal of trees along riparian zones has resulted in loss of buffers that filter runoff. Inadequate protection of important ecological zones including wildlife corridors and habitat throughout St Georges Basin	Removal of trees and coastal vegetation results in loss of buffers to filter run-off. Damage to vegetation and dunes results in loss of habitat for important coastal species including endangered birds.
Impacts on fisheries	
Community consultation raised the issue that there is a perception of decline in fisheries thought to be associated with a combination of habitat decline (as outlined above) and illegal overfishing. However DPI Fisheries information does not currently support these community perceptions	Reduced ecological health in terms of lower abundance and/or diversity. Impacts on endangered bird species.
Maintenance of infrastructure and channel sedimentation at Riviera Keys	
Drainage canals present unique challenges due to different management plans to the natural waterways.	Potential impacts on water quality are increased sedimentation which in turn can result in increased

Issue	Implication and Indicative Management Responses
The potential issues are increased sedimentation into the waters associated with identified areas of erosion around boat ramps, damaged retaining walls and a failing revetment on the island (Advisian 2019). Along the western shoreline in the canals, there is excessive overgrowth of weeds. There is also weed growth which has blocked stormwater outlets. There is limited depth in the Canals from Chris Creek to the Sussex Inlet Channel.	turbidity. Higher turbidity affects light penetration and can reduce DO production by phytoplankton and estuarine plants. Stormwater is a potential source of nutrients, sediments and toxic chemicals into the canals. If not maintained properly this increases the likelihood of impacts on water quality especially after large storm events.
Sea level rise	
Potential impacts on water quality and ecological health through changes to the hydrodynamics of the estuary. Sussex Inlet and Sanctuary Point in particular have been identified as susceptible to coastal inundation.	Changes to hydrodynamics has the potential to change flushing rates and nutrient assimilation. Potential implications for ecological health via inundation of infrastructure and endangered ecological communities and landward migration of saltmarsh, mangroves and changes to seagrass distribution. Added rubbish and contaminants being washed into waterways from urban areas during periods of inundation, particularly when combined with storm events
Management of entrance channel shoaling	
St Georges Basin is a large estuary which is permanently open to the ocean. It was previously estimated that it takes around 80 days to fully exchange the basin's volume with the ocean (SCC 2013). At times the opening can be confined by sand shoals.	A heavily shoaled entrance could restrict tidal flushing. The relatively long exchange period with ocean waters could result in a buildup of pollutants from catchment sources following wet weather events.
Impacts on water quality following bushfires (2019-2020)	
Increased catchment runoff and associated sediment and nutrients from burnt areas after the bushfires.	Bushfires can impact on water quality with key changes including increased sediment and nutrient loads (especially total organic carbon and dissolved carbon) and increased turbidity, which in turn can generate algae blooms where die off can raise pH and reduce dissolved oxygen (NSW EPA 2020), as well as impact seagrasses through smothering and blocking of sunlight.

7.2 Recommended Sampling Program

Recommended monitoring sites for inclusion in future sampling is shown in Figure 7-1 and a summary of the recommended program is provided in Table 7-2.

These recommendations are based on:

- Improvements to ongoing monitoring will ensure that the program can track improvements towards meeting current water quality objectives.
- Reducing the number of monitoring sites and increasing sampling frequency to improve statistical significance from the monitoring program.
  - Sampling during summer and spring. This is recommended to be undertaken monthly for physicochemistry and pathogens, once every 3 weeks for chlorophyll-*a* and turbidity, and once per season for nutrients and suspended sediments.
  - Monitoring sites around the shoreline, other than in popular swimming areas, have been recommended for exclusion as these may not be representative of the estuary and picking up localised issues (i.e., elevated enterococci associated with diffuse runoff and nutrients associated with sediment resuspension).
  - There is little spatial variability in physicochemistry between sites within Sussex Inlet and St Georges Basin which justifies a reduction in the number of sites.
- Continuing to monitor physicochemistry including turbidity, chlorophyll-*a* and nutrients across all recommended monitoring sites as indicators of estuary health.
- Continuing to monitor faecal coliforms and enterococci as indicators of recreational quality for primary and secondary recreational activities at key recreational swimming sites.
- Continuing to monitor the main tributaries Tomerong Creek and Wandandian Creek as potential sources of faecal contamination and nutrients.
- Recommendation to undertake water quality sampling during events including following high rainfall periods or pollution events (such as chemical spills or sewage overflows into tributaries). This is particularly important for enterococci. It is recommended that an appropriate trigger for wet weather sampling is developed (for example, >75mm combined rainfall in three days). It's important that this information is stored alongside the monitoring data.
- It is recommended that all enterococci sampling is paired with a sanitary inspection as undertaken for Beachwatch sites using the DPIE (2020b) template (see https://www.environment.nsw.gov.au/research-and-publications/publications-search/protocol-appendix-a-sanitary-inspection-report, **Appendix F**).

Water quality guidelines outlined in Section 2 are recommended for comparison to ongoing water quality monitoring.

In addition to the below program, estuary health monitoring should be coordinated with the existing DP&E three-year rotational schedule for estuaries across the state. This should target the maximum chlorophyll-*a* period from mid-November to the end of March. A minimum of six samples is recommended from within this period, with more samples providing more statistical confidence. This would consist of sampling approximately every three weeks during this period at the monitoring sites E-28, E-33 and E-772. At a minimum this would include turbidity and chlorophyll-*a* although it is recommended that all parameters listed in the table are included in the estuary health assessment.

Figure 7-1 Recommended monitoring sites for ongoing water quality sampling. Blue = recommended for inclusion; red = recommended for exclusion Orange = recommended for occasional wet weather sampling to understand catchment inputs

Table 7-2 Summary of proposed water quality program

Parameter	LOR	Frequency	Sites	Rationale
Physicochemistry				
pH	--	Six samples during November to March as per existing DP&E sampling regime[3].	Sussex Inlet canals: E-251, E-331 Sussex Inlet Channel: E-24, E-250, E-333 St Georges Basin: E-28[3], E-33[3], E-772[3], E-20[2], E-773[2]	Estuary health within basin and tributaries.
Temperature	0.1 °C			
Salinity	ppt			
Electrical conductivity	µS/cm			
Turbidity	0.1 ntu			

Parameter	LOR	Frequency	Sites	Rationale
DO	0.1 mg/L	Once each during other seasons winter, autumn and spring (i.e 3 sampling occasions)[3]. DPE estuary health sampling during November to March approximately every 3 years[3] Event sampling[1]	Wandandian Creek: E-25[2] E-239[1] Tomerong Creek: E-243[2]	
Algae				
Chlorophyll-*a*	0.5 mg/m^3	Council sampling - Six samples during November to March as per existing DP&E sampling regime[3]. Once each during other seasons winter, autumn and spring (i.e 3 sampling occasions) DPE sampling during November to March approximately every 3 years[3] Event sampling[1]	Sussex inlet canals: E-251, E-331 St Georges Basin: E-28[3], E-33[3], E-772[3], E-20[2], E-773[2] Wandandian Creek: E-25, E-249[1] Tomerong Creek: E-243	Estuary health within basin and tributaries.
Nutrients				

Parameter	LOR	Frequency	Sites	Rationale
TN	0.025 mg/L	Once during each season. Event sampling[1]	Sussex inlet canals: E-251, E-331 St Georges Basin: E-238, E-240, E-28, E-29[1], E-32, E-33, E-772, E-20[2], E-773[2] Wandandian Creek: E-25[2,1] E-249[1] Tomerong Creek: E-243[2, 1]	Estuary health within basin and tributaries
TP	0.005 mg/L			
Pathogens				
Enterococci	1 CFU/100ml	Monthly during swimming seasons (spring, summer and autumn). Event sampling[1] (If required based on high EC results and sanitary inspections)	Sussex Inlet canals: E-251, E-331 Sussex Inlet Channel: E-24, E-250, E-333 St Georges Basin: E-240[1], E-241, E-28, E-32, E-20[2], E-773[2] Wandandian Creek: E-25[2,1], E-249[1] Tomerong Creek: E-243[2, 1]	Recreational water quality within basin and tributaries.
Faecal coliforms	1 CFU/100ml			
Suspended sediments				
TDS	0. 1 mg/L	Once during each season. Event sampling[1]	Targeted sites depending on the erosion improvement works – likely to include: St Georges Basin: E-30[1] and E-240[1]	As key indicator to measure erosion improvements works.
TSS	0.1 mg/L			

LOR = limit of reporting. 1= to investigate potential impacts on water quality during events; 2= to investigate potential impacts associated with the main tributaries into St Georges Basin. 3= key sites to monitor estuary health utilising boat based sampling from the centre of the basin area following standard DPE methodology (DPIE, 2016). For the DPE estuary health assessment every 3 years, undertake 3 weekly monitoring of parameters (turbidity and chlorophyll-*a* as minimum) during November to March.

7.2.1 Ecological Health

Estuary macrophyte mapping is recommended to be continued to be undertaken every five years to assist with assessments of estuary health. Estuary health monitoring based on water quality data is recommended every three years at a minimum.

It is further recommended that Council continue to work collaboratively with National Parks and Wildlife Service staff and Volunteers to implement the NSW South Coast Shorebird Recovery Program, to monitor shorebird numbers and to:

- Raise awareness amongst residents and visitors of migratory shorebirds which are protected under international agreements, and federal and state legislation

- Manage the impacts of pest animals, vehicles and dogs, especially in regard to the breeding success of migratory shorebirds.

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Appendix A
Water Quality Data Summary 2010 - 2021

					Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
		ANZG (2018) DGVs Toxicants 95% protection																	
				NSW DPIE MER Triggers - Lakes		93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
				NSW DPIE MER Triggers - Creeks		84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
		NHRMC (2008) Primary contact recreational			15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-20	6/09/2010	Spring	13.93	91.8	7.8	7.73	31.9	48870	1.3		1						31000
Lake	St Georges Basin	E-20	13/12/2010	Summer	26.43		10.77	7.82	28.56	44280	0.5	1	1						28000
Lake	St Georges Basin	E-20	28/03/2011	Autumn	21.09	117.3	9.1	7.63	24.25	38200	1.4	8	3						
Lake	St Georges Basin	E-20	28/06/2011	Winter	13.04	86.5	7.7	7.89	26.48	41400	0.2	2	1						
Lake	St Georges Basin	E-20	1/11/2011	Spring	21.59	92.3	7	8.11	25.73	40310	0.2		1						26000
Lake	St Georges Basin	E-20	14/02/2012	Summer	24.89	31.6	2.3	7.49	25.95	40600	1.3		1						
Lake	St Georges Basin	E-20	17/04/2012	Autumn	19.58	86.9	6.98	8.23	22.54	35770	7.9		1						23000
Lake	St Georges Basin	E-20	19/11/2013	Spring	22.12	109.2	8.28	8.69	24.06	37940	2.7	1	6						24000
Lake	St Georges Basin	E-20	24/11/2014	Spring								1	1						
Lake	St Georges Basin	E-20	30/06/2015	Winter								1	1						
Lake	St Georges Basin	E-20	15/12/2015	Summer								1	1						
Lake	St Georges Basin	E-20	4/04/2016	Autumn								1	1						
Lake	St Georges Basin	E-20	14/11/2017	Spring								1	1						
Lake	St Georges Basin	E-20	18/04/2018	Autumn								2	1						
Lake	St Georges Basin	E-20	18/12/2018	Summer								1	1						
Lake	St Georges Basin	E-20	30/04/2019	Autumn								1	1						
Lake	St Georges Basin	E-20	7/11/2019	Spring								1	1						
Lake	St Georges Basin	E-20	6/04/2020	Autumn	20	108	8.14	7.96	31.87	48830	0.4	1	1						
Lake	St Georges Basin	E-20	12/11/2020	Spring								1	1						
Lake	St Georges Basin	E-20	21/04/2021	Autumn								1	1						
Lake	St Georges Basin	E-238	6/09/2010	Spring	14.09	89.4	7.56	7.82	31.98	48980	3.6		1	3	0.60	0.005			31000
Lake	St Georges Basin	E-238	13/12/2010	Summer	24.44	109.1	7.68	7.27	9.79	45980	0.3	1	1	0.5	0.20	0.005			29000
Lake	St Georges Basin	E-238	28/03/2011	Autumn	20.74	128.2	9.8	7.77	26.55	41500	1.7	1	1	0.5	0.60	0.005			
Lake	St Georges Basin	E-238	28/06/2011	Winter	11.78	91.7	8.4	7.83	26.77	41800	0.3	1	1	0.5	0.50	0.04			
Lake	St Georges Basin	E-238	1/11/2011	Spring	20.83	72.5	5.58	7.7	25.49	39960	15.5		18	0.5	0.40	0.005			25000
Lake	St Georges Basin	E-238	14/02/2012	Summer	22.87	45.1	3.3	6.68	26.91	42000	3.5		1	0.5	0.30	0.005			
Lake	St Georges Basin	E-238	17/04/2012	Autumn		71.1	5.67	7.77	22.79	36130	26.2	1	2	3	0.20	0.01			23000
Lake	St Georges Basin	E-238	19/11/2013	Spring	20.73	97.8	7.59	8.35	24.6	38700	14	41	1	2	0.10	0.005			25000
Lake	St Georges Basin	E-238	24/11/2014	Spring								1	1	0.5	0.40		0.03		
Lake	St Georges Basin	E-238	30/06/2015	Winter								1	1	0.5	0.20		0.0025		
Lake	St Georges Basin	E-238	15/12/2015	Summer								1	1	4	0.10		0.07		
Lake	St Georges Basin	E-238	4/04/2016	Autumn								5	1	3	0.60		0.03		
Lake	St Georges Basin	E-238	12/04/2017	Autumn								2	2	5	0.10		0.0025		
Lake	St Georges Basin	E-238	14/11/2017	Spring								1	1		0.10		0.0025		
Lake	St Georges Basin	E-238	18/04/2018	Autumn								1	1	2	0.10		0.02		
Lake	St Georges Basin	E-238	18/12/2018	Summer								1	1	0.5	0.35		0.0025		
Lake	St Georges Basin	E-238	30/04/2019	Autumn								1	2	0.5	0.27		0.0025		
Lake	St Georges Basin	E-238	7/11/2019	Spring								1	1	2	0.24		0.0025		
Lake	St Georges Basin	E-238	6/04/2020	Autumn	20.42	112.5	8.41	8.16	31.85	48800	0.7	1	1	4	0.43		0.008		
Lake	St Georges Basin	E-238	12/11/2020	Spring								1	1	0.5	0.30	0.005			
Lake	St Georges Basin	E-238	21/04/2021	Autumn								1	1	2	0.23		0.0025		
Lake	St Georges Basin	E-239	6/09/2010	Spring	14.46	88.1	7.39	7.74	31.99	49010	3.9		1						31000
Lake	St Georges Basin	E-239	13/12/2010	Summer	24.51	107.4	7.53	7.16	30.36	46770	1	1	1						30000
Lake	St Georges Basin	E-239	28/03/2011	Autumn	21.25	129.5	9.8	7.73	27	42100	1.7	1	2						
Lake	St Georges Basin	E-239	28/06/2011	Winter	12.53	100.1	9	7.84	26.81	41800	0.7	1	1						
Lake	St Georges Basin	E-239	1/11/2011	Spring	21.85	82.8	6.26	7.79	25.54	40040	31.6		1						26000
Lake	St Georges Basin	E-239	14/02/2012	Summer	24.09	41.5	3	7.09	26.8	41800	3.5		1						
Lake	St Georges Basin	E-239	17/04/2012	Autumn	20.05	76.7	6.1	7.82	22.7	35990	18	2	1						23000
Lake	St Georges Basin	E-239	19/11/2013	Spring	21.39	96.7	7.41	8.19	24.62	38730	11	1	1						25000
Lake	St Georges Basin	E-239	24/11/2014	Spring								1	1						

Classification	Area	Field ID	Date	Season	Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-239	30/06/2015	Winter								1	1						
Lake	St Georges Basin	E-239	15/12/2015	Summer								1	1						
Lake	St Georges Basin	E-239	4/04/2016	Autumn								1	1						
Lake	St Georges Basin	E-239	14/11/2017	Spring								1	1						
Lake	St Georges Basin	E-239	18/04/2018	Autumn								1	1						
Lake	St Georges Basin	E-239	18/12/2018	Summer								1	1						
Lake	St Georges Basin	E-239	30/04/2019	Autumn								1	1						
Lake	St Georges Basin	E-239	7/11/2019	Spring								1	1						
Lake	St Georges Basin	E-239	6/04/2020	Autumn	20.81	106.7	7.92	8.18	31.87	48830	1.2	1	1						
Lake	St Georges Basin	E-239	12/11/2020	Spring								1	1						
Lake	St Georges Basin	E-239	21/04/2021	Autumn								1	1						
Lake	St Georges Basin	E-240	6/09/2010	Spring	14.68	88.3	7.42	7.66	31	47640	1.6		2	0.5	0.60	0.03			30000
Lake	St Georges Basin	E-240	13/12/2010	Summer	26.03	110.1	7.66	7.63	27.15	42310	0.9	1	1	1	0.40	0.005			27000
Lake	St Georges Basin	E-240	28/03/2011	Autumn	20.34	105.2	8.2	7.48	24.21	38100	1.4	28	11	4	0.50	0.005			
Lake	St Georges Basin	E-240	28/06/2011	Winter	13.51	91.1	8.1	7.97	26.06	40800	0.2	8	54	0.5	0.60	0.12			
Lake	St Georges Basin	E-240	1/11/2011	Spring	22.39	82.9	6.24	8.05	24.48	38540	0.2		13	0.5	0.30	0.02			25000
Lake	St Georges Basin	E-240	14/02/2012	Summer	24.94	38.2	2.7	7.62	25.59	40100	1.9		2	0.5	0.20	0.005			
Lake	St Georges Basin	E-240	17/04/2012	Autumn	19.6	82.1	6.61	7.83	21.69	34540	9		3	0.5	0.10	0.005			22000
Lake	St Georges Basin	E-240	19/11/2013	Spring	21.76	96.4	7.38	8.48	23.69	37420	5	1	6	0.5	0.10	0.005			24000
Lake	St Georges Basin	E-240	30/06/2015	Winter								1	1	0.5	0.20		0.0025		
Lake	St Georges Basin	E-240	15/12/2015	Summer								2	1	7	0.30		0.0025		
Lake	St Georges Basin	E-240	4/04/2016	Autumn								16	4	2	0.30		0.03		
Lake	St Georges Basin	E-240	12/04/2017	Autumn								12	4	2	0.50		0.0025		
Lake	St Georges Basin	E-240	14/11/2017	Spring								1	1	0.5	0.70		0.06		
Lake	St Georges Basin	E-240	18/04/2018	Autumn								1	1	2	0.60		0.0025		
Lake	St Georges Basin	E-240	18/12/2018	Summer								1	2	0.5	0.38		0.006		
Lake	St Georges Basin	E-240	30/04/2019	Autumn								1	1	0.5	0.26		0.0025		
Lake	St Georges Basin	E-240	7/11/2019	Spring								1	1	2	0.23		0.0025		
Lake	St Georges Basin	E-240	6/04/2020	Autumn	20	107.7	8.11	7.91	31.9	48870	0.1	1	1	3	0.44		0.007		
Lake	St Georges Basin	E-240	12/11/2020	Spring								1	1	0.5	0.27	0.005			
Lake	St Georges Basin	E-240	21/04/2021	Autumn								1	1	2	0.21		0.0025		
Lake	St Georges Basin	E-241	6/09/2010	Spring			7.68						3						31000
Lake	St Georges Basin	E-241	13/12/2010	Summer	24.89	124	8.69	7.72	29.1	45020	0.8	1	1						29000
Lake	St Georges Basin	E-241	28/03/2011	Autumn	21.17	127.5	9.8	7.72	25.36	39800	1	1	1						
Lake	St Georges Basin	E-241	28/06/2011	Winter	12.57	93.3	8.4	8	26.78	41800	0.2	1	1						
Lake	St Georges Basin	E-241	1/11/2011	Spring	21.27	94.2	7.19	8.1	25.7	40270	0.1		1						26000
Lake	St Georges Basin	E-241	14/02/2012	Summer	23.78	34.8	2.5	7.38	26.99	42100	2.8		8						
Lake	St Georges Basin	E-241	17/04/2012	Autumn	19.64	90.5	7.26	8.11	22.44	35620	6.1	1	1						23000
Lake	St Georges Basin	E-241	19/11/2013	Spring	21	96.7	7.46	8.42	24.66	38790	4	1	1						25000
Lake	St Georges Basin	E-241	24/11/2014	Spring								1	11						
Lake	St Georges Basin	E-241	30/06/2015	Winter								1	1						
Lake	St Georges Basin	E-241	15/12/2015	Summer								1	1						
Lake	St Georges Basin	E-241	4/04/2016	Autumn								1	1						
Lake	St Georges Basin	E-241	12/04/2017	Autumn								1	1						
Lake	St Georges Basin	E-241	14/11/2017	Spring								1	1						
Lake	St Georges Basin	E-241	18/04/2018	Autumn								1	1						
Lake	St Georges Basin	E-241	18/12/2018	Summer								1	1						
Lake	St Georges Basin	E-241	30/04/2019	Autumn								1	1						
Lake	St Georges Basin	E-241	7/11/2019	Spring								1	1						
Lake	St Georges Basin	E-241	6/04/2020	Autumn	19.42	102.5	7.81	7.84	31.89	48860	0.4	1	1						

					Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
		ANZG (2018) DGVs Toxicants 95% protection																	
		NSW DPIE MER Triggers - Lakes				93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
		NSW DPIE MER Triggers - Creeks				84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
		NHRMC (2008) Primary contact recreational			15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-241	12/11/2020	Spring								1	1						
Lake	St Georges Basin	E-241	21/04/2021	Autumn								1	1						
Lake	St Georges Basin	E-28	12/01/2010	Summer	26.23	78.2	5.21	7.95	34.02	51760	2.5		1	0.5					33000
Lake	St Georges Basin	E-28	9/02/2010	Summer	24.53	113.3	7.8	7.79	33.46	51000	2.2		1	0.5					33000
Lake	St Georges Basin	E-28	23/02/2010	Summer	25.34	105	7.15	7.47	32.98	50350	1.3		11	0.5					
Lake	St Georges Basin	E-28	9/03/2010	Autumn	24.62	113.2	7.79	8	33.15	50580	1.7		1	5					32000
Lake	St Georges Basin	E-28	22/03/2010	Autumn	24	109.9	7.64	9.07	33.23	50690	1.2		1	4					32000
Lake	St Georges Basin	E-28	6/04/2010	Autumn									1	2					
Lake	St Georges Basin	E-28	13/04/2010	Autumn	21.14	104.4	7.62	8.19	33.59	51170	2.4		1	1					33000
Lake	St Georges Basin	E-28	25/05/2010	Autumn	15.84	98.2	7.91	7.71	33.96	51680	2.2		1	2					33000
Lake	St Georges Basin	E-28	22/06/2010	Winter	13.24	99.2	8.54	7.85	31.99	49010	0.5		1	2					31000
Lake	St Georges Basin	E-28	6/09/2010	Spring	13.81	90.1	7.66	7.08	32.03	49050	15.8		1						31000
Lake	St Georges Basin	E-28	5/10/2010	Spring	20.18	78.1	6.01	8.41	27.81	43220	17.6		1	2					28000
Lake	St Georges Basin	E-28	1/11/2010	Spring	20.23	95	7.13	7.66	31.72	48630	0.5		5	1					31000
Lake	St Georges Basin	E-28	1/12/2010	Summer	22.23	86.9	6.32	7.56	30.92	47530	0.5		14	2					30000
Lake	St Georges Basin	E-28	13/12/2010	Summer	24.88	109.2	7.63	7.68	29.74	45900	0.9	1	1						29000
Lake	St Georges Basin	E-28	10/01/2011	Summer	25.13	114	8.09	8.01	26.33	41150	1.6		121	2					26000
Lake	St Georges Basin	E-28	17/01/2011	Summer	26.34	111.4	7.67	8.09	27.96	43440	0.5		1	0.5					28000
Lake	St Georges Basin	E-28	8/02/2011	Summer	25.64	104.2	7.2	7.77	29.43	45480	0.2		1	2					29000
Lake	St Georges Basin	E-28	22/02/2011	Summer	23.8	102.8	7.34	7.9	29.36	45380	0		17	4					
Lake	St Georges Basin	E-28	28/03/2011	Autumn	21.91	90.6	6.8	7.44	26.27	41100	1.3	1	1						
Lake	St Georges Basin	E-28	28/06/2011	Winter	12.4	86.6	7.9	7.93	26.24	41000	0.2	1	1						
Lake	St Georges Basin	E-28	6/09/2011	Spring	16.17	104.7	8.87	7.99	24.7	38850	0.2		1	2					25000
Lake	St Georges Basin	E-28	4/10/2011	Spring	15.98	43.6	3.7	6.82	25.4	39800	0.6		1	0.5					
Lake	St Georges Basin	E-28	1/11/2011	Spring	21.74	80.2	6.09	7.81	25.1	39420	0.2		1						25000
Lake	St Georges Basin	E-28	8/11/2011	Spring	23.24	80.5	5.95	7.89	25.07	39380	0.2		1	0.5					25000
Lake	St Georges Basin	E-28	22/11/2011	Spring	23.44	92	6.77	7.78	25.22	39590	8.4		1	0.5					25000
Lake	St Georges Basin	E-28	6/12/2011	Summer	19.63	82.7	6.55	7.78	24.57	38660	14.2		7	2					25000
Lake	St Georges Basin	E-28	4/01/2012	Summer	25.54	86	6.07	7.72	25.98	40650	4.7		1	1					26000
Lake	St Georges Basin	E-28	14/02/2012	Summer	23.61	90.9	6.63	7.74	26.1	40820	10.9		1111	3					26000
Lake	St Georges Basin	E-28	14/02/2012	Summer	24.08	34.1	2.5	7.29	25.65	40200	3.2		3						
Lake	St Georges Basin	E-28	28/02/2012	Summer	25.73	88.2	6.18	7.84	26.5	41390	5.2		1	2					26000
Lake	St Georges Basin	E-28	17/04/2012	Autumn									1	0.5					
Lake	St Georges Basin	E-28	17/04/2012	Autumn	20.11	89.1	7.1	7.89	22.01	35000	15.9	1	1						22000
Lake	St Georges Basin	E-28	16/05/2012	Autumn	18.53	69.6	5.58	8.49	26.11	40840	31.7		1	1					26000
Lake	St Georges Basin	E-28	23/07/2012	Winter	12.33	25.8	2.4	8.2	23	36420	4.7		1	2					23000
Lake	St Georges Basin	E-28	27/08/2012	Winter	12.92	104.3	9.46	8.11	24.54	38620	7.3		1	0.5					25000
Lake	St Georges Basin	E-28	11/09/2012	Spring	15.24	99.5	8.59		24.71	38870	1.4		1	0.5					25000
Lake	St Georges Basin	E-28	19/11/2013	Spring	20.45	97	7.59	8.4	23.91	37730	11	1	1						24000
Lake	St Georges Basin	E-28	24/11/2014	Spring								1	1						
Lake	St Georges Basin	E-28	30/06/2015	Winter								1	1						
Lake	St Georges Basin	E-28	15/12/2015	Summer								1	1						
Lake	St Georges Basin	E-28	4/04/2016	Autumn								1	1						
Lake	St Georges Basin	E-28	12/04/2017	Autumn								1	1						
Lake	St Georges Basin	E-28	14/11/2017	Spring								1	1						
Lake	St Georges Basin	E-28	18/04/2018	Autumn								2	2						
Lake	St Georges Basin	E-28	18/12/2018	Summer								121	28						
Lake	St Georges Basin	E-28	30/04/2019	Autumn								1	1						
Lake	St Georges Basin	E-28	7/11/2019	Spring								1	1						
Lake	St Georges Basin	E-28	6/04/2020	Autumn	20.49	94.7	7.07	7.8	31.89	48870	1.4	1	1						

Classification	Area	Field ID	Date	Season	Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-28	12/11/2020	Spring								1	1						
Lake	St Georges Basin	E-28	21/04/2021	Autumn								1	1						
Lake	St Georges Basin	E-29	6/09/2010	Spring	13.58	87.6	7.48	7.43	31.95	48950			1	5	0.60	0.005			31000
Lake	St Georges Basin	E-29	13/12/2010	Summer	27.09	130.2	8.76	7.76	29.69	45840	1.9	1	2	3	0.20	0.005			29000
Lake	St Georges Basin	E-29	28/03/2011	Autumn	21.44	111.5	8.5	7.56	24.45	38500	1.1	2	4	1	0.80	0.005			
Lake	St Georges Basin	E-29	28/06/2011	Winter	12.58	88.7	8	7.96	26.67	41600	0.2	1	1	0.5	0.60	0.04			
Lake	St Georges Basin	E-29	1/11/2011	Spring	22.19	77.9	5.86	7.81	25.3	39700	4.7		1	0.5	0.60	0.005			25000
Lake	St Georges Basin	E-29	14/02/2012	Summer	25.4	33.8	2.4	7.4	25.69	40200	2.4		2	0.5	0.40	0.005			
Lake	St Georges Basin	E-29	17/04/2012	Autumn	20.02	87	6.94	7.97	22.17	35230	27	1	1	2	0.20	0.02			23000
Lake	St Georges Basin	E-29	19/11/2013	Spring	21.63	94.1	7.22	8.39	23.51	37160	10		1	2	0.10	0.005			24000
Lake	St Georges Basin	E-29	24/11/2014	Spring								1	1	2	0.30		0.08		
Lake	St Georges Basin	E-29	30/06/2015	Winter								1	2	0.5	0.50		0.09		
Lake	St Georges Basin	E-29	15/12/2015	Summer								1	1	3	0.30		0.03		
Lake	St Georges Basin	E-29	4/04/2016	Autumn								7	3	2	0.40		0.0025		
Lake	St Georges Basin	E-29	12/04/2017	Autumn								2	2	4	0.10		0.0025		
Lake	St Georges Basin	E-29	14/11/2017	Spring								1	1	3	0.10		0.0025		
Lake	St Georges Basin	E-29	18/04/2018	Autumn								1	1	2	0.70				
Lake	St Georges Basin	E-29	18/12/2018	Summer								21	5	1	0.44		0.009		
Lake	St Georges Basin	E-29	30/04/2019	Autumn								1	1	1	0.30		0.0025		
Lake	St Georges Basin	E-29	7/11/2019	Spring								1	1	2	0.24		0.0025		
Lake	St Georges Basin	E-29	6/04/2020	Autumn	20.28	98.4	7.38	7.8	31.83	48770	1.4	4	1	4	0.46		0.006		
Lake	St Georges Basin	E-29	12/11/2020	Spring								1	1	2	0.29	0.005			
Lake	St Georges Basin	E-29	21/04/2021	Autumn								1	1	2	0.21		0.0025		
Lake	St Georges Basin	E-30	6/09/2010	Spring	13.76	89.6	7.63	7.61	31.98	48990	1.6		1						31000
Lake	St Georges Basin	E-30	13/12/2010	Summer	25.5	123.2	8.53	7.74	29.43	45480	0.7	1	4						29000
Lake	St Georges Basin	E-30	28/03/2011	Autumn	20.31	112.3	8.8	7.59	24.5	38600	1.3	1	2						
Lake	St Georges Basin	E-30	28/06/2011	Winter	12.5	92.9	8.4	8	26.66	41600	0.1	1	1						
Lake	St Georges Basin	E-30	1/11/2011	Spring	21.86	95.8	7.24	7.99	25.46	39920	1.3		1	0.5					25000
Lake	St Georges Basin	E-30	14/02/2012	Summer	23.41	36.1	2.7	7.18	25.13	39500	2.3		11						
Lake	St Georges Basin	E-30	17/04/2012	Autumn	19.67	89.6	7.2	8.02	22.16	35230	11.9	2	1						22000
Lake	St Georges Basin	E-30	19/11/2013	Spring	20.67	97.1	7.58	8.42	23.68	37390	8.9	4	1						24000
Lake	St Georges Basin	E-30	24/11/2014	Spring								1	1						
Lake	St Georges Basin	E-30	30/06/2015	Winter								1	1						
Lake	St Georges Basin	E-30	15/12/2015	Summer								1	1						
Lake	St Georges Basin	E-30	4/04/2016	Autumn								1	1						
Lake	St Georges Basin	E-30	12/04/2017	Autumn								4	1						
Lake	St Georges Basin	E-30	14/11/2017	Spring								2	11						
Lake	St Georges Basin	E-30	18/04/2018	Autumn								1	1						
Lake	St Georges Basin	E-30	18/12/2018	Summer								21	13						
Lake	St Georges Basin	E-30	30/04/2019	Autumn								1	1						
Lake	St Georges Basin	E-30	7/11/2019	Spring								1	1						
Lake	St Georges Basin	E-30	6/04/2020	Autumn	20.32	102.4	7.67	7.84	31.75	48680	1.6	2	1						
Lake	St Georges Basin	E-30	12/11/2020	Spring								1	1						
Lake	St Georges Basin	E-30	21/04/2021	Autumn								1	1						
Lake	St Georges Basin	E-32	6/09/2010	Spring	13.8	89.5	7.61	7.7	32.04	49070	2.1		1						31000
Lake	St Georges Basin	E-32	13/12/2010	Summer	24.15	117.8	8.34	7.73	29.66	45790	0.5	1	1						29000
Lake	St Georges Basin	E-32	28/03/2011	Autumn	20.88	134	10.3	7.81	25.35	39800	1.3	1	3						
Lake	St Georges Basin	E-32	28/06/2011	Winter	12.47	92.2	8.3	8.14	26.82	41800	0.2	1	1						
Lake	St Georges Basin	E-32	1/11/2011	Spring	20.91	85.6	6.58	7.94	25.55	40050	0.2		1						26000
Lake	St Georges Basin	E-32	14/02/2012	Summer	23	29.3	2.2	7.37	26.51	41400	2.6		4						

Classification	Area	Field ID	Date	Season	Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-32	17/04/2012	Autumn	19.72	93.1	7.45	8.09	22.5	35720	6.3	1	1						23000
Lake	St Georges Basin	E-32	19/11/2013	Spring	19.72	100.4	7.95	8.48	24.37	38380	6.7	1	1						24000
Lake	St Georges Basin	E-32	24/11/2014	Spring								1	1						
Lake	St Georges Basin	E-32	30/06/2015	Winter								1	1						
Lake	St Georges Basin	E-32	15/12/2015	Summer								1	1						
Lake	St Georges Basin	E-32	4/04/2016	Autumn								1	1						
Lake	St Georges Basin	E-32	12/04/2017	Autumn								1	1						
Lake	St Georges Basin	E-32	14/11/2017	Spring								1	1						
Lake	St Georges Basin	E-32	18/04/2018	Autumn								1	1						
Lake	St Georges Basin	E-32	18/12/2018	Summer								1	1						
Lake	St Georges Basin	E-32	30/04/2019	Autumn								1	1						
Lake	St Georges Basin	E-32	7/11/2019	Spring								1	1						
Lake	St Georges Basin	E-32	6/04/2020	Autumn	17.49	112.6	8.9	7.74	31.92	48910	0.6	1	1						
Lake	St Georges Basin	E-32	12/11/2020	Spring								1	1						
Lake	St Georges Basin	E-32	21/04/2021	Autumn								1	1						
Lake	St Georges Basin	E-33	12/01/2010	Summer	25.53	75.3	5.08	7.93	34.07	51830	1.5		1	0.5					33000
Lake	St Georges Basin	E-33	9/02/2010	Summer	24.77	112.6	7.7	7.72	33.88	51570	1.6		1	0.5					33000
Lake	St Georges Basin	E-33	23/02/2010	Summer	25.22	111.2	7.57	7.64	33.19	50630	11.8		1	0.5					32000
Lake	St Georges Basin	E-33	9/03/2010	Autumn	24.42	115.1	7.95	8.15	33.35	50860	2.1		1	5					33000
Lake	St Georges Basin	E-33	22/03/2010	Autumn	23.94	102.3	7.11	8.58	33.56	51140	1.2		1	5					
Lake	St Georges Basin	E-33	6/04/2010	Autumn									1	4					
Lake	St Georges Basin	E-33	13/04/2010	Autumn	21.14	103.1	7.54	8.02	33.33	50820	2		1	2					33000
Lake	St Georges Basin	E-33	25/05/2010	Autumn	16.07	102.9	8.26	7.67	33.94	51650	1.5		1	1					33000
Lake	St Georges Basin	E-33	22/06/2010	Winter	13.24	99.5	8.56	7.81	32.03	49050	0.2		1	1					31000
Lake	St Georges Basin	E-33	6/09/2010	Spring	13.83	91.8	7.8	7.75	32.01	49030	3.2		1	0.5	0.70	0.02			31000
Lake	St Georges Basin	E-33	5/10/2010	Spring	19.64	79.1	6.15	8.44	27.83	43250	21.8		1	3					28000
Lake	St Georges Basin	E-33	1/11/2010	Spring	21.12	117.2	9.71	8.97	12.19	20430	0.2		6	1					13000
Lake	St Georges Basin	E-33	1/12/2010	Summer	21.31	93.3	6.91	7.52	30.62	47101	0.4		56	1					30000
Lake	St Georges Basin	E-33	13/12/2010	Summer	24.61	113	7.96	7.69	29.14	45080	0.6	1	1	5	0.20	0.005			29000
Lake	St Georges Basin	E-33	10/01/2011	Summer	24.92	113.7	7.99	8.01	28.59	44310	0.8		73	3					28000
Lake	St Georges Basin	E-33	17/01/2011	Summer	25.96	110.8	7.64	8.11	28.77	44560	17.8		1	0.5					28000
Lake	St Georges Basin	E-33	17/01/2011	Summer									1	0.5					
Lake	St Georges Basin	E-33	8/02/2011	Summer	25.6	99.4	6.86	7.71	29.62	45740	0.2		1	2					29000
Lake	St Georges Basin	E-33	22/02/2011	Summer	23.82	101.6	7.23	8	29.73	45890	0.2		1	3					
Lake	St Georges Basin	E-33	28/03/2011	Autumn	20.92	128.8	9.9	7.76	25.62	40100	1.4	1	1	2	0.60	0.01			
Lake	St Georges Basin	E-33	28/06/2011	Winter	12.01	90.2	8.2	7.99	26.78	41800	0.2	1	1	0.5	0.70	0.07			
Lake	St Georges Basin	E-33	6/09/2011	Spring	16.11	102.3	8.73	7.99	24.74	38910	0.2		1	0.5					25000
Lake	St Georges Basin	E-33	4/10/2011	Spring	15.66	41.8	3.6	6.97	25.57	40100	0.5		1	1					
Lake	St Georges Basin	E-33	1/11/2011	Spring	20.58	84	6.49	7.86	25.68	40230	0.2		1	0.5	0.40	0.005			26000
Lake	St Georges Basin	E-33	8/11/2011	Spring	22.63	82.1	6.12	7.94	25.34	39750	0.2		1	0.5					25000
Lake	St Georges Basin	E-33	22/11/2011	Spring	23.07	89	6.59	7.78	25.33	39740	8.8		1	0.5					25000
Lake	St Georges Basin	E-33	6/12/2011	Summer	20	83.8	6.56	7.82	25.39	39830	54.2		4	0.5					25000
Lake	St Georges Basin	E-33	4/01/2012	Summer	25.14	87.7	6.23	7.73	26.07	40780	3.6		1	0.5					26000
Lake	St Georges Basin	E-33	14/02/2012	Summer	22.95	43.6	3.2	7.56	27.05	42200	2.1		2	0.5	0.20	0.005			
Lake	St Georges Basin	E-33	14/02/2012	Summer	22.88	89.1	6.57	7.76	26.56	41480	4.9		11	1					26000
Lake	St Georges Basin	E-33	28/02/2012	Summer	25.43	85.9	6.05	7.83	26.88	41920	8.8		1	2					27000
Lake	St Georges Basin	E-33	17/04/2012	Autumn	19.51	90.7	7.29	8.08	22.54	35770	5	1	1	2	0.20	0.05			23000
Lake	St Georges Basin	E-33	17/04/2012	Autumn									2	2					
Lake	St Georges Basin	E-33	16/05/2012	Autumn	18.38	73.6	5.92	8.55	26.2	40970	33.5		1	0.5					26000
Lake	St Georges Basin	E-33	23/07/2012	Winter	12.27	35.7	3.32	8.21	23.08	36540	1		1	3					23000

					Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
				ANZG (2018) DGVs Toxicants 95% protection															
				NSW DPIE MER Triggers - Lakes		93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
				NSW DPIE MER Triggers - Creeks		84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
				NHRMC (2008) Primary contact recreational	15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-33	27/08/2012	Winter	12.69	101.1	9.22	8.15	24.47	38530	1		1	0.5					25000
Lake	St Georges Basin	E-33	11/09/2012	Spring	14.98	102.6	8.91		24.71	38860	0.2		1	0.5					25000
Lake	St Georges Basin	E-33	19/11/2013	Spring	19.88	94.3	7.43	8.36	24.61	38710	6.6	1	1	1	0.00	0.005			25000
Lake	St Georges Basin	E-33	24/11/2014	Spring								1	1	0.5	0.10		0.04		
Lake	St Georges Basin	E-33	30/06/2015	Winter								1	1	0.5	0.30		0.0025		
Lake	St Georges Basin	E-33	15/12/2015	Summer								1	1	3	0.10		0.06		
Lake	St Georges Basin	E-33	4/04/2016	Autumn								1	1	2	0.30		0.04		
Lake	St Georges Basin	E-33	12/04/2017	Autumn								1	2	5	0.10		0.0025		
Lake	St Georges Basin	E-33	14/11/2017	Spring								1	1	1	0.10		0.07		
Lake	St Georges Basin	E-33	18/04/2018	Autumn								1	1	2	0.10		0.28		
Lake	St Georges Basin	E-33	18/12/2018	Summer								1	1	0.5	0.53		0.012		
Lake	St Georges Basin	E-33	30/04/2019	Autumn								1	1	0.5	0.27		0.0025		
Lake	St Georges Basin	E-33	7/11/2019	Spring								1	1	2	0.21		0.0025		
Lake	St Georges Basin	E-33	6/04/2020	Autumn	20.82	103	7.64	7.82	31.96	48960	0	1	1	4	0.43		0.009		
Lake	St Georges Basin	E-33	12/11/2020	Spring								1	1	2					
Lake	St Georges Basin	E-33	21/04/2021	Autumn								1	1	2	0.22		0.0025		
Lake	St Georges Basin	E-772	12/01/2010	Summer	25.34	75.1	5.08	7.82	34.07	51830	1.5	1	1	0.5					
Lake	St Georges Basin	E-772	12/01/2010	Summer	25.34	75.1	5.08	7.82	34.07	51830	1.5		1	0.5					33000
Lake	St Georges Basin	E-772	23/02/2010	Summer	25.35	109	7.41	7.58	33.14	50570	1.5		9	0.5					32000
Lake	St Georges Basin	E-772	9/03/2010	Autumn	24.2	111.4	7.71	7.66	33.42	50940	1.3		1	5					33000
Lake	St Georges Basin	E-772	22/03/2010	Autumn	23.92	102.7	7.14	8.62	33.55	51130	1		1	4					33000
Lake	St Georges Basin	E-772	6/04/2010	Autumn									11	2					
Lake	St Georges Basin	E-772	13/04/2010	Autumn	21.03	104.8	7.67	7.97	33.55	51120	1.5		1	0.5					33000
Lake	St Georges Basin	E-772	25/05/2010	Autumn	15.87	100	8.07	7.35	33.71	51340	2.4		1	0.5					
Lake	St Georges Basin	E-772	22/06/2010	Winter	13.21	98.3	8.46	7.8	32.08	49130	0.4	1	1	1					31000
Lake	St Georges Basin	E-772	6/09/2010	Spring	13.85	93	7.91	7.69	32	49010	2.3		1	1	0.60	0.005			31000
Lake	St Georges Basin	E-772	5/10/2010	Spring	19.37	77.7	6.07	8.48	27.8	43210	20.4		1	2					28000
Lake	St Georges Basin	E-772	1/11/2010	Spring	21.25	98.1	8.11	8.53	12.18	20410	0.2		4	0.5					13000
Lake	St Georges Basin	E-772	1/12/2010	Summer	21.34	90.8	6.71	7.46	30.9	47510	0.4		5	2					30000
Lake	St Georges Basin	E-772	13/12/2010	Summer	24.5	113.4	8	7.68	29.16	45100	0.4	1	1	1	0.20	0.005			29000
Lake	St Georges Basin	E-772	10/01/2011	Summer	24.07	115.7	8.22	8	29.3	45300	0.8		5	3					29000
Lake	St Georges Basin	E-772	17/01/2011	Summer	25.18	110.2	7.69	8.14	28.96	44830	0.5		1	2					28000
Lake	St Georges Basin	E-772	8/02/2011	Summer	25.64	100	6.9	7.66	29.64	45770	0.2		1	3					29000
Lake	St Georges Basin	E-772	22/02/2011	Summer	23.8	109	7.76	7.51	29.67	45810	0		3	0.5					
Lake	St Georges Basin	E-772	28/03/2011	Autumn	20.26	122.4	9.6	7.7	24.45	38500	1	1	1	4	0.60	0.005			
Lake	St Georges Basin	E-772	28/06/2011	Winter	12.06	96	8.8	7.97	26.74	41700	0.2	1	1	0.5	0.50	0.03			
Lake	St Georges Basin	E-772	6/09/2011	Spring	15.88	105.8	9.04	7.97	24.2	38130	0.2		1	0.5					24000
Lake	St Georges Basin	E-772	4/10/2011	Spring	15.49	45.3	3.9		25.25	39600	0.9		2	0.5					
Lake	St Georges Basin	E-772	1/11/2011	Spring	20.37	84.5	6.55	--	25.99	40670	6.5		1	0.5	0.40	0.005			26000
Lake	St Georges Basin	E-772	8/11/2011	Spring	22.32	82.6	6.19	7.96	25.45	39900	4.8		1	0.5					25000
Lake	St Georges Basin	E-772	22/11/2011	Spring	22.88	86.5	6.42	7.76	25.37	39800	6.1		1	1					25000
Lake	St Georges Basin	E-772	6/12/2011	Summer	19.75	82.7	6.52	7.83	25.06	39360	4.8		16	0.5					25000
Lake	St Georges Basin	E-772	4/01/2012	Summer	24.68	87	6.22	7.77	26.2	40970	3.7		1	0.5					26000
Lake	St Georges Basin	E-772	14/02/2012	Summer	23.16	35.1	2.6	7.44	26.92	42000	1.7		1	0.5	0.20	0.005			
Lake	St Georges Basin	E-772	14/02/2012	Summer	23	86.7	6.34	7.76	27.42	42670	10.5		71	2					27000
Lake	St Georges Basin	E-772	28/02/2012	Summer	25.07	90	6.35	7.86	27.3	42510	2.7		1	2					27000
Lake	St Georges Basin	E-772	17/04/2012	Autumn	19.38	89.9	7.25	8.02	22.54	35770	3.3	1	1	2	0.10	0.005			23000
Lake	St Georges Basin	E-772	17/04/2012	Autumn									1	2					
Lake	St Georges Basin	E-772	16/05/2012	Autumn	18.77	76.8	6.14	8.72	25.85	40470	27.4		1	0.5					26000
Lake	St Georges Basin	E-772	23/07/2012	Winter	12.18	25.3	2.36	8.19	23.05	36490	1.8		1	3					23000

Classification	Area	Field ID	Date	Season	Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	St Georges Basin	E-772	27/08/2012	Winter	12.85	98.2	8.93	8.14	24.41	38440	1		1	0.5					24000
Lake	St Georges Basin	E-772	11/09/2012	Spring	14.85	102.6	8.92		24.88	39100	0.8		1	0.5					25000
Lake	St Georges Basin	E-772	19/11/2013	Spring	20.48	92.3	7.19	8.46	24.74	38910	4.7	1	1	0.5	0.10	0.005			25000
Lake	St Georges Basin	E-772	30/06/2015	Winter								1	1	0.5	0.30		0.0025		
Lake	St Georges Basin	E-772	15/12/2015	Summer								1	1	3	0.30		0.06		
Lake	St Georges Basin	E-772	4/04/2016	Autumn								1	2	1	0.30		0.0025		
Lake	St Georges Basin	E-772	12/04/2017	Autumn								1	1	2	0.10		0.0025		
Lake	St Georges Basin	E-772	14/11/2017	Spring								1	1	0.5	0.10		0.0025		
Lake	St Georges Basin	E-772	18/04/2018	Autumn								1	1	1	0.10		0.09		
Lake	St Georges Basin	E-772	18/12/2018	Summer								1	1	0.5	0.41		0.007		
Lake	St Georges Basin	E-772	30/04/2019	Autumn								1	1	1	0.25		0.0025		
Lake	St Georges Basin	E-772	7/11/2019	Spring								1	1	0.5	0.21		0.0025		
Lake	St Georges Basin	E-772	6/04/2020	Autumn	20.42	106.1	7.93	7.93	31.85	48810	0	1	1	5	0.42		0.007		
Lake	St Georges Basin	E-772	12/11/2020	Spring								1	1	2	0.24	0.005			
Lake	St Georges Basin	E-772	21/04/2021	Autumn								1	1	2	0.20		0.0025		
Lake	St Georges Basin	E-773	6/09/2010	Spring	13.76	89.1	7.59	7.3	31.95	48950	3		1	3	0.50	0.005			31000
Lake	St Georges Basin	E-773	13/12/2010	Summer	27.43	108.1	7.41	7.64	25.34	39750	1.2		1	1	0.20	0.005			25000
Lake	St Georges Basin	E-773	28/03/2011	Autumn	22.96	116.6	8.7	7.58	24.32	38300	1.3	1	4	4	0.50	0.005			
Lake	St Georges Basin	E-773	28/06/2011	Winter	12.58	96.5	8.1	7.4	26.64	41600	1	1	2	0.5	0.60	0.04			
Lake	St Georges Basin	E-773	1/11/2011	Spring	21.31	73.5	5.62	7.65	25.13	39460	0.1		1	0.5	0.50	0.005			25000
Lake	St Georges Basin	E-773	14/02/2012	Summer	23.54	44.2	3.2	7.36	26.56	41500	2.4		1	0.5	0.10	0.005			
Lake	St Georges Basin	E-773	17/04/2012	Autumn	21.59	76.5	5.98	7.64	20.63		53.2	2	1	2	0.20	0.005			21000
Lake	St Georges Basin	E-773	19/11/2013	Spring	20.13	97.8	7.69	8.14	24.09	37980	13	1	5	3	0.10	0.005			24000
Lake	St Georges Basin	E-773	24/11/2014	Spring								1	1	0.5	0.30		0.03		
Lake	St Georges Basin	E-773	30/06/2015	Winter								1	1	0.5	0.30		0.0025		
Lake	St Georges Basin	E-773	15/12/2015	Summer								1	1	7	0.50		0.06		
Lake	St Georges Basin	E-773	4/04/2016	Autumn								11	1	5	0.30		0.0025		
Lake	St Georges Basin	E-773	12/04/2017	Autumn								2	1	6	0.10		0.74		
Lake	St Georges Basin	E-773	14/11/2017	Spring								1	1	2	0.10		0.15		
Lake	St Georges Basin	E-773	18/04/2018	Autumn								2	1	2	0.10		0.07		
Lake	St Georges Basin	E-773	18/12/2018	Summer								11	6	0.5	0.45		0.006		
Lake	St Georges Basin	E-773	30/04/2019	Autumn								1	1	1	0.27		0.0025		
Lake	St Georges Basin	E-773	7/11/2019	Spring								1	1	3	0.25		0.0025		
Lake	St Georges Basin	E-773	6/04/2020	Autumn	20.5	107.2	8	8.16	31.8	48730	1.2	1	1	6	0.46		0.009		
Lake	St Georges Basin	E-773	12/11/2020	Spring								11	1	3	0.49	0.005			
Lake	St Georges Basin	E-773	21/04/2021	Autumn								1	1	2	0.27		0.0025		
Lake	Sussex Inlet Canals	E-251	6/09/2010	Spring	15.15	93	7.67	7.68	32.63	49870	1.5		3						32000
Lake	Sussex Inlet Canals	E-251	13/12/2010	Summer	24.94	106	7.44	7.45	28.86	44690	0.4	1	5	4	0.10	0.005			29000
Lake	Sussex Inlet Canals	E-251	28/03/2011	Autumn	21.87	116.8	8.8	7.58	26.86	41900	2.1		23	2	0.60	0.005			
Lake	Sussex Inlet Canals	E-251	28/06/2011	Winter	12.01	88.8	8.1	7.78	27.45	42700	0.1	1	3	0.5	0.60	0.05			
Lake	Sussex Inlet Canals	E-251	1/11/2011	Spring	20.82	84.5	6.37	7.86	29.17	45110	0.2		7	2	0.40	0.005			29000
Lake	Sussex Inlet Canals	E-251	14/02/2012	Summer	23.61	40	2.9	7.51	28.42	44100	2.1		11	0.5	0.10	0.02			
Lake	Sussex Inlet Canals	E-251	17/04/2012	Autumn	19.31	79.5	6.37	7.6	23.7	37430	8.9	18	14	2	0.20	0.005			24000
Lake	Sussex Inlet Canals	E-251	19/11/2013	Spring	20.7	94.9	7.31	8.35	25.9	40540	5.9	1	18	2	0.10	0.005			26000
Lake	Sussex Inlet Canals	E-251	24/11/2014	Spring								11	73	0.5	0.30		0.03		
Lake	Sussex Inlet Canals	E-251	30/06/2015	Winter								2	5	0.5	0.30		0.0025		
Lake	Sussex Inlet Canals	E-251	15/12/2015	Summer								7	12	3	0.30		0.02		
Lake	Sussex Inlet Canals	E-251	4/04/2016	Autumn								141	19	0.5	0.60		0.03		
Lake	Sussex Inlet Canals	E-251	12/04/2017	Autumn								34	38	1	0.10		0.06		
Lake	Sussex Inlet Canals	E-251	14/11/2017	Spring								1	1	2	0.10		0.0025		

					Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
			ANZG (2018) DGVs Toxicants 95% protection																
			NSW DPIE MER Triggers - Lakes			93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
			NSW DPIE MER Triggers - Creeks			84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
			NHRMC (2008) Primary contact recreational		15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	Sussex Inlet Canals	E-251	18/04/2018	Autumn								6	6	0.5	0.10		0.01		
Lake	Sussex Inlet Canals	E-251	18/12/2018	Summer								2	3	1	0.30		0.008		
Lake	Sussex Inlet Canals	E-251	30/04/2019	Autumn								27	46	0.5	0.15		0.0025		
Lake	Sussex Inlet Canals	E-251	6/04/2020	Autumn	19.6	111.1	8.33	8.14	33.93	51640	0.1	56	41	3	0.26		0.0025		
Lake	Sussex Inlet Canals	E-251	12/11/2020	Spring								5	5	0.5	0.27	0.005			
Lake	Sussex Inlet Canals	E-251	21/04/2021	Autumn								21	36	2	0.19		0.0025		
Lake	Sussex Inlet Canals	E-252	6/09/2010	Spring	15.14	91.6	7.57	7.76	32.26	49370	4.4		1						32000
Lake	Sussex Inlet Canals	E-252	13/12/2010	Summer	24.88	96.2	6.72	7.39	29.81	46000	2.4	1	3						29000
Lake	Sussex Inlet Canals	E-252	28/03/2011	Autumn	20.91	109.3	8.3	7.61	27.13	42300	2.1	1	4						
Lake	Sussex Inlet Canals	E-252	28/06/2011	Winter	12.35	91	8.2	7.95	27.17	42300	0.1	1	1						
Lake	Sussex Inlet Canals	E-252	1/11/2011	Spring	20.04	76.2	5.9	7.86	27.28	42490	0.2		1						27000
Lake	Sussex Inlet Canals	E-252	14/02/2012	Summer	22.98	43.5	3.2	7.13	27.58	42900	2.9		3						
Lake	Sussex Inlet Canals	E-252	17/04/2012	Autumn	19.35	77.9	6.25	7.78	23.34	36910	3.8	4	2						23000
Lake	Sussex Inlet Canals	E-252	19/11/2013	Spring	20.66	99.3	7.68	8.39	25.34	39750	4.1	1	1						25000
Lake	Sussex Inlet Canals	E-252	24/11/2014	Spring								4	4						
Lake	Sussex Inlet Canals	E-252	30/06/2015	Winter								2	2						
Lake	Sussex Inlet Canals	E-252	15/12/2015	Summer								2	3						
Lake	Sussex Inlet Canals	E-252	4/04/2016	Autumn								42	12						
Lake	Sussex Inlet Canals	E-252	12/04/2017	Autumn								18	12						
Lake	Sussex Inlet Canals	E-252	14/11/2017	Spring								1	3						
Lake	Sussex Inlet Canals	E-252	18/04/2018	Autumn								2	1						
Lake	Sussex Inlet Canals	E-252	18/12/2018	Summer								2	1						
Lake	Sussex Inlet Canals	E-252	30/04/2019	Autumn								6	1						
Lake	Sussex Inlet Canals	E-252	7/11/2019	Spring								1	1						
Lake	Sussex Inlet Canals	E-252	6/04/2020	Autumn	19.03	111.1	8.48	8.1	32.84	50160	0.2	1	1						
Lake	Sussex Inlet Canals	E-252	12/11/2020	Spring								1	1						
Lake	Sussex Inlet Canals	E-252	21/04/2021	Autumn								1	3						
Lake	Sussex Inlet Canals	E-330	6/09/2010	Spring	14.75	94.3	7.84	7.65	32.49	49690	1.6		1						32000
Lake	Sussex Inlet Canals	E-330	13/12/2010	Summer	24.77	114.2	8.01	7.47	29.55	45650	0.3	1	4						29000
Lake	Sussex Inlet Canals	E-330	28/03/2011	Autumn	20.56	123.2	9.5	7.75	26	40700	2.1	2	5						
Lake	Sussex Inlet Canals	E-330	28/06/2011	Winter	12.36	90.8	8.2	7.98	26.93	42000	0.1	1	1						
Lake	Sussex Inlet Canals	E-330	1/11/2011	Spring	20.64	80.2	6.13	7.89	27.27	42470	17.3		6						27000
Lake	Sussex Inlet Canals	E-330	14/02/2012	Summer	23.13	39.4	2.9	7.44	27.46	42700	2.9		5						
Lake	Sussex Inlet Canals	E-330	17/04/2012	Autumn	19.69	75.9	6.01	7.82	24.35	38350	72.1	8	5						24000
Lake	Sussex Inlet Canals	E-330	19/11/2013	Spring	20.76	96	7.39	8.34	25.9	40540	6.5	8	2						26000
Lake	Sussex Inlet Canals	E-330	24/11/2014	Spring								7	7						
Lake	Sussex Inlet Canals	E-330	30/06/2015	Winter								1	1						
Lake	Sussex Inlet Canals	E-330	15/12/2015	Summer								14	5						
Lake	Sussex Inlet Canals	E-330	4/04/2016	Autumn								96	8						
Lake	Sussex Inlet Canals	E-330	12/04/2017	Autumn								41	18						
Lake	Sussex Inlet Canals	E-330	14/11/2017	Spring								2	3						
Lake	Sussex Inlet Canals	E-330	18/04/2018	Autumn								5	2						
Lake	Sussex Inlet Canals	E-330	18/12/2018	Summer								1	1						
Lake	Sussex Inlet Canals	E-330	30/04/2019	Autumn								6	4						
Lake	Sussex Inlet Canals	E-330	7/11/2019	Spring								1	1						
Lake	Sussex Inlet Canals	E-330	6/04/2020	Autumn	18.8	121.4	9.18	8.14	35.09	53210	0.6	11	7						
Lake	Sussex Inlet Canals	E-330	12/11/2020	Spring								4	1						
Lake	Sussex Inlet Canals	E-330	21/04/2021	Autumn								1	1						
Lake	Sussex Inlet Canals	E-331	6/09/2010	Spring	14.97	91.3	7.56	7.56		49680	1.7		2	1	0.60	0.005			32000
Lake	Sussex Inlet Canals	E-331	13/12/2010	Summer	25.65	109.1	7.56	7.42	29.03	44920	0.7	28	16	3	0.10	0.005			29000

Classification	Area	Field ID	Date	Season	Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	Sussex Inlet Canals	E-331	28/03/2011	Autumn	21.03	110.1	8.3	7.64	27.86	43300	1.8	3	11	4	0.70	0.005			
Lake	Sussex Inlet Canals	E-331	28/06/2011	Winter	12.51	89.3	8	7.92	27.71	43100	0.1	1	1	0.5	0.40	0.02			
Lake	Sussex Inlet Canals	E-331	1/11/2011	Spring	21.95	72.7	5.35	7.77	29.8	45980	0.2		17	2	0.40	0.005			29000
Lake	Sussex Inlet Canals	E-331	14/02/2012	Summer	23.76	43.2	3.1	6.39	28.14	43700	3.1		5	0.5	0.20	0.005			
Lake	Sussex Inlet Canals	E-331	17/04/2012	Autumn	19.77	75	5.93	7.76	24.6	38700	9.2	6	11	0.5	0.20	0.01			25000
Lake	Sussex Inlet Canals	E-331	19/11/2013	Spring	21.26	92.6	7.05	8.29	26.15	40890	8.5	4	27	2	0.10	0.005			26000
Lake	Sussex Inlet Canals	E-331	24/11/2014	Spring								4	7	0.5	0.10		0.04		
Lake	Sussex Inlet Canals	E-331	30/06/2015	Winter								7	4	0.5	0.40		0.0025		
Lake	Sussex Inlet Canals	E-331	15/12/2015	Summer								4	7	3	0.10		0.02		
Lake	Sussex Inlet Canals	E-331	4/04/2016	Autumn								11	9	19	0.40		0.03		
Lake	Sussex Inlet Canals	E-331	12/04/2017	Autumn								22	14	2	0.10		0.0025		
Lake	Sussex Inlet Canals	E-331	14/11/2017	Spring								4	3	2	0.10		0.08		
Lake	Sussex Inlet Canals	E-331	18/04/2018	Autumn								11	6	0.5	0.10		0.03		
Lake	Sussex Inlet Canals	E-331	18/12/2018	Summer								1	8	1	0.37		0.017		
Lake	Sussex Inlet Canals	E-331	30/04/2019	Autumn								7	7	0.5	0.16		0.0025		
Lake	Sussex Inlet Canals	E-331	7/11/2019	Spring								1	2	0.5	0.21		0.0025		
Lake	Sussex Inlet Canals	E-331	6/04/2020	Autumn	19.61	107.4	8.06	8.01	33.81	51480	0.8	8	21	2	0.27		0.0025		
Lake	Sussex Inlet Canals	E-331	12/11/2020	Spring								17	5	0.5	0.29	0.005			
Lake	Sussex Inlet Canals	E-331	21/04/2021	Autumn								11	2	2	0.18		0.0025		
Lake	Sussex Inlet Channel	E-24	6/09/2010	Spring	14.02	92.8	7.85	7.7	32.03	49060	2.4		1						31000
Lake	Sussex Inlet Channel	E-24	13/12/2010	Summer	24.36	116.5	8.23	7.42	29.44	45490	0.1	1	1						29000
Lake	Sussex Inlet Channel	E-24	28/03/2011	Autumn	20.81	127	9.8	7.74	25.52	40000	2.1	1	2						
Lake	Sussex Inlet Channel	E-24	28/06/2011	Winter	13.28	99.3	8.8	7.98	26.77	41800	0.1	1	2						
Lake	Sussex Inlet Channel	E-24	1/11/2011	Spring	20.28	74.5	5.78	7.83	26.08	40800	0.4		1						26000
Lake	Sussex Inlet Channel	E-24	14/02/2012	Summer	23.85	40.7	2.9	6.66	27.1	42200	1.9		9						
Lake	Sussex Inlet Channel	E-24	17/04/2012	Autumn	19.5	83.5	6.7	7.8	23	36420	77.9	2	1						23000
Lake	Sussex Inlet Channel	E-24	19/11/2013	Spring	20.37	99.5	7.63	8.34	27.82	43230	7.3	1	5						28000
Lake	Sussex Inlet Channel	E-24	24/11/2014	Spring								3	34						
Lake	Sussex Inlet Channel	E-24	30/06/2015	Winter								1	1						
Lake	Sussex Inlet Channel	E-24	15/12/2015	Summer								1	4						
Lake	Sussex Inlet Channel	E-24	4/04/2016	Autumn								1	2						
Lake	Sussex Inlet Channel	E-24	12/04/2017	Autumn								14	8						
Lake	Sussex Inlet Channel	E-24	14/11/2017	Spring								1	1						
Lake	Sussex Inlet Channel	E-24	18/04/2018	Autumn								1	1						
Lake	Sussex Inlet Channel	E-24	18/12/2018	Summer								1	1						
Lake	Sussex Inlet Channel	E-24	30/04/2019	Autumn								1	1						
Lake	Sussex Inlet Channel	E-24	7/11/2019	Spring								1	1						
Lake	Sussex Inlet Channel	E-24	6/04/2020	Autumn	19.05	119.7	9.04	8.08		52490	1	1	1						
Lake	Sussex Inlet Channel	E-24	12/11/2020	Spring								1	1						
Lake	Sussex Inlet Channel	E-24	21/04/2021	Autumn								1	1						
Lake	Sussex Inlet Channel	E-250	6/09/2010	Spring	15.04	89.5	7.32	7.73	34.33	52180	1.3		1	1	0.40	0.1			33000
Lake	Sussex Inlet Channel	E-250	13/12/2010	Summer	23.68	117.8	8.32	7.61	31.49	48320	0.3	1	2						31000
Lake	Sussex Inlet Channel	E-250	28/03/2011	Autumn	21.12	116.9	8.8	7.7	27.69	43100	1.1	3	6						
Lake	Sussex Inlet Channel	E-250	28/06/2011	Winter	12.92	89.6	8	7.97	28.04	43500	0.1	1	2						
Lake	Sussex Inlet Channel	E-250	1/11/2011	Spring	18.71	93.9	7.08	8.08	35.72	54060	26.6		1						35000
Lake	Sussex Inlet Channel	E-250	14/02/2012	Summer	23.26	35.3	2.5	7.35	28.78	44600	2.1		1						
Lake	Sussex Inlet Channel	E-250	17/04/2012	Autumn	19.79	84.9	6.32	8.15	34.58	52510	0.7	1	1						34000
Lake	Sussex Inlet Channel	E-250	19/11/2013	Spring	20.11	98.5	7.26	8.44	35.17	53310	4.3	1	4						34000
Lake	Sussex Inlet Channel	E-250	24/11/2014	Spring								1	1						
Lake	Sussex Inlet Channel	E-250	30/06/2015	Winter								3	1						

Classification	Area	Field ID	Date	Season	Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
			ANZG (2018) DGVs Toxicants 95% protection																
			NSW DPIE MER Triggers - Lakes			93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
			NSW DPIE MER Triggers - Creeks			84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
			NHRMC (2008) Primary contact recreational		15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Lake	Sussex Inlet Channel	E-250	15/12/2015	Summer								1	4						
Lake	Sussex Inlet Channel	E-250	4/04/2016	Autumn								8	6						
Lake	Sussex Inlet Channel	E-250	12/04/2017	Autumn								2	2						
Lake	Sussex Inlet Channel	E-250	14/11/2017	Spring								1	1						
Lake	Sussex Inlet Channel	E-250	18/04/2018	Autumn								1	1						
Lake	Sussex Inlet Channel	E-250	18/12/2018	Summer								1	1						
Lake	Sussex Inlet Channel	E-250	30/04/2019	Autumn								1	1						
Lake	Sussex Inlet Channel	E-250	7/11/2019	Spring								1	1						
Lake	Sussex Inlet Channel	E-250	6/04/2020	Autumn	19.08	121.6	9.13	8.06	35.41	53640	1.4	3	31						
Lake	Sussex Inlet Channel	E-250	12/11/2020	Spring								1	1						
Lake	Sussex Inlet Channel	E-250	21/04/2021	Autumn								2	3						
Lake	Sussex Inlet Channel	E-333	13/12/2010	Summer	24.44	126.7	8.92	7.72	29.86	46080	0	64	1						29000
Lake	Sussex Inlet Channel	E-333	28/03/2011	Autumn	20.53	121.8	9.4	7.73	25.53	40000	1.1	1	1						
Lake	Sussex Inlet Channel	E-333	28/06/2011	Winter	12.27	93.3	8.5	7.97	26.76	41800	0.2	1	1						
Lake	Sussex Inlet Channel	E-333	1/11/2011	Spring	20.4	79.1	6.07	7.91	27.46	42740	0.2		2						27000
Lake	Sussex Inlet Channel	E-333	14/02/2012	Summer	23.33	41	3	7.02	27.16	42300	2.8		22						
Lake	Sussex Inlet Channel	E-333	17/04/2012	Autumn	19.62	65.8	5.25	7.76	23.27	36810	3.1	1	1						23000
Lake	Sussex Inlet Channel	E-333	19/11/2013	Spring	20.47	102.1	7.57	8.44	33.29	50770	3.9	1	1						32000
Lake	Sussex Inlet Channel	E-333	24/11/2014	Spring								1	1						
Lake	Sussex Inlet Channel	E-333	30/06/2015	Winter								1	1						
Lake	Sussex Inlet Channel	E-333	15/12/2015	Summer								11	6						
Lake	Sussex Inlet Channel	E-333	4/04/2016	Autumn								1	51						
Lake	Sussex Inlet Channel	E-333	12/04/2017	Autumn								6	1						
Lake	Sussex Inlet Channel	E-333	14/11/2017	Spring								1	1						
Lake	Sussex Inlet Channel	E-333	18/04/2018	Autumn								12	2						
Lake	Sussex Inlet Channel	E-333	18/12/2018	Summer								1	1						
Lake	Sussex Inlet Channel	E-333	30/04/2019	Autumn								3	1						
Lake	Sussex Inlet Channel	E-333	7/11/2019	Spring								1	1						
Lake	Sussex Inlet Channel	E-333	6/04/2020	Autumn	18.71	114.4	8.66	8.06	35.13	53260	0.8	4	5						
Lake	Sussex Inlet Channel	E-333	12/11/2020	Spring								1	1						
Lake	Sussex Inlet Channel	E-333	21/04/2021	Autumn								1	1						
Creek	Tomerong Creek	E-750	6/09/2010	Spring	17.42	68.4	5.45	7.06	29.86	46070	111.8		78						
Creek	Tomerong Creek	E-243	6/09/2010	Spring	13.3	45.9	4.8	7.35	0.43	866	159		200						
Creek	Tomerong Creek	E-243	13/12/2010	Summer	21.35	46.8	4.05	6.44	4.28	7707	4		47						
Creek	Tomerong Creek	E-243	28/03/2011	Autumn	21.77	22.5	1.7	6.65	25.39	39800	0.3	120	120						
Creek	Tomerong Creek	E-243	28/06/2011	Winter	12.6	64.7	5.8	7.32	26.46	41300	3.2	9	17						
Creek	Tomerong Creek	E-243	13/02/2012	Summer								274	160						
Creek	Tomerong Creek	E-243	17/04/2012	Autumn	20.04	30.3	2.55	6.76	13.13	21870	25.9	47	9						
Creek	Tomerong Creek	E-243	19/11/2013	Spring	22.87	87.4	6.62	7.63	21.96	34930	17		80						
Creek	Tomerong Creek	E-243	24/11/2014	Spring								74	20						
Creek	Tomerong Creek	E-243	30/06/2015	Winter	13.79	42	3.75	7.45	24.35	38350	7.7	66	43						
Creek	Tomerong Creek	E-243	14/12/2015	Summer	26.7	41.4	2.95	7.31	21.09	26700	1.4	250	81						
Creek	Tomerong Creek	E-243	4/04/2016	Autumn								330	360						
Creek	Tomerong Creek	E-243	12/04/2017	Autumn								200	90						
Creek	Tomerong Creek	E-243	14/11/2017	Spring	21.28	43.1	3.3	8.38	24.68	38810	44.1	6	1						
Creek	Tomerong Creek	E-243	18/04/2018	Autumn	19.22	16.5	1.29	7.37	28.13	43670	32.1	16	6						
Creek	Tomerong Creek	E-243	18/12/2018	Summer	24.85	87.3	6.25	6.99	25.47	39940	46.7	16	10						
Creek	Tomerong Creek	E-243	30/04/2019	Autumn	18.19	24.4	1.88	7.2	33.72	51350	2.7	320	22						
Creek	Tomerong Creek	E-243	30/04/2019	Autumn								15	22						
Creek	Tomerong Creek	E-243	7/11/2019	Spring	23.26	50.1	3.78	7.37	21.38	34.1	1.4	70	2						

					Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
			EQL		0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	Area	Field ID	Date	Season	°C	%	mg/L	-	ppt	µS/cm	ntu	CFU/100mL	cfu/100mL	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
Creek	Tomerong Creek	E-243	7/11/2019	Spring								4	2						
Creek	Tomerong Creek	E-243	6/04/2020	Autumn	22.07	26.5	1.93	7.45	30.95	47570	43	870	120	49	0.56		0.01		
Creek	Tomerong Creek	E-243	12/11/2020	Spring								70	22						
Creek	Tomerong Creek	E-243	21/04/2021	Autumn								870	`						
Creek	Wandandian Creek	E-249	7/09/2010	Spring	14.65	21	2.14	6.55			6.7		78	2	0.40	0.1			0
Creek	Wandandian Creek	E-249	13/12/2010	Summer	19.71	78	7.06	5.95	1.87	3586	7.4	111	181	5	0.30	0.005			2000
Creek	Wandandian Creek	E-249	28/03/2011	Autumn	18.31	85.2	7.9	6.16	2.22	3220	0.4	46	78	1	0.70	0.005			
Creek	Wandandian Creek	E-249	28/06/2011	Winter	13.22	43.8	3.9	6.99	24.9	39100	1.5	2	17	0.5	0.40	0.04			
Creek	Wandandian Creek	E-249	13/02/2012	Summer								216	174	0.5	0.40	0.005			
Creek	Wandandian Creek	E-249	17/04/2012	Autumn	20.03	66.1	5.78	7.29	6.68	11740	23.3	12	2	1	0.30	0.01			7000
Creek	Wandandian Creek	E-249	19/11/2013	Spring	24.53	100.4	8.27	7.7	2.02	3444			44	0.5	0.20	0.01			2000
Creek	Wandandian Creek	E-249	24/11/2014	Spring								7	5	1	0.10		0.1		
Creek	Wandandian Creek	E-249	30/06/2015	Winter								27	16	0.5	0.10		0.04		
Creek	Wandandian Creek	E-249	15/12/2015	Summer								161	1511	0.5	0.30		0.0025		
Creek	Wandandian Creek	E-249	4/04/2016	Autumn								26	35	4	0.40		0.03		
Creek	Wandandian Creek	E-249	12/04/2017	Autumn								68	36	0.5	0.80		<0.01		
Creek	Wandandian Creek	E-249	14/11/2017	Spring								22	2	0.5	0.10		0.06		
Creek	Wandandian Creek	E-249	18/04/2018	Autumn								32	11	2	1.30		0.0025		
Creek	Wandandian Creek	E-249	18/12/2018	Summer								261	191	0.5	0.57		0.013		
Creek	Wandandian Creek	E-249	30/04/2019	Autumn								11	5	0.5	0.51		0.0025		
Creek	Wandandian Creek	E-249	7/11/2019	Spring								4	9	1	0.40		0.0025		
Creek	Wandandian Creek	E-249	6/04/2020	Autumn	19.2	95.2	8.25	7.97	10.82	18310	5.7	91	231	0.5	0.49		0.0025		
Creek	Wandandian Creek	E-249	12/11/2020	Spring								48	121	0.5	0.28	0.005			
Creek	Wandandian Creek	E-249	21/04/2021	Autumn								361	6	0.5	0.43		0.007		
Creek	Wandandian Creek	E-25	19/04/2010	Autumn	18.26	7.6	0.7	7.39	0.5	877	52.4	4	1		3.90	0.48			
Creek	Wandandian Creek	E-25	6/09/2010	Spring	14.92	83	6.93	7.69	31.3		8.5		1						31000
Creek	Wandandian Creek	E-25	13/12/2010	Summer	23.82	97.2	6.98	6.9	18.2	43770	1.1	24	11						28000
Creek	Wandandian Creek	E-25	28/03/2011	Autumn	21.65	94.8	7.2	7.33	25.08	39400	1.1	1	15						
Creek	Wandandian Creek	E-25	28/06/2011	Winter	13.9	87.1	7.7	7.57	25.57	40100	0.4		1						
Creek	Wandandian Creek	E-25	1/11/2011	Spring	22.73	68.6	5.17	7.44	23.1	36570	0.2		2						23000
Creek	Wandandian Creek	E-25	14/02/2012	Summer	23.22	41	3	6.55	26.15	40900	2.8		78						
Creek	Wandandian Creek	E-25	17/04/2012	Autumn	20.75	82	6.45	7.81	22.25	35360	14.1	3	1						22000
Creek	Wandandian Creek	E-25	19/11/2013	Spring	21.85	86.9	6.7	6.2	22.05	35060	13	124	36						22000
Creek	Wandandian Creek	E-25	24/11/2014	Spring								1	2						
Creek	Wandandian Creek	E-25	30/06/2015	Winter								11	7						
Creek	Wandandian Creek	E-25	15/12/2015	Summer								1	2						
Creek	Wandandian Creek	E-25	4/04/2016	Autumn								1	17						
Creek	Wandandian Creek	E-25	12/04/2017	Autumn								8	3						
Creek	Wandandian Creek	E-25	14/11/2017	Spring								1	1						
Creek	Wandandian Creek	E-25	18/04/2018	Autumn								2	1						
Creek	Wandandian Creek	E-25	18/12/2018	Summer								121	51						
Creek	Wandandian Creek	E-25	30/04/2019	Autumn								1	1						
Creek	Wandandian Creek	E-25	7/11/2019	Spring								1	1						
Creek	Wandandian Creek	E-25	6/04/2020	Autumn	20.79	107.4	8.01	8.15	31.24	47980	1.9	1	6						
Creek	Wandandian Creek	E-25	12/11/2020	Spring								17	11						
Creek	Wandandian Creek	E-25	21/04/2021	Autumn								1	1						

WQ Triggers

NSW DPIE MER Triggers for Lakes

					Temperature	Dissolved Oxygen (% Saturation)	Dissolved Oxygen	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll a	Total Nitrogen	Total Phosphorus	Total Phosphorus as P (Organic Phosphate as P)	TSS	TDS
		EQL			0.1	0.1	0.1	0.1		100	0.1	1	1	0.5	0.03	0.005	0.005	1	
ANZG (2018) DGVs Toxicants 95% protection																			
NSW DPIE MER Triggers - Lakes						93 - 115		8.1 - 9.1			5.5			5.3	0.75	0.024			
NSW DPIE MER Triggers - Creeks						84 - 107		7.9 - 9.1			1.4			3.3	0.36	0.015			
NHRMC (2008) Primary contact recreational					15-35							median <150	95%ile <40						
Classification	**Area**	**Field ID**	**Date**	**Season**	**°C**	**%**	**mg/L**	**-**	**ppt**	**µS/cm**	**ntu**	**CFU/100mL**	**cfu/100mL**	**mg/m3**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**

NSW DPIE MER Triggers for Creeks
NHRMC (2008) Primary contact recreational

Data Review Notes

Data range was restricted to 2010-current.

Only parameters with a min sample size of 10 were selected.

Data that were clearly erroneous due to instrument error or data entry were removed

Where errorenous results were seen in field data, the rest of that sampling period was reviewed to identify other errors as a result of incorrect calibration.

It is likely that there has been some inconsistency in reporting <EQL with some values converted as negative or zero. Negative or zero values were converted to the next lowest EQL for purposes of calculating statistics.

Chemistry values that were reported as <EQL were converted by * 0.5, which is the recommended approach by ANZG.

For micro values -1 were assumed to be <EQL and converted to EQL of 1.

Microbiology values <EQL were replaced with EQL.

For turbidity negative values were assumed as 0. This is common with water quality meters and can be calibrated within the sampling period by setting the lowest negative result as 0 and adding the difference to the rest of dataset.

For chemistry and field data, values over 4 standard deviations from the median were review and removed from dataset if obviously errors due to being outside the possible range for that parameter. Most of these were likely related to a calibration issue with field instrument, as consistent outliers were reported within the same month/sampling period. Other outliers were related to data entry (an extra 0 added).

Turbidity values >100 were removed.

Dissolved oxygen % above 150 were removed.

EC below 100 at all sites during April 2018 were removed.

Appendix B
Water Quality Summary Statistics

Table 8-1 Summary of water quality sampling replication during 2010 – October 2021

<table>
<tr><th>Parameter/s</th><th>Frequency</th><th>Sites</th></tr>
<tr><td>pH, temperature, salinity, turbidity, DO, enterococci</td><td rowspan="3">At least twice per year (except in 2013 and 2014 where sampling was undertaken once). Generally, in summer, autumn and/or spring.</td><td>Sussex inlet canals: E-251, E-252, E-330, E-331
Sussex inlet: E-24, E-250, E-333
St Georges Basin: E-20, E-238, E-239, E-240, E241, E-28, E-29, E-30, E-32, E-33, E-772, E-773
Wandandian Creek: E-25, E249
Tomerong Creek: E-243, E-750</td></tr>
<tr><td>Chlorophyll-a</td><td>Sussex inlet canals: E-251, E-331
St Georges Basin: E-28, E-29, E-33, E-238, E-240, E-772, E-773
Wandandian Creek: E-249
Tomerong Creek:</td></tr>
<tr><td>TP and TN</td><td>Sussex inlet canals: E-251, E-331,
St Georges Basin: E-28, E-33, E-238, E-240 and E-772
Wandandian Creek: E-249</td></tr>
<tr><td>TSS</td><td>Occasionally monitored during 2020 and 2021.</td><td>E-28, E-33, E-772</td></tr>
<tr><td>Chlorophyll-a and turbidity</td><td>Monthly since November 2020 to 2023 as part of DP&E program</td><td>E-28, E-33, E-772</td></tr>
</table>

Table 8-2 Summary of water quality statistics from 2010 - 2021

			Temperature	DO (%)	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll *a*	Ammonia	Nitrogen	TP	Total Organic Phosphorous	TSS	TDS
Estimated Quantification Limit			0.1	0.1	0.1		100	0.1	1	1	0.5	0.05	0.025	0.005	0.005	1	
NSW DP&E MER Triggers – Creeks				84-107	6.7-8.8	7.9-9.1		1.4			3.3	0.021	0.36	0.015			
NSW DP&E MER Triggers – Lakes				93-115	6.7-8.9	8.1-9.1		5.5			5.3	0.014	0.75	0.024			
ANZG (2018) DGVs 95% protection												0.91					
NHRMC (2008) Primary Recreational			15-35						median <150	median < 35							
Area	**Site**	**Stats**	**°C**	**%**	**-**	**ppt**	**µS/cm**	**ntu**	**CFU/100mL**	**cfu/100mL**	**mg/m3**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Sussex Inlet Canals	E-251	Mean	20.07	85.96	8.11	29.44	45457	5.92	20.88	18.45	1.47	--	0.27	0.01	0.02	--	28000
Sussex Inlet Canals	E-251	StDeV	3.55	25.35	0.46	3.34	4615	7.94	35.53	19.09	1.07	--	0.17	0.02	0.02	--	3082
Sussex Inlet Canals	E-251	Median	20.76	90.90	8.17	28.64	44395	2.10	6.50	11.50	1.00	--	0.26	0.01	0.01	--	29000
Sussex Inlet Canals	E-251	Min	12.01	21.40	7.45	23.70	37430	0.10	1.00	1.00	0.50	--	0.10	0.01	0.00	--	24000
Sussex Inlet Canals	E-251	Max	24.94	116.80	9.07	35.59	53880	25.90	141.00	73.00	4.00	--	0.60	0.05	0.06	--	32000
Sussex Inlet Canals	E-251	Count	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Sussex Inlet Canals	E-252	Mean	20.33	82.91	8.05	27.69	43213	7.02	5.06	2.90	--	--	--	--	--	--	27200
Sussex Inlet Canals	E-252	StDeV	3.83	23.03	0.45	3.86	4953	7.93	10.06	3.21	--	--	--	--	--	--	3493
Sussex Inlet Canals	E-252	Median	20.66	90.60	8.05	27.17	42300	3.80	1.50	2.00	--	--	--	--	--	--	27000
Sussex Inlet Canals	E-252	Min	12.35	19.40	7.13	20.82	33280	0.10	1.00	1.00	--	--	--	--	--	--	23000
Sussex Inlet Canals	E-252	Max	26.80	111.10	9.12	35.21	53370	28.50	42.00	12.00	--	--	--	--	--	--	32000
Sussex Inlet Canals	E-252	Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
Sussex Inlet Canals	E-330	Mean	20.43	85.43	8.09	27.72	43047	10.33	11.67	4.19	--	--	--	--	--	--	27600
Sussex Inlet Canals	E-330	StDeV	3.81	26.78	0.38	3.80	5283	16.86	23.05	3.93	--	--	--	--	--	--	3050
Sussex Inlet Canals	E-330	Median	20.64	91.10	8.14	26.93	42000	3.75	4.50	4.00	--	--	--	--	--	--	27000
Sussex Inlet Canals	E-330	Min	12.36	21.10	7.44	20.54	32890	0.10	1.00	1.00	--	--	--	--	--	--	24000
Sussex Inlet Canals	E-330	Max	26.31	123.20	8.91	35.09	53210	72.10	96.00	18.00	--	--	--	--	--	--	32000
Sussex Inlet Canals	E-330	Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
Sussex Inlet Canals	E-331	Mean	20.70	82.55	8.01	27.80	43708	5.63	8.33	8.81	2.26	--	0.26	0.01	0.02	--	28200
Sussex Inlet Canals	E-331	StDeV	3.73	23.72	0.54	3.33	4813	5.55	7.45	6.85	3.97	--	0.17	0.01	0.02	--	2775
Sussex Inlet Canals	E-331	Median	21.26	89.30	8.10	27.79	43500	2.75	6.50	7.00	1.00	--	0.20	0.01	0.01	--	29000
Sussex Inlet Canals	E-331	Min	12.51	20.90	6.39	20.74	33170	0.10	1.00	1.00	0.50	--	0.10	0.01	0.00	--	25000
Sussex Inlet Canals	E-331	Max	25.81	110.10	8.92	35.27	53450	16.60	28.00	27.00	19.00	--	0.70	0.02	0.08	--	32000
Sussex Inlet Canals	E-331	Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
Sussex Inlet Channel	E-24	Mean	20.08	87.38	8.01	26.76	40139	10.42	1.89	3.76	--	--	--	--	--	--	27400
Sussex Inlet Channel	E-24	StDeV	3.71	27.56	0.49	3.62	10992	19.32	3.07	7.31	--	--	--	--	--	--	3050
Sussex Inlet Channel	E-24	Median	20.32	94.35	8.12	26.43	41300	2.40	1.00	1.00	--	--	--	--	--	--	28000
Sussex Inlet Channel	E-24	Min	12.62	18.20	6.66	19.56	1460	0.10	1.00	1.00	--	--	--	--	--	--	23000
Sussex Inlet Channel	E-24	Max	25.80	127.00	8.85	34.03	52490	77.90	14.00	34.00	--	--	--	--	--	--	31000
Sussex Inlet Channel	E-24	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Sussex Inlet Channel	E-250	Mean	20.07	80.75	7.87	28.53	44126	10.16	1.83	3.43	1.00	--	0.40	0.10	--	--	33400
Sussex Inlet Channel	E-250	StDeV	3.50	31.32	0.52	8.35	11611	18.12	1.72	6.52	--	--	--	--	--	--	1517
Sussex Inlet Channel	E-250	Median	20.53	89.50	8.01	30.97	47600	1.40	1.00	1.00	1.00	--	0.40	0.10	--	--	34000
Sussex Inlet Channel	E-250	Min	12.92	16.80	6.37	1.47	6533	0.10	1.00	1.00	1.00	--	0.40	0.10	--	--	31000
Sussex Inlet Channel	E-250	Max	25.33	127.80	8.47	35.72	54060	64.00	8.00	31.00	1.00	--	0.40	0.10	--	--	35000
Sussex Inlet Channel	E-250	Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31

			Temperature	DO (%)	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll *a*	Ammonia	Nitrogen	TP	Total Organic Phosphorous	TSS	TDS
Estimated Quantification Limit			0.1	0.1	0.1		100	0.1	1	1	0.5	0.05	0.025	0.005	0.005	1	
NSW DP&E MER Triggers – Creeks				84-107	6.7-8.8	7.9-9.1		1.4			3.3	0.021	0.36	0.015			
NSW DP&E MER Triggers – Lakes				93-115	6.7-8.9	8.1-9.1		5.5			5.3	0.014	0.75	0.024			
ANZG (2018) DGVs 95% protection												0.91					
NHRMC (2008) Primary Recreational			15-35						median <150	median < 35							
Sussex Inlet Channel	E-333	Mean	20.30	86.74	8.12	28.33	43829	8.66	6.22	5.10	--	--	--	--	--	--	27750
Sussex Inlet Channel	E-333	StDeV	3.59	28.03	0.42	4.55	6345	14.36	14.83	11.80	--	--	--	--	--	--	3775
Sussex Inlet Channel	E-333	Median	20.44	92.90	8.18	27.16	42520	2.60	1.00	1.00	--	--	--	--	--	--	28000
Sussex Inlet Channel	E-333	Min	12.27	19.70	7.02	19.49	31360	0.00	1.00	1.00	--	--	--	--	--	--	23000
Sussex Inlet Channel	E-333	Max	26.29	126.70	8.87	35.25	53430	50.60	64.00	51.00	--	--	--	--	--	--	32000
Sussex Inlet Channel	E-333	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
St Georges Basin	E-20	Mean	20.27	91.32	8.07	25.60	40079	1.72	1.56	1.35	--	--	--	--	--	--	26400
St Georges Basin	E-20	StDeV	4.43	21.50	0.36	3.44	4827	2.11	1.75	1.18	--	--	--	--	--	--	3209
St Georges Basin	E-20	Median	21.08	92.50	8.07	24.64	38770	1.30	1.00	1.00	--	--	--	--	--	--	26000
St Georges Basin	E-20	Min	13.04	31.60	7.49	20.42	32700	0.10	1.00	1.00	--	--	--	--	--	--	23000
St Georges Basin	E-20	Max	26.43	117.30	8.69	31.90	48870	7.90	8.00	6.00	--	--	--	--	--	--	31000
St Georges Basin	E-20	Count	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
St Georges Basin	E-21	Mean	11.73	91.00	8.18	33.41	50940	4.30	--	--	--	--	--	--	--	--	--
St Georges Basin	E-21	StDeV	--		--	--	--	--	--	--	--	--	--	--	--	--	--
St Georges Basin	E-21	Median	11.73	91.00	8.18	33.41	50940	4.30	--	--	--	--	--	--	--	--	--
St Georges Basin	E-21	Min	11.73	91.00	8.18	33.41	50940	4.30	--	--	--	--	--	--	--	--	--
St Georges Basin	E-21	Max	11.73	91.00	8.18	33.41	50940	4.30	--	--	--	--	--	--	--	--	--
St Georges Basin	E-21	Count	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
St Georges Basin	E-22	Mean	21.82	104.20	8.42	21.39	34100	13.20	--	--	--	--	--	--	--	--	--
St Georges Basin	E-22	StDeV	5.03	28.85	0.34	2.19	3168	--	--	--	--	--	--	--	--	--	--
St Georges Basin	E-22	Median	21.82	104.20	8.42	21.39	34100	13.20	--	--	--	--	--	--	--	--	--
St Georges Basin	E-22	Min	18.26	83.80	8.18	19.84	31860	13.20	--	--	--	--	--	--	--	--	--
St Georges Basin	E-22	Max	25.37	124.60	8.66	22.94	36340	13.20	--	--	--	--	--	--	--	--	--
St Georges Basin	E-22	Count	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
St Georges Basin	E-238	Mean	20.25	84.96	8.03	25.34	40985	8.57	3.50	1.95	1.75	--	0.30	0.01	0.01	--	26600
St Georges Basin	E-238	StDeV	3.92	26.45	0.50	5.49	5105	8.76	9.41	3.69	1.47	--	0.17	0.01	0.02	--	3286
St Georges Basin	E-238	Median	20.74	90.55	8.13	25.43	40730	3.80	1.00	1.00	1.25	--	0.27	0.01	0.00	--	25000
St Georges Basin	E-238	Min	11.78	18.30	6.68	9.79	32470	0.30	1.00	1.00	0.50	--	0.10	0.01	0.00	--	23000
St Georges Basin	E-238	Max	25.19	128.20	8.68	34.01	48980	26.20	41.00	18.00	5.00	--	0.60	0.04	0.07	--	31000
St Georges Basin	E-238	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
St Georges Basin	E-239	Mean	20.74	86.04	8.01	26.27	40896	9.58	1.06	1.05	--	--	--	--	--	--	27000
St Georges Basin	E-239	StDeV	3.79	23.63	0.40	3.98	5705	11.01	0.24	0.22	--	--	--	--	--	--	3391
St Georges Basin	E-239	Median	21.32	88.10	8.13	25.54	40040	3.55	1.00	1.00	--	--	--	--	--	--	26000
St Georges Basin	E-239	Min	12.53	19.60	7.09	20.52	32850	0.00	1.00	1.00	--	--	--	--	--	--	23000
St Georges Basin	E-239	Max	25.40	129.50	8.49	34.02	51760	31.60	2.00	2.00	--	--	--	--	--	--	31000
St Georges Basin	E-239	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
St Georges Basin	E-240	Mean	21.11	85.42	8.11	25.67	41411	7.21	4.81	5.55	1.53	--	0.36	0.02	0.01	--	25600
St Georges Basin	E-240	StDeV	4.06	24.15	0.38	3.90	5025	9.08	7.71	11.90	1.64	--	0.18	0.04	0.02	--	3050

			Temperature	DO (%)	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll *a*	Ammonia	Nitrogen	TP	Total Organic Phosphorous	TSS	TDS
Estimated Quantification Limit			0.1	0.1	0.1		100	0.1	1	1	0.5	0.05	0.025	0.005	0.005	1	
NSW DP&E MER Triggers – Creeks				84-107	6.7-8.8	7.9-9.1		1.4			3.3	0.021	0.36	0.015			
NSW DP&E MER Triggers – Lakes				93-115	6.7-8.9	8.1-9.1		5.5			5.3	0.014	0.75	0.024			
ANZG (2018) DGVs 95% protection												0.91					
NHRMC (2008) Primary Recreational			15-35						median <150	median < 35							
St Georges Basin	E-240	Median	20.76	91.90	8.06	24.80	40010	1.70	1.00	1.50	0.50	--	0.30	0.01	0.00	--	25000
St Georges Basin	E-240	Min	13.51	19.70	7.48	20.48	34540	0.10	1.00	1.00	0.50	--	0.10	0.01	0.00	--	22000
St Georges Basin	E-240	Max	28.13	110.10	8.70	34.00	51730	25.98	28.00	54.00	7.00	--	0.70	0.12	0.06	--	30000
St Georges Basin	E-240	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
St Georges Basin	E-241	Mean	20.65	87.31	8.19	26.12	40898	7.77	1.00	1.90	--	--	--	--	--	--	26800
St Georges Basin	E-241	StDeV	3.78	35.66	0.42	3.93	5467	10.07	0.00	2.61	--	--	--	--	--	--	3194
St Georges Basin	E-241	Median	20.97	96.25	8.25	25.53	40035	2.35	1.00	1.00	--	--	--	--	--	--	26000
St Georges Basin	E-241	Min	12.57	7.66	7.38	19.56	31450	0.10	1.00	1.00	--	--	--	--	--	--	23000
St Georges Basin	E-241	Max	26.54	127.50	8.92	34.10	51870	30.70	1.00	11.00	--	--	--	--	--	--	31000
St Georges Basin	E-241	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
St Georges Basin	E-28	Mean	21.04	86.44	7.89	26.65	41937	6.34	7.72	27.18	1.68	0.03	0.34	--	0.00	2.90	27828
St Georges Basin	E-28	StDeV	4.20	21.23	0.68	4.26	5662	9.69	28.27	157.37	1.38	0.01	0.07	--	0.00	1.75	3402
St Georges Basin	E-28	Median	21.74	90.30	7.89	25.65	40650	2.30	1.00	1.00	1.00	0.03	0.34	--	0.00	3.00	26000
St Georges Basin	E-28	Min	12.33	19.10	4.13	16.70	32370	0.00	1.00	1.00	0.50	0.02	0.24	--	0.00	0.50	22000
St Georges Basin	E-28	Max	27.28	114.00	9.35	34.02	51760	54.50	121.00	1111.00	7.00	0.04	0.46	--	0.00	5.00	33000
St Georges Basin	E-28	Count	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126
St Georges Basin	E-29	Mean	21.10	84.65	8.05	25.77	40559	12.41	2.82	1.62	2.05	--	0.37	0.01	0.02	--	26400
St Georges Basin	E-29	StDeV	4.25	26.83	0.38	3.93	5564	15.37	4.94	1.12	1.26	--	0.20	0.01	0.03	--	3435
St Georges Basin	E-29	Median	21.63	88.70	8.00	25.28	39685	4.70	1.00	1.00	2.00	--	0.30	0.01	0.00	--	25000
St Georges Basin	E-29	Min	12.58	18.70	7.40	19.55	31450	0.20	1.00	1.00	0.50	--	0.10	0.01	0.00	--	23000
St Georges Basin	E-29	Max	27.09	130.20	8.78	34.05	51800	55.60	21.00	5.00	5.00	--	0.80	0.04	0.09	--	31000
St Georges Basin	E-29	Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
St Georges Basin	E-30	Mean	20.62	86.17	8.07	25.88	40743	9.64	2.61	2.71	0.50	--	--	--	--	--	26200
St Georges Basin	E-30	StDeV	4.04	26.85	0.40	3.98	5641	12.34	4.69	3.82	--	--	--	--	--	--	3701
St Georges Basin	E-30	Median	20.62	93.05	8.09	25.18	39600	2.10	1.00	1.00	0.50	--	--	--	--	--	25000
St Georges Basin	E-30	Min	12.50	16.70	7.18	19.58	31480	0.00	1.00	1.00	0.50	--	--	--	--	--	22000
St Georges Basin	E-30	Max	25.64	123.20	8.78	33.99	51720	36.99	21.00	13.00	0.50	--	--	--	--	--	31000
St Georges Basin	E-30	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
St Georges Basin	E-31	Mean	--	--	--	--	--	--	1.00	--	--	--	1.20	--	0.18	35.00	--
St Georges Basin	E-31	StDeV	--		--	--	--	--	--	--	--	--	--	--	--	--	--
St Georges Basin	E-31	Median	--		--	--	--	--	1.00	--	--	--	1.20	--	0.18	35.00	--
St Georges Basin	E-31	Min	--		--	--	--	--	1.00	--	--	--	1.20	--	0.18	35.00	--
St Georges Basin	E-31	Max	--		--	--	--	--	1.00	--	--	--	1.20	--	0.18	35.00	--
St Georges Basin	E-31	Count	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
St Georges Basin	E-32	Mean	20.38	87.63	8.15	26.27	40970	9.11	1.00	1.24	--	--	--	--	--	--	26600
St Georges Basin	E-32	StDeV	3.82	28.27	0.37	3.64	5080	13.88	0.00	0.77	--	--	--	--	--	--	3362
St Georges Basin	E-32	Median	20.91	92.20	8.17	25.55	40050	2.10	1.00	1.00	--	--	--	--	--	--	26000
St Georges Basin	E-32	Min	12.47	18.00	7.37	20.86	33340	0.00	1.00	1.00	--	--	--	--	--	--	23000

			Temperature	DO (%)	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll *a*	Ammonia	Nitrogen	TP	Total Organic Phosphorous	TSS	TDS
Estimated Quantification Limit			0.1	0.1	0.1		100	0.1	1	1	0.5	0.05	0.025	0.005	0.005	1	
NSW DP&E MER Triggers – Creeks				84-107	6.7-8.8	7.9-9.1		1.4			3.3	0.021	0.36	0.015			
NSW DP&E MER Triggers – Lakes				93-115	6.7-8.9	8.1-9.1		5.5			5.3	0.014	0.75	0.024			
ANZG (2018) DGVs 95% protection												0.91					
NHRMC (2008) Primary Recreational			15-35						median <150	median < 35							
St Georges Basin	E-32	Max	25.50	134.00	8.90	34.09	51850	44.70	1.00	4.00	--	--	--	--	--	--	31000
St Georges Basin	E-32	Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
St Georges Basin	E-33	Mean	20.68	91.22	8.03	26.88	41923	7.06	1.00	3.90	1.63	0.02	0.30	0.02	0.03	2.40	27448
St Georges Basin	E-33	StDeV	4.03	21.06	0.70	4.40	6291	13.80	0.00	12.58	1.33	0.01	0.18	0.03	0.07	2.04	4273
St Georges Basin	E-33	Median	21.12	94.30	8.02	26.07	40780	1.60	1.00	1.00	1.00	0.02	0.30	0.01	0.00	2.00	27000
St Georges Basin	E-33	Min	12.01	17.50	4.11	12.19	20430	0.00	1.00	1.00	0.50	0.02	0.00	0.01	0.00	0.50	13000
St Georges Basin	E-33	Max	25.96	128.80	9.47	34.07	51830	77.00	1.00	73.00	7.00	0.03	0.70	0.07	0.28	5.00	33000
St Georges Basin	E-33	Count	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127
St Georges Basin	E-772	Mean	20.62	90.01	7.95	27.27	42503	4.06	1.00	3.41	1.55	0.02	0.29	0.01	0.01	1.60	27467
St Georges Basin	E-772	StDeV	4.04	21.86	0.83	4.49	6282	6.48	0.00	10.26	1.34	0.01	0.14	0.01	0.02	1.08	4249
St Georges Basin	E-772	Median	21.03	92.65	7.97	26.47	41335	1.50	1.00	1.00	1.00	0.02	0.30	0.01	0.00	2.00	27500
St Georges Basin	E-772	Min	12.06	19.10	4.14	12.18	20410	0.00	1.00	1.00	0.50	0.02	0.10	0.01	0.00	0.50	13000
St Georges Basin	E-772	Max	28.05	124.90	9.62	35.04	53140	28.20	1.00	71.00	8.00	0.03	0.60	0.03	0.09	3.00	33000
St Georges Basin	E-772	Count	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127
St Georges Basin	E-773	Mean	21.09	83.30	8.07	26.10	40620	14.47	2.94	1.62	2.52	--	0.31	0.01	0.09	--	25200
St Georges Basin	E-773	StDeV	3.74	26.74	0.45	4.23	5477	15.68	3.86	1.47	2.05	--	0.17	0.01	0.21	--	3633
St Georges Basin	E-773	Median	21.45	88.75	8.15	25.27	39655	11.60	1.00	1.00	2.00	--	0.30	0.01	0.01	--	25000
St Georges Basin	E-773	Min	12.58	17.40	7.30	19.93	31990	0.10	1.00	1.00	0.50	--	0.10	0.01	0.00	--	21000
St Georges Basin	E-773	Max	27.43	116.60	9.05	34.03	51670	53.20	11.00	6.00	7.00	--	0.60	0.04	0.74	--	31000
St Georges Basin	E-773	Count	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Wandandian Creek	E-25	Mean	20.82	74.18	7.75	24.13	38387	8.12	17.94	11.36	--	0.02	3.90	0.48	--	--	25200
Wandandian Creek	E-25	StDeV	3.36	27.16	0.66	6.86	10826	11.77	38.58	19.53	--	--	--	--	--	--	4087
Wandandian Creek	E-25	Median	21.45	82.50	7.88	24.86	39780	2.95	1.50	2.00	--	0.02	3.90	0.48	--	--	23000
Wandandian Creek	E-25	Min	13.90	7.60	6.20	0.50	877	0.20	1.00	1.00	--	0.02	3.90	0.48	--	--	22000
Wandandian Creek	E-25	Max	26.23	107.40	8.68	34.07	51830	52.40	124.00	78.00	--	0.02	3.90	0.48	--	--	31000
Wandandian Creek	E-25	Count	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Wandandian Creek	E-249	Mean	19.95	68.74	7.59	16.17	27693	10.75	83.67	137.65	1.15	--	0.42	0.02	0.02	--	2750
Wandandian Creek	E-249	StDeV	4.36	30.12	0.88	11.09	15982	10.35	102.30	331.60	1.25	--	0.28	0.03	0.03	--	2986
Wandandian Creek	E-249	Median	20.56	78.00	7.40	18.13	31770	6.65	39.00	35.50	0.50	--	0.40	0.01	0.01	--	2000
Wandandian Creek	E-249	Min	9.20	17.70	5.95	1.87	3220	0.40	2.00	2.00	0.50	--	0.10	0.01	0.00	--	0
Wandandian Creek	E-249	Max	25.33	110.30	9.08	33.96	51680	34.20	361.00	1511.00	5.00	--	1.30	0.10	0.10	--	7000
Wandandian Creek	E-249	Count	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Tomerong Creek	E-243	Mean	20.77	42.62	7.27	21.53	31347.31	54.3	190.89	81.55	49	--	0.561	--	0.01	--	--
Tomerong Creek	E-243	StDeV	4.28	23.42	0.48	7.03	14100.96	41.3	263.25	102.38	33.23	--	0.11	--	--	--	--
Tomerong Creek	E-243	Median	21.525	41.7	7.315	24.35	38350	65	72	32.5	5	--	0.4	0.0525	0.01	--	1000
Tomerong Creek	E-243	Min	12.6	5.5	5.95	1.87	34.1	0.4	4	1	1	--	0.3	0.005	0.01	--	0
Tomerong Creek	E-243	Max	26.7	87.4	8.38	33.72	51350	255.3	870	360	49	--	0.7	0.1	0.01	--	2000
Tomerong Creek	E-243	Count	16	16	16	15	15	16	20	22	6	--	6	5	1	--	2

			Temperature	DO (%)	pH	Salinity	Electrical Conductivity	Turbidity	Faecal Coliforms	Enterococci	Chlorophyll *a*	Ammonia	Nitrogen	TP	Total Organic Phosphorous	TSS	TDS
Estimated Quantification Limit			0.1	0.1	0.1		100	0.1	1	1	0.5	0.05	0.025	0.005	0.005	1	
NSW DP&E MER Triggers – Creeks				84-107	6.7-8.8	7.9-9.1		1.4			3.3	0.021	0.36	0.015			
NSW DP&E MER Triggers – Lakes				93-115	6.7-8.9	8.1-9.1		5.5			5.3	0.014	0.75	0.024			
ANZG (2018) DGVs 95% protection												0.91					
NHRMC (2008) Primary Recreational			15-35						median <150	median < 35							
Tomerong Creek	E-750	Mean	19.16	51.28	6.93	23.39	35586.67	54.31	65.25	78	--	--	--	--	--	--	--
Tomerong Creek	E-750	StDeV	5.60	17.46	0.52	4.33	9651.47	89.31	41.4356931	--	--	--	--	--	--	--	--
Tomerong Creek	E-750	Median	18.31	49.60	7.05	21.40	33620.00	13.60	65	78	--	--	--	--	--	--	--
Tomerong Creek	E-750	Min	9.33	18.20	6.17	20.92	27070.00	0.50	15	78	--	--	--	--	--	--	--
Tomerong Creek	E-750	Max	27.07	73.60	7.64	29.86	46070.00	255.30	116	78	--	--	--	--	--	--	--
Tomerong Creek	E-750	Count	8.00	8.00	8.00	4.00	3.00	8.00	4	1	--	--	--	--	--	--	--

DP&E MER Guidelines

CoA (2018) ANZG (2018) DGVs -Protection of Aquatic Ecosystems Toxicants

NHRMC (2008) Primary contact recreational

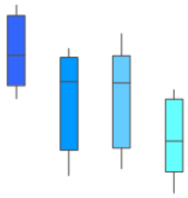
Data review notes: Data range was restricted to 2010 to October 2021; Only parameters with a minimum sample size of 10 were selected; Data that were clearly erroneous due to instrument error or data entry were removed; Where erroneous results were seen in field data, the rest of that sampling period was reviewed to identify other errors which possibly as a result of incorrect probe calibration; microbiology values -1 were assumed to be <EQL and converted to EQL of 1; microbiology values <EQL were replaced with EQL; turbidity negative values were assumed as 0, negative values are related to instrument calibration; chemistry values that were reported as <EQL were converted by * 0.5 (which is the recommended approach by ANZG); negative or zero values were converted to the next lowest EQL for purposes of calculating statistics; chemistry and field data, values over 4 standard deviations from the median were review and removed from dataset if obviously errors due to being outside the possible range for that parameter; DO % above 150 were removed; EC below 100 at all sites during April 2018 were removed.

Appendix C
Water Quality Graphs – 2010 to 2021

Notes on boxplots

Where practical, the relevant water quality triggers (listed in Section 2, Table 2-1) were included as reference lines on graphs, with the colour of the reference line matching the relevant sites area (for example, St Georges Basin sites were coloured orange, with respective DP&E MER guidelines for lakes also coloured orange etc.). Where reference lines for lakes could not be included (for ease of interpreting graphs) they were instead listed in the figure caption.

In the boxplots, the following information is shown:



End of upper whisker = maximum value excluding outliers
Upper end of box = 75th percentile value
Middle line = median value
Lower end of box = 25th percentile value
End of lower whisker = minimum value excluding outliers

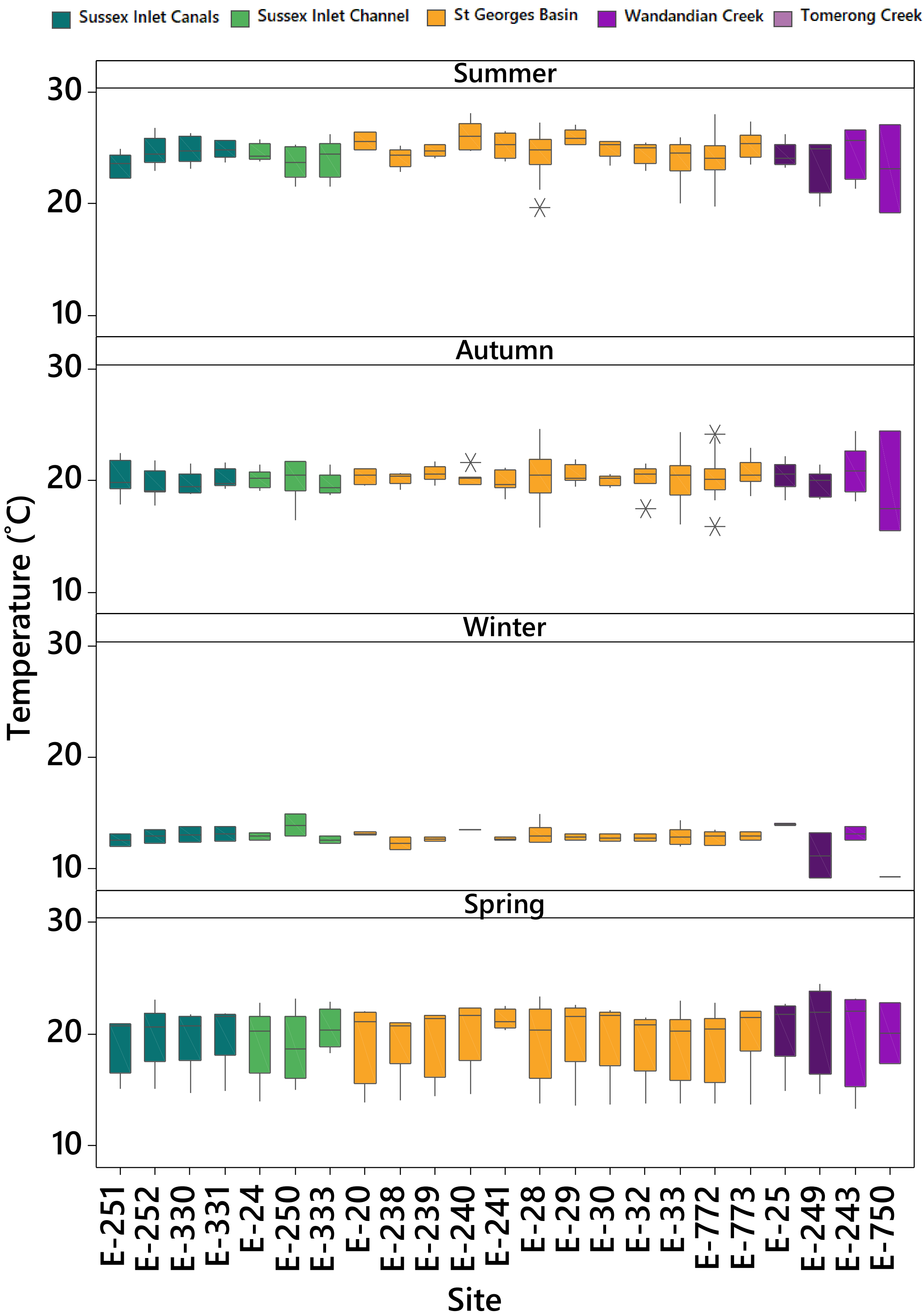


Figure 8-1 Temperature (°C) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021.

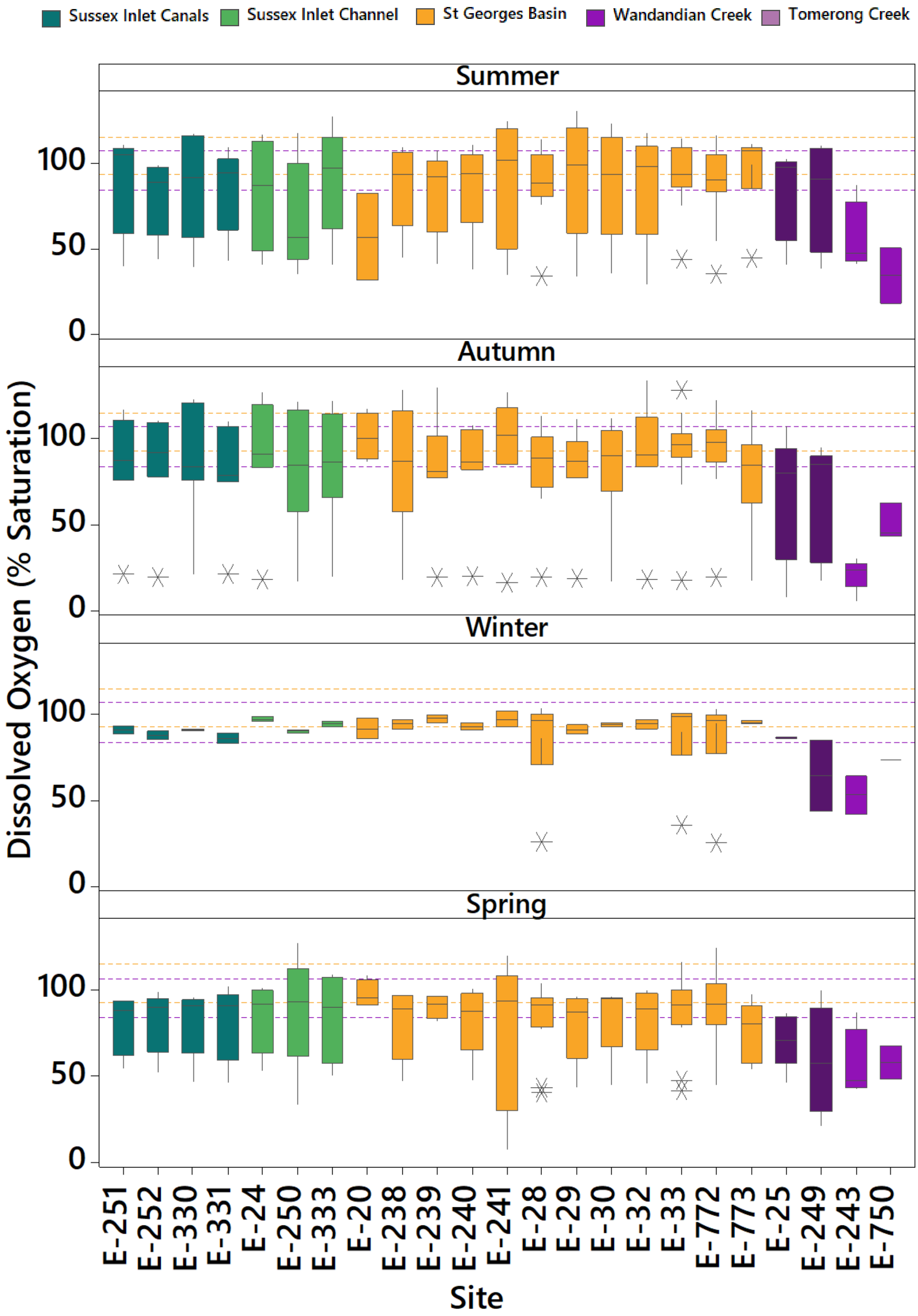


Figure 8-2 Dissolved oxygen (%) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Dotted lines show DP&E MER triggers for Rivers (mid salinity) (green) and Lakes (Orange).

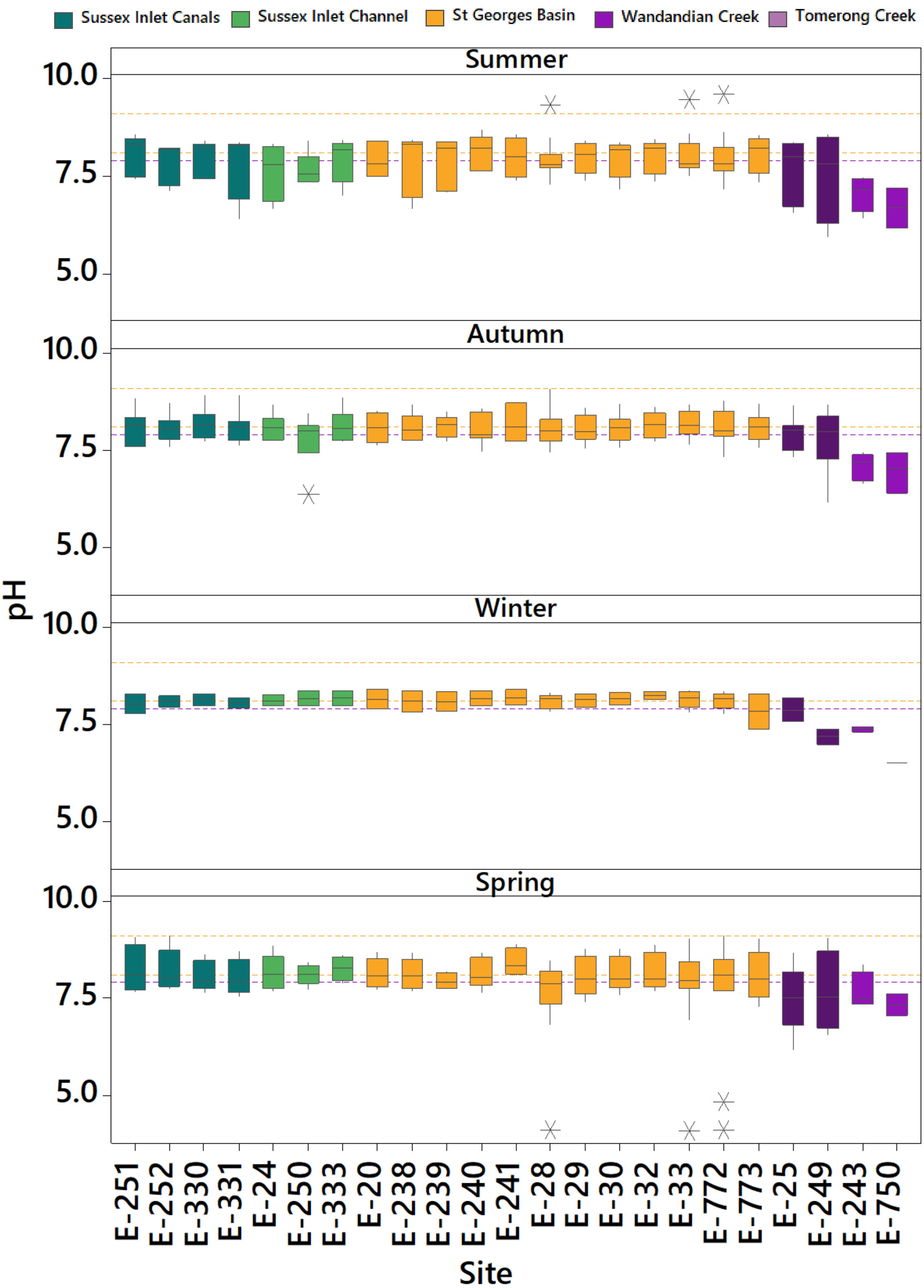


Figure 8-3 pH by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Dotted lines show DP&E MER triggers for Rivers (mid salinity) (green) and Lakes (Orange).

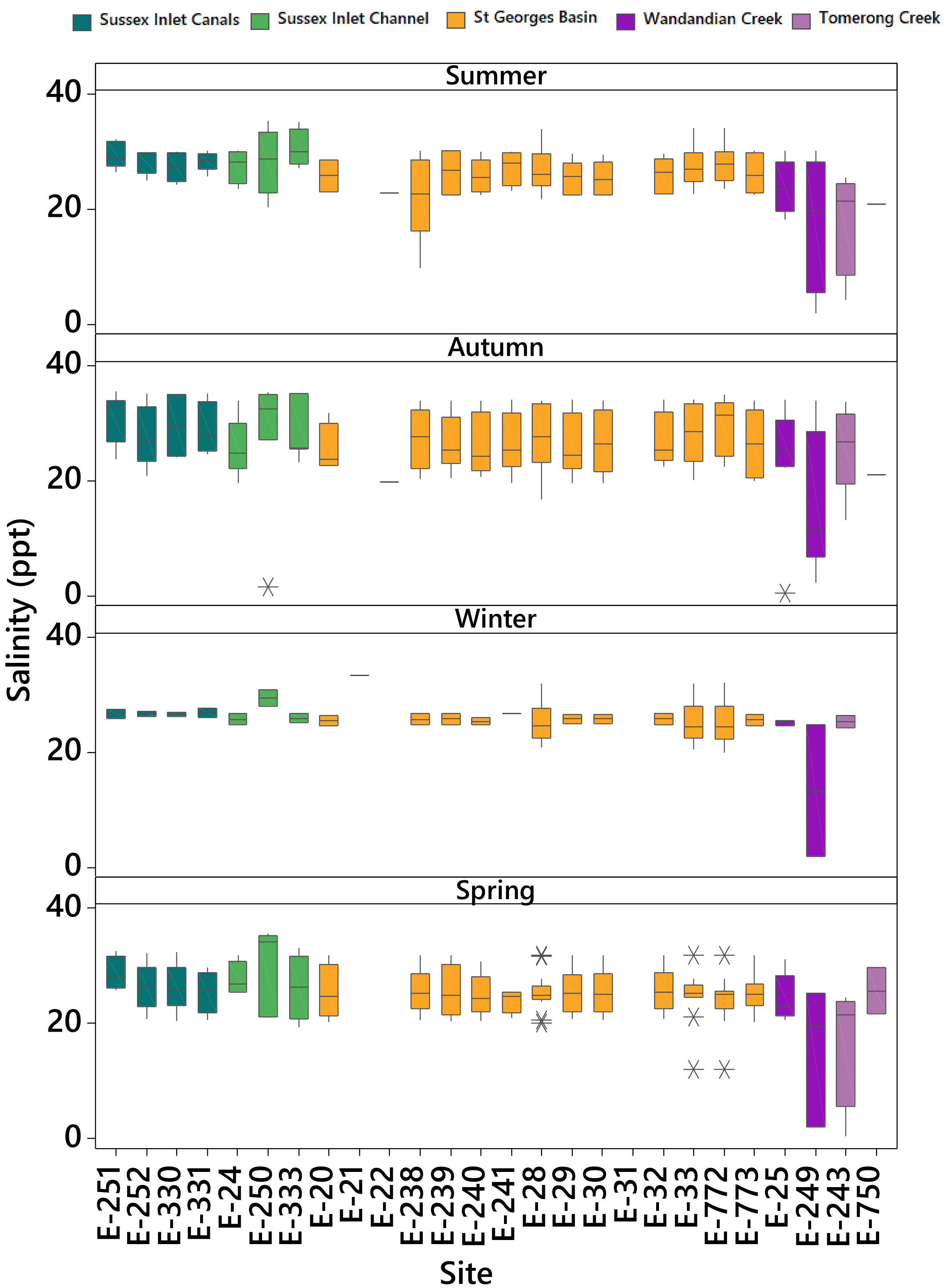


Figure 8-4 Salinity (ppt) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021.

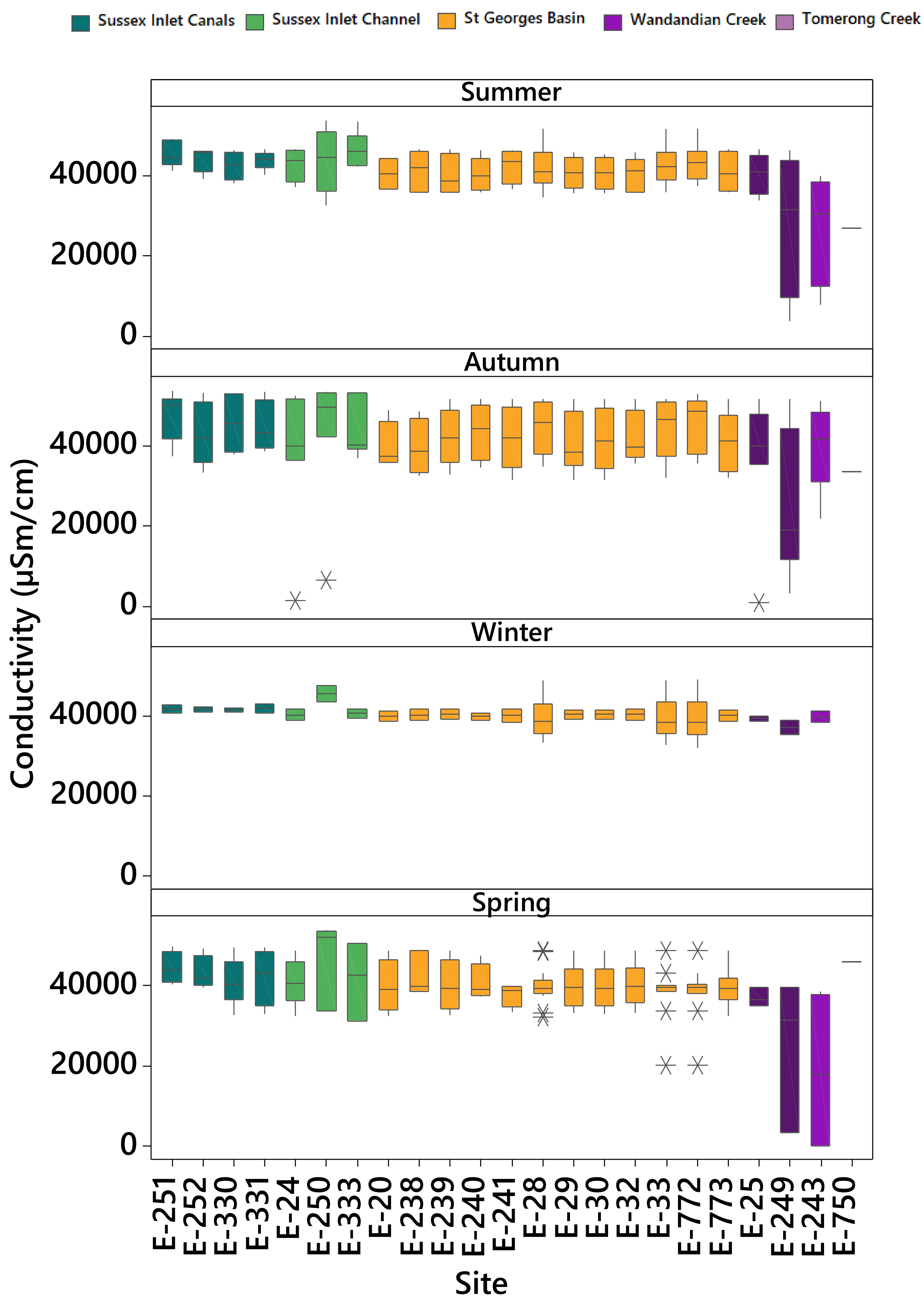


Figure 8-5 Conductivity (µS/cm) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021.

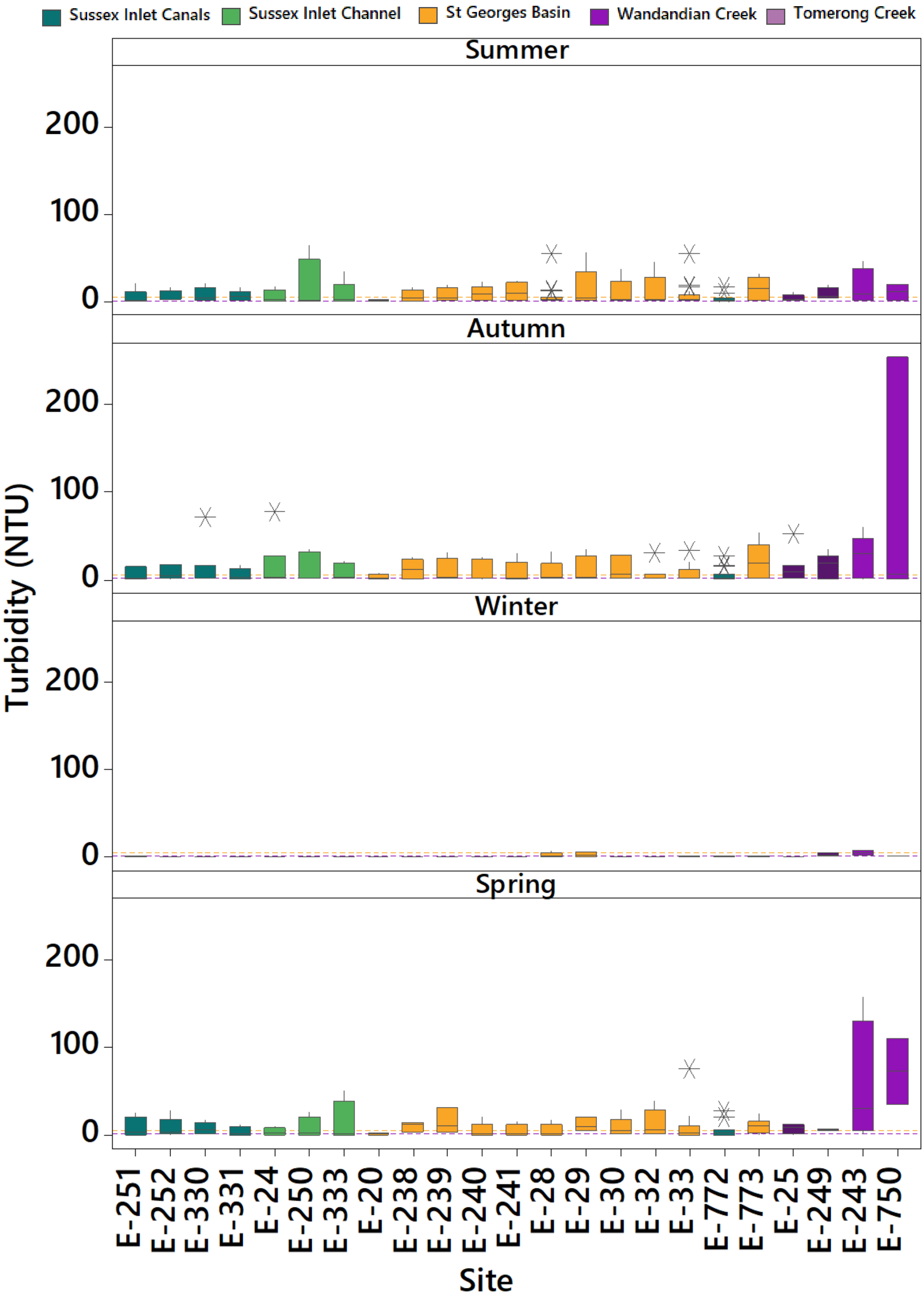


Figure 8-6 Turbidity (NTU) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Dotted lines show DP&E MER triggers for Rivers (mid salinity) (green), Lakes (orange) and Creeks (purple).

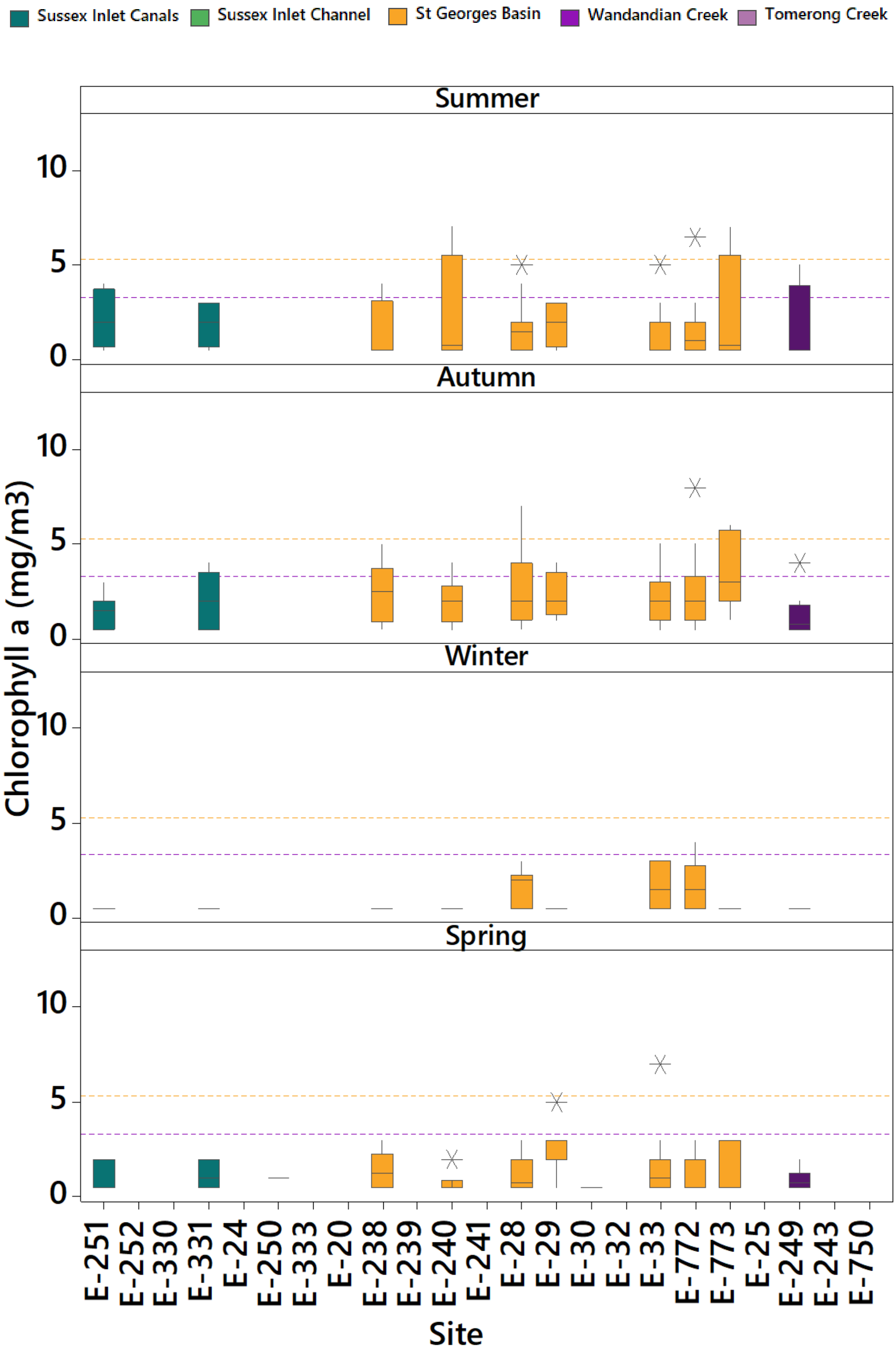


Figure 8-7 Chlorophyll-a (mg/m^3) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Dotted lines show the DP&E MER triggers for Rivers (mid salinity) (green), Lakes (orange) and Creeks (purple).

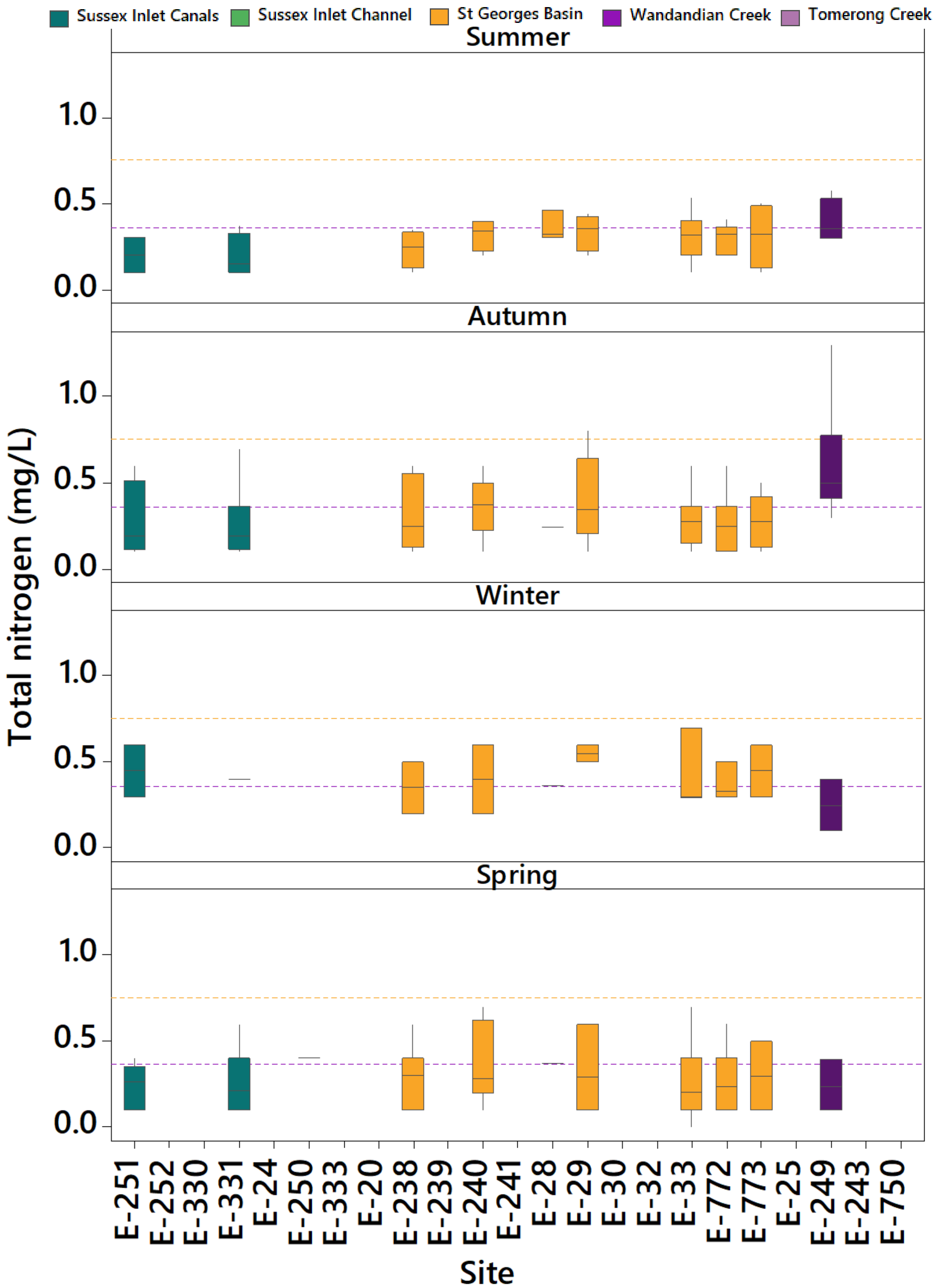


Figure 8-8 Total nitrogen as N (mg/L) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Dotted lines show the DP&E MER triggers for Rivers (mid salinity) (green), Lakes (orange) and Creeks (purple). Note: an elevated value of 0.39 mg/L TN at E-25 in autumn is not shown.

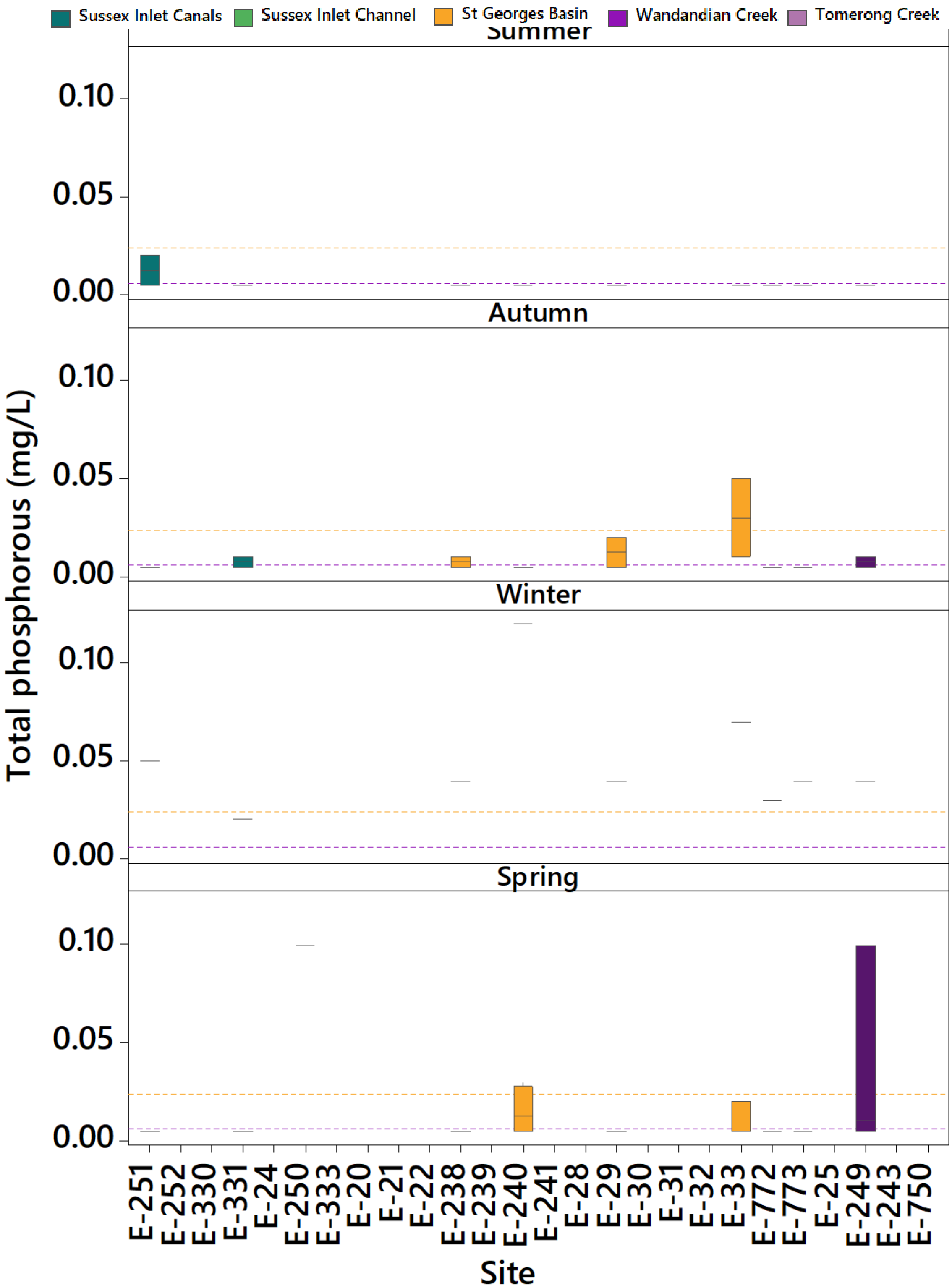


Figure 8-9 Total phosphorous as P (mg/L) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Dotted lines show DP&E MER triggers for Rivers (mid salinity) (green) and Lakes (orange). Note: an elevated value of 0.48 mg/L at E-25 in autumn is not shown.

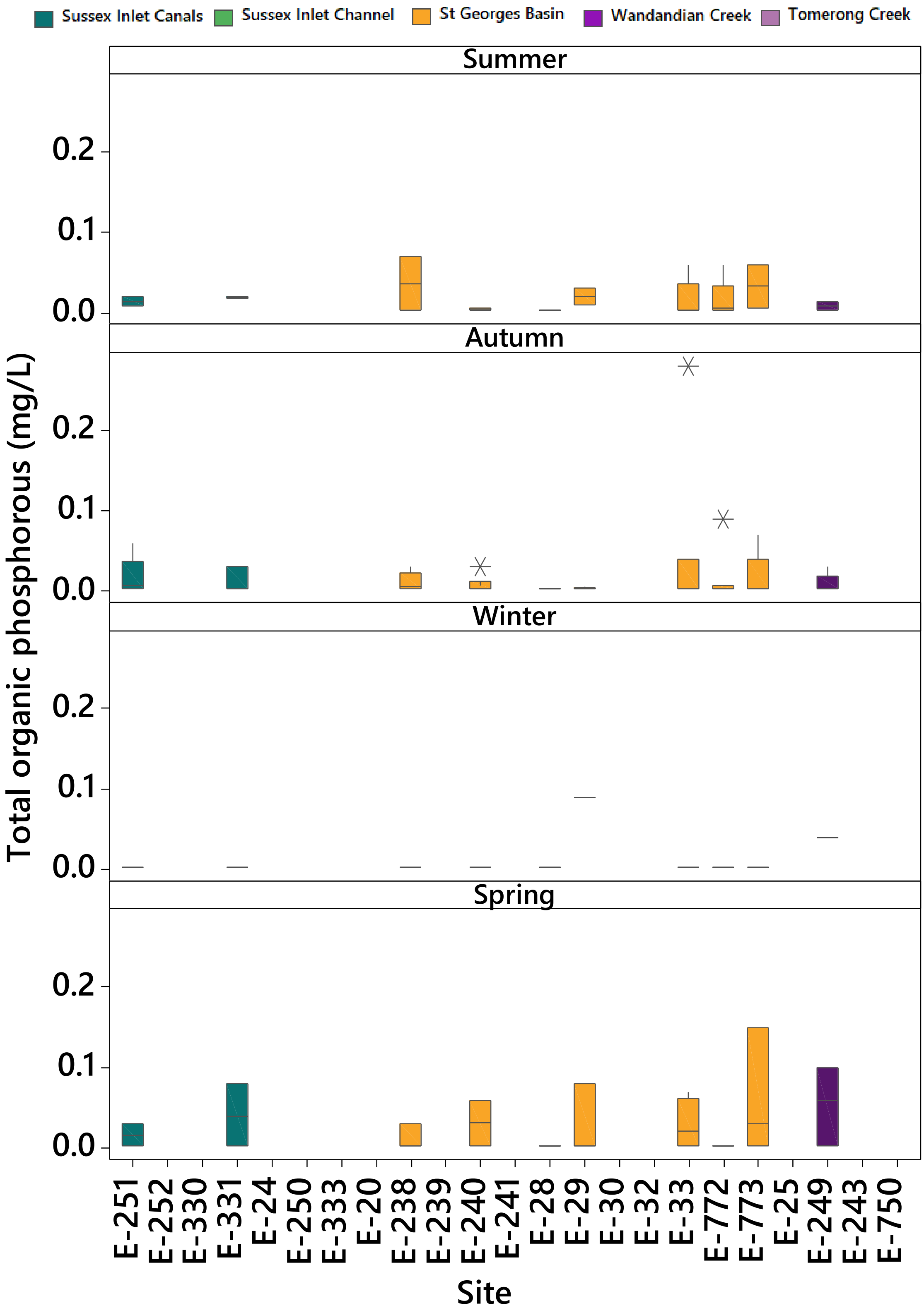


Figure 8-10 Total organic phosphorous as P (mg/L) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021.

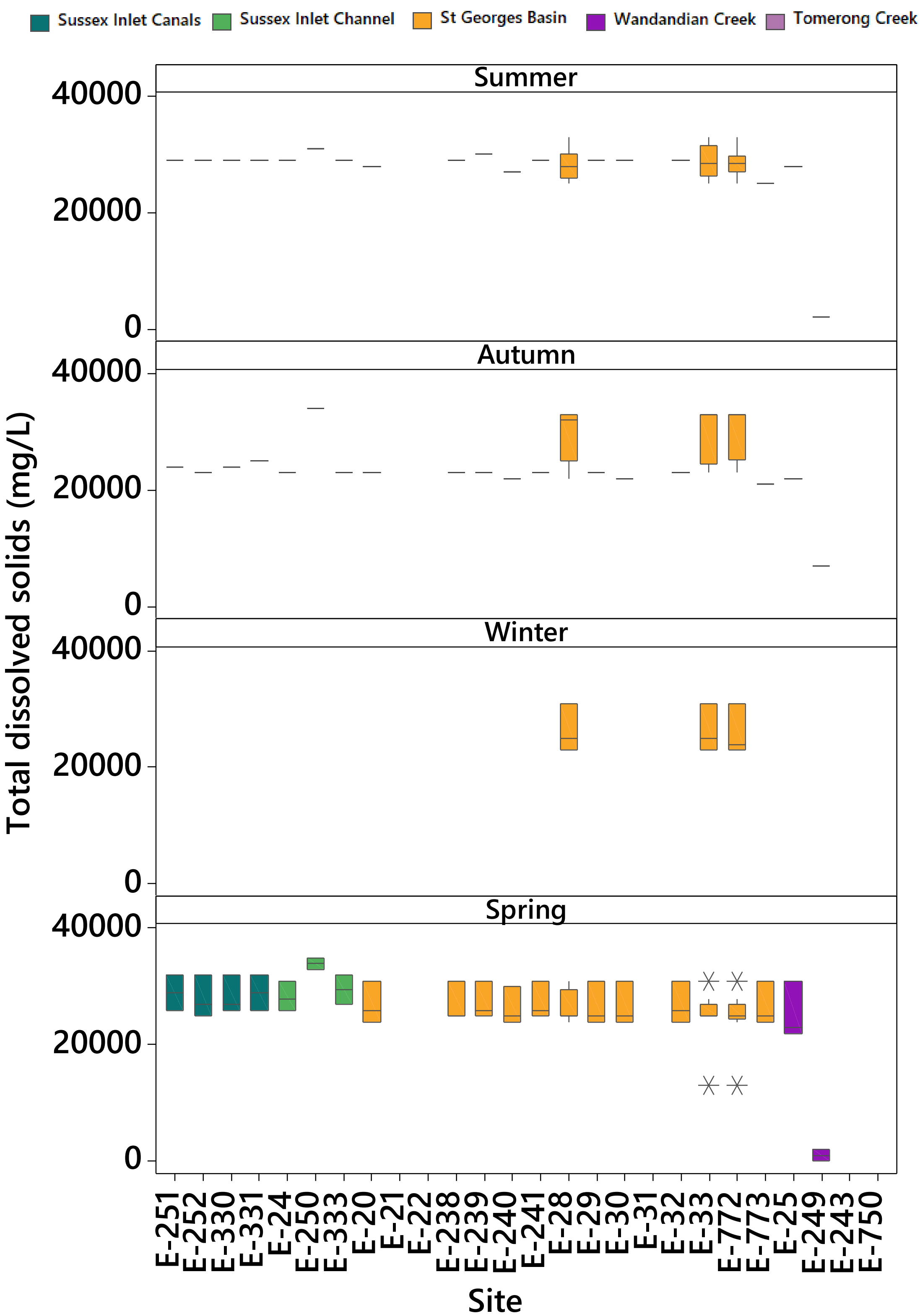


Figure 8-11 Total dissolved solids (mg/L) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021.

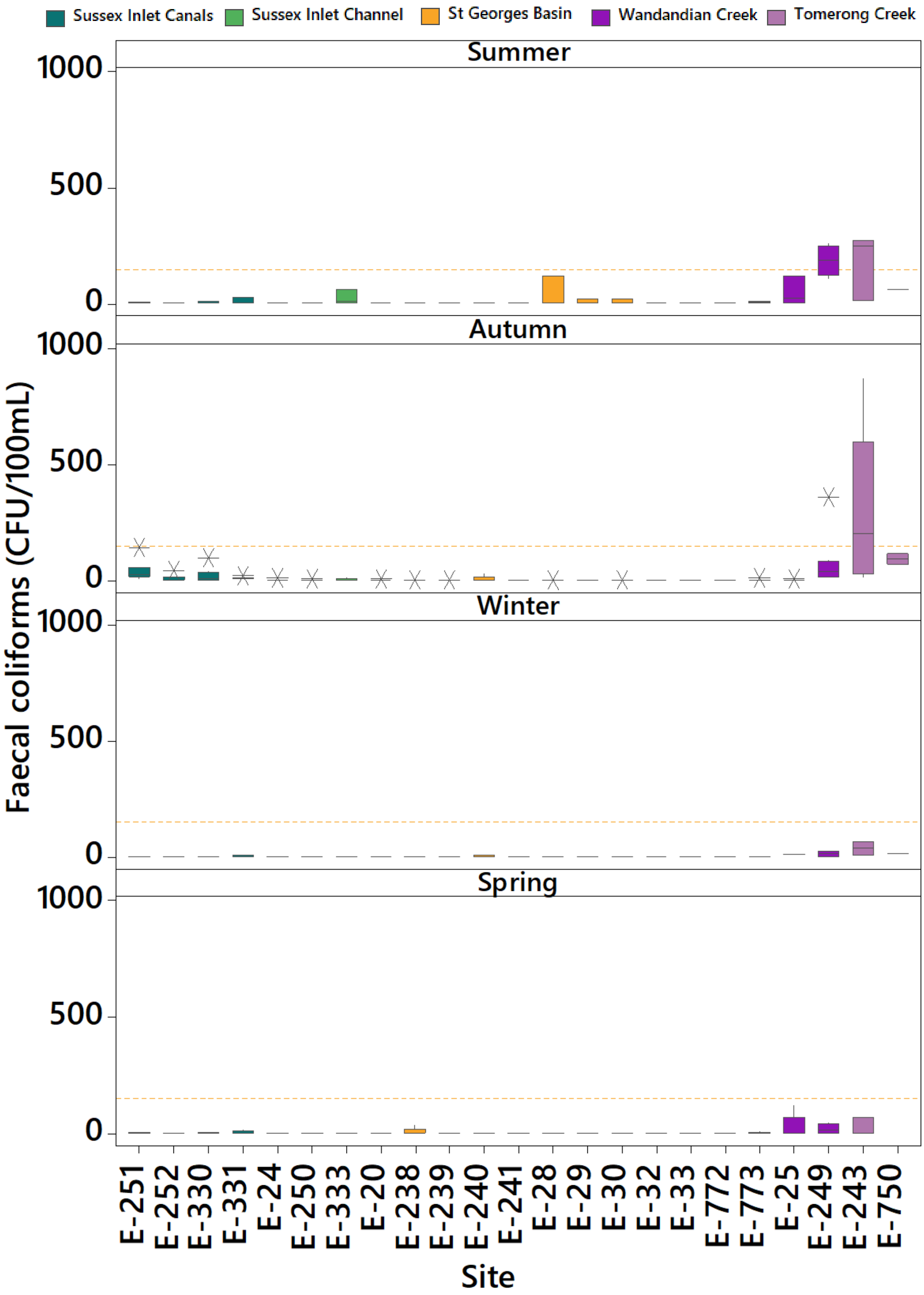


Figure 8-12 Faecal coliforms by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Orange dotted line shows the NHMRC (2008) Primary Recreational Guidelines for comparison to median values at primary recreational sites within the inlet and basin only.

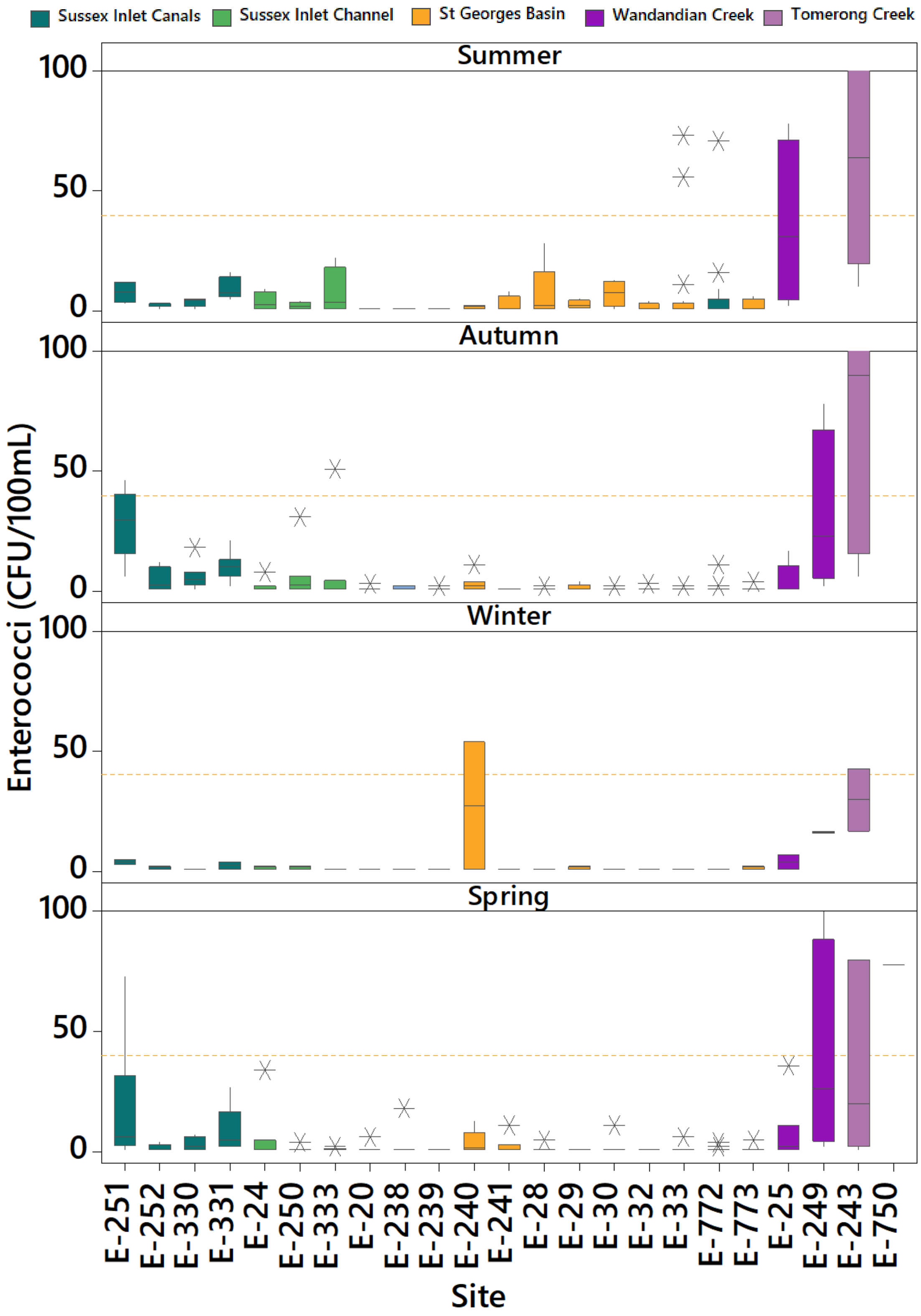


Figure 8-13 Enterococci (CFU/100ml) by season in St Georges Basin and Sussex Inlet from January 2010 - October 2021. Orange dotted line shows the NHMRC (2008) Primary Recreational Guidelines for comparison to 95%ile values at primary recreational sites within the inlet and basin only.

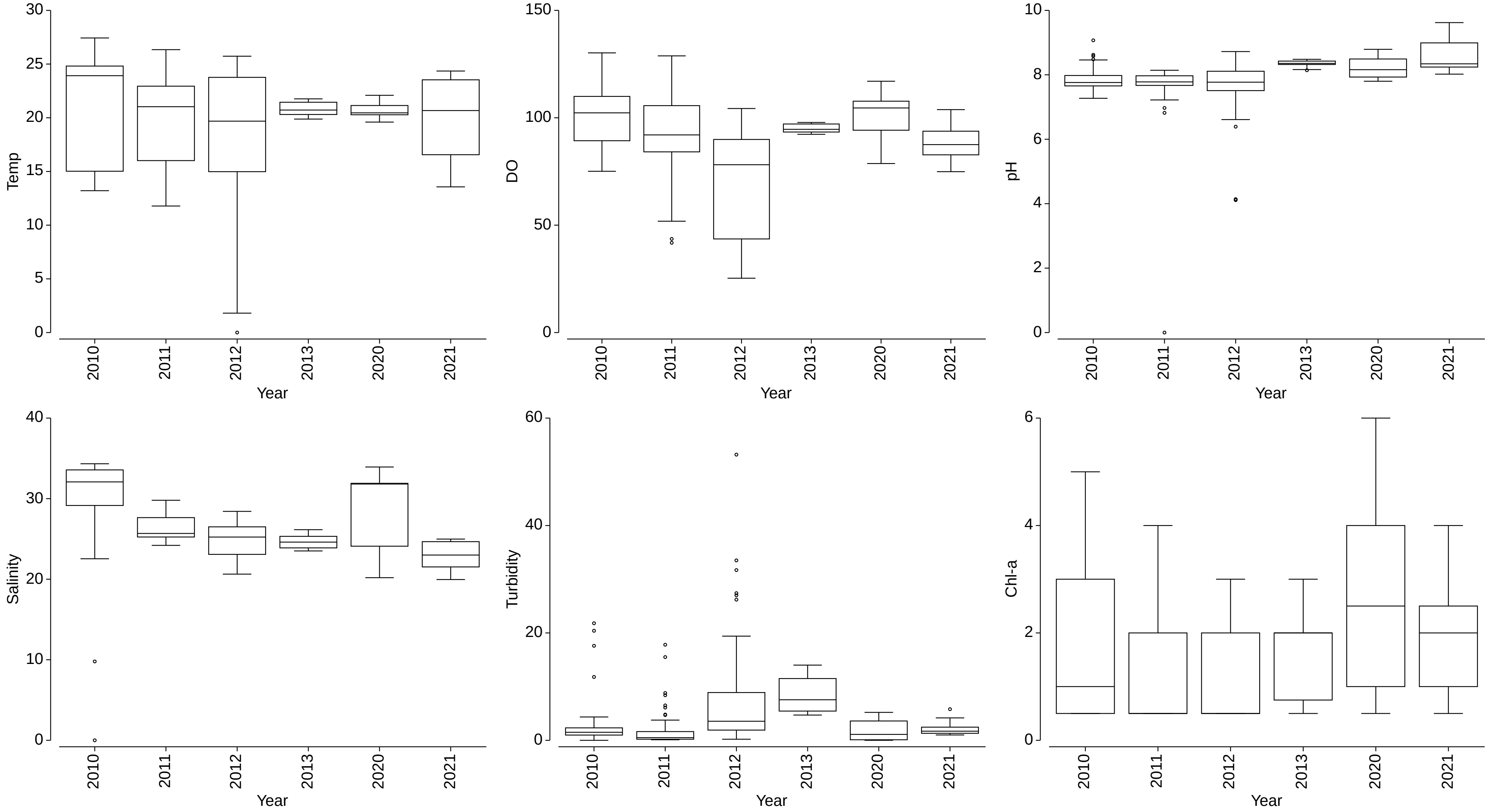


Figure 8-14 Summary of physicochemical parameters in St Georges Basin and Sussex Inlet Channel during all sampling years (all sampling sites pooled).

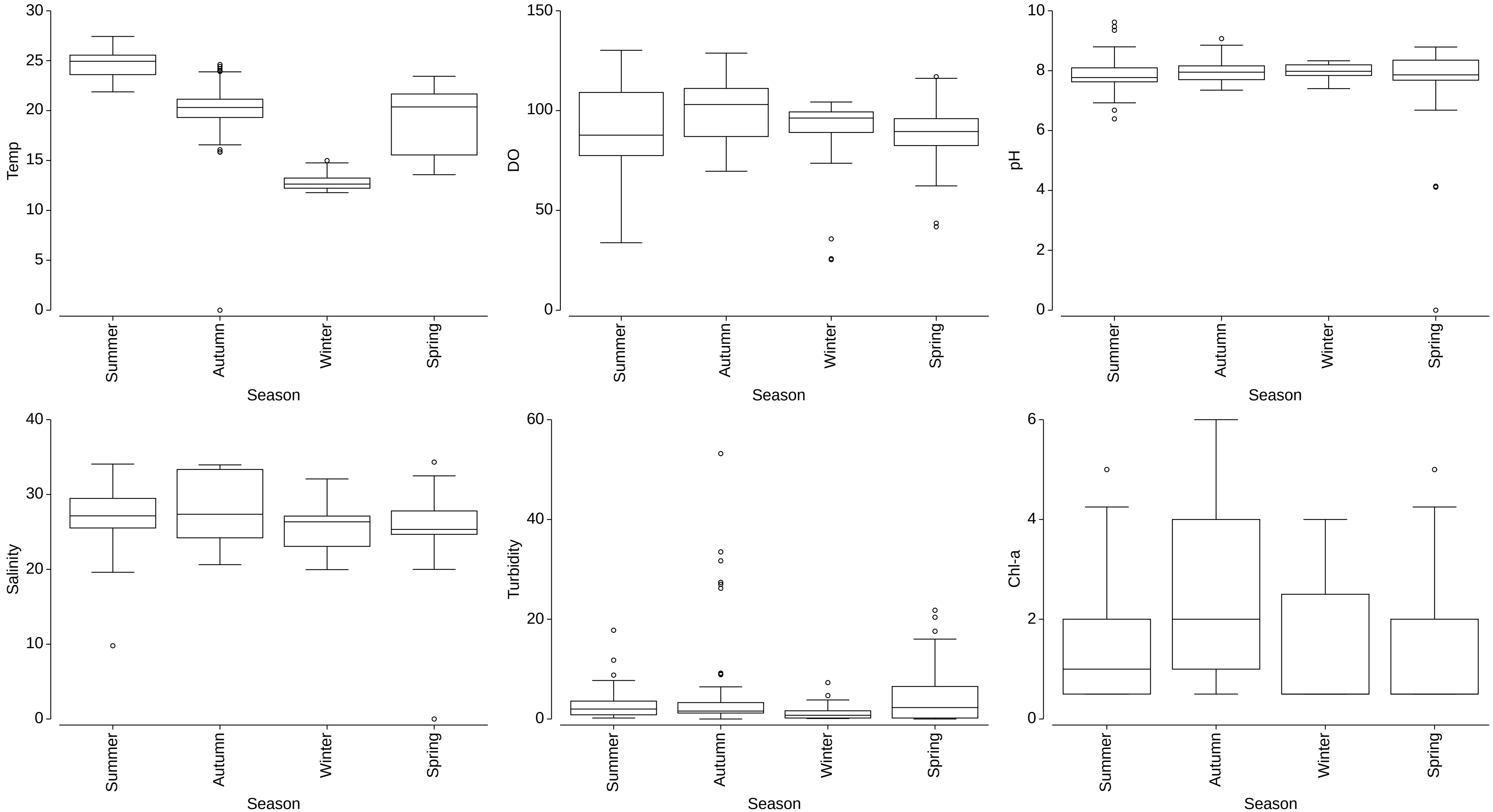


Figure 8-15 Summary of physicochemical parameters in St Georges Basin and Sussex Inlet Channel during all sampling seasons (all sampling sites pooled).

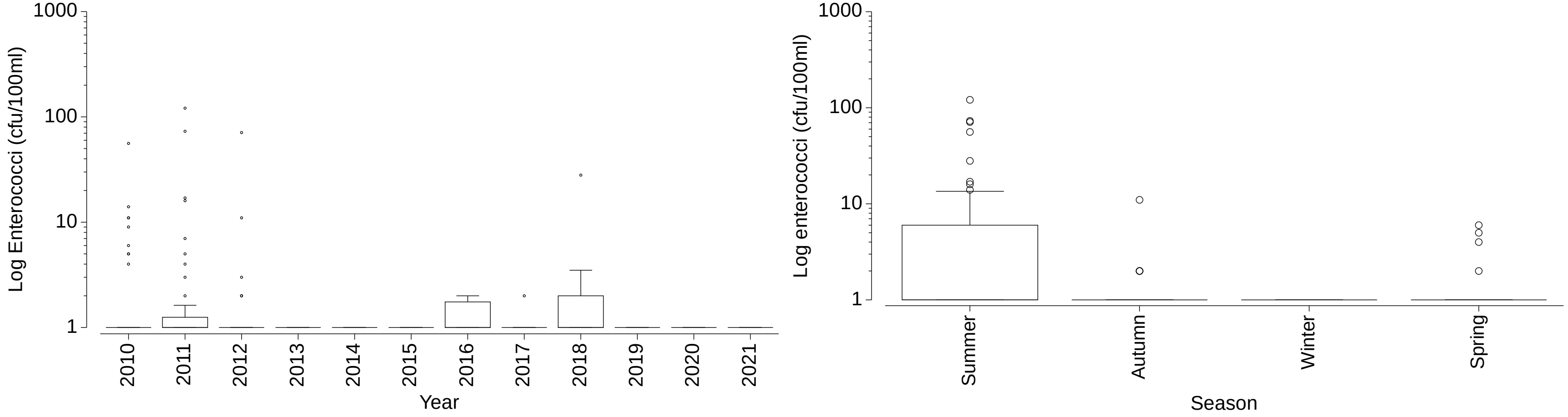


Figure 8-16 Summary of enterococci at selected sites (E-28, E-33 and E-772) in St Georges Basin during all sampling seasons and sampling years.

Appendix D
Water Quality Analysis

Water Quality Analysis

Multivariate analyses were undertaken in PRIMER7 with the PERMANOVA add on (Anderson et al. 2008; Clarke et al. 2014a) to determine differences in physicochemical water quality signature between sites, areas, seasons or years. Due to the nature of multivariate analysis, there needs to be a matched dataset available for all parameters included in the analysis, which restricted the data that could be included. The selected dataset used for analysis included sites within the Sussex Inlet Channel and St Georges Basin from 2010 - 2021, where data was available for all the physiochemical parameters including temperature (°C), pH, salinity (PSU), DO (%), turbidity (NTU) and chlorophyll-*a* (mg/m^3). Sufficient data was not available for the Sussex Inlet Canals, Wandandian Creek and Tomerong Creek meaning it could not be included in the analysis.

For multivariate analysis, the data needs to be transformed to achieve similar distribution among the variables. The water quality dataset was transformed using log + 1 transformation which is typical for this type of environmental data. The transformed dataset was then used to make a resemblance matrix using the Euclidean similarity metric, which is robust to environmental data measured on different scales. A resemblance matrix is a matrix of scores which represents the pairwise similarity between each pairwise combination of data points. This matrix was used to generate multi-dimensional scaling (MDS) plots which were then overlaid with various factors of interest (e.g. area, site, season and year). Goodness of fit (stress) was assessed using Kruskal's stress formula and compared to maximum values (stress should be less than 0.2) as recommended by Sturrock and Rocha (2000).

The below graphs show the combined physicochemistry and chlorophyll-*a* data, where points that are closer together have more similar water quality and points further apart are more different. In each plot below, the points are in the same position but are shaded by the different factors of site, year and season. This allows a visualisation of whether there are differences between sites, years or seasons. Vectors were overlaid on the graphs of all physiochemical parameters and chlorophyll-*a*. The direction of the vector indicates sample points most influenced by that parameter and the length correlates to the strength of the relationship.

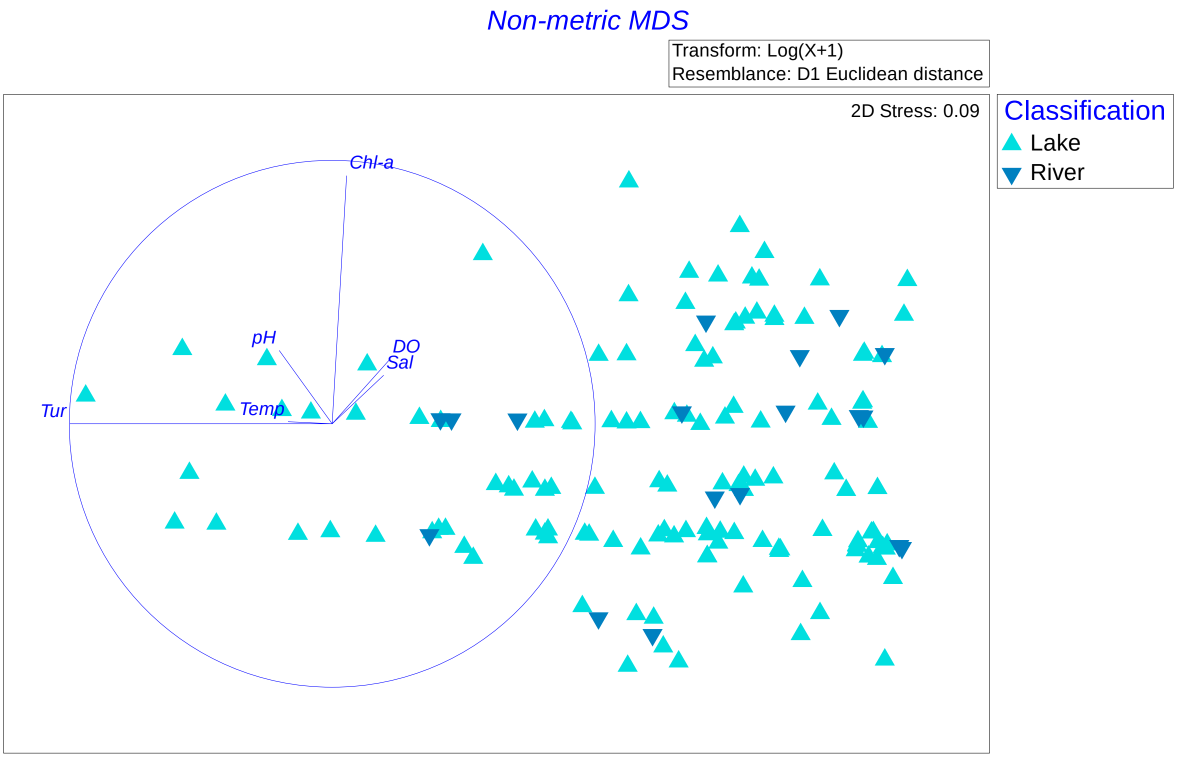


Figure 8-17 nMDS plot of water quality in St Georges Basin and Sussex Inlet Channel grouped by classification (Lake/River).

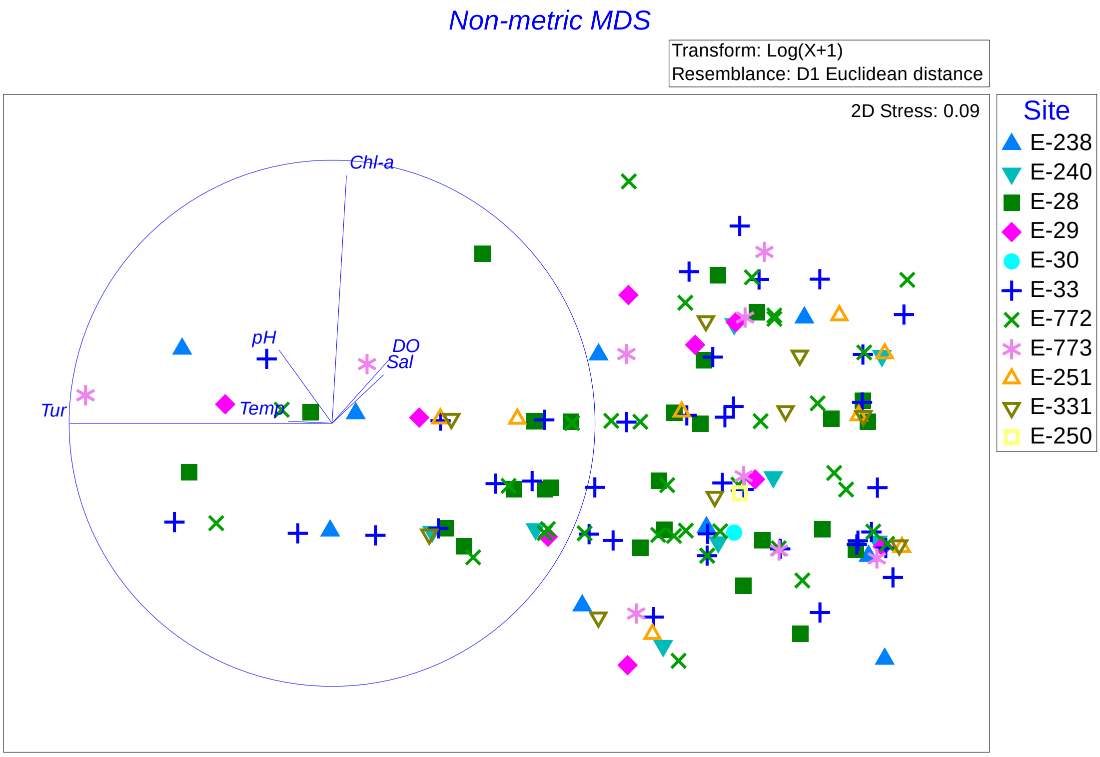


Figure 8-18 nMDS plot of water quality in St Georges Basin and Sussex Inlet Channel grouped by site.

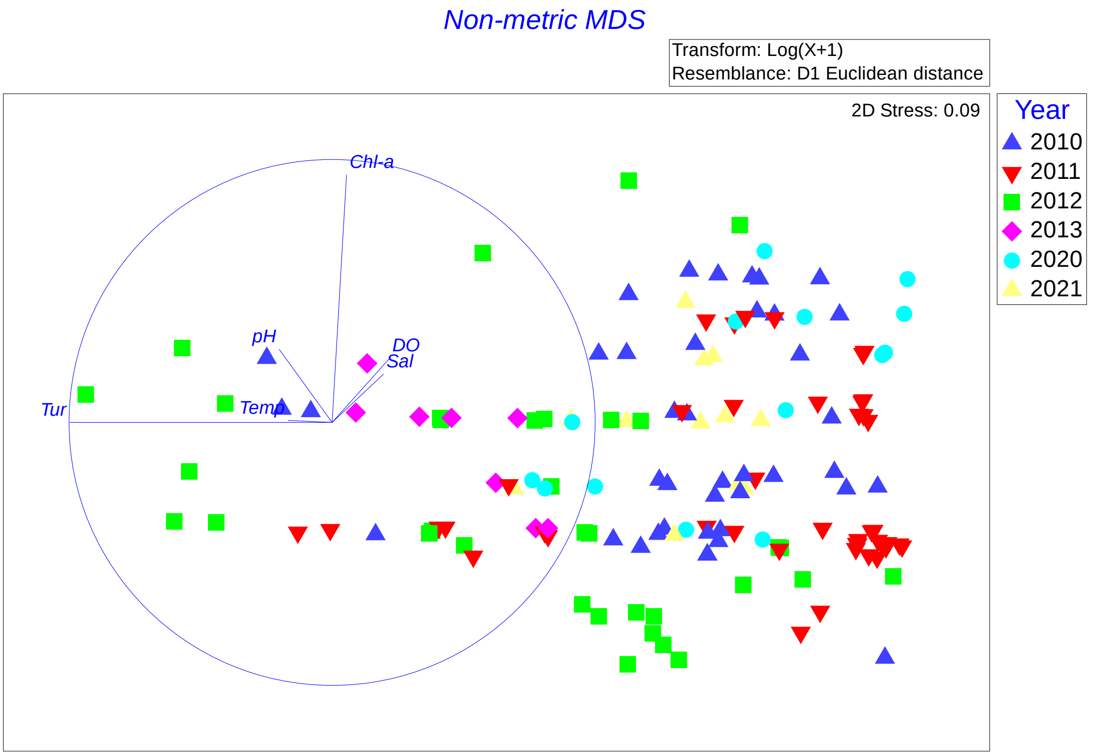


Figure 8-19 nMDS plot of water quality in St Georges Basin and Sussex Inlet Channel grouped by year.

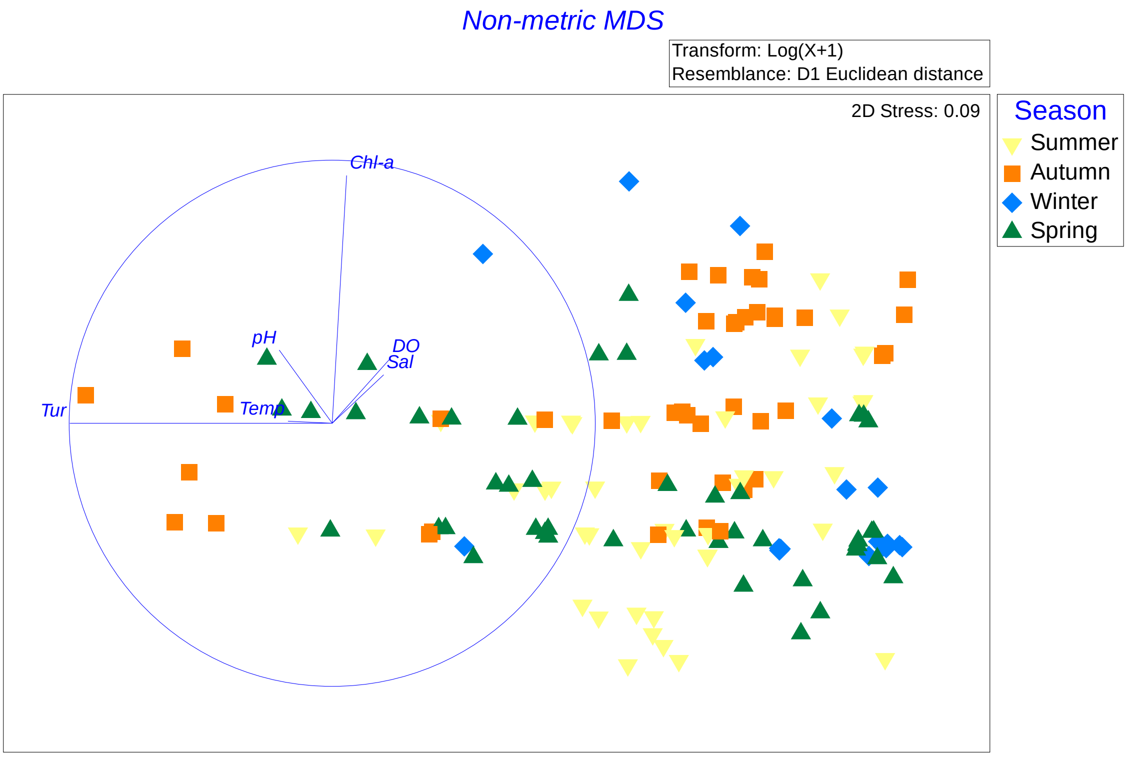
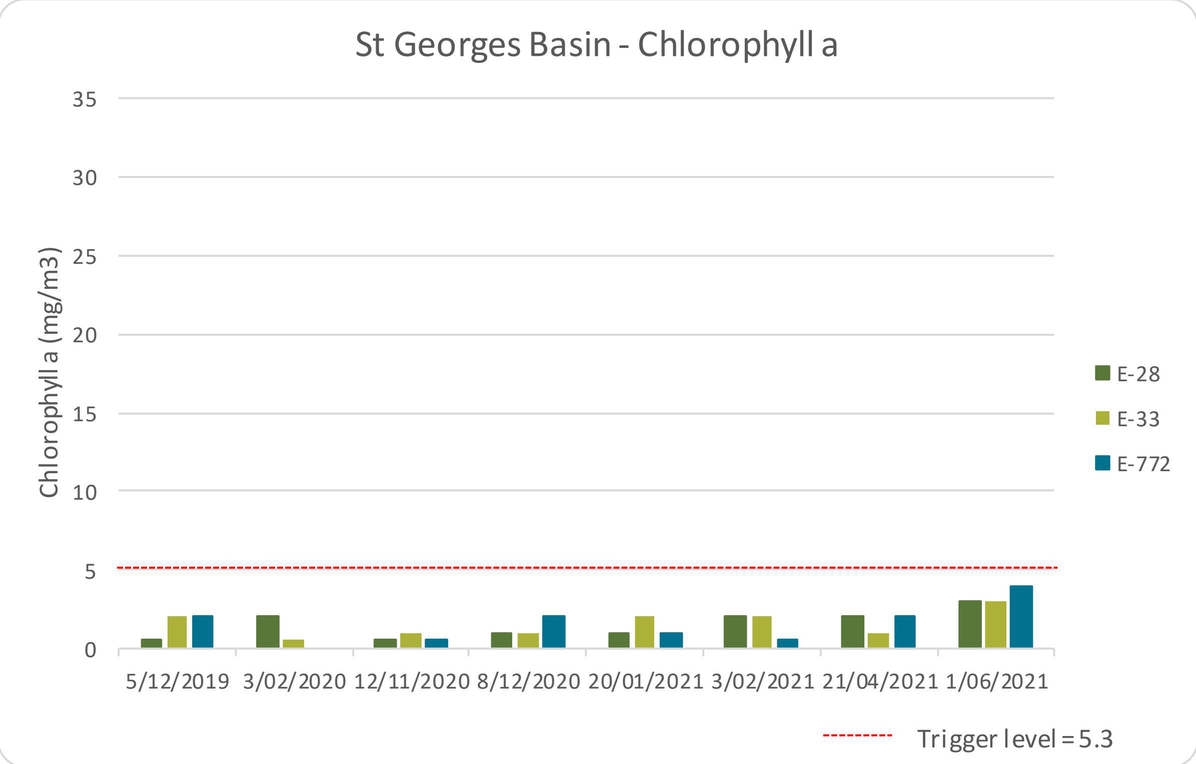
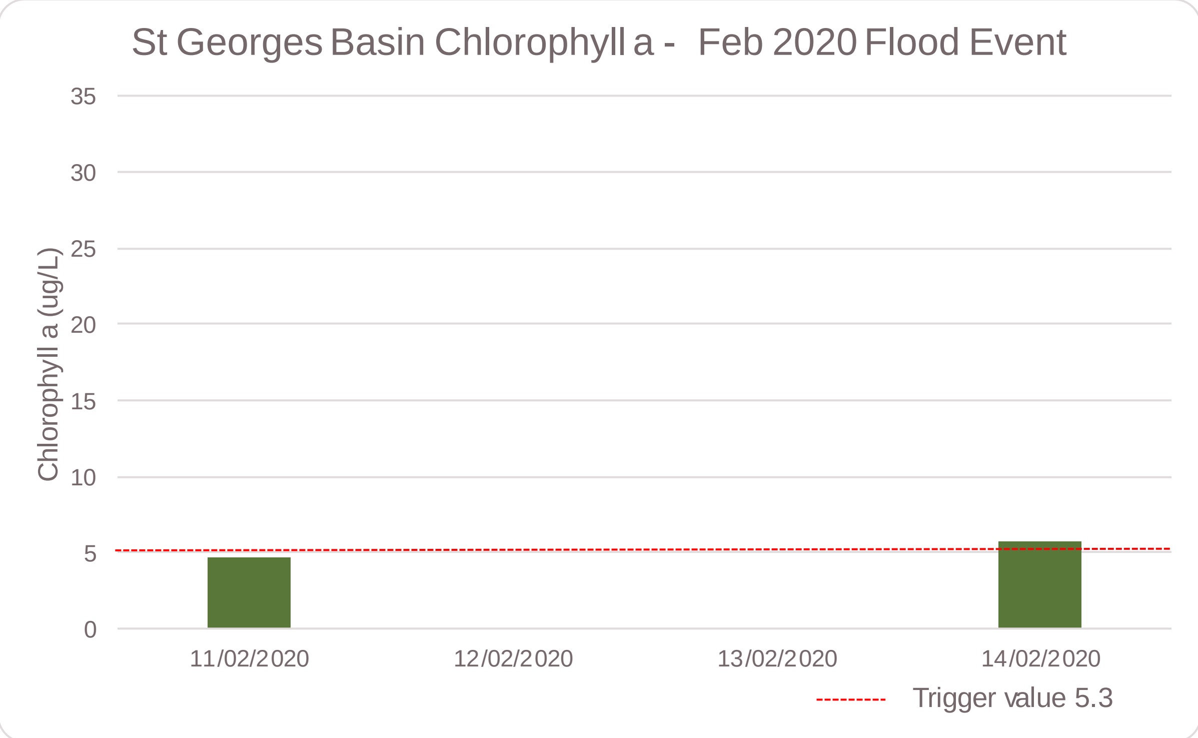


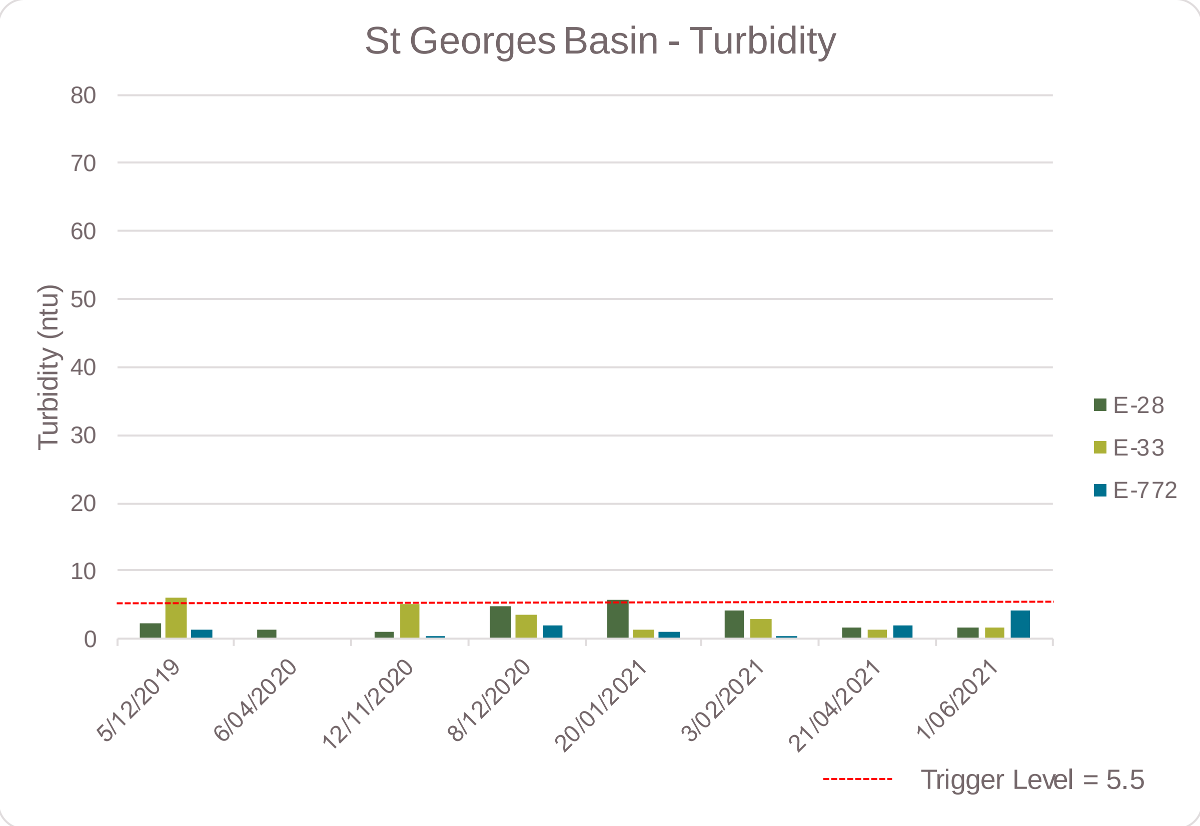
Figure 8-20 nMDS plot of water quality in St Georges Basin and Sussex Inlet Channel grouped by season.

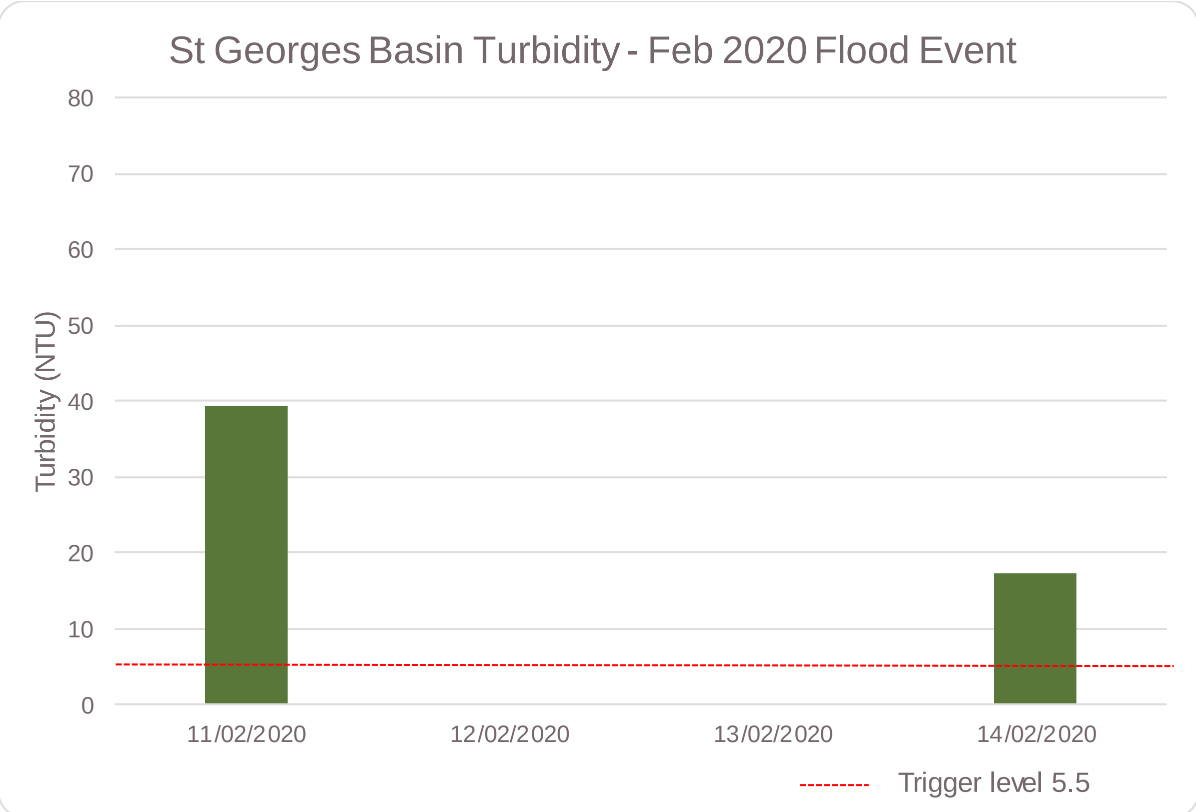
Appendix E
DP&E Water Quality Graphs 2020 - 2021

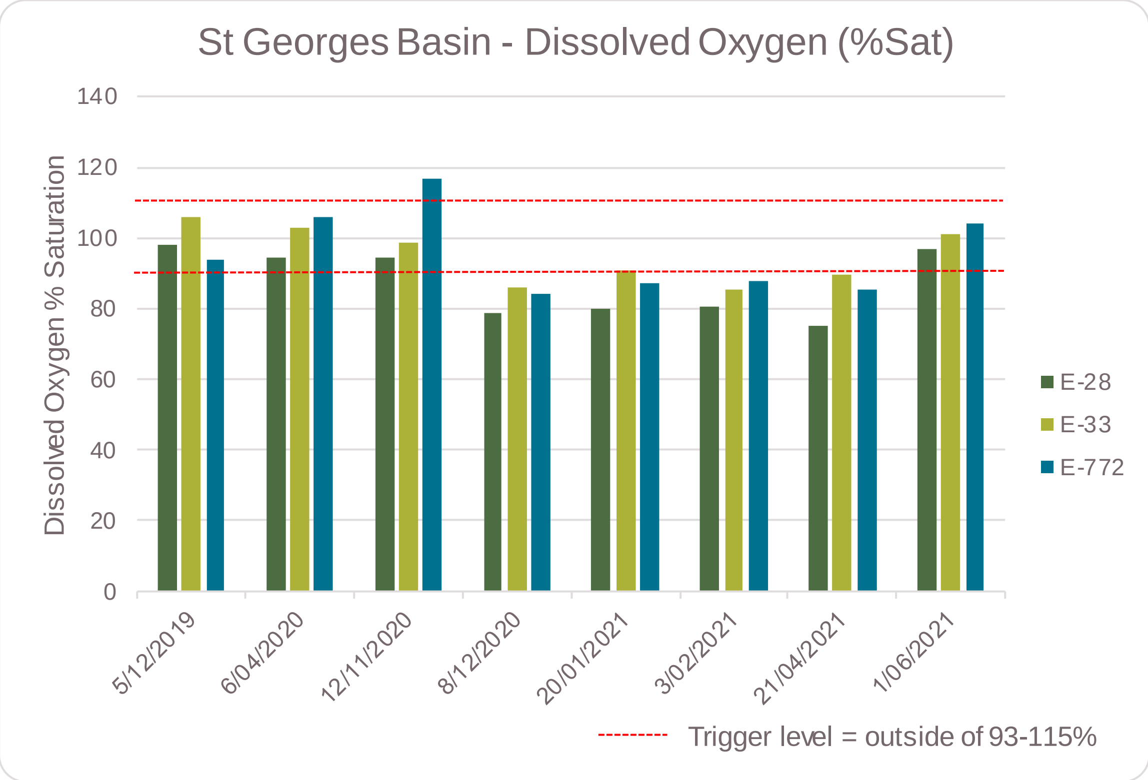
Note: Details of all Council water quality data for all sites is available via the Aqua Data web-site including data prior to 2020 https://www.shoalhaven.nsw.gov.au/Environment/Aqua-Data. *Note: Aqua data shows the raw data which has not been adjusted for outliers or errors in measurement as per the results presented in this report.* The 2020 February Flood Event results were collected separately by DPE and the EPA on two sampling occasions and are not part of Councils data set on Aqua-data.

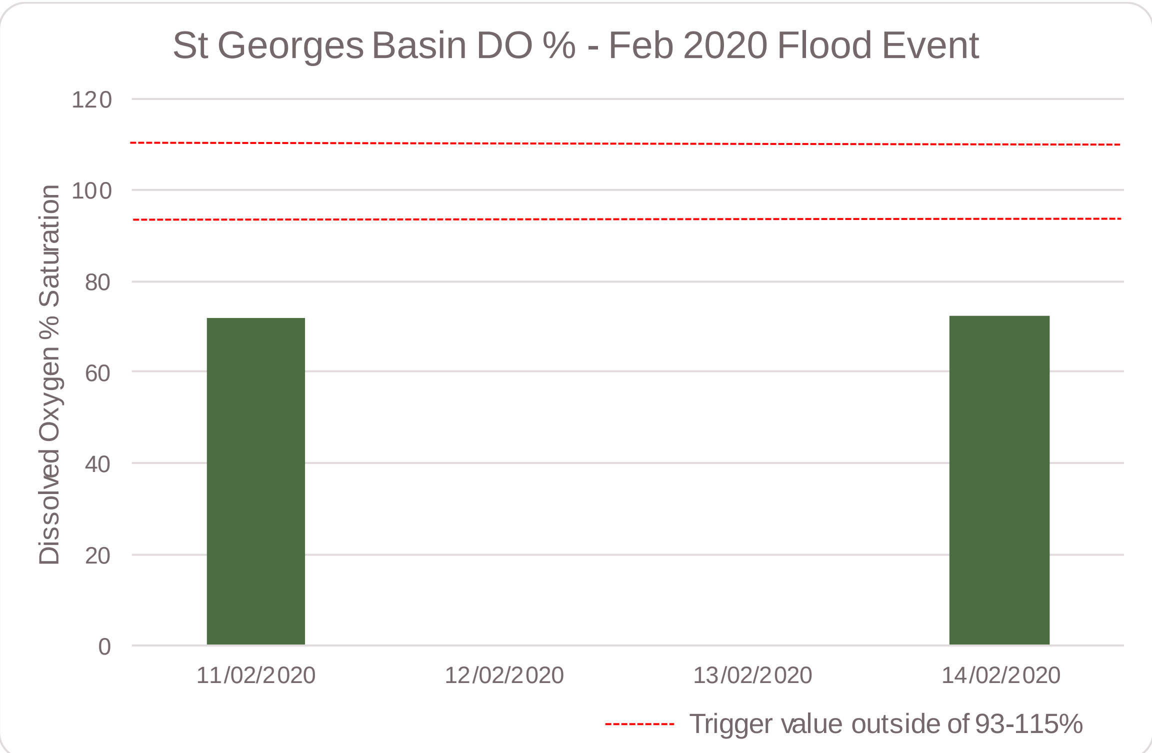


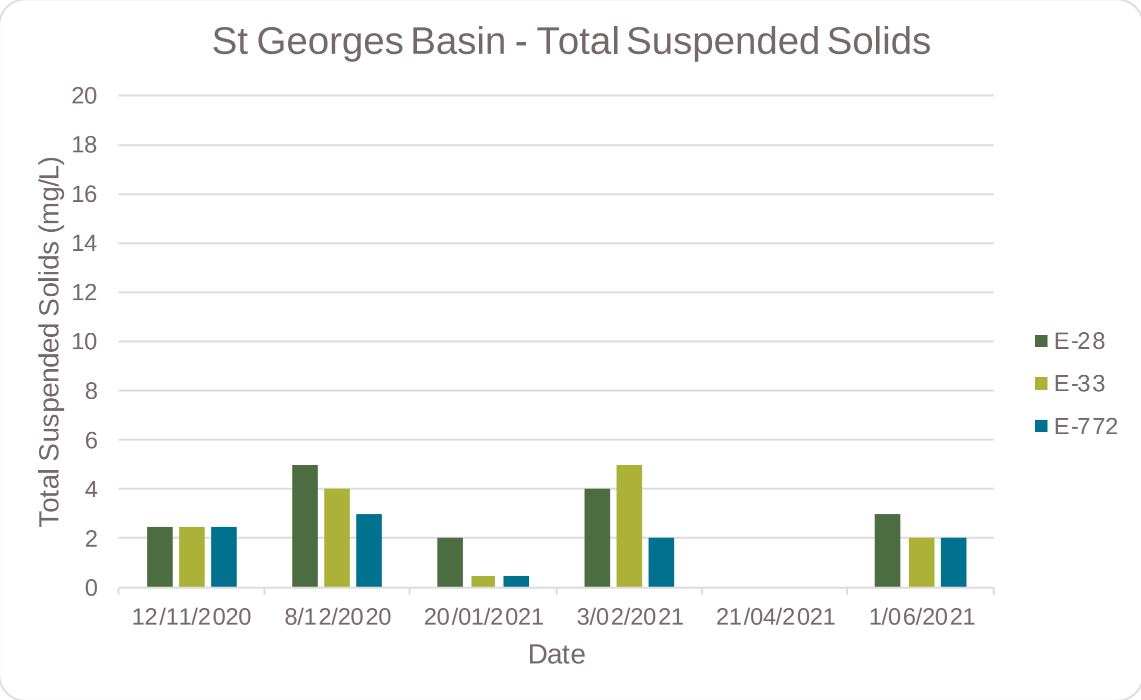



St Georges Basin - Turbidity
Turbidity (ntu)
80
70
60
50
40
30
20
10
0
5/12/2019
6/04/2020
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger Level = 5.5

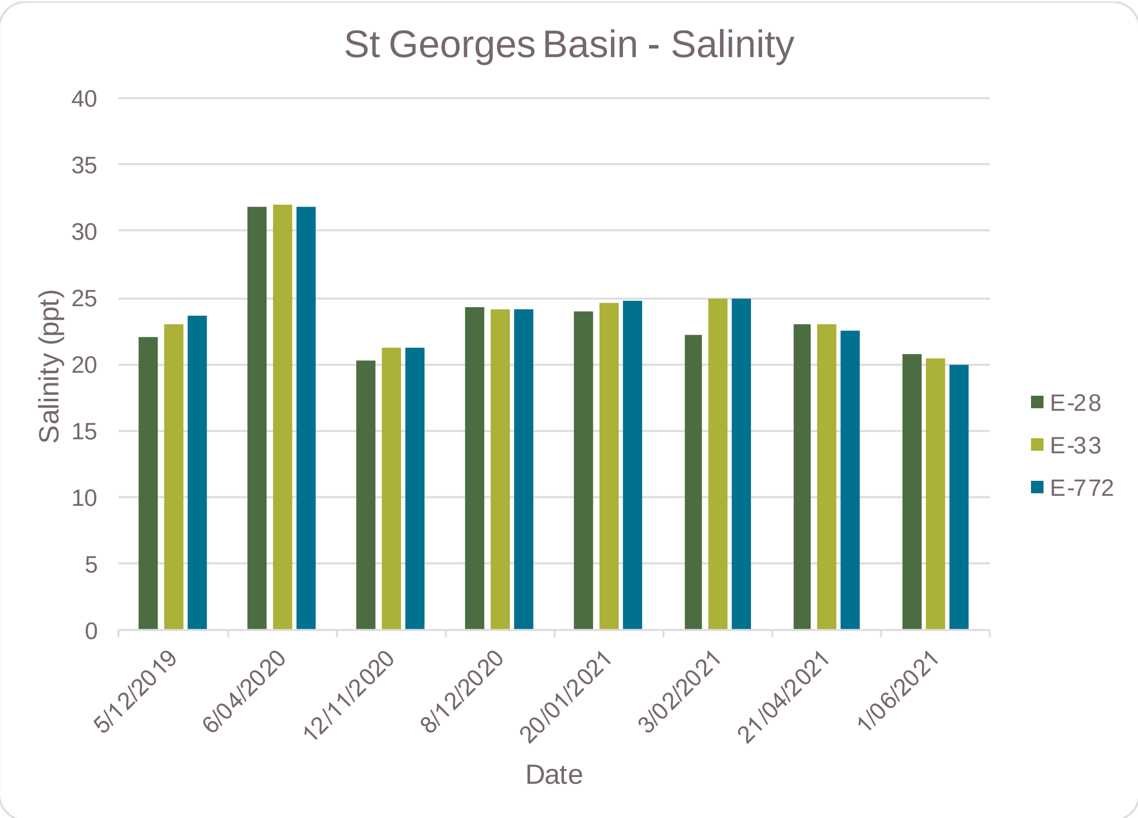

St Georges Basin Turbidity - Feb 2020 Flood Event
Turbidity (NTU)
80
70
60
50
40
30
20
10
0
11/02/2020
12/02/2020
13/02/2020
14/02/2020
Trigger level 5.5


St Georges Basin - Dissolved Oxygen (%Sat)
Dissolved Oxygen % Saturation
140
120
100
80
60
40
20
0
5/12/2019
6/04/2020
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level = outside of 93-115%

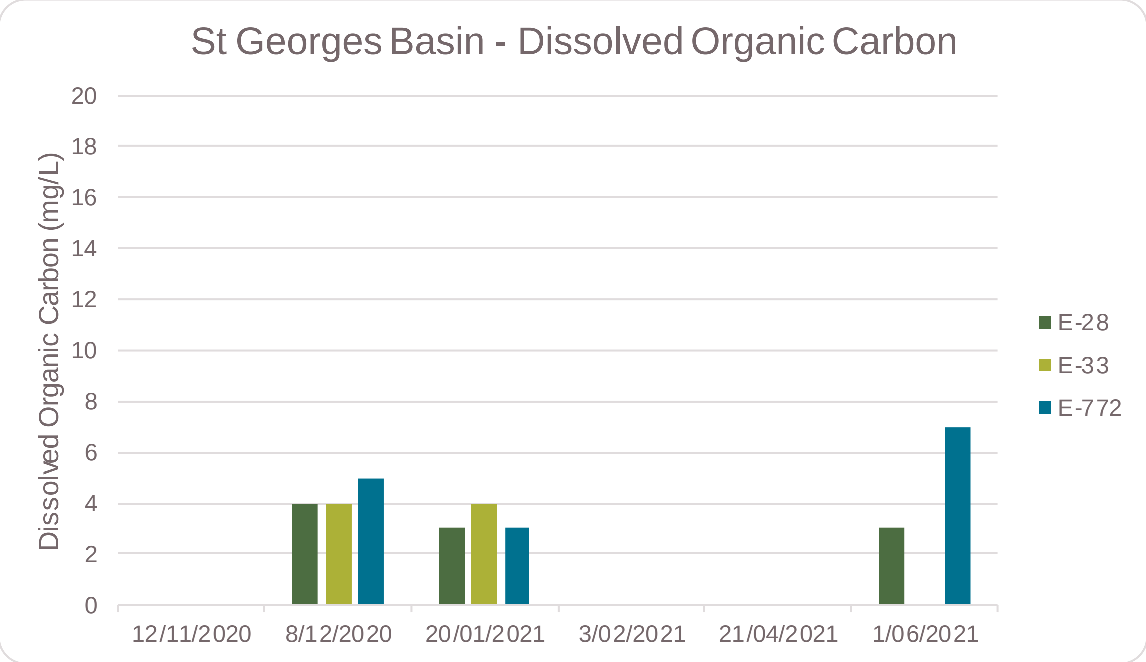

St Georges Basin DO % - Feb 2020 Flood Event
Dissolved Oxygen % Saturation
120
100
80
60
40
20
0
11/02/2020
12/02/2020
13/02/2020
14/02/2020
Trigger value outside of 93-115%



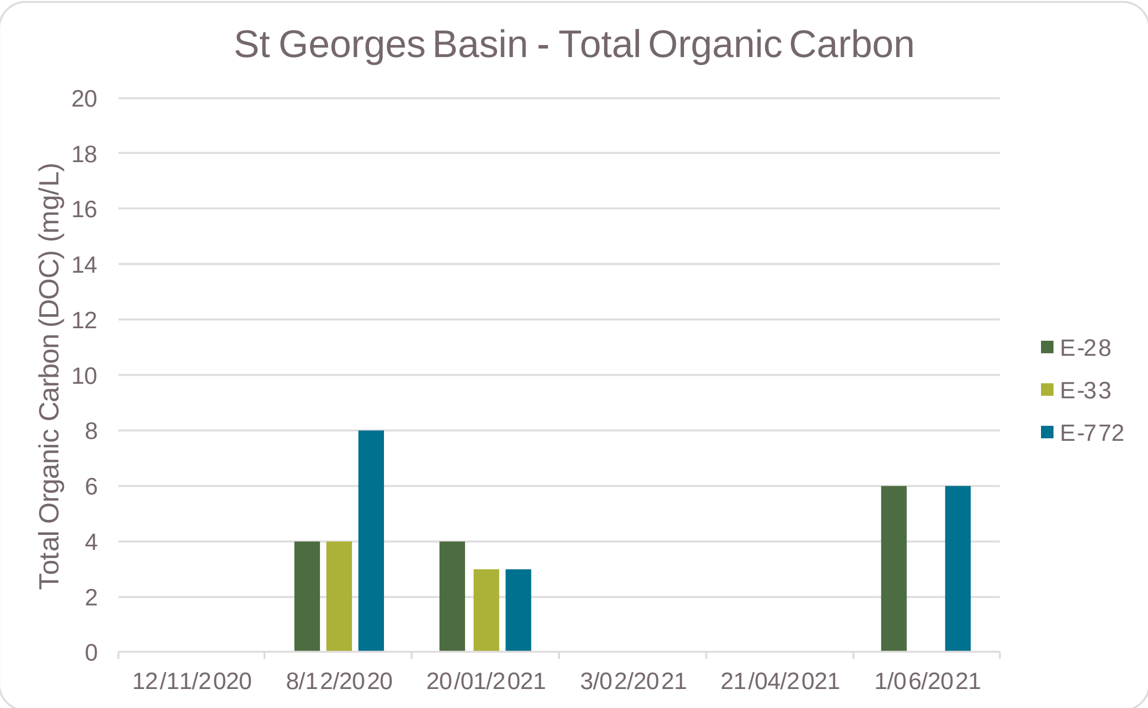
St Georges Basin - Total Suspended Solids
Total Suspended Solids (mg/L)
20
18
16
14
12
10
8
6
4
2
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
Date
E-28
E-33
E-772



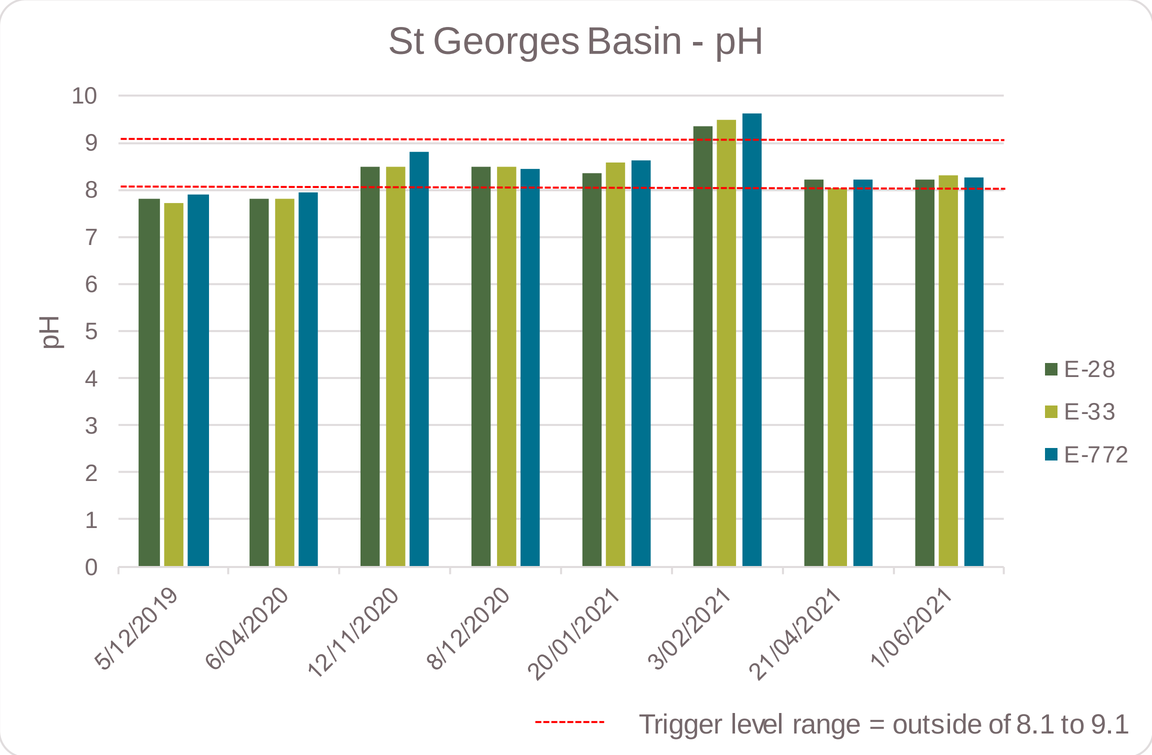
St Georges Basin - Salinity
Salinity (ppt)
40
35
30
25
20
15
10
5
0
5/12/2019
6/04/2020
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
Date
E-28
E-33
E-772



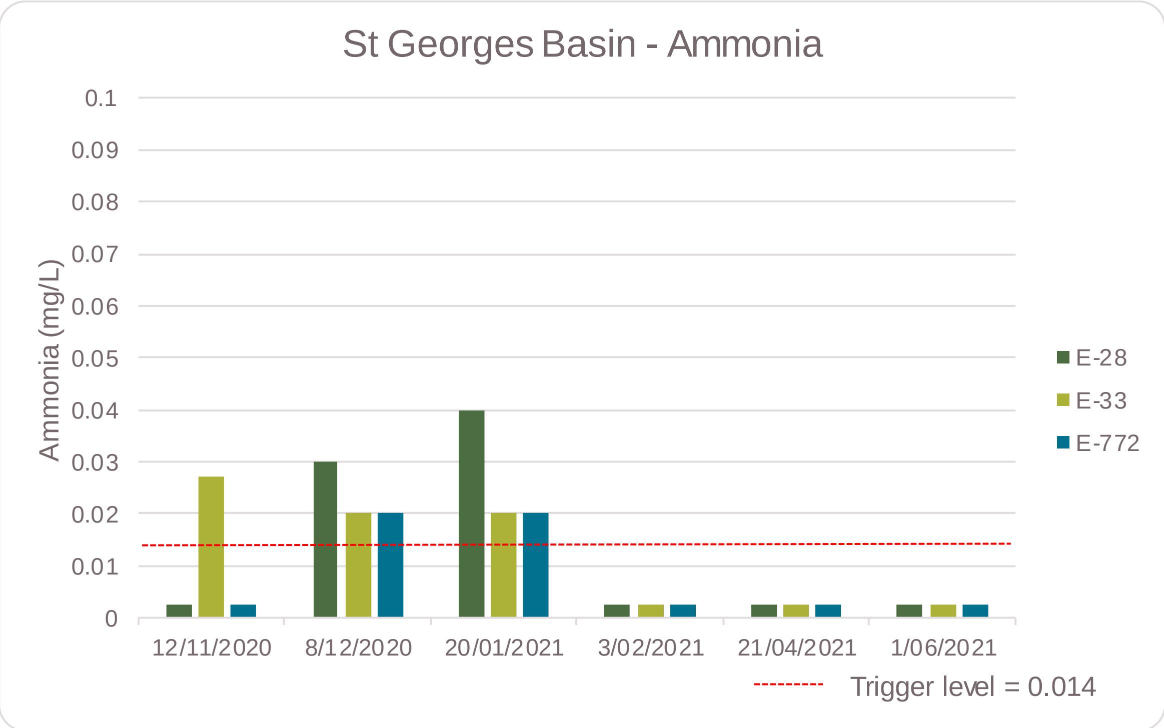
St Georges Basin - Dissolved Organic Carbon
Dissolved Organic Carbon (mg/L)
20
18
16
14
12
10
8
6
4
2
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772



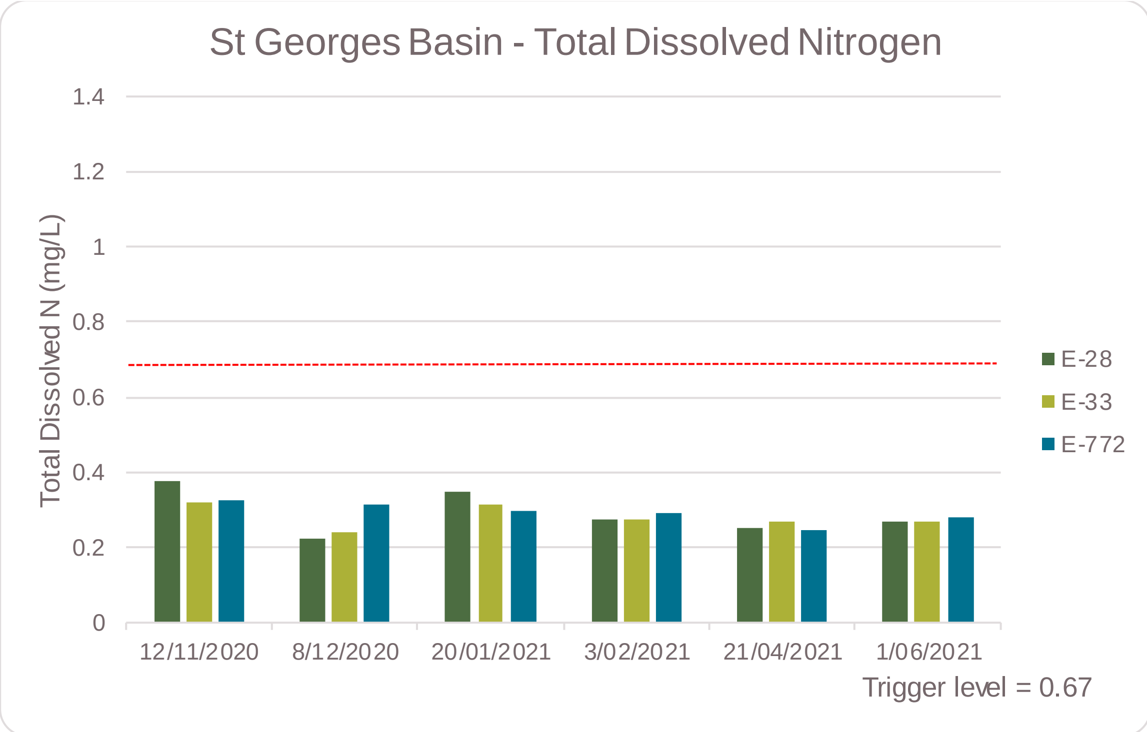
St Georges Basin - Total Organic Carbon
Total Organic Carbon (DOC) (mg/L)
20
18
16
14
12
10
8
6
4
2
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772

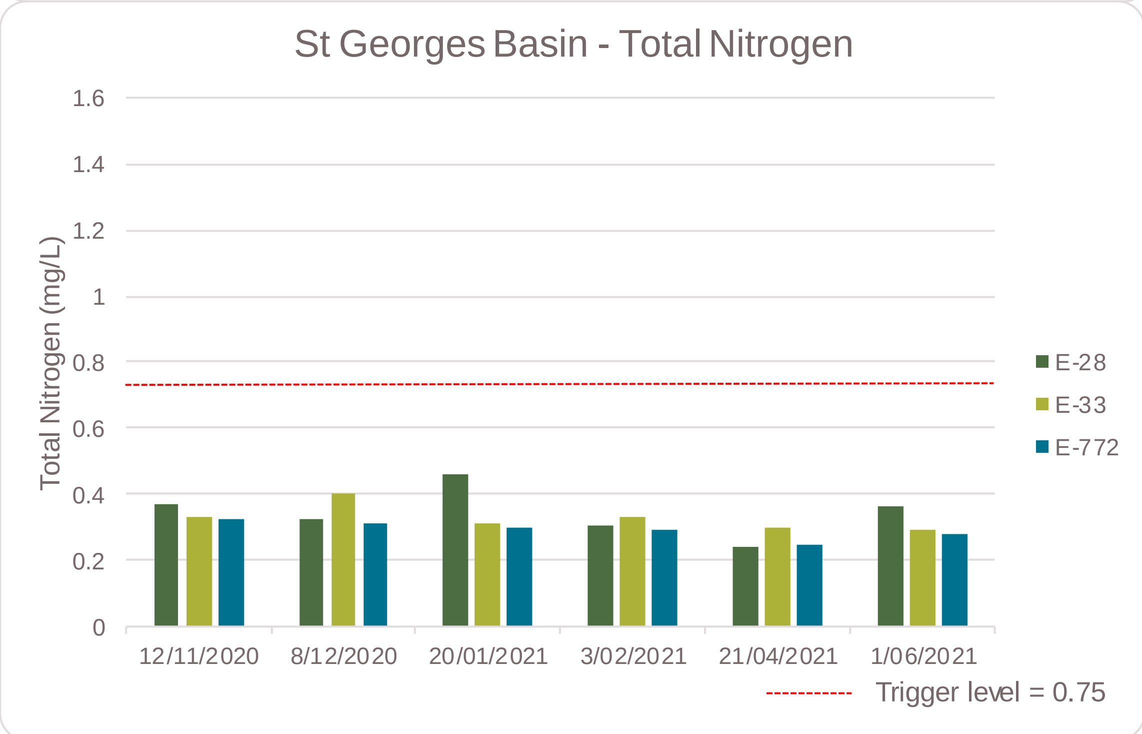


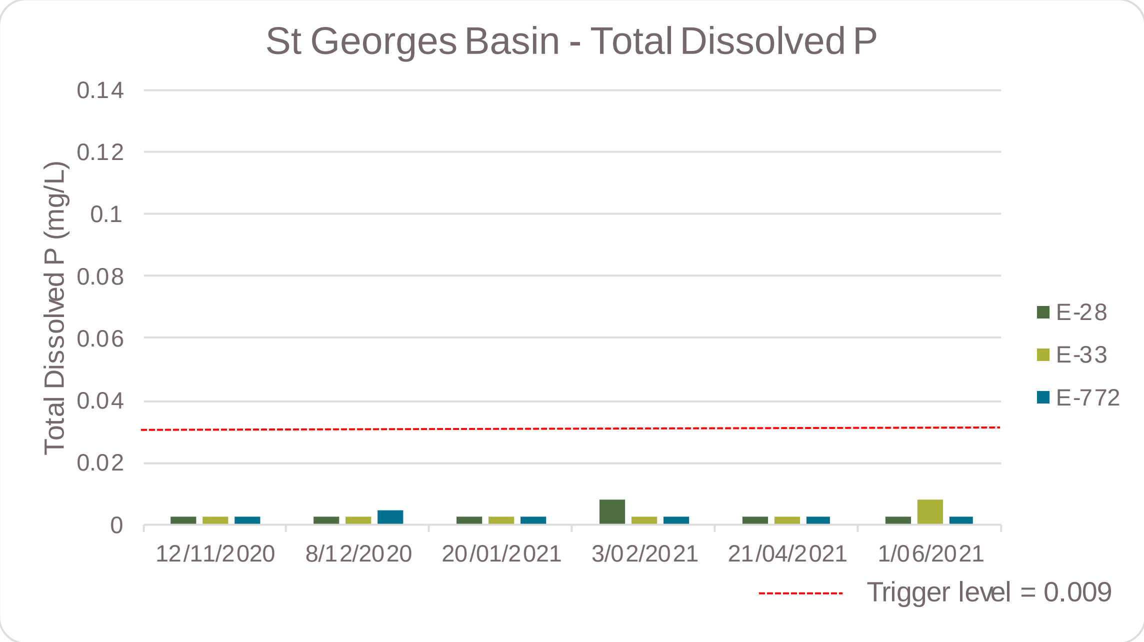
St Georges Basin - pH
pH
10
9
8
7
6
5
4
3
2
1
0
5/12/2019
6/04/2020
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level range = outside of 8.1 to 9.1

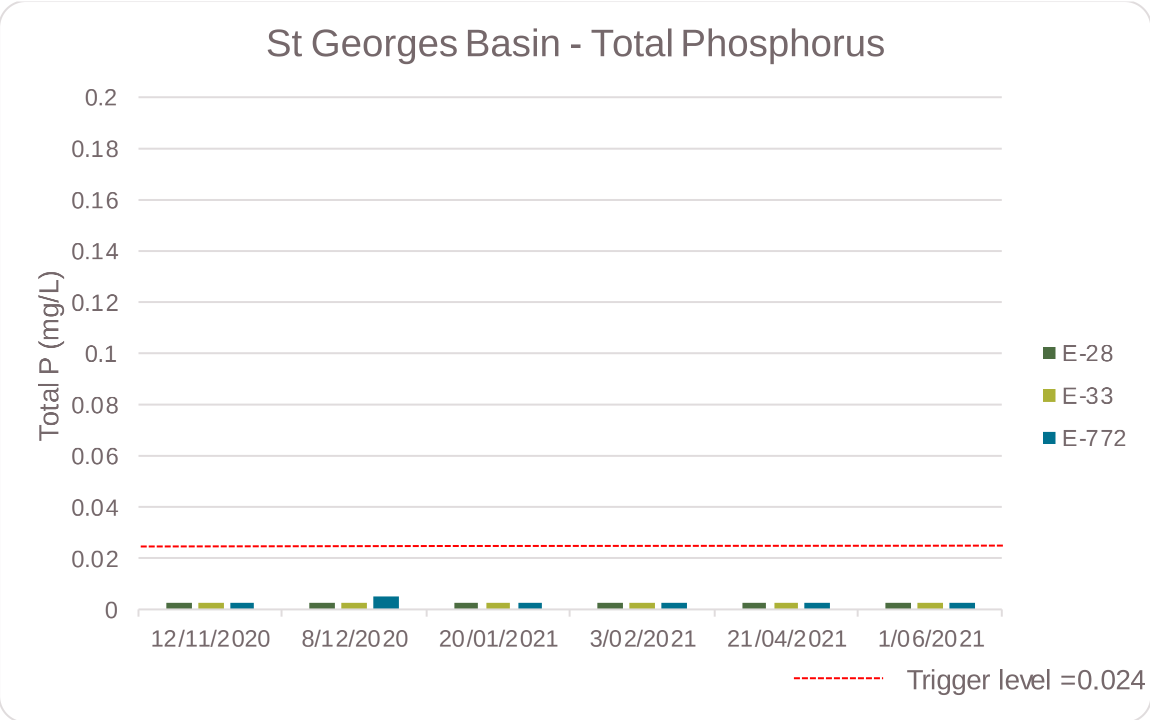


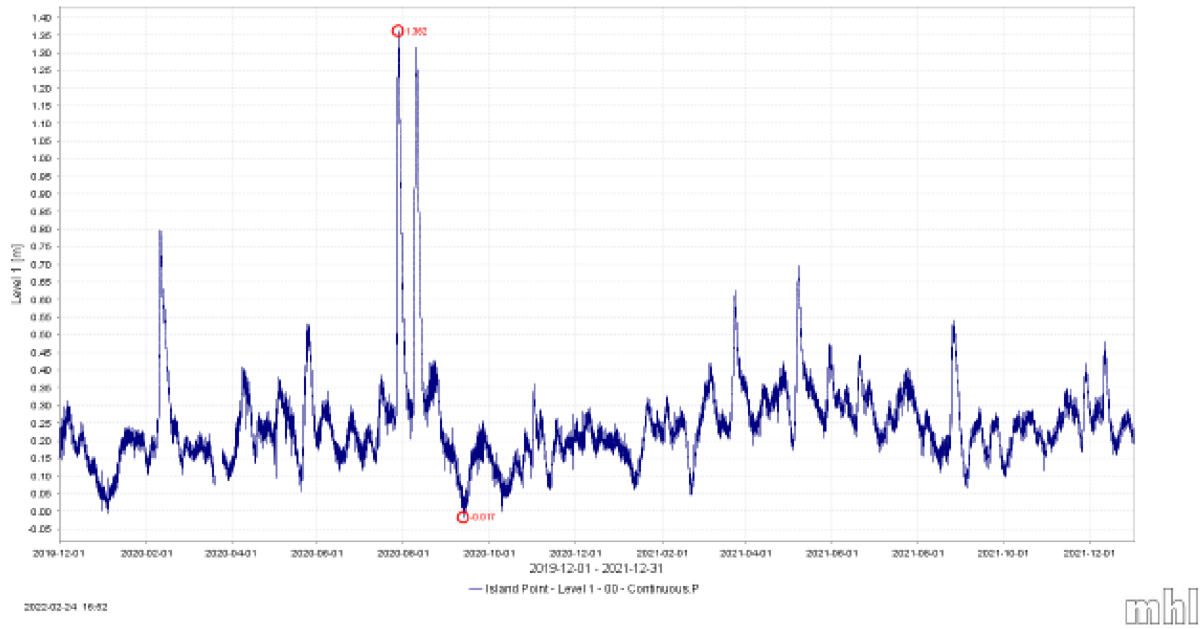
St Georges Basin - Ammonia
Ammonia (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level = 0.014


St Georges Basin - Total Dissolved Nitrogen
Total Dissolved N (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level = 0.67


St Georges Basin - Total Nitrogen
Total Nitrogen (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level = 0.75


St Georges Basin - Total Dissolved P
Total Dissolved P (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level = 0.009


St Georges Basin - Total Phosphorus
Total P (mg/L)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12/11/2020
8/12/2020
20/01/2021
3/02/2021
21/04/2021
1/06/2021
E-28
E-33
E-772
Trigger level =0.024



St Georges Basin (Island Point gauge) Water Levels 2019-2021

Appendix F
DPIE Sanitary Inspection Template

Appendix A: Sanitary inspection report

Sanitary inspection report

+ Determination of Beach Suitability Grade

Version 11

Summary of findings

Site name: ________________________________ Site reference number: __________

Site visit date:______________ Council meeting date:______________

Sanitary Inspection Category (SIC): ______________ Determined on: ______________

Microbial Assessment Category (MAC): ___________ Calculated on: _______________

Matrix for determining the Beach Suitability Grade

Sanitary Inspection Category (SIC)	Microbial Assessment Category (MAC) (95th percentiles – enterococci cfu/100 mL)			
	A ≤40	**B 41–200**	**C 201–500**	**D >500**
Very Low	Very Good	Very Good	Follow up	Follow up
Low	Very Good	Good	Follow up	Follow up
Moderate	Good	Good	Poor	Poor
High	Good	Fair	Poor	Very Poor
Very High	Follow up	Fair	Poor	Very Poor

Beach Suitability Grade: _______________ for the year: __________

Entered into database on: _______________

This template can be used as a field sheet for the Beachwatch Sanitary Inspection Database or on its own as a sanitary inspection report. The template is available as a fillable form on the Beachwatch website.

For further guidance in determining the likelihood of pollution from each pollution source contact Beachwatch – beachwatch@environment.nsw.gov.au

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- Toilet facilities 65
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- Wastewater re-use 71
- Stormwater 72
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1. Site information

Site name: ______________________ Site reference number: __________

Type of site: ☐ Ocean ☐ Estuarine ☐ Freshwater

☐ Other ______________________

Sandy beach? ☐ Yes ☐ No

Swimming dimensions: Length (m): ________ Width (m): ________ = Area (m^2): ________

Catchment area: __________ square kilometres

Catchment land use: Bushland: ________% Rural: ________% Urban: ________%

Contact details

Responsible authority: ______________________

Name: ______________________ Position: ______________________

Landline: __________ Mobile: __________ Fax: __________

Email: ______________________

Site location

Address: ______________________

Latitude: ______________________ Longitude: ______________________

Site description: ______________________

____

Diagram of site

1. Site information, cont.

Level of flushing:
- ☐ High (e.g. coastal beach)
- ☐ Medium (e.g. estuarine)
- ☐ Low (e.g. lagoon)

Elevated enterococci (>40 cfu/100mL):
- ☐ After light rain (5 mm in 24hrs)
- ☐ After moderate rain (10 mm in 24hrs)
- ☐ After heavy rain (20 mm in 24hrs)
- ☐ After very heavy rain (50 mm in 24hrs)

2A. Site use

Activities at site: ☐ Swimming ☐ Surfing ☐ Jet skiing ☐ Canoeing/kayaking

☐ Fishing ☐ Sailing ☐ Boating ☐ Diving

☐ Other ___________________________________

Groups using site: ☐ Young children (<7yrs) ☐ Elderly (>60yrs)

☐ Adults & older children ☐ Tourists

Number of users: _________ to _________ people per day on weekends

_________ to _________ people per weekday (non-holiday period)

_________ to _________ people per weekday (holiday period)

Off-street parking? ☐ No ☐ Yes, number of bays: ___________

Lifeguards: ☐ Unpatrolled ☐ Weekends ☐ Weekdays (non-holiday)

☐ Summer/School holidays

Do conditions deter people from entering?

☐ No ☐ Yes, details: ____

Any complaint of illness recorded?

☐ No ☐ Yes, details: ____

Consequence

☐ Minor

- Rarely used on weekdays
- Occasionally used on weekends or holidays
- Few people enter the water
- Location not popular with children or the elderly
- Location of minimal importance to the local economy

☐ Moderate

- Occasionally used on weekdays (e.g. <100 people per day for non-holiday period)
- Frequently used on weekends or holidays
- Most people enter the water
- Location very popular with children or the elderly
- Location of some importance to the local economy

☐ Major

- Frequently used on weekdays, weekends and holidays
- Most people enter the water
- Location very popular with children or the elderly
- Location of great importance to the local economy

2B. Pollution sources

Pollution source inventory

Pollution sources that could affect the water quality at the swimming site:

- ☐ Do **bathers** use the site?
- ☐ Are **toilet facilities** located within close proximity to the site?
- ☐ Are **wastewater treatment plants (including outfalls)** located within 2 km of the site?
- ☐ Do **designated sewage overflows** occur in the catchment (or within approximately 1 km radius of the site)?
- ☐ Do **sewer chokes or leakages** occur in the catchment (or within approximately 1 km radius of the site)?
- ☐ Do surrounding properties use **onsite sewage disposal systems**?
- ☐ Does **wastewater re-use** occur within 100 m radius of the site?
- ☐ Does **stormwater** discharge within 500 m of the site?
- ☐ Do **rivers** discharge within 1 km of the site?
- ☐ Do **lagoons** discharge within 500 m of the site?
- ☐ Are **boats** located in the vicinity of the site?
- ☐ Are **animals** (wildlife or domestic animals) present at the site?

Bather shedding

☐ Applicable ☐ Not applicable, details:____

Number of bathers at busy times: _________

Toilets available? ☐ No ☐ Yes, location: ___________________________________

Bather density calculation

Use **area** as defined on the *Site details* sheet.

Use **number at busy times** as defined above.

Number at busy times:__________ *divided by* site area: _________ = __________(people/m^2)

☐ Low (bather density <0.2)

☐ High (bather density ≥0.2)

Likelihood of pollution from bathers (select from the following matrix)

		Toilets available = YES		Toilets available = NO	
		Low bather density	**High bather density**	**Low bather density**	**High bather density**
Flushing	**Low**	Low	Moderate	Low	Moderate
	Medium	Very Low	Low	Low	Moderate
	High	Very Low	Low	Low	Moderate

Likelihood of pollution from bathers is: ________________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** _________________

Comments/Justification: ____

____

____

Toilet facilities

☐ Applicable ☐ Not applicable, details:________________________________

Distance from toilets to site (m): __________

Total number of toilets: _________

Total number of showers: ________

Type of sewerage system: ☐ Sewered

☐ Onsite system, how often serviced?____________________

Discharges/odours recorded? ☐ No, details: ________________________________

☐ Yes, details: ________________________________

____

Likelihood of pollution from toilet facilities (select from the following matrix)

		Distant proximity		Close proximity	
		Low use/flow	**High use/flow**	**Low use/flow**	**High use/flow**
Facility condition	**Poor**	Low	Moderate	Moderate	High
	Good	Very Low	Low	Low	Moderate

Likelihood of pollution from toilet facilities is: ________________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** _________________

Comments/Justification: ____

____

____

Wastewater treatment plant (within 2 km)

☐ Applicable ☐ Not applicable, details:________________________________

Name of outfall: ______________________________

Distance from site (m):__________

a. Discharges from wastewater treatment plants

Outfall type: ☐ Direct ☐ Short ☐ Long (offshore)

Treatment level: ☐ None ☐ Preliminary ☐ Primary ☐ Secondary + disinfection

☐ Tertiary ☐ Tertiary + disinfection ☐ Lagoon

Likelihood of pollution for discharges from wastewater treatment plants (select from the following matrix)

		Outfall type		
		Direct	**Short**	**Long (offshore)**
Treatment level	**None**	Very High	High	Low
	Preliminary	Very High	High	Low
	Primary	Very High	High	Low
	Secondary	High	High	Low
	Secondary + disinfection	Moderate	Moderate	Very Low
	Tertiary	Moderate	Moderate	Very Low
	Tertiary + disinfection	Low	Low	Very Low
	Lagoons	High	High	Low

b. Wastewater treatment plant bypasses

Average discharge volume per bypass event (mL):__________

Dilution of bypass effluent: ☐ High ☐ Low

Minimum treatment level of bypassed effluent:

☐ None ☐ Primary ☐ Secondary ☐ Tertiary/lagoon

Bypassed effluent disinfected: ☐ Never ☐ Sometimes ☐ Always

Bypass discharge location: ☐ Direct ☐ Short ☐ Long (offshore)

Wastewater treatment plant (within 2 km), cont.

Likelihood of pollution for wastewater treatment plant bypasses (select from the following matrix)

		Wastewater treatment plant bypass frequency (assuming effluent is not disinfected)				
		May occur in exceptional circumstances (1 in 10 years)	**Unlikely to occur but could occur at least once in a 5-year period**	**Might occur at least once or twice per bathing season**	**Will probably occur at least 3–4 times per bathing season**	**Will occur on a regular basis (once a week)**
Dilution (from discharge location)	**High**	Very Low	Very Low	Low	Moderate	High
	Low	Very Low	Low	Moderate	High	Very High

If there is no history of bypasses the likelihood of contamination for wastewater treatment plants is determined using the likelihood of pollution from wastewater treatment plant discharge matrix (a); however, if there is a history of treatment bypasses at the wastewater treatment plant the likelihood is determined by using likelihood of pollution for wastewater treatment plant bypasses matrix (b).

Likelihood of pollution from the wastewater treatment plant is:________________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** ________________

Comments/Justification: ____

____

____

Designated sewage overflows

☐ Applicable ☐ Not applicable, details:______________________________

For each overflow in the catchment (or 1 km radius), list:

Name	Address	Frequency/10yrs	Volume

Dilution: ☐ High ☐ Low

Likelihood of pollution from designated sewage overflows (select from the following matrix)

		Frequency				
		May occur in exceptional circumstances (1 in 10 years)	**Unlikely to occur but could occur at least once in a 5-year period**	**Might occur at least once or twice per bathing season**	**Will probably occur at least 3–4 times per bathing season**	**Will occur on a regular basis (once a week)**
Dilution	**High**	Very Low	Very Low	Low	Moderate	High
	Low	Very Low	Low	Moderate	High	Very High

Likelihood of pollution from designated sewage overflows is:_______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** _______________

Comments/Justification: ______________________________

____

____

Sewer chokes and leakages

☐ Applicable ☐ Not applicable, details:____________________________________

For each overflow in the catchment (or 1 km radius), list:

Date	**Address**

Dilution: ☐ High ☐ Low

Likelihood of pollution from sewer chokes and leakages (select from the following matrix)

		Frequency				
		May occur in exceptional circumstances (1 in 10 years)	**Unlikely to occur but could occur at least once in a 5-year period**	**Might occur at least once or twice per bathing season**	**Will probably occur at least 3–4 times per bathing season**	**Will occur on a regular basis (once a week)**
Dilution	**High**	Very Low	Very Low	Low	Moderate	High
	Low	Very Low	Low	Moderate	High	Very High

Likelihood of pollution from sewer chokes and leakages is: __________________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** __________________

Comments/Justification: ____

Onsite sewage disposal systems

☐ Applicable ☐ Not applicable, details:______________________________

Approximate number of systems in catchment: __________

Distance to site from nearest system (m): _________ (not including onsite toilet facilities identified under 'Toilets facilities')

Discharges/odours recorded? ☐ No, details: ______________________________

☐ Yes, details: ______________________________

____

Likelihood of pollution from onsite sewage disposal systems (select from the following matrix)

		Distant proximity		Close proximity	
		<50 systems	**≥50 systems**	**<50 systems**	**≥50 systems**
Condition	**Good – no complaints**	Very Low	Very Low	Low	Low
	Poor – history of odours and discharges	Low	Moderate	Moderate	High

Likelihood of pollution from onsite sewage disposal systems is: ______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** ______________

Comments/Justification: ______________________________

____

____

Wastewater re-use

☐ Applicable ☐ Not applicable, details:____________________________________

Location of wastewater re-use area: ____

Distance from site to re-use area: ____________

Wastewater treated prior to use? ☐ No ☐ Yes, details: ________________________

____

Likelihood of pollution from wastewater re-use (select from the following matrix)

		Distant proximity		Close proximity	
		Low volume	**High volume**	**Low volume**	**High volume**
Treatment level	**High – disinfected**	Very Low	Very Low	Low	Low
	Low – not disinfected	Low	Moderate	Moderate	High

Likelihood of pollution from wastewater re-use is: _______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** ________________

Comments/Justification: ____

____

____

Stormwater

☐ Applicable ☐ Not applicable, details:______________________________

Total number of drains at swimming site: _________

Pick the **two drains** that have the most influence on your sampling site (or if there is only one drain, enter its details).

Drain 1

Location: ______________________ Authority: ______________________

______________________ ______________________

Distance from site (m):______________

Type of drain: ☐ Box culvert ☐ Creek ☐ Pipe

Discharge area: ☐ Dune ☐ Beach ☐ Offshore ☐ Direct <50m ☐ Direct ≥50m

Drain 2

Location: ______________________ Authority: ______________________

______________________ ______________________

Distance from site (m):______________

Type of drain: ☐ Box culvert ☐ Creek ☐ Pipe

Discharge area: ☐ Dune ☐ Beach ☐ Offshore ☐ Direct <50m ☐ Direct ≥50m

Primary land use: ☐ High density urban ☐ Low density urban ☐ Rural – grazing ☐ Rural – cropping ☐ Bushland/reserve

Likelihood of pollution from stormwater (select from the following matrix – choose the highest likelihood if you have two different drains)

		Discharge area		
		Dune	**Beach, offshore or direct ≥50 m**	**Direct <50 m**
Land use	**High density urban**	Low	Moderate	High
	Low density urban	Very Low	Low	Moderate
	Rural – grazing	Very Low	Low	Moderate
	Rural – cropping	Very Low	Low	Low
	Bushland/reserve	Very Low	Low	Low

Stormwater, cont.

Likelihood of pollution from stormwater drains is: ________________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** ________________

Comments/Justification: ____

____

____

River discharge

☐ Applicable ☐ Not applicable, details:________________________________

Name of river: ______________________________

Distance from discharge point to site (m): ________

Pollution sources in river discharge: ☐ Urban stormwater ☐ Leachate from onsite wastewater systems

☐ Agricultural runoff ☐ Intensive livestock production

☐ Other, details: _________________________

____

Likelihood of pollution from river discharge (select from the following matrix)

		Distant proximity		Close proximity	
		Low discharge volume	**High discharge volume**	**Low discharge volume**	**High discharge volume**
River water quality	**Good**	Very Low	Very Low	Low	Low
	Poor	Low	Moderate	Moderate	High

Likelihood of pollution from river discharge is: _______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** _______________

Comments/Justification: ____

____

____

Lagoons

☐ Applicable ☐ Not applicable, details:____

Name of lagoon:________________________________

Distance from site (m):__________

Area of lagoon (sq. km):__________

Catchment area (sq. km): __________

Sources of pollution to lagoon: ☐ Urban stormwater ☐ Agricultural runoff

☐ Other, details:________________________________

____

% time open to ocean (recent average): ________

Entrance managed or modified?

☐ No ☐ Yes, details:____

Likelihood of pollution from lagoons (select from the following matrix)

Likelihood of pollution from lagoons				
Very Low	**Low**	**Moderate**	**High**	**Very High**
May occur only in exceptional circumstances, e.g. 1 in 10 years	Unlikely to occur but could occur at least once within a 5-year period	Might occur at least once or twice per bathing season	Will probably occur at least 3–4 times per bathing season	Will occur on a regular basis, e.g. once a week

Likelihood of pollution from lagoons is: _______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** ________________

Comments/Justification: ____

____

____

Boots

☐ Applicable ☐ Not applicable, details:________________________________

What is located near the site?

☐ Marina ☐ Permanent moorings

☐ Harbour ☐ Temporary moorings

☐ Anchorage ☐ Jetty

☐ Boat ramp ☐ Ferry berth

Distance from site to nearest boat (m): __________

Number of boats near site:___________

Pump-out facilities provided?

☐ No ☐ Yes, details:________________________________

Complaints of boat discharges?

☐ No ☐ Yes, details:________________________________

Onshore toilets provided?

☐ No ☐ Yes, details:________________________________

Likelihood of pollution from boats (select from the following matrix)

		Number of boats		
		<20 boats	**20–50 boats**	**50–100 boats**
Waste management	**Good (holding-tanks required)**	Very Low	Very Low	Low
	Poor (holding-tanks not required)	Low	Moderate	Moderate

Likelihood of pollution from boats is: _______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:**_______________

Comments/Justification: ________________________________

____

____

Animals

☐ Applicable ☐ Not applicable, details:________________________________

Aquatic birds? ☐ Yes ☐ No

Density: ☐ Low ☐ Medium ☐ High

Roosting structures present? ☐ Yes ☐ No

Native animals? ☐ Yes ☐ No

Density: ☐ Low ☐ Medium ☐ High

Domestic animal exercise area? ☐ Yes ☐ No

Type: ☐ Dogs ☐ Horses ☐ Other, details: ________________________

Dog waste bags available? ☐ Yes ☐ No

Animals directly access water? ☐ Yes ☐ No

Area regularly cleaned? ☐ Yes ☐ No

Likelihood of pollution from animals (select from the following matrix)

Likelihood of pollution from animals				
Very Low	**Low**	**Moderate**	**High**	**Very High**
May occur only in exceptional circumstances, e.g. 1 in 10 years	Unlikely to occur but could occur at least once within a 5-year period	Might occur at least once or twice per bathing season	Will probably occur at least 3–4 times per bathing season	Will occur on a regular basis, e.g. once a week

Likelihood of pollution from animals is: ______________

Is this likelihood appropriate? ☐ Yes ☐ **No, revised likelihood:** ______________

Comments/Justification: ____

____

____

2C. Management

Which management controls are in place to warn people of periods of increased risk?

☐ None ☐ Permanent onsite signage ☐ Temporary onsite signage

☐ Media releases ☐ Beach closures ☐ Website

☐ Other, details: ______________________________

Provide details of advisories: ______________________________

____

____

Do management controls effectively prevent people from entering the water during these periods?

☐ No ☐ Yes, details: ______________________________

____

____

Is there a management response plan in place to deal with exceptional events such as sewage overflows and bypasses?

☐ No ☐ Yes, details: ______________________________

____

____

3. Calculating the Sanitary Inspection Category

On the **form on the next page** complete the following steps:

STEP 1: Fill out the likelihood for each of the pollution sources in the top part of the form (leave blank if pollution source is not applicable).

STEP 2: By referring to the table below, fill out the numerical likelihood values for these pollution sources.

Likelihood	Numerical likelihood
Very Low	0.1
Low	0.2
Moderate	1
High	3
Very High	12

STEP 3: Sum the numerical likelihoods.

STEP 4: By referring to the table below, fill out the numerical likelihood for animal pollution source (if applicable) in the second part of the form and sum the total numerical likelihood.

Likelihood	Numerical likelihood
Very Low	0.1
Low	0.1
Moderate	0.2
High	1
Very High	1

STEP 5: Using the total numerical likelihood, identify the Sanitary Inspection Category using the table below.

Total numerical likelihood	Sanitary Inspection Category
0–0.19	Very Low
0.2–0.99	Low
1–2.99	Moderate
3–11.99	High
>12	Very High

Pollution source	Likelihood		Numerical likelihood
Bathers	____________________	…………	= _______
Toilet facilities	____________________	…………	= _______
Wastewater treatment plant	____________________	…………	= _______
Designated sewage overflows	____________________	…………	= _______
Sewer chokes and leakages	____________________	…………	= _______
Onsite sewage disposal systems	____________________	…………	= _______
Wastewater re-use	____________________	…………	= _______
Stormwater	____________________	…………	= _______
River discharge	____________________	…………	= _______
Lagoons	____________________	…………	= _______
Boats	____________________	…………	= _______
	Sum of numerical likelihoods		= _______

Pollution source	Likelihood		Numerical likelihood
Animals	____________________	…………	= _______
	Sum of numerical likelihoods from previous table		= _______
	Total numerical likelihood		= _______

The **Sanitary Inspection Category** for this site is: ________________________