B8

VOLUME B: AIRPORT AND SURROUNDS

Water Quality

Water Quality

CONTENTS

FIGURES AND TABLES

Figures

Tables

APPENDICES

GLOSSARY

EHMP: Ecosystem Health Monitoring Program: a monitoring exercise undertaken in partnership with a range of agencies across South East Queensland under the Moreton Bay Waterways and Catchments Partnership.

WQOs: Water Quality Objectives: long term goals for water quality that, if met, will ensure that the community's needs and wants for a waterway (commonly termed Environmental Values) can be achieved.

Ambient: The background or most common condition, usually associated with a period of stable climate such as dry weather.

Median: A statistical term defining the middle value of a group of values, sometimes also referred to as the 50th percentile.

Supernatant: The clear water left after turbid water (that containing sediment particles) is allowed to settle.

TSS: Total Suspended Solids: those particles, both inorganic and organic, in water which are suspended in the water column, sometimes incorrectly referred to as total suspended sediment. TSS is also related to, but not the same as, turbidity, which is a measure of how particles in the water scatter light.

TN: Total Nitrogen: nitrogen is a common nutrient essential to plant growth. Excessive nitrogen can lead to algal blooms and eutrophication, where plant growth is so excessive as to 'choke' a waterway or water body. Total nitrogen refers to all forms of nitrogen that may be in the water being measured, including ammonia, nitrate, nitrite and that associated with organic material.

TP: Total Phosphorus: as with nitrogen, phosphorus is also a nutrient essential for plant growth. Total phosphorus refers to all forms of phosphorus that may be in a water, including filterable reactive phosphate, sometimes referred to as soluble phosphorus, and that which is associated with particulate matter or is not readily soluble in water.

SUMMARY OF KEY FINDINGS

Baseline Condition

- Aspects of the New Parallel Runway (NPR) which may have an impact on the receiving waters as a result of works on or near the airport site include:
  - Tailwater taken up from near the mouth of the Brisbane River and used to pump the sand/water slurry mix to the airport site where it is discharged onto the site and recollected for treatment prior to release into Serpentine Inlet or Kedron Brook Floodway via newly constructed drainage channels;
  - General construction site run-off due to erosion or sediment liberation during reclamation and surcharge phases of the project; and
  - Operational phase stormwater management.
- The water quality issues of concern to be managed most closely for the project are nutrients and suspended material (commonly referred to as suspended solids).
- Existing water quality in the receiving waters surrounding the airport is characterised as 'poor' by the Ecosystem Health Monitoring Program (EHMP).
- Spatial trends reported in the EHMP indicate that poor water quality in Bramble Bay is due to the inputs from nearby waterways, wastewater treatment plants (WWTP) (such as Luggage Point) and the fine nutrient laden nature of sediment on the seabed floor that is easily resuspended. Testing of sewage nitrogen signals also indicated that Bramble Bay contains the highest sewage nitrogen levels in Moreton Bay. Water quality was observed to be poorest closer to the coast because of the proximity to these pollutant sources. This is supported by Brisbane Airport Corporations (BAC) water quality monitoring which records nutrients and suspended solids at higher levels closer to the shore in the same vicinity as the EHMP monitoring sites.
- Water quality on Brisbane Airport is administered by the Australian Government Department of Transport and Regional Services under the Airports (Environment Protection) Regulations 1997.
- Water quality outside the boundary of the Airport is administered by the Queensland Environment Protection Agency (EPA) under the *Environment Protection Act 1994* and subordinate legislation the Environmental Protection (Water) Policy 1997 (Water EPP). Recently, under the Water EPP, Environmental Values (EVs) and Water Quality Objectives (WQOs) have been developed and gazetted for the receiving waters immediately adjacent to the airport site.
- The process for assessing impacts on water quality involved the use of data collected as part of the baseline studies to be utilised as boundary conditions for a two-dimensional receiving water quality model of Moreton Bay.
- This model, developed in recent years on behalf of the Moreton Bay Waterways and Catchments Partnership (MBWCP) for various water quality management studies of Moreton Bay and its estuaries, allows both a detailed assessment of impacts at each of the discharge points, in addition to a regional assessment of the potential discharges through its extensive coverage of the whole of the Bay.
- Outputs from the receiving water quality model have then been used as a basis for comparison against pre-defined water quality objectives for the immediate and ultimate receiving waters and as part of the optimization process for best management practices to be incorporated into the construction and operational stages of the project.

Impact Assessment – Construction Phase

Pump-out Facility at Luggage Point

- Construction of the dredge pump-out facility at Luggage Point (involving the driving of marine piles) will only have a minimal, if any, effect on water quality.

Approach Lighting System

- Some minor short term turbidity may be possible during the driving of piles for the approach lighting structure but this is not expected to be significant.

Filling Operations

- Modelling results of tailwater discharges during the reclamation process on the project site show that localised increases in turbidity and suspended solids would occur in the vicinity of the two discharges at Kedron Brook Floodway and Serpentine Inlet during times when discharge is occurring. These impacts reduce significantly at locations further away from the discharge site where considerable mixing with existing water has occurred.
- It is likely that the construction operations will have minimal impact on the receiving waters of Bramble Bay and are not expected to exacerbate existing water quality issues such as algal blooms or seagrass loss.
- Given that the current water quality within Kedron Brook Floodway is already exceeding water quality objectives for most parameters, the construction phase water quality is not likely to be a major cause of non-compliance with WQOs .
- The results also indicate that the construction phase water quality impacts are not likely to result in non-compliance with WQOs for any of the parameters where compliance is currently being achieved.
- It is expected that some effects of discharge within Kedron Brook will be observable up to around 500 m upstream and downstream of the discharge, but only minimal (if any) change observable at the mouth due to greater mixing in that area.
- It is possible that the effects of discharge will be observable out to approximately 1 km from the Serpentine Inlet discharge point, but beyond this, effects are likely to be negligible.

Impact Assessment – Operational Phase

- The operational phase of the NPR is expected to be very similar to existing operations on the Airport. Water quality monitoring data and studies of run-off from the existing terminal apron areas have shown low total suspended solids concentrations in the run-off suggesting that airport operations are not generating significant sources of pollutants as concentrations of other contaminants such as heavy metals and phosphorus are strongly associated with sediment.
- It is anticipated that the likely impact from the NPR project on operational phase water quality is likely to be minimal given the performance of stormwater treatment measures already in place and those proposed for the NPR.

8.1 Proposed Development and Receiving Waters

While existing water quality in the receiving waters surrounding the Airport is characterised as 'poor' by the Ecosystem Health Monitoring Program (EHMP), the NPR will carefully manage any potential impacts to water quality to support the long term aims of restoring these waterways to acceptable ecosystem health levels.

Aspects of the NPR which may have an impact on the receiving waters as a result of works on or near the Airport site are examined within this chapter. They include:

Construction Phase:

- Tailwater taken up from near the mouth of the Brisbane River and used to pump the sand/water slurry mix to the Airport site where it is discharged onto the site and recollected for treatment prior to release into Serpentine Inlet or Kedron Brook via newly constructed drainage channels;
- General construction site run-off due to erosion or sediment liberation during reclamation and surcharge phases of the project; and

Operation Phase:

- Operational phase stormwater management.

This chapter focuses on the water quality issues known to be of management concern for this project, these being:

- Suspended material; and
- Nutrients.

8.2 Policies and Guidelines – Environmental Values and Water Quality Objectives

Water quality issues associated with the NPR have relevance to the following jurisdictions:

- Australian Government Department of Transport and Regional Services (DOTARS); and
- Queensland Environment Protection Agency.

Water quality on Brisbane Airport is administered by DOTARS under the Airports (Environment Protection) Regulations 1997. The Regulations provide for a number of mechanisms for compliance including a general duty to take all reasonable and practicable measures to prevent the generation of pollution from an undertaking, and if prevention is not reasonable or practicable, to minimise the generation of pollution from the undertaking (Regulation 4.01).

Water quality outside the boundary of the airport is administered by the Queensland Environment Protection Agency (EPA) under the *Environment Protection Act 1994* and subordinate legislation the Environmental Protection (Water) Policy 1997 (Water EPP). Recently, under the Water EPP, Environmental Values (EVs) and Water Quality Objectives (WQOs) have been developed and gazetted for the receiving waters immediately adjacent to the airport site.

8.3 Methodology

Assessment of water quality issues for the NPR was undertaken in the following manner:

1. Describe the existing water quality conditions of locations which will potentially be affected by NPR construction works:
   - Bramble Bay (to the location of the nearest EHMP sites)
   - Serpentine Inlet
   - Kedron Brook (extent of Floodway)
   - Brisbane River (near mouth).
2. Describe the regulators' target objectives for the individual location;
3. Model what is likely to happen at the above locations during the construction phase;
4. Comment on the likely effects of the construction phase of the project on the receiving environment; and
5. Describe what is likely to occur to water quality in the receiving environment once the NPR is in its operational phase.

8.3.1 Data Used to Describe Existing Conditions

The following were used to describe existing conditions:

- Ecosystem Health Monitoring Program (EHMP) – a comprehensive water quality monitoring program aimed at objectively assessing the health of South East Queensland's marine and freshwater waterways; since 2002 monthly water quality monitoring has been undertaken at approximagely 228 sites across South East Queensland. (Visit www.healthywaterways.org for more information)
- Brisbane City Council's Kedron Brook Waterway Quality Assessment;
- Brisbane City Council and Queensland EPA's Citywide Ambient Monitoring Program;
- BAC's Water Quality Monitoring Program which commenced in February 2000 at the Airport lease boundary at all 10 points where water enters and/or leaves the site and has been refined in subsequent years; and
- A research project conducted by Queensland University of Technology (QUT) which investigated the quality of stormwater being generated from the Airport aprons (where the aircraft park, refuel and load passengers) and the effectiveness of the grassed verge abutting these aprons for contaminant removal from stormwater run-off.

8.3.2 Water Quality Objectives for Each Waterway

Water Quality Objectives have been developed for the waterways of Queensland by the Queensland EPA and gazetted under Schedule 1 – Environmental Values and Water Quality Objectives of the Environmental Protection (Water) Policy 1997 (EPP Water). Where more local objectives were available (for example, within Kedron Brook Brisbane City Council had previously developed Water Quality Objectives for specific sections of the waterway), these were adopted where relevant within the EPA objectives.

It must be stressed that Water Quality Objectives are seen as long term, or aspirational, targets for a given waterway and may not (and in most case in fact are not) necessarily be being achieved in the waterway currently. These objectives are also usually set as median values, or ranges within which median values should lie, rather than being strict standards or discharge limits. Hence it is possible for water quality to exceed the values given in the Water Quality Objectives listed under Schedule 1 for a short period of time, as long as the overall median value still complies.

8.3.3 Model Used for Modelling Potential Impacts

Water quality modelling of the proposed supernatant discharges to Serpentine Inlet, Kedron Brook and Moreton Bay was undertaken using the two-dimensional RWQM2 (Receiving Water Quality Model 2) modelling software. The modelling undertaken is fully described in section 8.7.

8.3.4 Criteria Used to Describe Level of Impact

As described in Volume A, Chapter A1, a common methodology is being used to describe the level of impact for each aspect of the environment. In accordance with this approach a table has been developed which establishes a set of criteria for the level of impact associated with water quality. See section 8.7 for details of the significance criteria for water quality.

8.4. Existing Conditions

The water quality issues of concern to be managed most closely for this project are nutrients and suspended material (commonly referred to as Suspended Solids).

Nutrients

If not managed appropriately, a project of this nature has the potential to result in increased levels of nutrients being released to waterways from the following activities:

- Release of nutrient rich water off the Airport site due to the known elevated nutrient levels in the uptake water from the mouth of Brisbane River; and
- Release of nutrient rich water off the Airport site due to the potential release of nutrient rich sediments on the cleared Airport site.

Suspended Material

Also, if not managed appropriately, this project has the potential to result in increased levels of sediment laden water due to the following:

- The sand resource from Middle Banks may potentially contain fine particulate material which is too fine and light to settle out prior to release; and
- When pumping the sand onto the cleared Airport site, in situ sediment material too fine and light to settle out prior to release from the site may be entrained in the run-off water.

Water quality conditions which result in sustained high levels of nutrients and/or suspended material can have adverse environmental effects. High levels of nutrients, measured in the form of total nitrogen (TN) and total phosphorus (TP), have been identified as one of the principal polluting processes in Moreton Bay. Likewise, suspended material, commonly measured as either Total Suspended Solids (TSS) or turbidity (in NTUs) can cause unwanted physical and ecological impacts if it is a continuing condition of the water.

Taking into account the existing poor condition of the receiving waters with respect to nutrients and suspended material, water quality from the NPR will be managed to avoid any long term sustained effects.

In the sections which follow the existing conditions for nutrients and suspended material for each relevant location will be described in the following way:

- The ambient background levels as recorded in relevant monitoring programs; and
- The relevant water quality guideline or objective assigned for the water body.

8.4.1 General Context of Airport Site

Due to its low lying coastal location, Brisbane Airport drainage is characterised by tidal channels and drains. Water quality on the site is dominated by the character of tidal waters which enter and leave the site on a daily basis. Brisbane Airport is situated immediately adjacent to Bramble Bay, the north-western part of the larger Moreton Bay, extending north from the mouth of the Brisbane River to the Redcliffe Peninsula. It straddles the land area between the Brisbane River and Kedron Brook catchments which both discharge into Bramble Bay in the direct proximity of the Airport.

Bramble Bay is the ultimate receiving water for the most highly populated and developed regions of South East Queensland via the Brisbane River, Kedron Brook and Pine River catchments. These river systems transport significant loads of nutrients and suspended sediments from their highly urbanized catchments. Luggage Point Wastewater Treatment Plant, commonly identified as one of the principal contributors of nitrogen and phosphorus to Bramble Bay, discharges directly into the tidal region which influences the Airport. Therefore, as waters flow into airport lands from up-catchment and also enter directly from Bramble Bay, it is not surprising that existing water quality within Airport drains and surrounding waterways is dominated by water quality of a similar nature to the degraded adjacent embayment.

Waters also flow directly onto airport land, on the western side where the NPR works will be undertaken, via Schulz Canal, Battery Drain and Jacksons Creek near the mouth of Kedron Brook. Water enters the airport drainage system directly from Bramble Bay at Serpentine Inlet and Jubilee Creek Drain.

Figure 8.4a: *Bramble Bay and Brisbane River Monitoring Locations.*

8.4.2 Existing Water Quality – Bramble Bay

Water quality in Bramble Bay has been monitored as part of the EHMP since January 2000. The three monitoring sites located within Bramble Bay that are most relevant to the proposed NPR site are sites E902, E905 and E906. **Figure 8.4a** shows the location of these monitoring sites.

The EHMP's 2004-2005 Report Card for Bramble Bay indicates that it continues to be characterised by poor water quality and biological health, with the poorest recorded water quality of all Moreton Bay zones. Bramble Bay received a D+ on its 2004-2005 Report Card, a slight improvement over that which was received in the previous year, indicating minor reductions in sewage nitrogen, but poor overall ecosystem health and no major improvement.

Spatial trends reported in the EHMP indicate that poor water quality in Bramble Bay is due to the inputs from nearby waterways, WWTPs (such as Luggage Point) and the fine nutrient laden nature of sediment on the seabed floor that is easily resuspended. Testing of sewage nitrogen signals also indicated that Bramble Bay contains the highest sewage nitrogen levels in Moreton Bay. Water quality was observed to be poorest closer to the coast because of the proximity to these pollutant sources. This is supported by BAC's water quality monitoring which records nutrients and suspended solids at higher levels closer to the shore in the same vicinity as the EHMP monitoring sites.

Table 8.4a below shows the median concentration of various water quality parameters recorded at EHMP monitoring sites 902, 905 and 906 in Bramble Bay for year 2002 to 2005 inclusive. Recorded values have been averaged across the three sites for each reporting year.

8.4.2.1 Ambient Water Quality

Table 8.4a: Water Quality in Bramble Bay near the NPR Site for EHMP Sites 902, 905 and 906 Averaged Across the Sites for Each Reporting Year 2002-2005.

Parameter	Median Values			
	2002	2003	2004	2005
Conductivity at 25 deg C (mS/cm)	53.45	52.56	52.40	52.63
Salinity (ppt)	35.30	34.64	34.52	34.69
Temperature (°C)	23.76	21.71	21.14	23.76
Turbidity (NTU)	4.5	4.0	3.0	3.0
Light penetration (Secchi depth) (m)	1.40	1.75	1.60	2.05
Chlorophyll-a (μg/L)	2.57	1.74	1.94	1.69
Nitrogen (ammonia) as N (mg/L)	0.003	0.004	0.002	0.002
Nitrogen (organic) as N (mg/L)	0.20	0.17	0.23	0.14
Nitrogen (oxidised) as N (mg/L)	0.002	0.002	0.002	0.002
Nitrogen (total) as N (mg/L)	0.21	0.18	0.23	0.16
Oxygen per cent saturation (%sat)	102.15	100.20	102.60	101.15
Oxygen (dissolved) (mg/L)	7.10	7.20	7.64	7.03
pH	8.18	8.24	8.19	8.14
Phosphorus (total) as P (mg/L)	0.055	0.056	0.061	0.055
Phosphorus (dissolved reactive) as P (mg/L)	0.035	0.040	0.045	0.039

Concentrations highlighted in red in **Table 8.4a** indicate where relevant water quality objectives are exceeded. This may be due to a range of reasons, including inputs from upstream catchments, wastewater treatment plant inputs and localised disturbances such as sediment resuspension or wind mixing. Monitoring undertaken by BAC as shown in section 8.4.4 shows that current airport operations are not likely to be influencing the water quality at these locations to any significant degree in comparison to those other influences noted above. Note that water quality objectives do not exist for all parameters.

From **Table 8.4a** it can be seen that existing water quality at these monitoring points (approximately 2 km offshore) in Bramble Bay generally comply with Bramble Bay water quality objectives. **Figure 8.4b, Figure 8.4c** and **Figure 8.4d** show the median annual concentrations recorded at the selected sites for Turbidity, Total Nitrogen and Total Phosphorus respectively. These figures are described as 'box and whisker plots' and are commonly used to show the characteristics of the water quality parameter monitored. Each box represents 50 percent of the data with the median value of the water quality parameter displayed as a line. The top and bottom of the box mark the limits of ± 25 percent of all the data (also called the upper and lower quartiles). The lines extending from the top and bottom of each box mark the minimum and maximum values within the data set that fall within an acceptable range. Any value outside this range, called an outlier, is displayed as an individual point. This is also shown in the legend.

Figure 8.4b: *Turbidity in Bramble Bay at EHMP Sites 905, 906 and 902 (pooled data).*

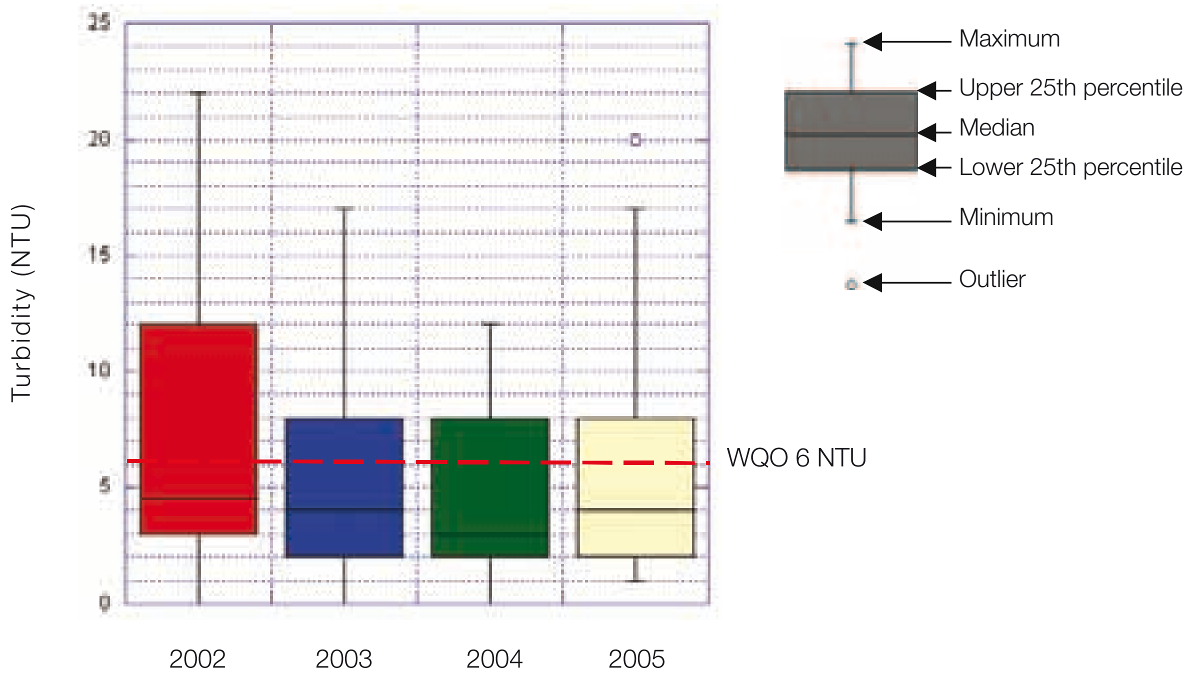


Figure 8.4c: *Total Nitrogen in Bramble Bay at EHMP Sites 905, 906 and 902 (pooled data).*

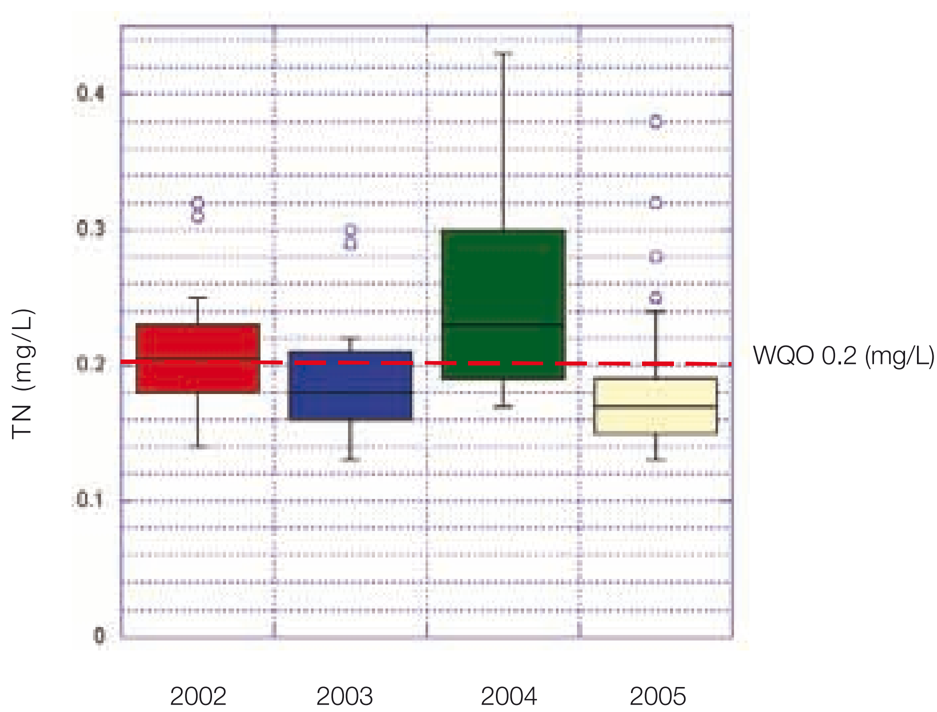
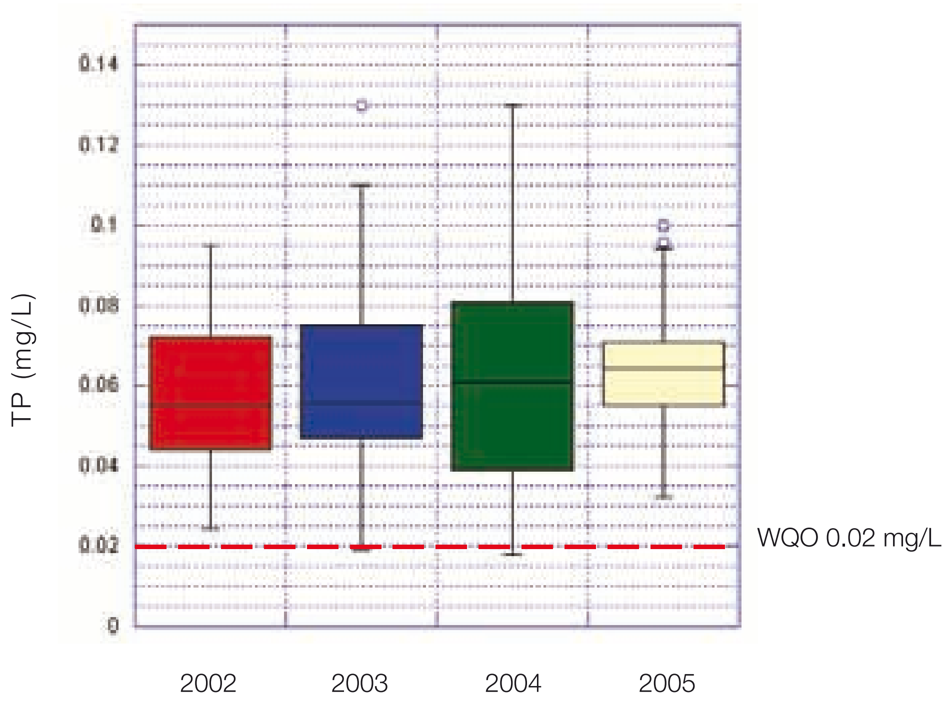


Figure 8.4d: *Total Phosphorus at Bramble Bay at EHMP Sites 905, 906 and 902 (pooled data).*



From **Figure 8.4b** to **Figure 8.4d**, it can be seen that water quality in Bramble Bay approximately 2 km offshore from the Airport is generally close to or within the prescribed water quality objectives for that receiving water for turbidity and total nitrogen, however it exceeds the total phosphorus water quality objective. This is due to the influence of wastewater treatment plant discharges from Luggage Point which contain elevated concentrations of phosphorus as shown in phosphorus concentrations within the Brisbane River documented in section 8.4.4.

For Bramble Bay the EVs and WQOs as defined by the EPA's Environmental Protection (Water) Policy 1997 Schedule 1 – Moreton Bay and Islands, are considered to be the most locally specific documented values and are listed in **Table 8.4b.** In this document, a hierarchy of protection levels are defined depending on the nature of the receiving water. These protection levels dictate how the water quality objectives are to be assessed, e.g. whether they are assessed as annual median values of a series of monitoring data. In the case of Bramble Bay, the aquatic ecosystem protection level is defined as Level 2 "slightly to moderately disturbed", which requires that water quality objectives are assessed based on annual median values of monitoring results. For the purposes of setting specific water quality objectives related to the physical locations of receiving waters, sets of objectives have been defined depending on waterway type, to account for the varying characteristics of fresh, tidal and marine waters. Bramble Bay is defined as an enclosed coastal water type.

This is significant to the NPR as water will be released through two newly constructed drains to enter waters at Kedron Brook Floodway and Serpentine Inlet which flow to and directly into Bramble Bay.

Table 8.4b: Bramble Bay Environmental Values and Water Quality Objectives.

Environmental Value	Water Quality Objectives
	Enclosed Coastal Waters, Aquatic Ecosystem Level 2
Aquatic Ecosystem	• Annual median turbidity <6NTU, suspended solids <15 mg/L • Annual median chlorophyll a <2 µg/L • Annual median total nitrogen <200 µg/L, oxidised N <3µg/L, Amm N <8 µg/L, Org N <180 µg/L • Annual median total phosphorus <20 µg/L, FRP <6 µg/L • Annual median dissolved oxygen between 90-105% saturation • Annual median pH between 8.0 and 8.4 • Annual Median Secchi depth >1.5 m
Human Consumer	Objectives as per AWQGC 2000 and Food Standards Code, Australia New Zealand Food Authority, 1996 and updates
Primary Recreation	Objectives as per AWQGC including; • Median faecal coliforms <150 organisms per 100 mL or Median enterococci organisms <35 per 100 mL • Secchi depth >1.2 m
Secondary Recreation	Objectives as per AWQGC including; • Median faecal coliforms <1,000 organisms per 100 mL or Median enterococci organisms <230 per 100 Ml
Visual Recreation	Objectives as per AWQGC including water being free from: • Floating debris, oil, grease and other objectionable matter • Substances that produce undesirable colour, odour, taste or foaming • Undesirable aquatic life such as algal blooms, or dense growths of attached plants or insects.
Cultural Heritage	Protect or restore Indigenous and non-Indigenous cultural heritage consistent with relevant policies and plans.
Seagrass	The minimum WQOs required to restore seagrass to areas where it has been lost are: • Annual median suspended solids <10 mg/L • Annual median Secchi depth >1.7 m • Light Attenuation coefficient >0.9

8.4.3 Existing Water Quality – Kedron Brook

The Kedron Brook Floodway currently discharges directly into Bramble Bay. Water quality within the Floodway is heavily influenced by both upstream catchments and tidal flushing with Bramble Bay. With regard to the NPR project, the Kedron Brook Floodway is an important receiving water as it will be one location where water will be discharged during the construction phase in addition to continuing to receive stormwater from existing and future Airport operations. BAC currently monitors the waterways which discharge into Kedron Brook to ensure that its operations continue to be properly managed. The results of this monitoring are discussed further in section 8.4.5.

Consistent with the Environmental Protection (Water) Policy 1997, the most locally specific document for deriving EVs and WQOs for Kedron Brook Floodway is defined by Brisbane City Council's Guidelines on Identifying and Applying Water Quality Objectives in Brisbane (version 1 – March 2000). These have now been incorporated within Schedule 1 of the EPP Water, however the boundary for the definition of which WQOs should apply has also been updated consistent with Plan WQ1423 which now defines the majority of the Kedron Brook Floodway as falling within the 'enclosed coastal/lower estuary' waterway type.

The Environmental Values and WQOs as adopted in Schedule 1 are listed in **Table 8.4c** and **Table 8.4d** respectively.

Table 8.4c: Environmental Values for Kedron Brook.

Waterway Catchment Description	Environmental Value
Kedron Brook Floodway (estuarine and enclosed coastal)	• Aquatic Ecosystem • Human Consumer • Primary Recreation • Secondary Recreation • Visual Recreation • Cultural and Spiritual Values

Table 8.4d: Water Quality Objectives for Kedron Brook Floodway.

Environmental Value	Water Quality Objectives
	Enclosed Coastal Waters, Aquatic Ecosystem Level 2
Aquatic Ecosystem	• Annual median turbidity <6NTU, suspended solids <15 mg/L • Annual median chlorophyll a <2 µg/L • Annual median total nitrogen <200 µg/L, oxidised N <3µg/L, Amm N <8 µg/L, Org N <180 µg/L • Annual median total phosphorus <20 µg/L, FRP <6 µg/L • Annual median dissolved oxygen between 90-105% saturation • Annual median pH between 8.0 and 8.4 • Annual Median Secchi depth >1.5 m
Human Consumer	Objectives as per AWQGC 2000 and Food Standards Code, Australia New Zealand Food Authority, 1996 and updates.
Primary Recreation	Objectives as per AWQGC including: • Median faecal coliforms <150 organisms per 100 mL or Median enterococci organisms <35 per 100mL • Secchi depth >1.2m
Secondary Recreation	Objectives as per AWQGC including; • Median faecal coliforms <1,000 organisms per 100 mL or Median enterococci organisms <230 per 100 Ml
Visual Recreation	Objectives as per AWQGC including water being free from: • Floating debris, oil, grease and other objectionable matter • Substances that produce undesirable colour, odour, taste or foaming • Undesirable aquatic life such as algal blooms, or dense growths of attached plants or insects.
Cultural and Spiritual Values	Protect or restore Indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.

The Queensland EPA has recently notified BAC of its intention to amend the water quality objectives in Schedule 1 of the EPP Water for Kedron Brook Floodway from 'enclosed coastal/lower estuary' to water quality objectives associated with a 'constructed estuary, canal or artificial waterway'. The water quality objectives for this class of waterway match the Brisbane City Council Guidelines classification for estuaries and provide less stringent objectives for nutrients and sediments.[1]

[1] *Water Quality Objectives for this class of waters for key parameters are: TN: 450 µg/L TP: 60 µg/L TSS: 30 mg/L for combined wet and dry period, Turbidity: 20 NTU*

The proposed amendment to the Water EPP is subject to Queensland Government approval processes and on that basis, the current water quality objectives from the Water EPP have been used in this Chapter for comparative purposes as they represent the lawful requirements at the current time. If the change to the Water EPP is effected during the public notification period, this will be addressed in the final EIS/MDP document.

8.4.3.1 Ambient Water Quality

The most recent water quality monitoring within the Kedron Brook Floodway was undertaken over a six-month period between October 1999 – March 2000 by BCC and the Queensland EPA as part of a citywide assessment of water quality in Brisbane. As this constitutes the most recent monitoring undertaken within the Floodway itself, it has been used to establish ambient water quality in Kedron Brook. The results of the monitoring are detailed in **Table 8.4e** below**.** It should also be noted that BAC's monitoring program, while not sampling water quality within the Floodway, monitors waterways which directly join the Floodway, hence may also indicate current water quality within the Floodway. These are discussed further in section 8.4.4.

Table 8.4e: Ambient Water Quality in Kedron Brook.

Parameter	Median Recorded Value
Organic Nitrogen (mg/L)	0.43
Ammonia (mg/L)	0.004
Oxidised Nitrogen (mg/L)	0.002
Total Nitrogen (mg/L)	0.44
Filterable Reactive Phosphorus (mg/L)	0.028
Total Phosphorus (mg/L)	0.10
Chlorophyll-a (µg/L)	20.7
Total Suspended Solids (mg/L)	19.5
Turbidity (NTU)	12
pH	8.1
Dissolved Oxygen (% saturation)	121
Conductivity (mS/cm)	38.25
Temperature (degrees Celsius)	25.9
Faecal Coliforms (CFU/100 mL)	13

Results exceeding WQOs have been highlighted in red for easy identification. The results in **Table 8.4e** show that existing water quality is generally not compliant with water quality objectives, with elevated concentrations of nutrients, turbidity, suspended solids, chlorophyll-a and dissolved oxygen. Given the large, heavily urbanized, catchment area draining to the Kedron Brook Floodway (approximately 110 km^2), these elevated results are to be expected and are typical of urbanized catchments within the region. Given the tidal influence in the Floodway, the major upstream catchment inputs and current water quality management activities within the BAC area, it is unlikely that water quality within Kedron Brook is influenced to any significant degree by current airport operations.

8.4.4 Existing Water Quality – Brisbane River

The water quality of the Brisbane River is important for the NPR Project as water will be extracted from the Brisbane River in the vicinity of the mouth to fluidise settled sand material from Middle Banks and allow transportation of the sand via a pipeline to the proposed runway reclamation site. Characterisation of the water quality at the river mouth is therefore necessary to allow assessment of the impacts of this process during later stages of the Environmental Impact Statement (EIS).

EVs WQOs for the Brisbane River, as defined by Schedule 1 of the EPP Water are listed in **Table 8.4f** and **Table 8.4g** respectively.

Table 8.4f: Brisbane River Environmental Values.

Waterway Catchment Description	Environmental Value
Brisbane River (estuarine and enclosed coastal)	• Aquatic Ecosystem • Human Consumer (except oysters) • Primary Recreation • Secondary Recreation • Visual Recreation • Cultural and Spiritual Values • Industrial Uses

Table 8.4g: Brisbane River Water Quality Objectives.

Environmental Value	Water Quality Objectives
	Enclosed Coastal Waters, Aquatic Ecosystem Level 2
Aquatic Ecosystem	• Annual median turbidity <6NTU, suspended solids <15 mg/L • Annual median chlorophyll a <2 µg/L • Annual median total nitrogen <200 µg/L, oxidised N <3µg/L, Amm N <8 µg/L, Org N <180 µg/L • Annual median total phosphorus <20 µg/L, FRP <6 µg/L • Annual median dissolved oxygen between 90-105% saturation • Annual median pH between 8.0 and 8.4 • Annual Median Secchi depth >1.5 m
Human Consumer	Objectives as per AWQGC 2000 and Food Standards Code, Australia New Zealand Food Authority, 1996 and updates
Primary Recreation	Objectives as per AWQGC including; • Median faecal coliforms <150 organisms per 100 mL or Median enterococci organisms <35 per 100 mL • Secchi depth >1.2 m
Secondary Recreation	Objectives as per AWQGC including; • Median faecal coliforms <1,000 organisms per 100 mL or Median enterococci organisms <230 per 100 Ml
Visual Recreation	Objectives as per AWQGC including water being free from: • Floating debris, oil, grease and other objectionable matter • Substances that produce undesirable colour, odour, taste or foaming • Undesirable aquatic life such as algal blooms, or dense growths of attached plants or insects.
Cultural and Spiritual Values	Protect or restore Indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.
Industrial Uses	No relevant water quality objectives - refer AWQGC.

8.4.4.1 Ambient Water Quality

Water quality in Brisbane River has been monitored as part of the EHMP since January 2000. The monitoring site located near the mouth of the river, Site E700, is most relevant to the proposed NPR as it is in the direct proximity of where the dredge will intake water to fluidise collected sand and pump the sand slurry to the Airport site. **Figure 8.4a** shows the location of the monitoring site.

Table 8.4h: Ambient Water Quality in Brisbane River.

Parameter	Median Values			
	2002	2003	2004	2005
Conductivity at 25 deg C (mS/cm)	51.99	50.77	50.97	51.73
Salinity (g/L)	34.22	33.32	33.46	34.03
Temperature (°C)	23.02	22.23	23.53	22.71
Turbidity (NTU)	5.00	4.50	6.00	5.50
Light penetration (Secchi depth) (m)	1.50	1.65	1.55	1.40
Chlorophyll-a (µg/L)	2.00	2.40	1.67	1.80
Nitrogen (ammonia) as N (mg/L)	0.02	0.02	0.02	0.01
Nitrogen (organic) as N (mg/L)	0.19	0.18	0.28	0.17
Nitrogen (oxidised) as N (mg/L)	0.10	0.10	0.08	0.06
Nitrogen (total) as N (mg/L)	0.35	0.32	0.41	0.30

Parameter	Median Values			
	2002	2003	2004	2005
Oxygen per cent saturation (%sat)	98.40	96.60	97.75	97.05
Oxygen (dissolved) (mg/L)	6.89	6.81	6.87	7.02
pH	8.14	8.18	8.16	8.16
Phosphorus (total) as P (mg/L)	0.094	0.110	0.115	0.090
Phosphorus (dissolved reactive) as P (mg/L)	0.077	0.092	0.087	0.068

Results exceeding WQOs have been highlighted in red for easy identification, however it should be noted that not all parameters have recommended WQOs for comparison. The results in **Table 8.4h** show that current water quality in the Brisbane River at the EHMP monitoring sites meets WQOs for some parameters, however nutrient concentrations are elevated. This is to be expected given that the discharge from the Luggage Point Wastewater Treatment Plant is in the vicinity of this monitoring location.

Figure 8.4e, Figure 8.4f and **Figure 8.4g** show annual median concentrations of turbidity, TN and TP respectively at the Brisbane River monitoring location.

Figure 8.4e: *Turbidity in Brisbane River.*

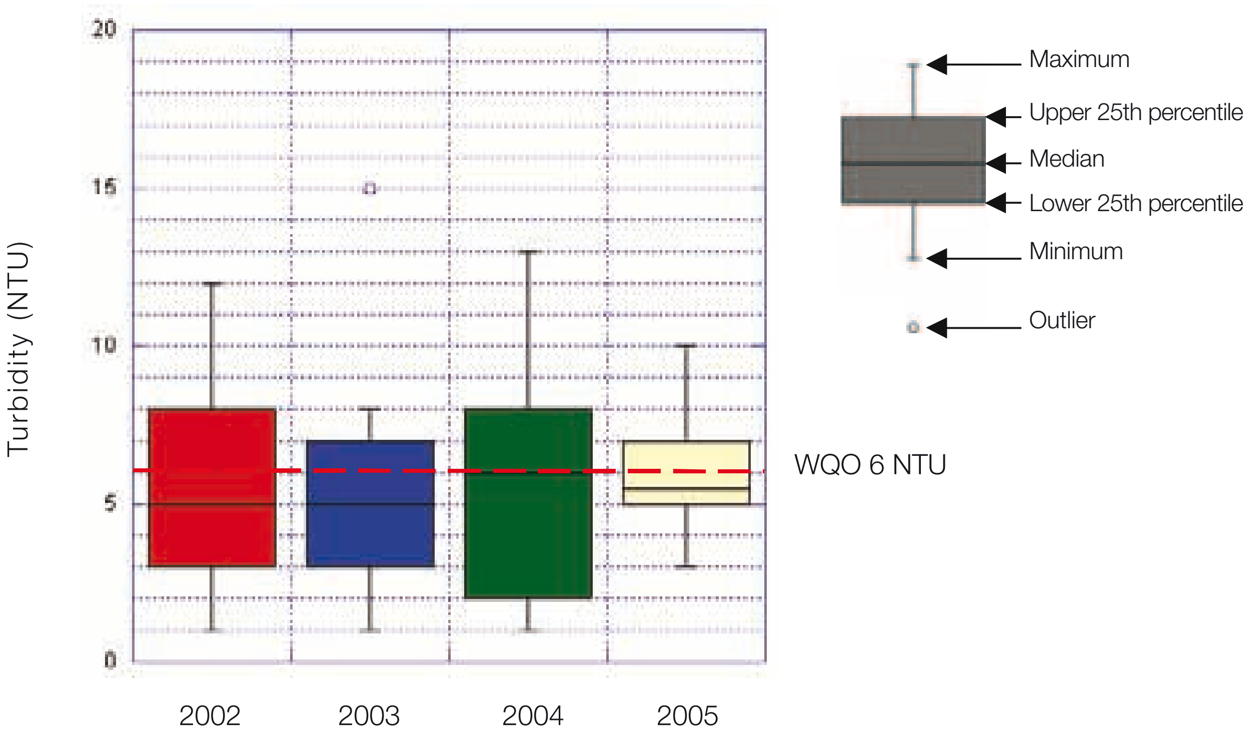


Figure 8.4f: *Total Nitrogen in Brisbane River.*

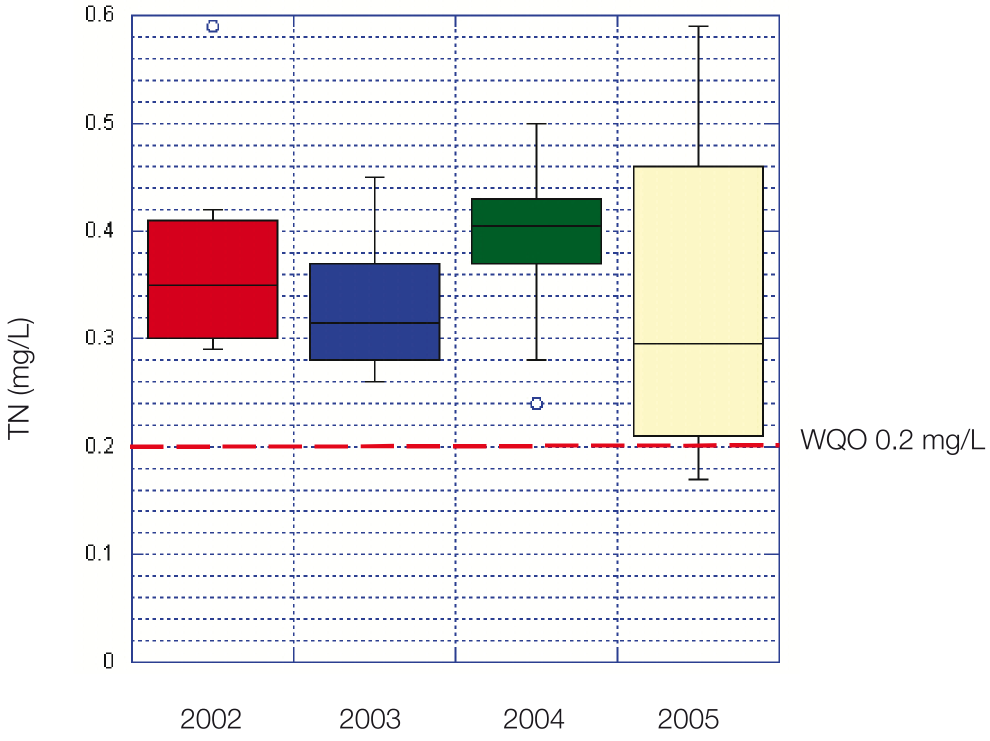
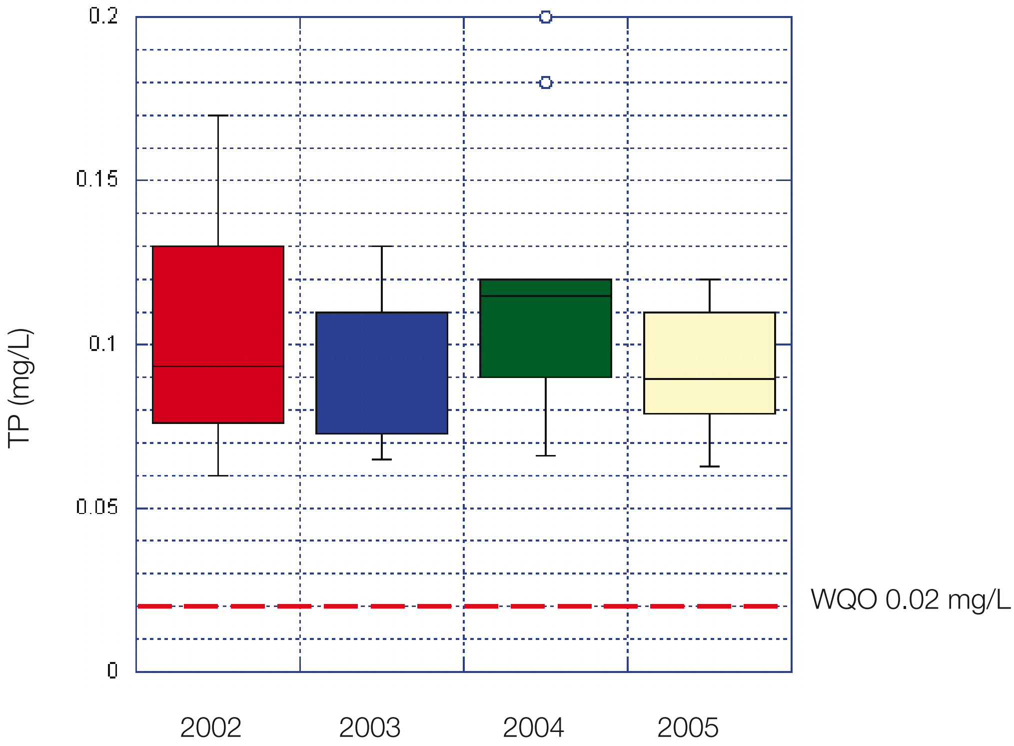


Figure 8.4g: *Total Phosphorus in Brisbane River.*



Of interest for this project is that water is to be extracted from the Brisbane River to be used in the fluidisation of dredge material. This water will ultimately be released into either Bramble Bay via Serpentine Inlet, or into the Kedron Brook Floodway and this has been assessed through the modelling undertaken and outlined in subsequent sections. While this Brisbane River water may have differing concentrations to that of Bramble Bay and Kedron Brook Floodway, it should be noted that water from the river is currently mixing with both of these waterways simply through natural tidal advection and dispersion processes.

8.4.5 Existing Water Quality – Airport Lands and Waters

8.4.5.1 Regulatory Framework

Water quality on Brisbane Airport is administered by DOTARS under the Airports (Environment Protection) Regulations 1997. The Regulations provide for a number of mechanisms for compliance including a general duty to take all reasonable and practicable measures to prevent the generation of pollution from an undertaking, and if prevention is not reasonable or practicable, to minimise the generation of pollution from the undertaking (Regulation 4.01).

Schedule 2 of the Regulations sets out a range of limits for various water quality parameters that if met, addresses and meets the general duty. In the absence of achieving the water quality limits set out in Schedule 2, the regulations also set out processes for obtaining a authorisation or a local standard to meet the general duty.

8.4.5.2 Ambient Water Quality

Water quality monitoring for Brisbane Airport is undertaken as part of the BAC's Airport Environment Strategy. The quality of water coming off the Airport is important to this project as it indicates the likely quality of water that will be present during the operational phase of the NPR.

The BAC monitoring program was commenced in February 2000 to establish baseline water quality conditions across the Airport. Water quality was monitored regularly at the 10 sites where water enters or leaves the Airport. This regime continued until 2003 when, in consultation with the Airport Environment Officer (AEO), the on-site DOTARS environment regulator, it was agreed that water quality trends had been established. A more targeted monitoring program was then implemented which is still continuing. Part way through the program, several of the monitoring locations' identifications were changed but the location remained the same. Water quality sampling locations with both the previous and current identifications are detailed in **Figure 8.4h**.

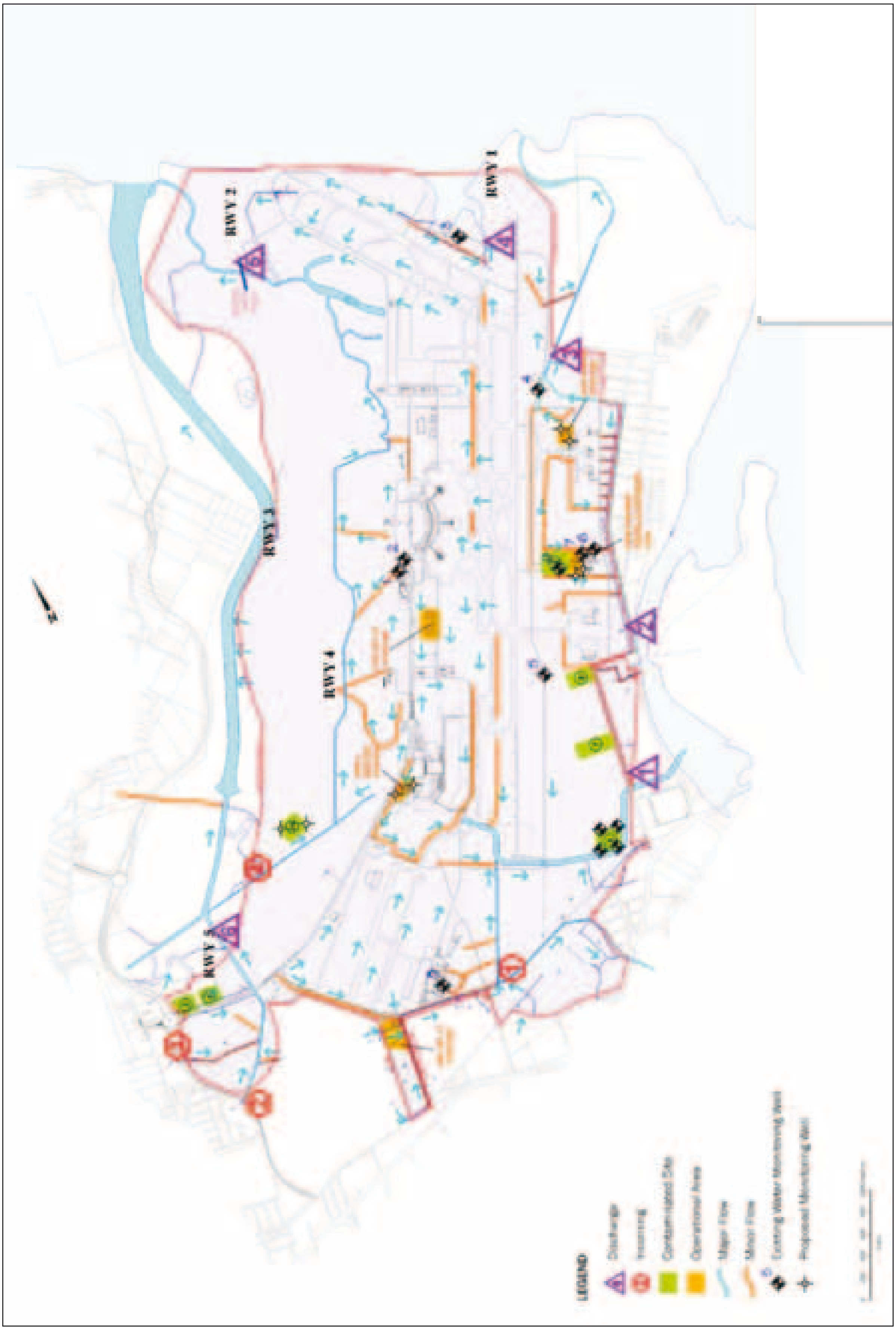


Figure 8.4h: *Airport Water Quality Monitoring Locations.*

8.4.5.3 *Comparison Against Water Quality Objectives Under the EPP Water*

For comparison against the receiving water quality objectives set under the Water EPP, ambient water quality has been examined at Discharge Locations 1 and 2, which discharge to Boggy Creek, and Discharge Locations 3 and 5, which discharge to Bramble Bay. **Figure 8.4i** to **Figure 8.4r** detail median concentrations of Turbidity, TN and Phosphate over the entire monitoring period for these discharge locations respectively.

Ambient water quality results for each of the incoming flow locations detailed in **Figure 8.4h** over the monitoring period are shown in **Figure 8.4o** to **8.4r**. Ambient water quality results for each of the discharge locations are also detailed in **Figure 8.4o** to **Figure 8.4r**. Where possible, the results for the locations have been pooled, however when changes to the location identities were changed, some parameters were also changed which prevents them from being combined into one data set. Where this has occurred, both sets of results are presented.

For the purposes of this document, locations Runway 2/Discharge 5, Runway 3 and Runway 4 are considered as reference points as they currently receive little, if any, discharge from airport activities. They could therefore be representative of 'background' or reference site water quality of the poorly flushed tidal estuaries that some of the airport discharges flow into. These may be considered more appropriate to compare against the current airport operational discharge location Discharge 4 than the current EPA WQOs which have been inferred to apply at these sites.

Comparison of **Figure 8.4i** to **Figure 8.4r** indicate that current water quality at the discharge locations generally does not meet the specified water quality objectives, but are very similar to the 'reference' site water quality as seen in location Discharge 5/Runway 2, and additional sites Runway 3 and 4. This is to be expected given the nature of the Airport site, being relatively flat with tidally influenced drainage channels, hence the water quality within those channels is relatively similar to surrounding receiving waters.

As such, this water experiences tidal movement during each diurnal cycle, but these 'upper estuary' sites experience little mixing. Consequently, the concentrations noted in the discharges from the current airport operational areas are not considered to be of concern due to their similarity to the 'reference' locations, especially when viewed in conjunction with stormwater quality event data as detailed below. This indicates that current Airport operations are not likely to be significantly influencing water quality in these locations.

Figure 8.4i: *Median Turbidity at Discharge Location 1 and Discharge Location 2.*

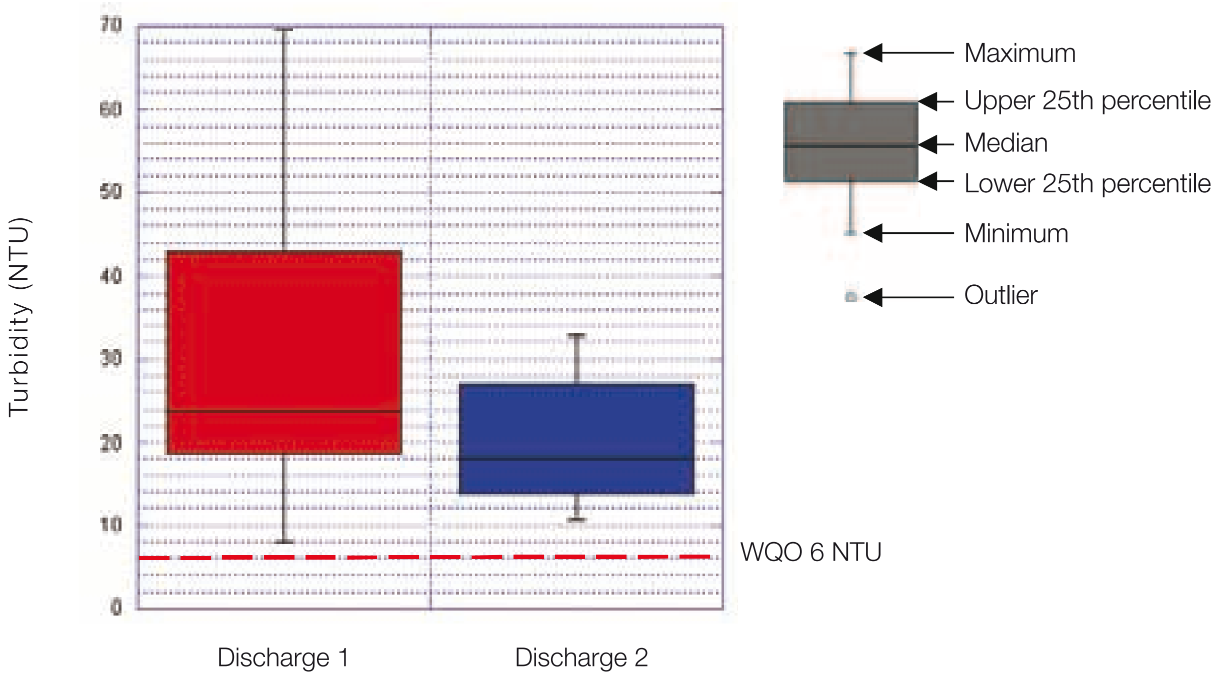


Figure 8.4j: *Median TN at Discharge Location 1 and Discharge Location 2.*

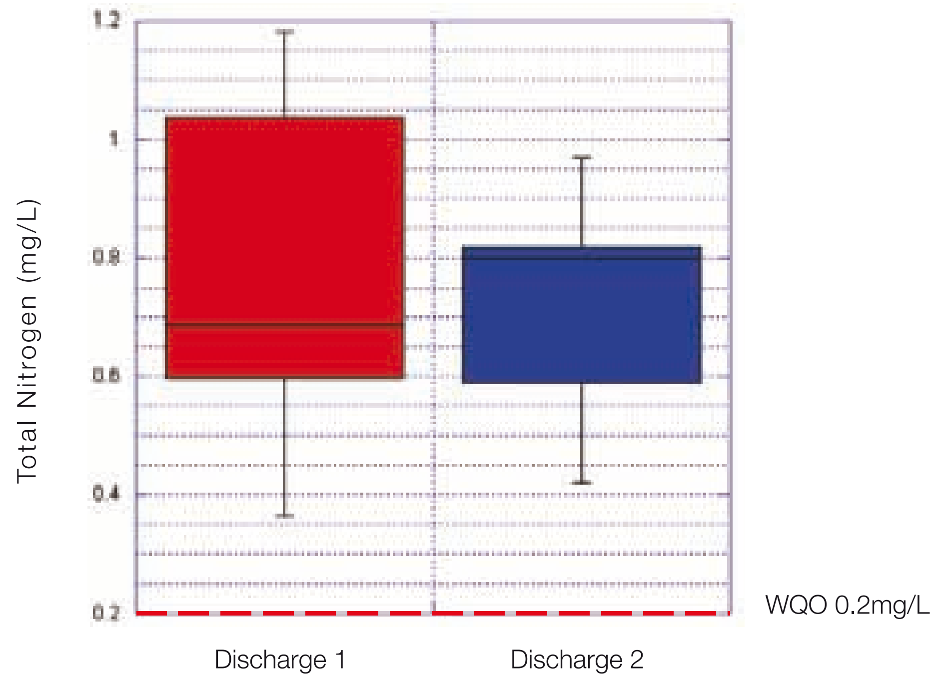


Figure 8.4k: *Median Phosphate at Discharge Location 1 and Discharge Location 2.*

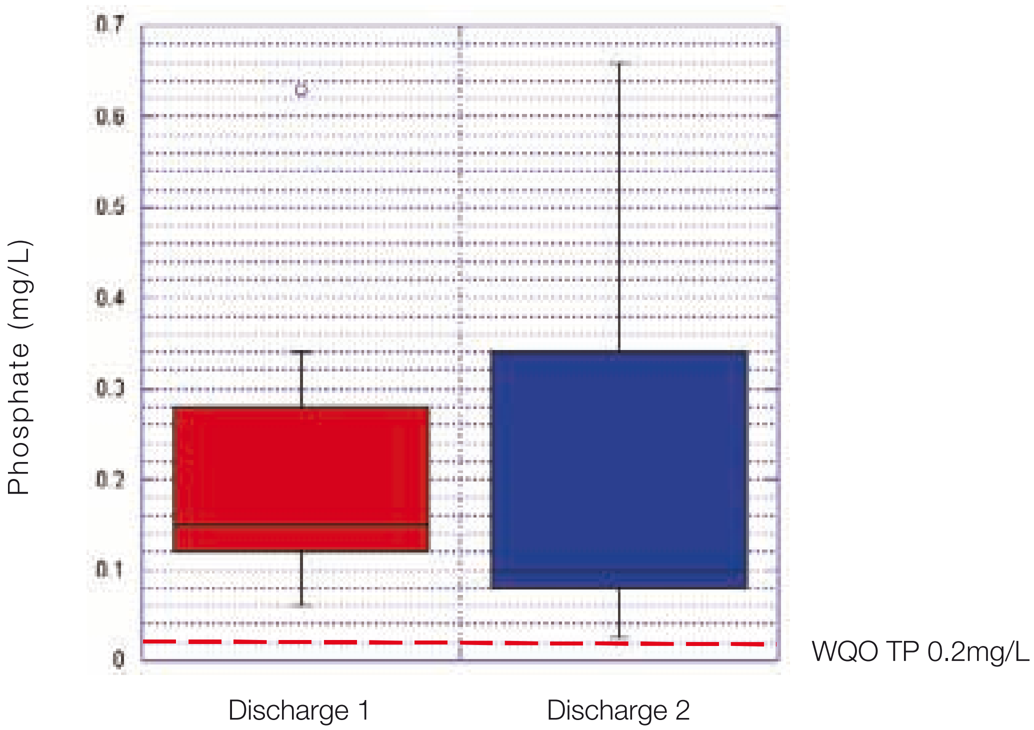


Figure 8.4l: *Median Turbidity at Discharge Location 3 and Discharge Location 5.*

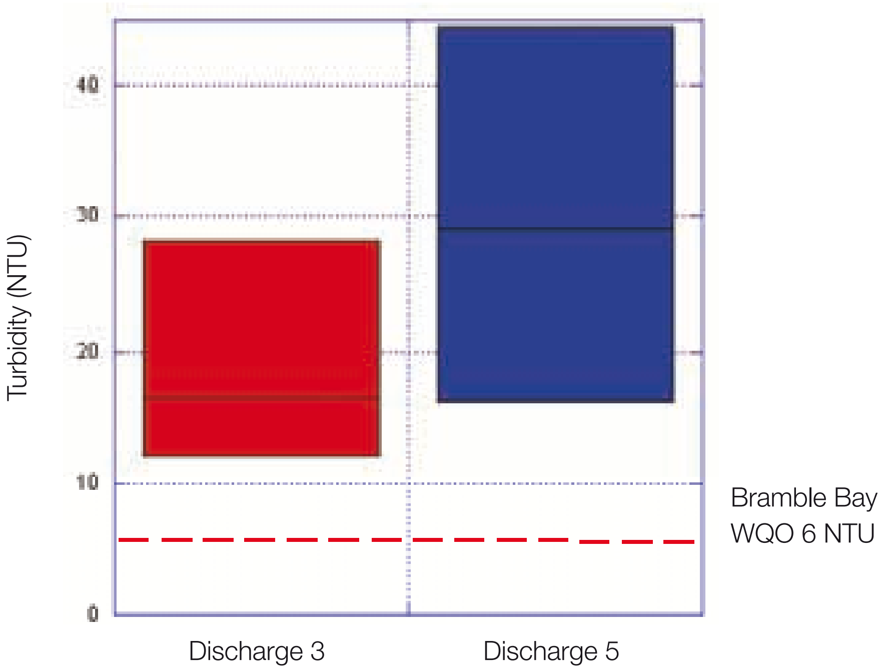


Figure 8.4m: *Median TN at Discharge Location 3 and Discharge Location 5.*

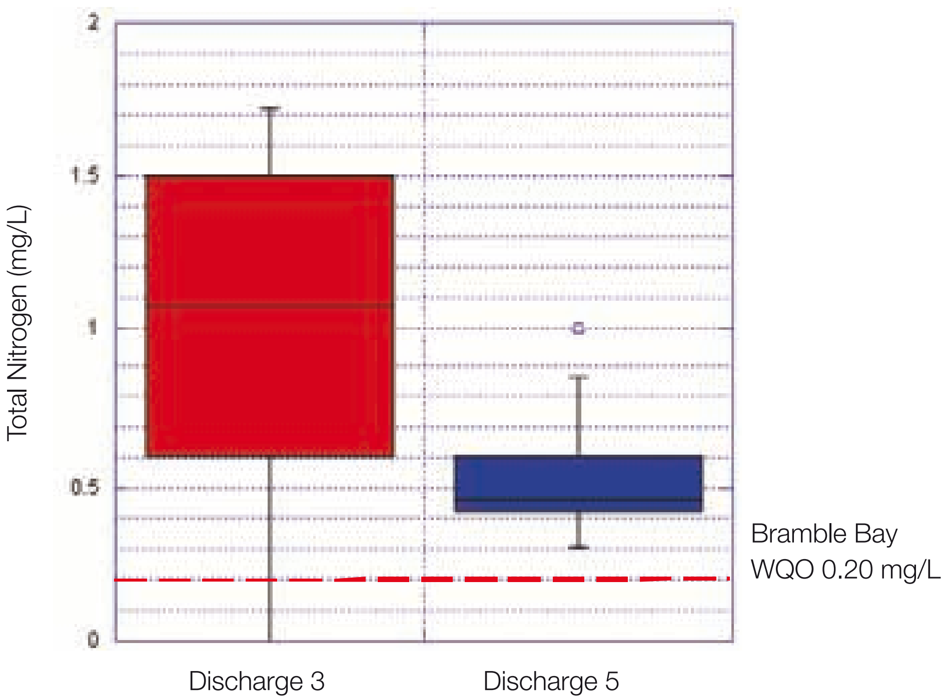


Figure 8.4n: *Median Phosphate at Discharge Location 3 and Discharge Location 5.*

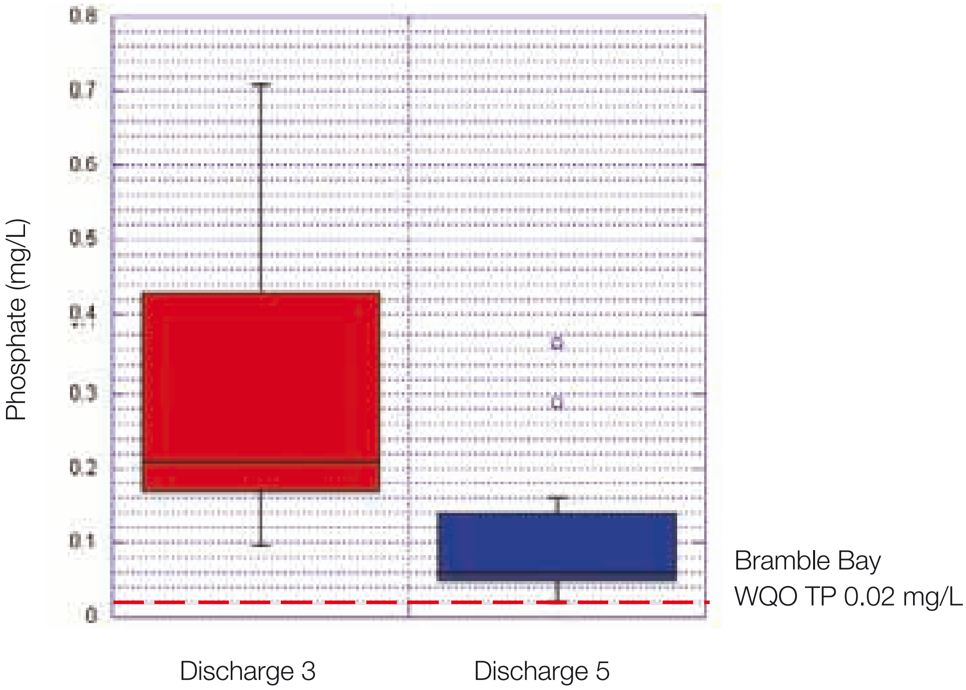


Figure 8.4o: *Median Turbidity at Airport Incoming, Reference and Discharge Locations.*

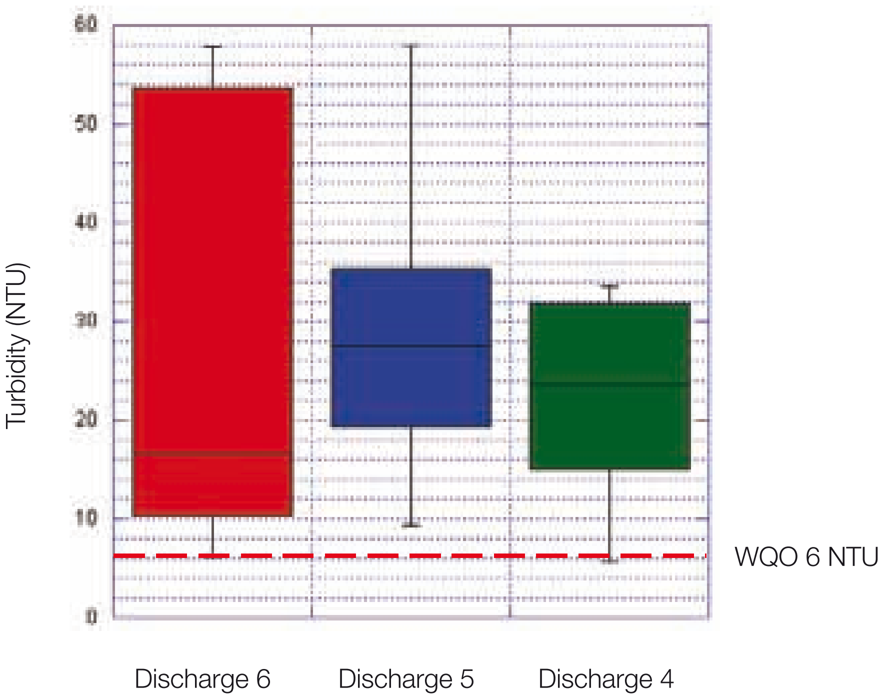


Figure 8.4p: *Median TSS at Airport Incoming, Reference and Discharge Locations.*

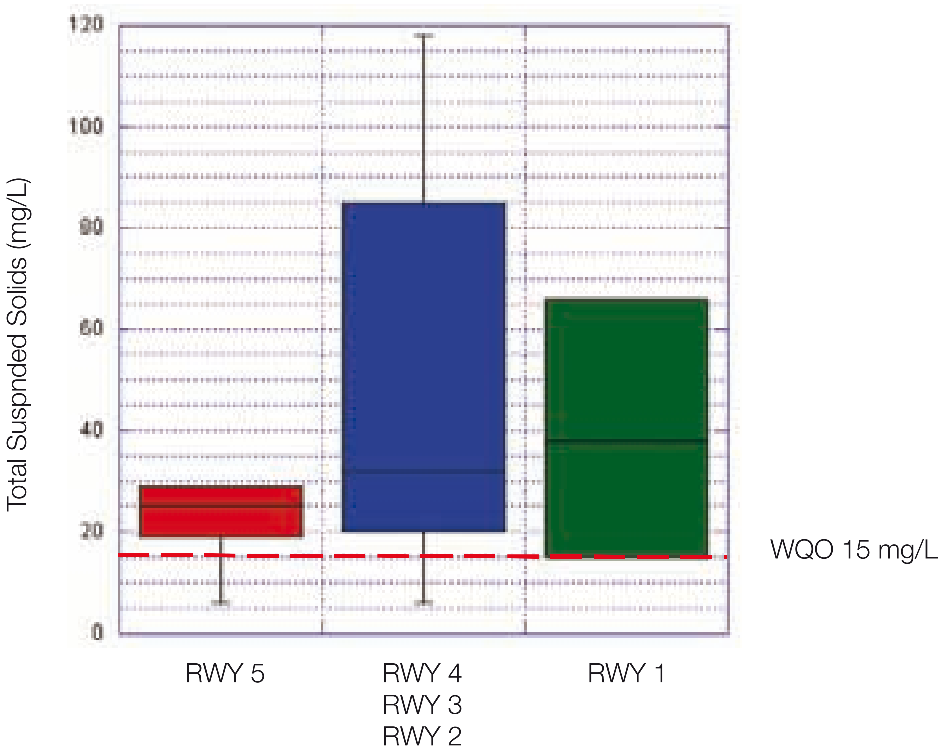


Figure 8.4q: *Median TN at Airport Incoming, Reference and Outgoing Locations.*

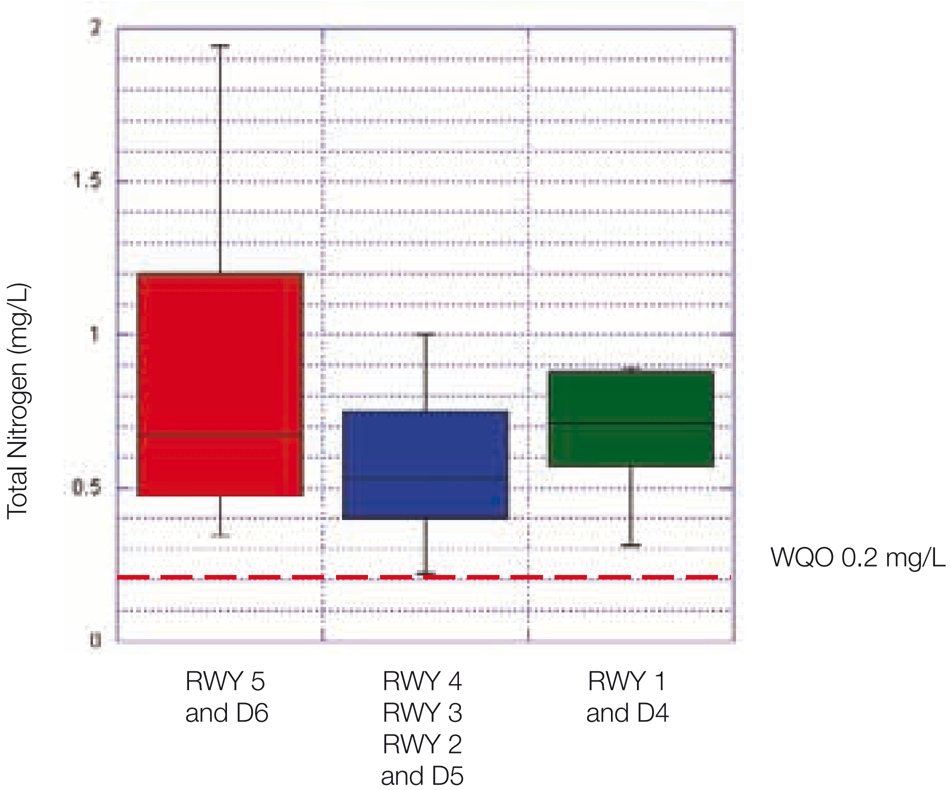
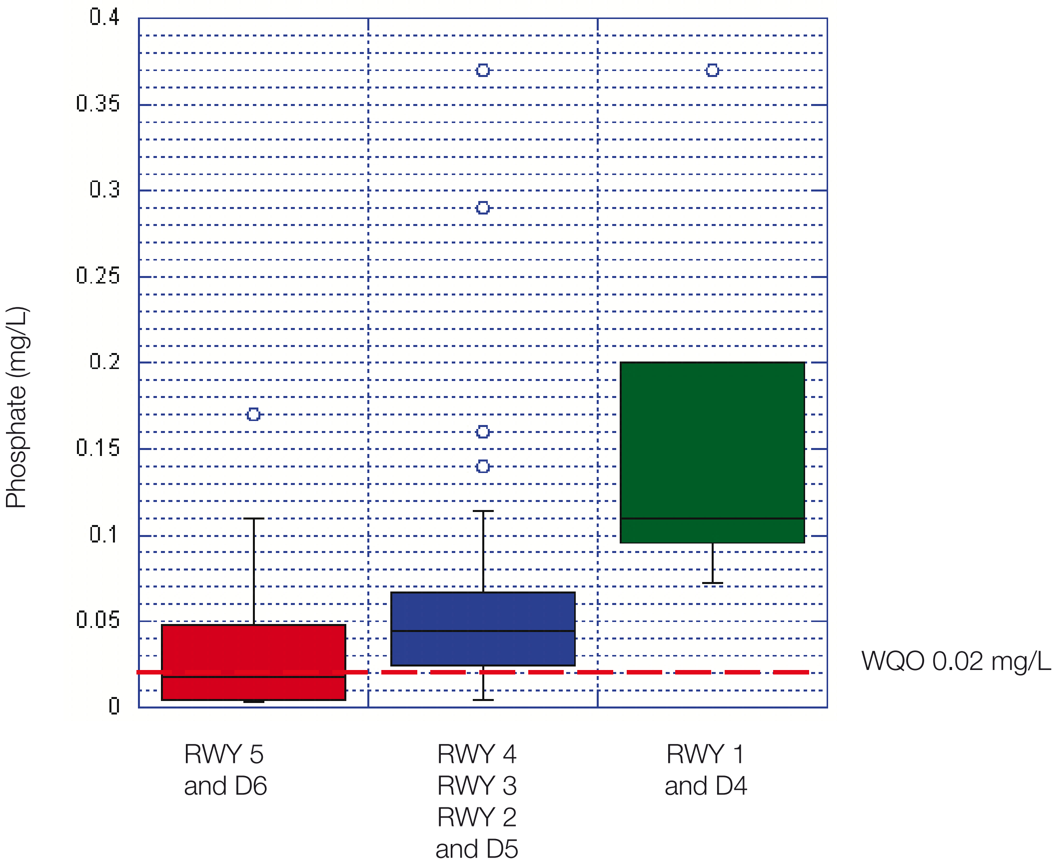


Figure 8.4r: *Median Phosphate at Airport Incoming, Reference and Outgoing Locations.*



8.4.5.4 Comparison Against Water Quality Limits Under the Airport Environment Regulation

Appendix A provides an analysis of the BAC water quality data against the Schedule 2 limits for water quality under the Airport (Environment Protection) Regulations 1997. The water quality limits in the Regulations use slightly different parameters to the State water quality objectives and are not directly comparable on the basis that they are not measured as annual median values. For this reason, the water quality limits have not been shown in the graphs shown in **Figure 8.4i** to **Figure 8.4r**.

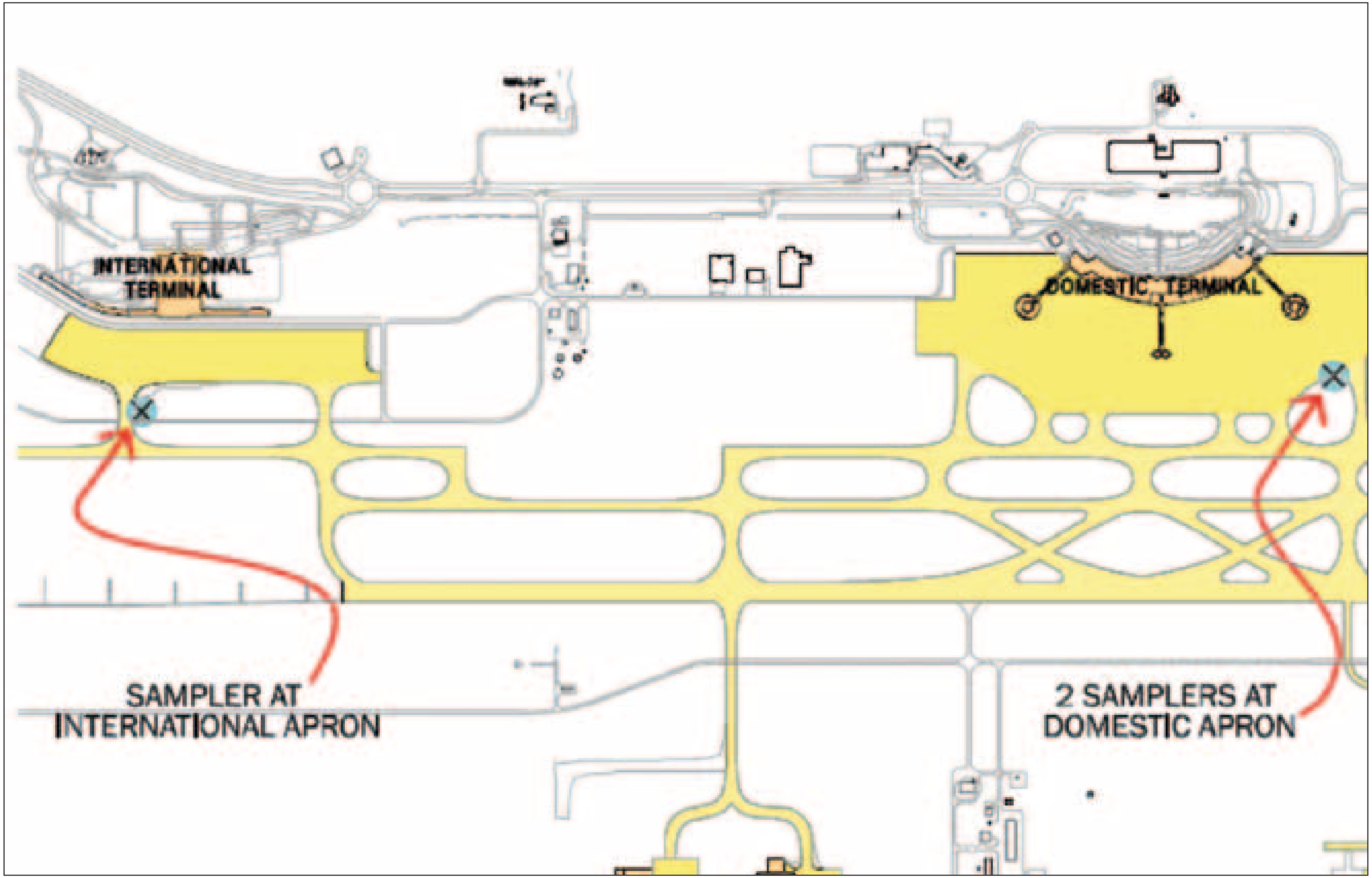
The analysis in the Appendix shows that waters within and around the Airport based on BAC water quality monitoring already significantly exceed key parameter limits for nutrients and sediments. As documented in the Airport Environment Strategy 2004 and as a part of this report, these elevated sediment and nutrient concentrations predominantly result from the Airport's location at the end of major urban catchment areas and its proximity to a number of significant point source of pollution such as the Luggage Point Wastewater Treatment Plant

8.4.5.5 Storm Event Run-off Water Quality

Monitoring of water quality from apron run-off at the Brisbane Domestic and International Airport was undertaken as part of a study by QUT (December 2005).

As part of the study, automatic water samplers were installed at the Airport, with two at the Domestic Apron and one at the International Apron. The two samplers at the Domestic Apron were installed with one at the edge of the apron and one, 1 m inside the grass swale. The sampler at the International Apron was installed at the edge of the apron. **Figure 8.4s** shows a schematic diagram of the installation of the water sampler at the edge of the Domestic Apron and the location of all three samplers.

Figure 8.4s: *Location of Three Stormwater Run-off Samplers from BAC QUT Apron Study (2005).*



Some of the key findings of the report were as follows:

- The surface run-off from the International Apron was found to carry relatively less pollutant concentrations when compared to the run-off from the Domestic Apron. This is despite the fact that the International Apron offers a much larger surface area for pollutant build-up and wash-off. However, as the International Apron is less busy in terms of aircraft movements, it confirms that the quality of surface run-off can be directly related to the aircraft movements and associated ground traffic.
- Based on the results obtained, it was found that there is a first flush effect during rainfall events associated with run-off from the aprons, but only for a limited number of water quality parameters. The parameters where there is an appreciable first flush effect are, electrical conductivity, total suspended solids and total dissolved solids.
- As most of the metal elements investigated as part of the Study were generally strongly bound to suspended solids in run-off, the grass swale present at the edge of the Domestic Apron was found to be quite effective in improving water quality.
- The swale not only reduced pollutant concentrations, but also the volume of surface run-off. Both these mechanisms in turn reduced the total pollutant load to receiving waters.
- Data analysis from the study showed that the filtering actions of the grass swale was effective in lowering the concentrations of metals in both particulate, and to a lesser extent, dissolved forms of metals.
- The water quality from the sample sites was relatively uniform after being filtered through the grass swale. Event mean concentrations (EMC) were recorded as part of the study for 13 rainfall events and median concentrations have been determined using this data. **Table 8.4i** and **Table 8.4j**, detail the EMC for each event and the median concentrations recorded over the duration of the sampling period for run-off from the Domestic and International Terminal Aprons respectively.

Table 8.4i: Water Quality of Apron Run-off from Domestic Terminal.

Date	pH	EC (ms/cm)	TSS (mg/L)	TDS (mg/L)	TOC (mg/L)	DOC (mg/L)
10/11/2003	7.00	58.31	19.0	52.5	8.69	7.62
22/11/2003	7.39	167.8	18.5	88.8	19.67	18.18
2/12/2003	7.43	90.7	25.4	42.5	10.28	7.35
14/12/2003	7.07	169.1	19.9	74	32.29	25.9
14/01/2004	6.96	77	7.8	33	10.62	7.99
10/01/2004	7.46	164.1	33	70	27.27	19.03
28/01/2004	6.59	69.7	16.7	35	12.70	7.65
2/02/2004	6.89	65.1	4	60	10.65	7.62
22/02/2004	7.34	113.3	4	150	15.69	14.53
5/04/2004	6.88	70.8	2	55	8.65	7.35
5/11/2004	6.8	46	24	5	3.42	2.02
13/12/2004	7.24	58.9	2		7.11	5.34
5/01/2005	7.21	28.5	179		6.09	4.94
Median	**7.07**	**70.8**	**18.5**	**55**	**10.62**	**7.62**
90%ile*			**31.48**			

** 90th percentiles are given for TSS only as this allows comparison against the BCC WQO for TSS during wet weather events.*

Table 8.4j: Water Quality of Apron Run-off from International Terminal.

Date	pH	EC (ms/cm)	TSS (mg/L)	TDS (mg/L)	TOC (mg/L)	DOC (mg/L)
10/11/2003	7.23	86.325	13.25	65	7.58	7.26
22/11/2003	7.603	89.988	20.75	47.5	8.57	7.54
2/12/2003	7.55	70.5	9	30	5.105	3.546
14/12/2003	7.33	51.4	17.13	18.75	6.49	5.61
14/01/2004	7.78	96.4	41.8	26	7.33	5.66
10/01/2004	7.77	72.7	20.6	26	6.13	4.81
28/01/2004	6.91	84.7	32	28	7.12	5.32
2/02/2004	6.81	93.3	11	80	6.81	5.85
22/02/2004	6.51	154.8	5	145	6.55	5.99
5/04/2004	6.95	110.5	2	80	5.34	5.02
5/11/2004	6.98	58.5	14	nd	5	4.02
13/12/2004	6.91	51.6	6	85	4.08	3.98
5/01/2005	8.08	40.8	157	nd	4.05	3.01
Median	**7.23**	**84.7**	**14**	**47.5**	**6.49**	**5.32**
90%ile*			**39.84**			

** 90th percentiles are given for TSS only as this allows comparison against the BCC WQO for TSS during wet weather events.*

Table 8.4i and **Table 8.4j** show that the 90th percentile of TSS is well below 100 mg/L for wet weather periods which is the water quality objective specified by BCC for wet weather events. Note that there are no other similar wet weather objectives defined by other agencies.

The low TSS concentrations in the run-off suggest that Airport operations are not generating significant sources of pollutants as concentrations of other contaminants such as heavy metals and phosphorus are strongly associated with sediment.

This is further highlighted by the results given in **Table 8.4k**[2] which shows that the quality of water being discharged off the aprons during a stormwater event has relatively low concentrations of heavy metals such as lead, chromium, and copper – even before any improvement as a result of treatment or retention of TSS in the grass swale.

Table 8.4k: Water Quality (metals) of Apron Run-off (Event Mean Concentrations).

Parameter (mg/L)	Domestic Terminal	International Terminal	AEPR Sch 2 Limit
Pb	0.002	0.003	0.005
Cr	0.002	0.002	0.05
Zn	0.21	0.22	0.05
Al	0.23	0.27	n/a
Cu	0.039	0.023	0.005
Cd	nd	nd	0.002
Fe	0.14	0.23	n/a
Mn	0.004	0.005	n/a

n/a No applicable guideline value
nd Not Detected/Insufficient Data points

[2] The source of slightly elevated concentrations of Zinc and Copper as shown in the table is likely to be a combination of tyre wear associated with aircraft and support vehicle traffic on the apron and/or originating from soil particles (Zn and Cu are common elements within the soil) mobilising in rainfall events.

The relatively low concentrations of pollutants generated and effectiveness of grass swale treatment measures documented in the QUT Apron Study indicate that run-off from current Airport operations does not contain significant levels of contaminants.

This finding is important for the NPR project as it suggests that operational phase impacts associated with stormwater run-off from the runway and apron area are likely to be negligible in receiving waters, especially considering the proposed use of several best management practices such as grassed swales and buffer strips to treat run-off as discussed in section 8.7.4.11.

8.5 Consultation

Agencies that were consulted regarding water quality impacts within the receiving waters surrounding the NPR Project area included:

- Moreton Bay Waterways and Catchments Partnership Scientific Expert Panel;
- Environment Protection Agency;
- Brisbane City Council; and
- Australian Government Department of Transport and Regional Services.

8.6 Impact Assessment – General Considerations

The construction of the NPR at Brisbane Airport will involve a lengthy construction phase, including extensive filling and preloading activities associated with ensuring appropriate settlement and consolidation of marine sediments underlying the proposed runway location and with providing an appropriate final level for the runway.

Associated with this preloading and filling operation is the transport and delivery of some 15 million cubic metres (Mm^3) of sand fill from the Middle Banks of Moreton Bay. After dredging, the transport of this material from the dredge to the site will entail the fluidisation of stored material on the dredging vessel using water obtained from the Brisbane River, at a mooring point specifically constructed for this process. This sand/water mix will be transported across the existing airport site and discharged at the new runway area to a height of several metres in some areas. The water draining from the fill areas will then be allowed to discharge via defined overland flow paths to one of two sediment ponds to be constructed by bunding existing depressions on the construction site. The supernatant (remaining water after the sediment has been settled out) will then be discharged either to Serpentine Inlet or the Kedron Brook Floodway via tidal channels.

When the new runway, associated taxiways and other infrastructure are finally completed, the new impervious surfaces will have the potential to generate greater amounts of stormwater than the existing, mostly vegetated site. This stormwater is to be managed through grassed swales which will act as both the treatment and conveyance mechanisms for the operational phase.

The process for this impact assessment has involved the use of data collected as part of the baseline studies to be utilized as boundary conditions for a two-dimensional receiving water quality model of Moreton Bay. This model, developed in recent years on behalf of the Moreton Bay Waterways and Catchments Partnership (MBWCP) for various water quality management studies of Moreton Bay and its estuaries, allows both a detailed assessment of impacts at each of the discharge points, in addition to a regional assessment of the potential discharges through its extensive coverage of the whole of the Bay.

Outputs from the receiving water quality model have then been used as a basis for comparison against predefined water quality objectives for the immediate and ultimate receiving waters and as part of the optimisation process for best management practices to be incorporated into the construction and operational stages of the project.

8.7 Assessment of Impacts

Table 8.7a identifies the significance criteria that have been derived for the purpose of the impact assessment section of this Chapter.

Table 8.7a: Significance Criteria for Near Shore (Airport and Surrounds) Water Quality.

Level of Impact	Criteria: Water Quality
Major Adverse	Permanent change in the Annual Ecosystem Health Report Card for Bramble Bay or Kedron Brook Floodway resulting from changes to water quality due to direct impacts of the construction or operational phases of the New Parallel Runway and associated activities.
High Adverse	Water quality within Bramble Bay or Kedron Brook Floodway is permanently altered due to direct impacts of the construction or operational phases of the New Parallel Runway and associated activities such that the scheduled Environmental Values and Water Quality Objectives are no longer achievable if currently being achieved, or are prevented from being achieved in the future if currently not being achieved.
Moderate Adverse	Water quality within Bramble Bay or Kedron Brook Floodway is temporarily altered due to direct impacts of the construction phase of the New Parallel Runway and associated activities such that the scheduled Environmental Values and Water Quality Objectives are no longer achievable if currently being achieved, or are prevented from being achieved in the future if currently not being achieved.
Minor Adverse	Water quality within Bramble Bay or Kedron Brook Floodway area is temporarily impacted such that mitigation measures prevent changes to water quality over an annual period, though short term exceedences may occur during construction activities.
Negligible	No perceptible impacts on Bramble Bay or Kedron Brook Floodway water quality through the use of effective mitigation measures during the construction and operational phases and no perceptible change to long term water quality through altered flow regimes or other hydrologic changes resulting from the project.
Beneficial	Existing water quality is improved in Bramble Bay or Kedron Brook Floodway due to altered flow regimes, hydrological changes or operational phase mitigation measures.

With regard to the component works that directly affect water quality levels near the Airport, the following general points are significant.

8.7.1 Pump-out Facility at Luggage Point

Construction of the pump-out facility at Luggage Point is likely to result in minimal disturbance to water quality within the Brisbane River. It is possible that some minor, short term turbidity increases may occur during the driving of piles for the mooring point and other pump-out infrastructure, however this is likely to occur only during this operation and is not likely to result in any ongoing water quality issue.

During the pump-out of sand material, the sand delivery pipelines are flushed with water at the end of each discharge phase to remove material from the pipeline. The potential for loss of sand during disconnection of the pipes is likely therefore to be negligible. There will be disturbance of bottom sediments at the pump-out location through prop wash during docking and departure of the dredge, however it is considered that this will be comparable to existing impacts from vessels using the same location currently for oil product deliveries and as such have not been specifically modeled.

8.7.2 Approach Lighting System

As for the construction of the Luggage Point mooring, it is possible that some minor, short term turbidity increase may be possible during the driving of piles for the lighting system. This is likely to occur only during this operation and is not anticipated to result in any ongoing water quality issue.

8.7.3 Filling and Surcharge Operations

The development of the NPR requires large quantities of dredged material, sourced from the Middle Banks of Moreton Bay, to be placed over the area required for the runway to effect settlement of underlying marine sediments. This filling and surcharge operation requires that the dredged material be transported from the dredge by fluidisation of the material with Brisbane River water sourced at the mooring point at Luggage Point. This water, mixed in a ratio of approximately 4:1, water:dredged material, is needed to ensure that the dredged sand can be pumped over the distance from the mooring point to the area where it is to be placed.

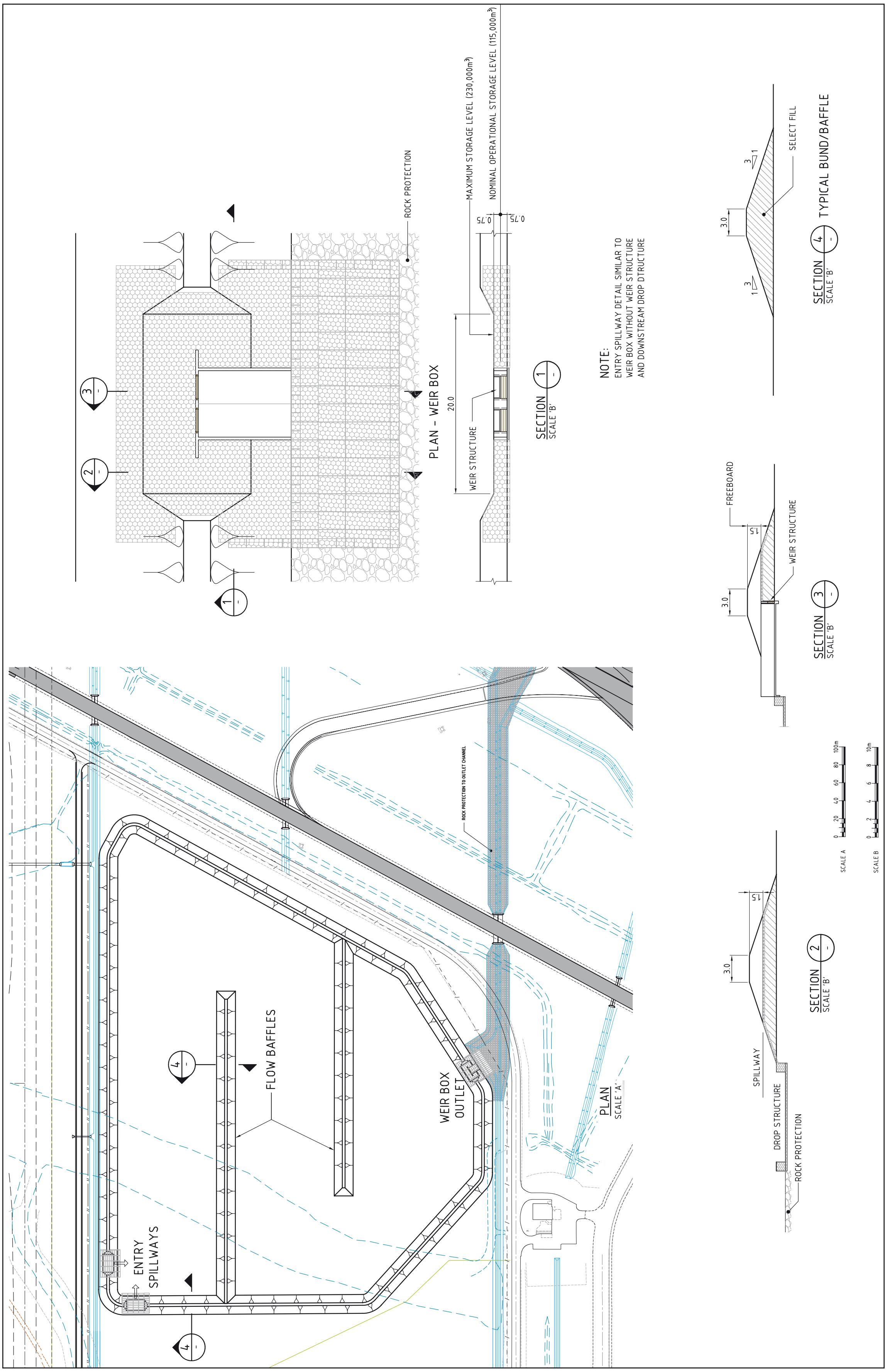


Figure 8.7a: Sedimentation Pond Layout.

Once the material is discharged, the water will drain from the preloaded area and be directed into one of two sedimentation ponds. These ponds have been sized to deal with the expected volumes of water likely to be released from two dredge pump-outs, approximately 230,000 m^3, in order to allow the dredge to remain operational should releases from the ponds be prevented for any period of time. **Figure 8.7a** shows the general configuration of these ponds. Treated water from the ponds will flow to either Serpentine Inlet, or the Kedron Brook Floodway, depending on where filling operations are taking place on the project site.

8.7.4 Model Development

Water quality modelling of the proposed supernatant discharges to Serpentine Inlet and Kedron Brook was undertaken using the two-dimensional RWQM2 (Receiving Water Quality Model 2) modelling software. This software is a derivative of the RMA suite of models. It is a coupled two-dimensional (depth averaged) finite element model that is configured to consecutively simulate the evolution of hydrodynamic and water quality variations in a water body subject to external forcing. Whilst the RWQM2 has its origins in the RMA suite of models, it has undergone further development over recent years, such that it is now markedly distinct from the standard RMA suite. Much of this development has involved the inclusion of additional algorithms and processes necessary for the reliable simulation of water quality processes in Moreton Bay.

The schematisation and functionality of both the hydrodynamic and water quality modules comprising the RWQM2 are described in Bell (1998) and Bell and Amghar (2002). The most important feature of the RWQM2 to note is the relationship between the hydrodynamic and water quality modules. Namely, the hydrodynamic model is initially executed (subject to tidal forcing, catchment and other local inflows), and the result files are subsequently provided to the water quality model to solve the desired conservation equations, again subject to boundary and element/nodal pollutant loading.

The model was applied in previous studies by the Queensland EPA and more recently by WBM for the South East Queensland Water Quality Improvement Plan (WQIP) under commission by the MBWCP. In contrast to previous work by the EPA, the WQIP study involved an extensive calibration/validation exercise, followed by considerable spatial and temporal use of the model for scenario testing of potential management strategies throughout the South East Queensland region. The principal aim of this work was to provide information on the predicted efficacies of various management strategies with respect to improving ambient water quality within the region's waterways.

To provide adequate resolution for this project, the original RWQM2 mesh was refined in the vicinity of the Airport to adequately incorporate Kedron Brook and Serpentine Inlet. The mesh incorporated recent bathymetric data for the region supplied by Maunsell. **Figure 8.7b** shows the extent of the refined RWQM2 mesh. The refined mesh representing the airport surrounds is shown in **Figure 8.7c**.

Figure 8.7b: RWQM2 Mesh of Moreton Bay.

Figure 8.7c: Revised RWQM2 Mesh of the Airport Surrounds showing Bathymetric Data.

8.7.4.1 Model Calibration/Validation

The Moreton Bay RWQM2 model was successfully calibrated and validated to industry standards. The results of the calibration and validation exercises were reviewed, and approved, internally by the MBWCP Modelling Advisory Panel (MAP), and externally by Dr Barbara Robson of CSIRO.

Full details of the calibration and validation exercises can be found in the WBM report, Water Quality Improvement Plan -– Receiving Water Quality Modelling: Final Calibration Report (WBM, 2005).

8.7.4.2 Boundary Conditions

The hydrodynamic model was driven by tidal boundary conditions and catchment inflows. The tidal boundary conditions were derived from 10 minute interval water elevation data supplied by Maritime Safety Queensland for Mooloolaba and Gold Coast Seaway. Catchment inflows were derived from the output from the South East Queensland Regional Environmental Management Support System (EMSS). The EMSS model was developed by the former Cooperative Research Centre for Catchment Hydrology as a tool to assist water quality managers in understanding relative contributions from a range of land uses and the types of best management practices which may be suitable to address them. The regional EMSS model was recently upgraded in order to better represent both current and future land uses in the region. This work was used to disaggregate diffuse loads for input into receiving water quality modelling. Using the regional EMSS, flows from the catchment and associated pollutant loads were extracted for the key catchments flowing into Moreton Bay through input nodes within the RWQM2 model.

To simulate flows and loads from point sources such as Wastewater Treatment Plants, relationships were derived for the flows from STPs based on antecedent rainfall to properly account for the impacts of rainfall interception and infiltration which is a common occurrence in Brisbane.

Boundary conditions representing the supernatant discharges to Kedron Brook and Serpentine Inlet are discussed in a later section of this report.

8.7.4.3 Scenario Assumptions

The same simulation period was adopted for all scenarios in order to maintain consistency. This period was of one year duration and was representative of an ‘average’ year in terms of rainfall. In order to isolate this annual period, WBM conducted decile analysis of rainfall data at Kedron Brook/Enoggera Creek, which was considered a representative catchment. It was found that the most appropriate ‘average’ rainfall year to adopt for this study was from 1st July 1999 to 30th June 2000, where the corresponding total rainfall was 985 mm. A fiscal year was adopted to maintain consistency with the EHMP approach.

As initial conditions have the capacity to influence model results, a ‘restart’ file from the calibration exercise was used to start a further three months of ‘warm up’ for each scenario. This warm up represented the conditions of April, May and June 1999 and also represented the same loading conditions that each scenario was tested under. The length of the ‘warm up’ period was restricted to 3 months as significant rain events were experienced in February and March 1999 that could significantly influence the behaviour of the models and hence be unrepresentative of ’average‘ climatic conditions.

8.7.4.4 Sedimentation Pond Supernatant Discharge Assumptions

The following assumptions were made for both discharge scenarios (Kedron Brook and Serpentine Inlet):

- Volume of supernatant to be discharged per dredge cycle = 115,000 m^3:
- Duration of typical dredge cycle = 8 hrs;
- Duration of discharge = 6 months (for each pond);
- The fill material in the dredge is fluidised with water from the Brisbane River in the vicinity of Luggage Point; and
- Assumed supernatant concentrations: TN = 0.45 mg/L, TP = 0.18 mg/L, TSS = 47 mg/L. [3]

The following assumptions were made in consultation with the project team for the Kedron Brook discharge scenario:

- Discharge pattern = Continuous throughout tidal cycle; and
- Discharge flow rate ~ 4 m^3/s.

The following assumptions were made in consultation with the project team for the Serpentine Inlet discharge scenario:

- Discharge pattern = Discharge occurs when sea level is greater than mean sea level; and
- Discharge flow rate ~ 8 m^3/s.

8.7.4.5 Scenario Descriptions

Four scenarios were selected to assess potential impacts from the supernatant discharges. As discussed previously, all scenarios were run for a 15 month period incorporating an initial 3 month warm up phase. Descriptions of the scenarios are provided below.

- Kedron Brook Discharge Scenario: Continuous discharge of supernatant to Kedron Brook over 6 and 9 month durations; and
- Serpentine Inlet Discharge Scenario: Continuous discharge of supernatant to Serpentine Inlet over 6 and 9 month durations.

8.7.4.6 Component Works Impacts

The key focus of this assessment has been the quantification of discharges from the sedimentation ponds in terms of water quality impacts on the receiving waters surrounding the Airport site. Discussions with the design engineers indicated that the discharges from each sedimentation pond (one discharging to Serpentine Inlet and the other discharging to Kedron Brook) are likely to occur separately, i.e. it is very unlikely that both discharges will be operating concurrently, as sand filling operations are intended to occur in discrete cells. Each one of these cells will only flow to one pond, as such, during the filling of the cell, only one sedimentation pond is likely to be discharging. The duration of the discharge was assumed to be 6 months based on a particular class of trailer suction hopper dredge. If the final dredge size differs significantly from the assumed sizing, the duration of discharge may change, and as such, the predicted impacts are likely to vary in accordance with the duration of discharge. As part of the modelling, extension of the duration of the discharge to nine months (though still assuming the same total discharge) was examined and is discussed later in this section.

[3] These concentrations were derived using the following assumptions:

- *The supernatant is assumed to be a fully mixed combination of hopper water in the dredge and Brisbane River water (assuming current water quality);*
- *No reduction in TN and TP is assumed between the time of fluidisation and discharge; and*
- *The supernatant concentration of TSS was based on kinetic decay analysis undertaken by the design consultants (as documented in A4).*

Model outputs were extracted and spreadsheet analyses undertaken to derive predicted time series of the key water quality parameters of concern, these being total suspended solids, turbidity, total nitrogen and total phosphorus. These parameters were selected based on their potential to cause greatest receiving water quality impact from the component works. Total suspended solids and turbidity were selected given that these will be the primary pollutants generated by the construction process in relation to disturbance of sediments on-site and from any residual fines in the extracted material from Middle Banks (though it is likely that the majority of these fines will remain at Middle Banks).

The nutrients (total nitrogen and total phosphorus) were selected as the use of Brisbane River water in the fluidisation process will result in the discharge from the sedimentation ponds being strongly influenced by the nutrient concentrations in the Brisbane River water. Given the location where the water is to be extracted from the River is near the Luggage Point Wastewater Treatment Plant, the modelling was conducted to examine impacts of these nutrient concentrations on the receiving waters of the Kedron Brook Floodway, Serpentine Inlet and Bramble Bay.

It is noted that in regard to Moreton Bay as a whole, this process will simply be relocating nutrients from one point of discharge into the Bay (the Brisbane River) to another (Kedron Brook or Serpentine Inlet), and there should be no net effect. It should also be considered that at the time of the NPR construction, it is highly likely that current efforts directed at reusing the majority (if not all) of the treated waste water at Luggage Point will be in place, hence nutrient concentrations are likely to be significantly lower at the intake point on the Brisbane River. As such, the nutrient results should be considered a very conservative estimate.

8.7.4.7 Predicted Time Series

Time series were extracted from the modelling at several locations surrounding the Airport site over the same climatic sequence for each scenario to allow direct comparison of results. These locations were used to describe impacts close to the actual discharge point (70 m from the Kedron Brook discharge and at the mouth of Serpentine Inlet), at areas where mixing of the discharge water with the receiving water may occur (500 m upstream and downstream of the Kedron Brook discharge and 1 km offshore of Serpentine Inlet) and finally at areas where complete mixing is likely to have occurred with Moreton Bay waters (EHMP monitoring points E00902, E00905 and E00906). The locations of the EHMP Monitoring Points and the discharge locations are shown in **Figure 8.7d** and **Figure 8.7e** respectively.

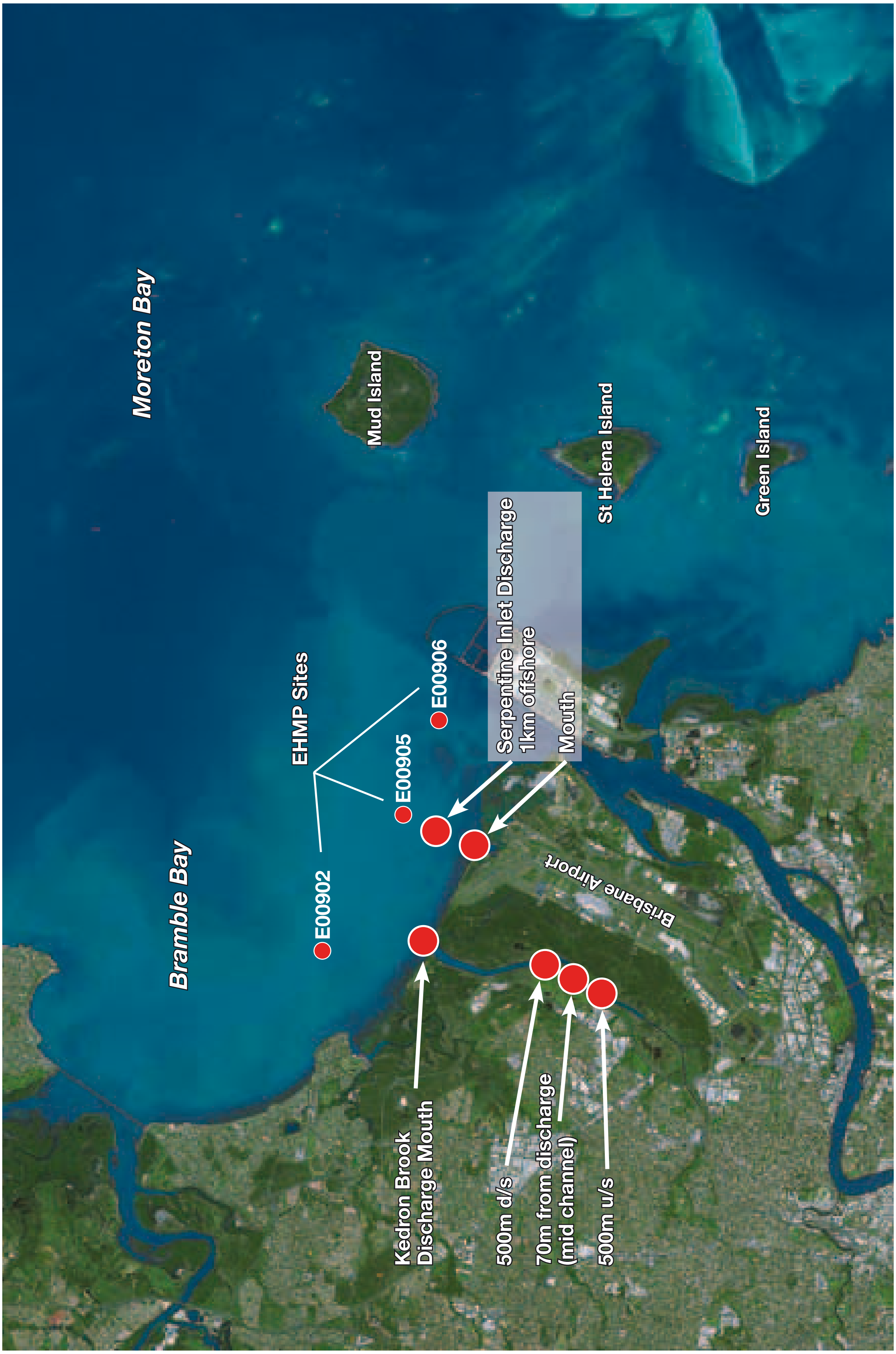


Figure 8.7d: *EHMP Monitoring Locations.*

Figure 8.7e: *Discharge Locations.*

For each location, time series were derived for the base case and for each discharge scenario (Kedron Brook or Serpentine Inlet). Selected time series are shown in **Figure 8.7f** to **Figure 8.7q** for each parameter and both Kedron Brook and Serpentine Inlet discharge scenarios at two locations.

Figure 8.7f: *TN at Kedron Brook Discharge Point – Kedron Brook Discharge Scenario.*

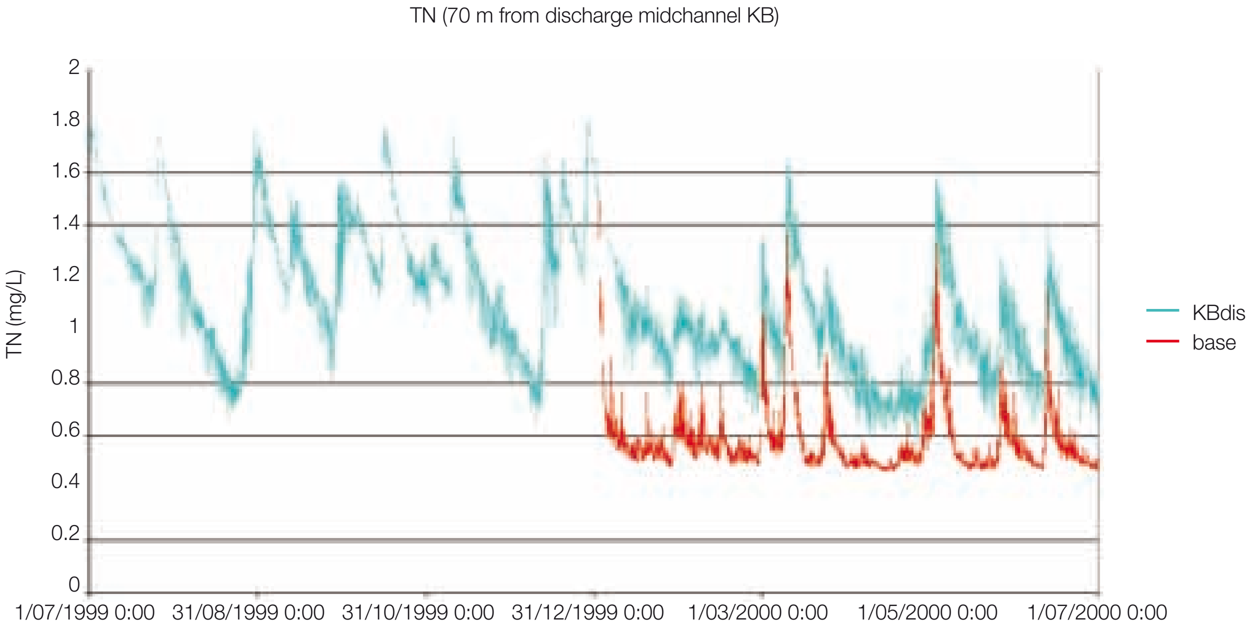


Figure 8.7g: *TP at Kedron Brook Discharge Point – Kedron Brook Discharge Scenario.*

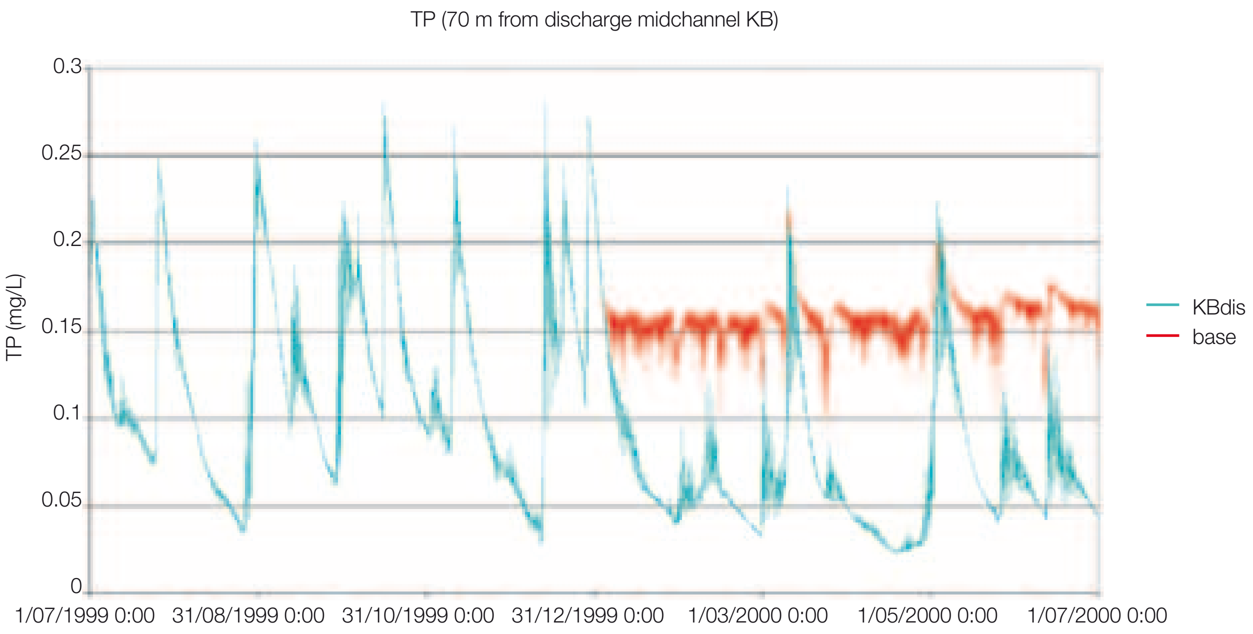


Figure 8.7h: *TSS at Kedron Brook Discharge Point – Kedron Brook Discharge Scenario.*

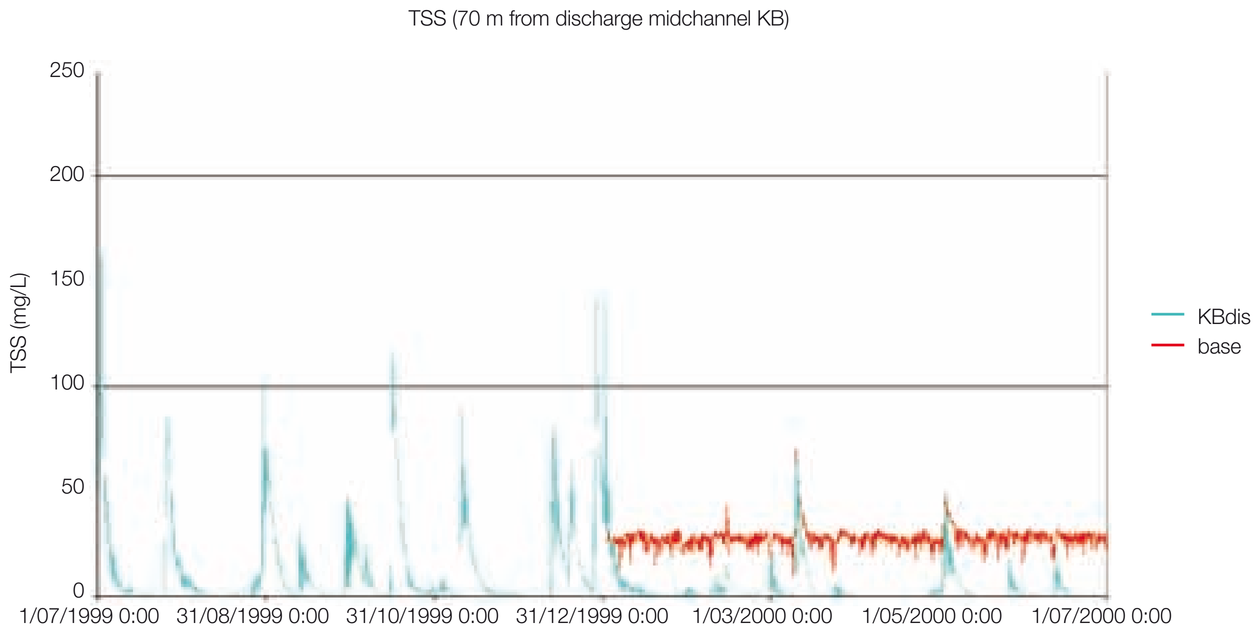


Figure 8.7i: *TN – EHMP Monitoring Point E00902 – Kedron Brook Discharge Scenario.*

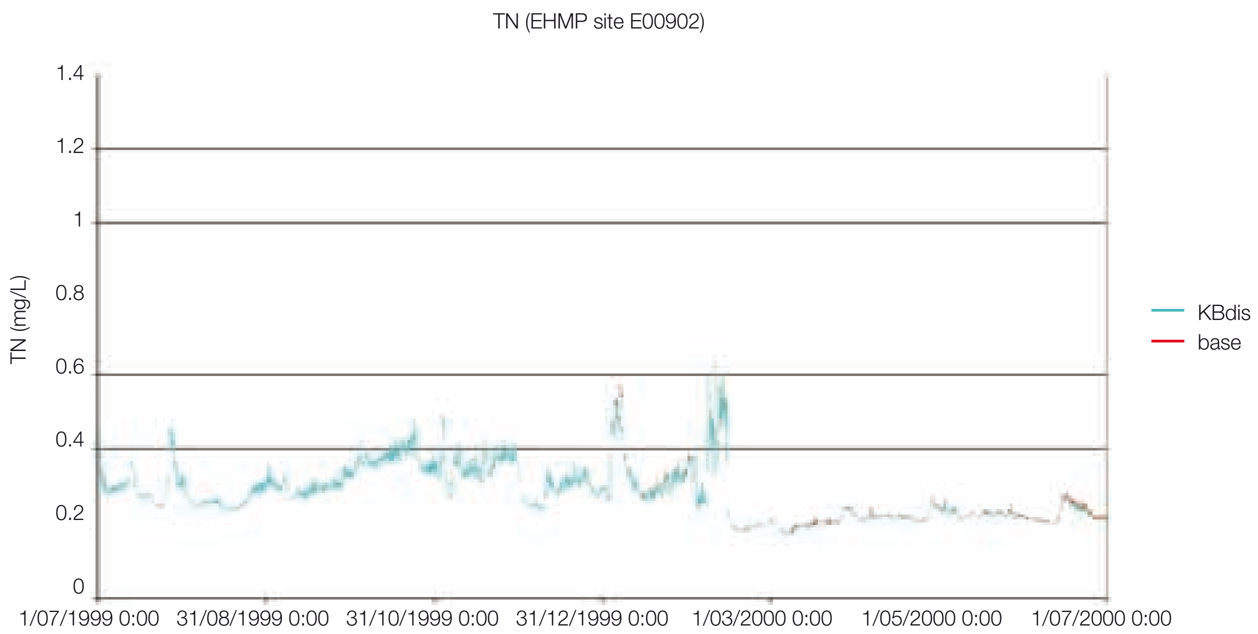


Figure 8.7j: *TP – EHMP Monitoring Point E00902 – Kedron Brook Discharge Scenario.*

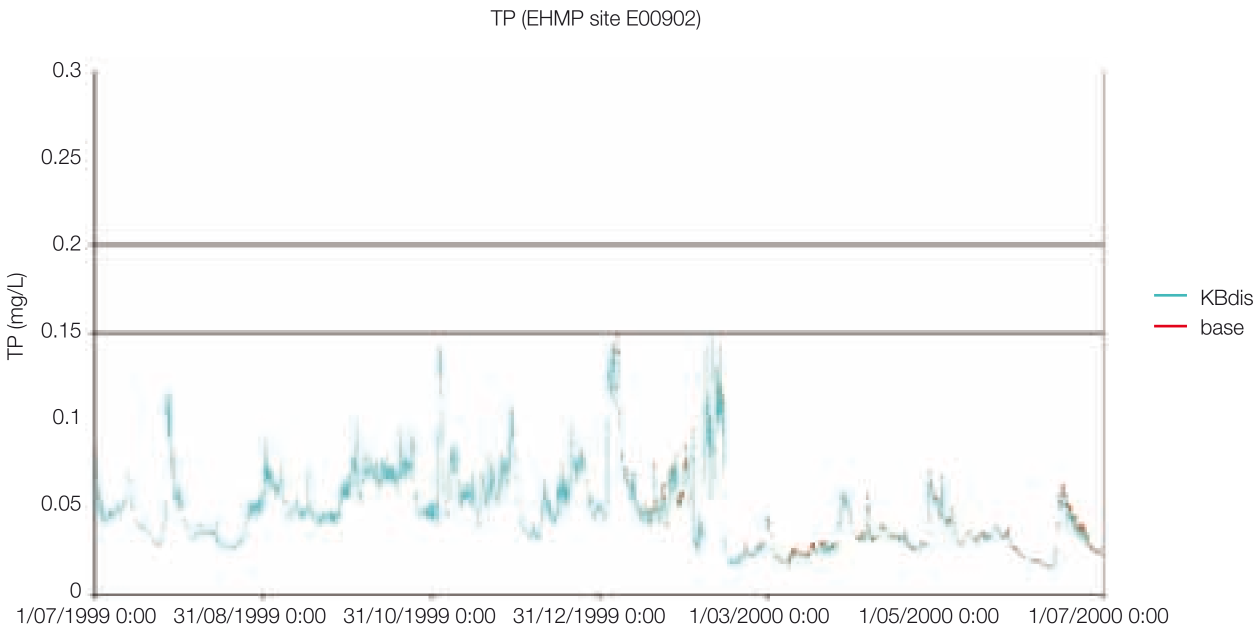


Figure 8.7k: *TSS – EHMP Monitoring Point E00902 – Kedron Brook Discharge Scenario.*

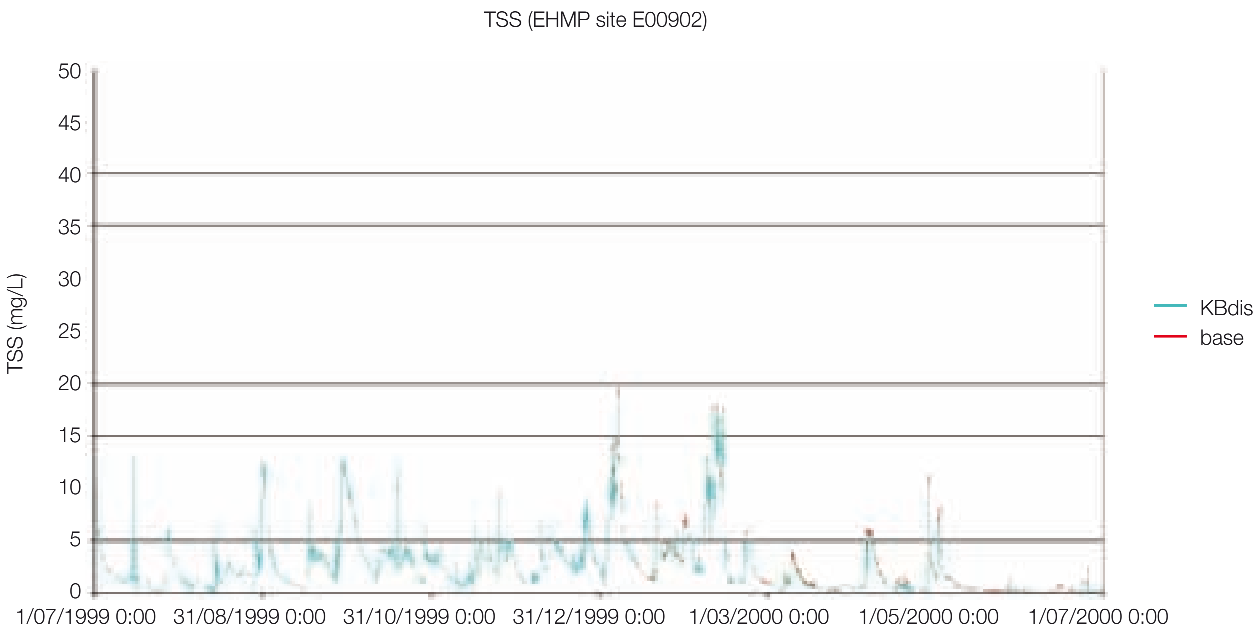


Figure 8.7l: *TN – Serpentine Inlet Mouth – Serpentine Inlet Discharge Scenario.*

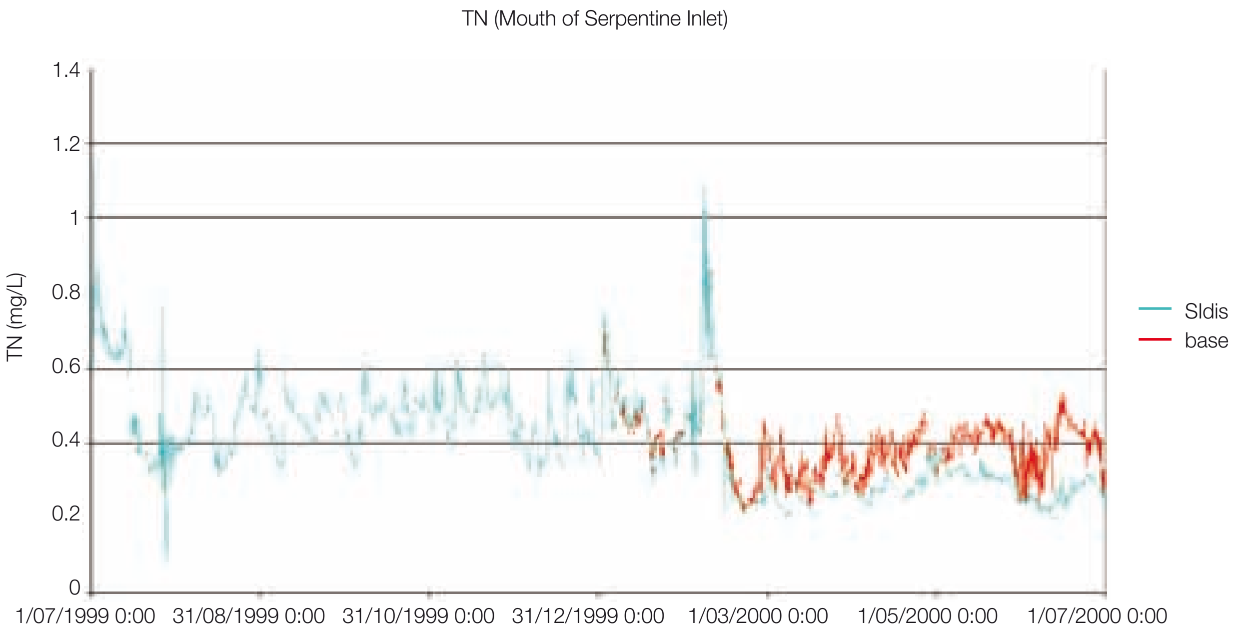


Figure 8.7m: *TP – Serpentine Inlet Mouth – Serpentine Inlet Discharge Scenario.*

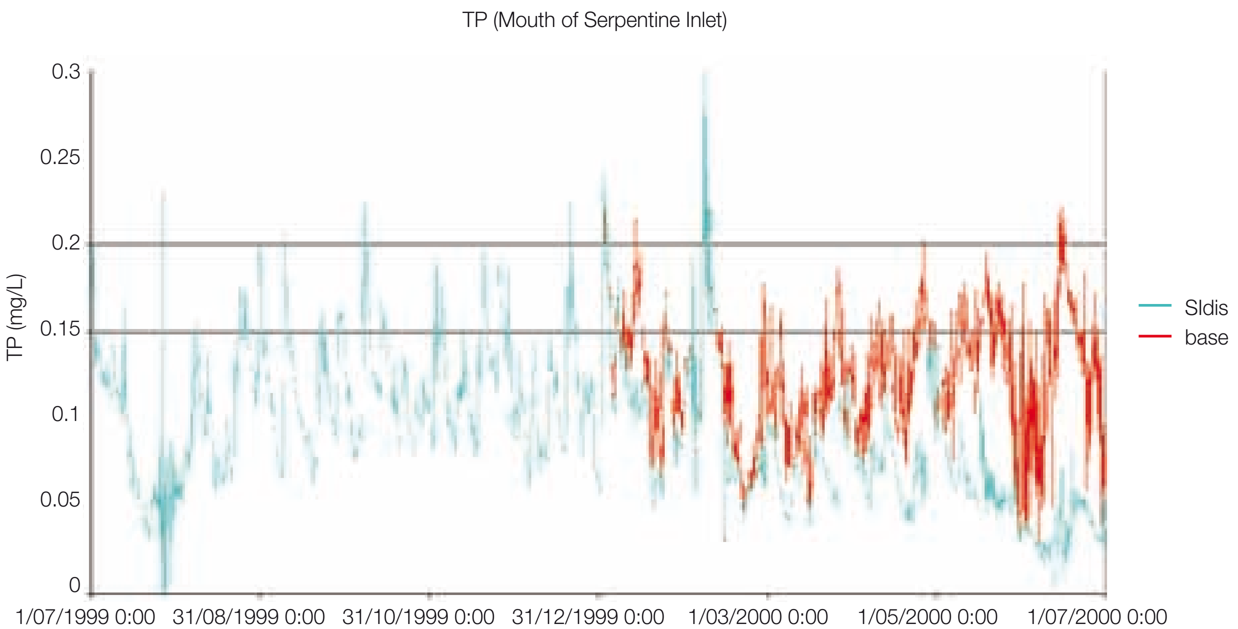


Figure 8.7n: *TSS – Serpentine Inlet Mouth – Serpentine Inlet Discharge Scenario.*

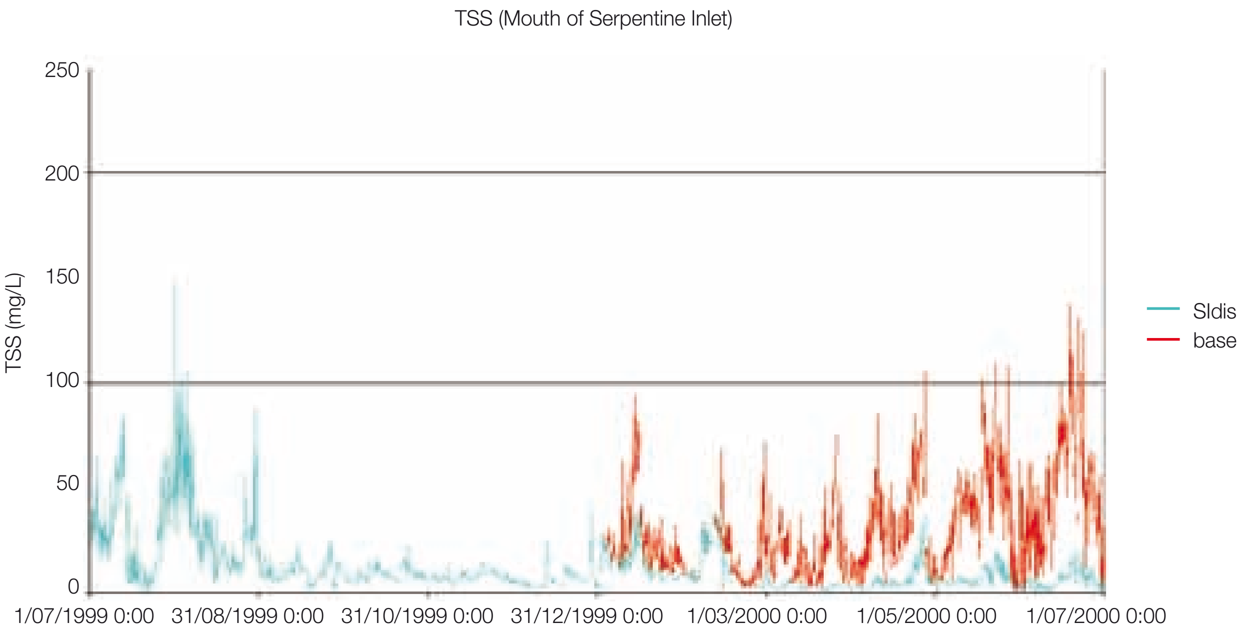


Figure 8.7o: *TN – EHMP Monitoring Point E00906 – Serpentine Inlet Discharge Scenario.*

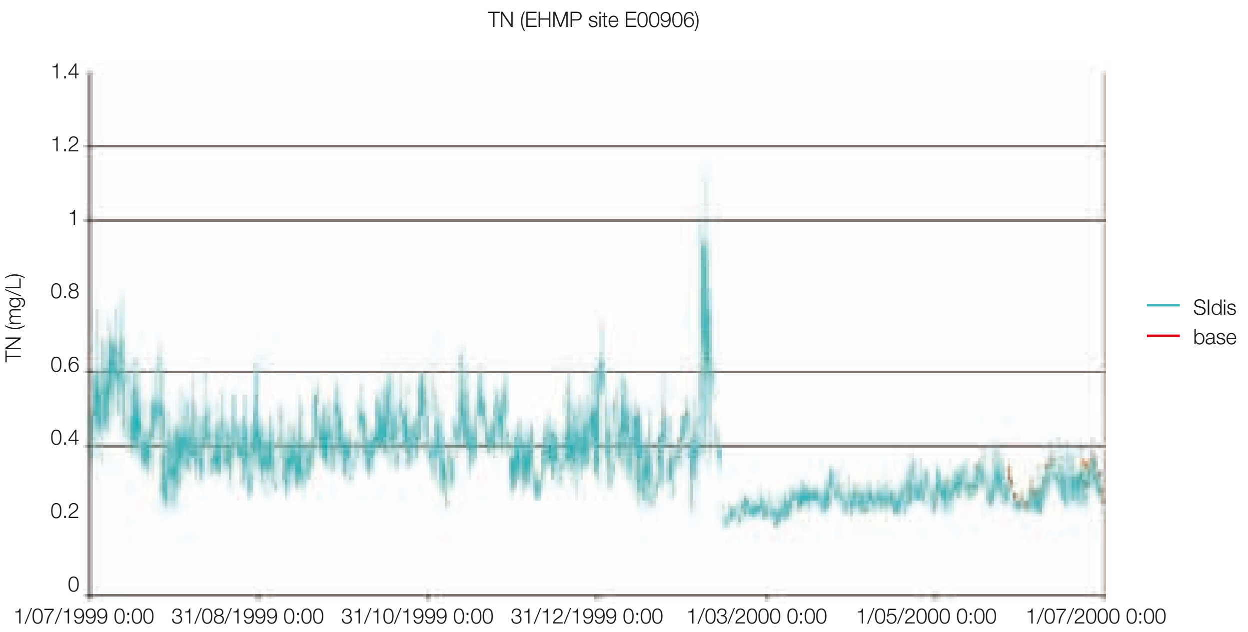


Figure 8.7p: *TP – EHMP Monitoring Point E00906 – Serpentine Inlet Discharge Scenario.*

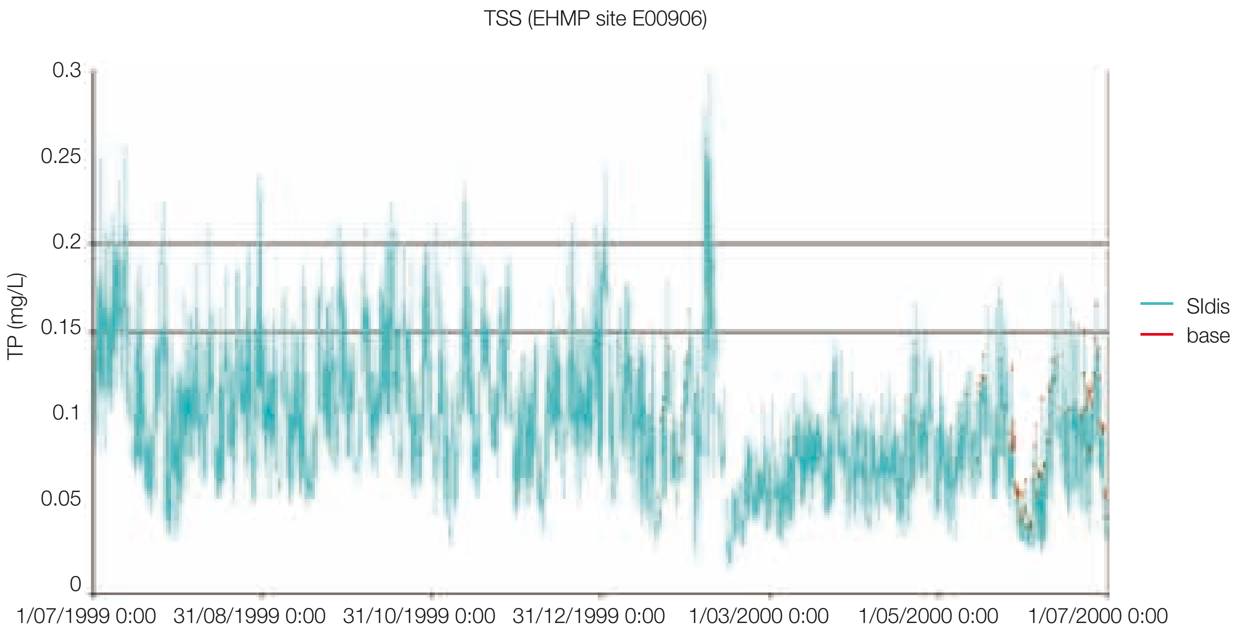
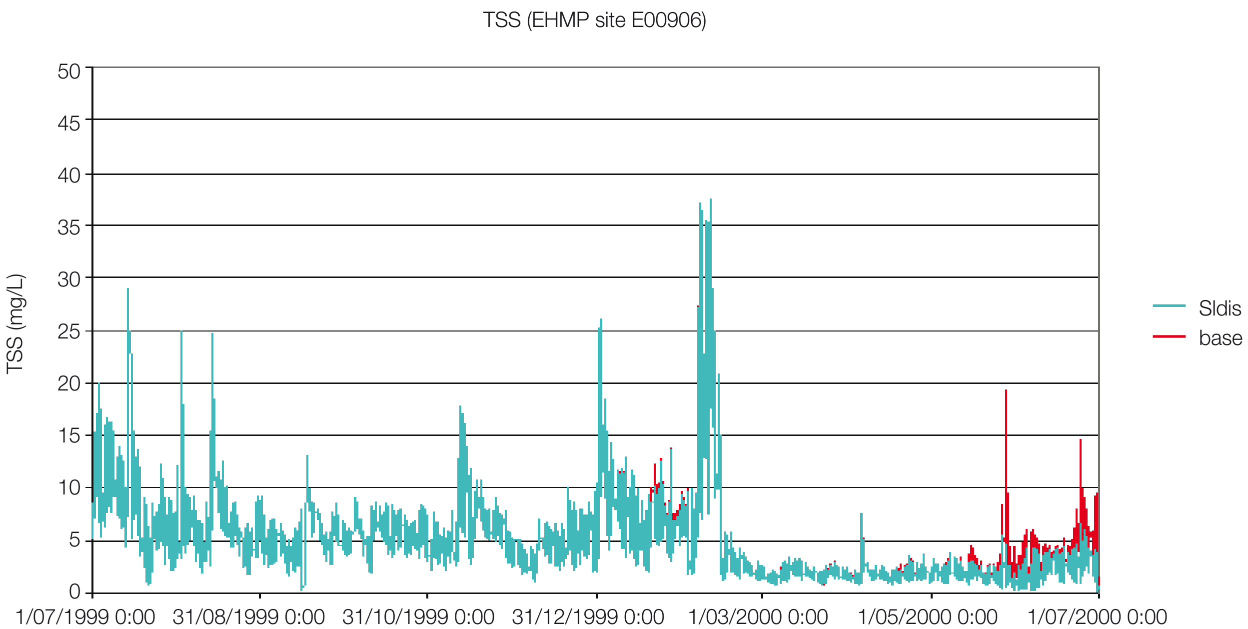


Figure 8.7q: *TSS – EHMP Monitoring Point E00906 – Serpentine Inlet Discharge Scenario.*



The modelling conducted as part of this impact assessment should be viewed in a comparative sense, that is the results of the discharge scenarios have been reported as changes to ambient concentrations, rather than explicit values, to assist in gauging the likely effects on existing water quality.

These time series indicate that while localised impacts are expected in the vicinity of the discharge, minimal effects are observed within Bramble Bay, where complete mixing has occurred. In the case of total nitrogen within Kedron Brook, given that the concentration of nitrogen in the discharge (derived from the Brisbane River water used for fluidisation) is less than that predicted within the Floodway, it may actually result in an improvement in nitrogen concentrations within Kedron Brook during the discharge. In all of the time series shown above, it is apparent that the concentrations of the immediate receiving waters become heavily influenced by the discharge, as could be expected given the volumes of discharge anticipated. During the discharge period though, large catchment inflow events result in concentrations being reduced for a short time post event, however they return to concentrations similar to the discharge reasonably quickly.

At the two EHMP sampling points shown in these time series, a slight increase is noticeable for total suspended solids due to the Serpentine Inlet discharge during the extended dry period at the latter half of the model run, though for the majority of time the concentrations at the locations are very similar to the base case. For this reason, while the time series provide an indication of the magnitude of concentration change, it is necessary to examine the data in greater detail to determine the effects on median concentrations within the receiving waters of interest.

8.7.4.8 Compliance Against Water Quality Objectives

Predicted changes to existing median water quality concentrations were obtained from all data extracted from the model. These allow comparison of likely compliance with established WQOs for the enclosed coastal and lower estuary receiving waters at Kedron Brook, Bramble Bay and Serpentine Inlet through reference to current ambient median water quality concentrations (2005/2006 BAC and EHMP monitoring data as per the Existing Environment section). This approach was taken given that existing water quality within the Kedron Brook Floodway and Bramble Bay exceeds water quality objectives for a range of parameters as discussed earlier.

Model results are presented below in tabular and graphical form as differences to median concentrations at all previously described model data analysis locations. In the graphical representations of the scenario predictions, two columns are shown to represent the effect at that location of each the two discharge scenarios (Kedron Brook and Serpentine Inlet discharges), such that the change above existing ambient water quality as a result of the relevant discharge scenario can be observed.

Table 8.7b: Total Nitrogen Annual Median Concentrations (mg/L).

Location	Kedron Brook discharge – Predicted change to current water quality	Serpentine Inlet discharge – Predicted change to current water quality	Ambient Kedron Brook (2005 median)	Ambient Bramble Bay (2005 Median)	Ambient Serpentine Inlet (2005 median)	WQO[4]
500 m downstream of discharge (KB)	-0.24	0.00	0.63			0.2
70 m from discharge mid-channel (KB)	-0.25	0.00	0.63			0.2
500 m upstream of discharge (KB)	-0.19	0.00	0.63			0.2
Mouth of KB	0.02	0.00	0.63			0.2
EHMP site E00902	0.00	0.00		0.16		0.2
EHMP site E00905	0.00	0.01		0.16		0.2
EHMP site E00906	0.00	0.00		0.16		0.2
Mouth of Serpentine Inlet	0.00	0.04			0.79	0.2
1 km offshore from Serpentine Inlet	0.00	0.02			0.79	0.2

[1] *WQO – Water Quality Objective*

Figure 8.7r: *Total Nitrogen Scenario Predictions.*

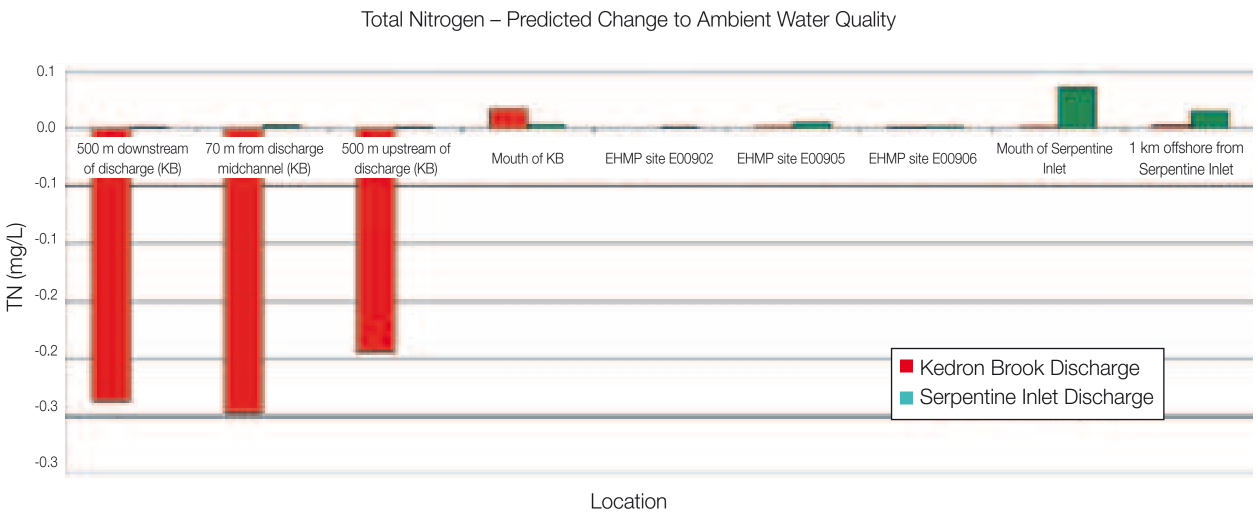


Table 8.7c: Total Phosphorus Annual Median Concentrations (mg/L).

Location	Kedron Brook discharge – Predicted change to current water quality	Serpentine Inlet discharge – Predicted change to current water quality	Ambient Kedron Brook (2005 median)	Ambient Bramble Bay (2005 Median)	Ambient Serpentine Inlet (2005 median)	WQO
500 m downstream of discharge (KB)	0.07	0.00	0.04			0.020
70 m from discharge midchannel (KB)	0.07	0.00	0.04			0.020
500 m upstream of discharge (KB)	0.05	0.00	0.04			0.020
Mouth of KB	0.02	0.01	0.04			0.020
EHMP site E00902	0.00	0.00		0.055		0.030
EHMP site E00905	0.00	0.00		0.055		0.030
EHMP site E00906	0.00	0.00		0.055		0.030
Mouth of Serpentine Inlet	0.00	0.03			0.1	0.020
1 km offshore from Serpentine Inlet	0.00	0.00			0.1	0.020

Figure 8.7s: *Total Phosphorus Scenario Predictions.*

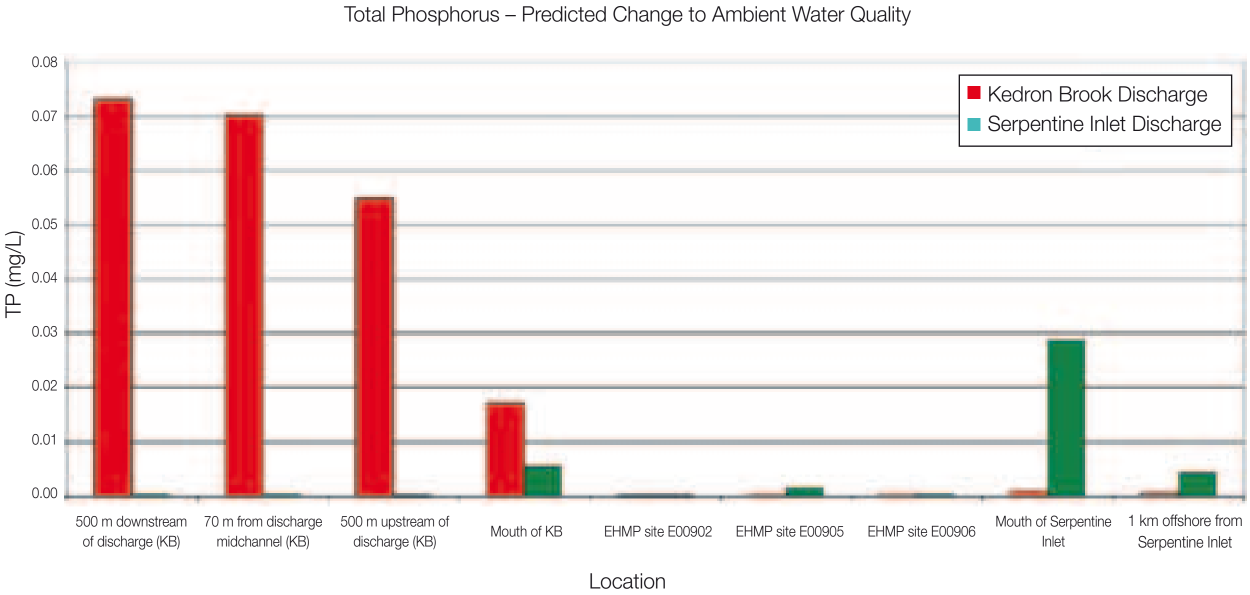


Table 8.7d: Turbidity Annual Median Concentrations (NTU).

Location	Kedron Brook discharge – Predicted change to current water quality	Serpentine Inlet discharge – Predicted change to current water quality	Ambient Kedron Brook (2005 median)	Ambient Bramble Bay (2005 Median)	Ambient Serpentine Inlet (2005 median)	WQO
500 m downstream of discharge (KB)	58.26	0.88	NA			6.00
70 m from discharge midchannel (KB)	58.03	0.39	NA			6.00
500 m upstream of discharge (KB)	37.22	0.14	NA			6.00
Mouth of KB	6.75	4.73	NA			6.00
EHMP site E00902	0.06	0.11		3.00		6.00
EHMP site E00905	0.38	1.68		3.00		6.00
EHMP site E00906	0.20	0.68		3.00		6.00
Mouth of Serpentine Inlet	2.43	15.44			NA	6.00
1 km offshore from Serpentine Inlet	0.88	4.46			NA	6.00

NA – Data not available/not collected

Figure 8.7t: *Turbidity Scenario Predictions.*

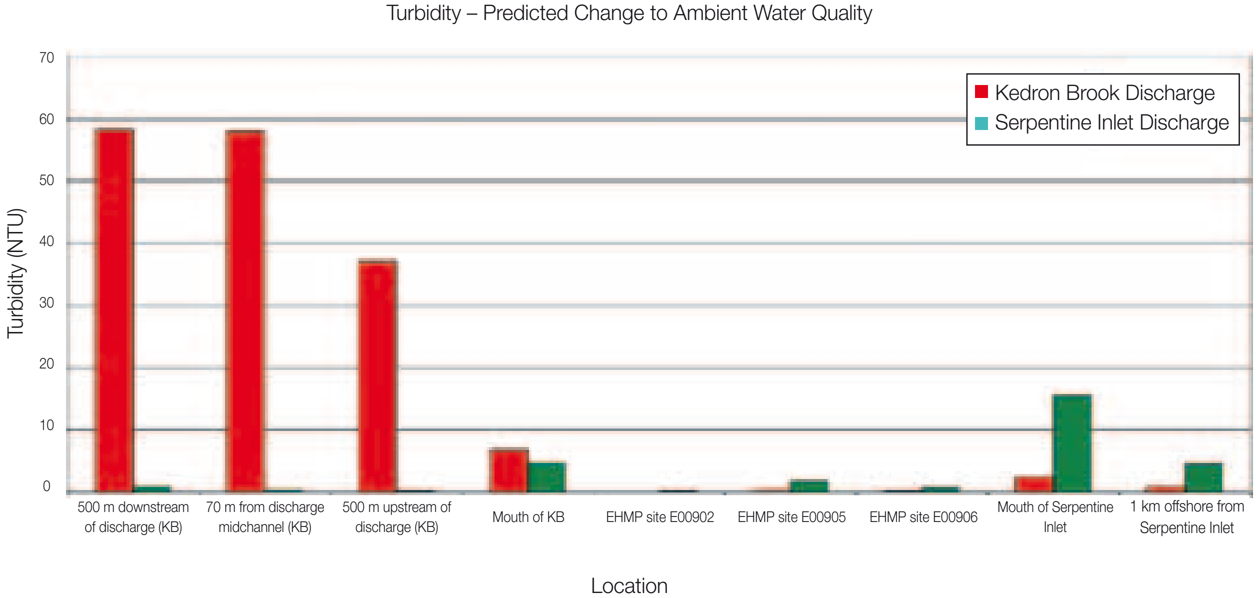
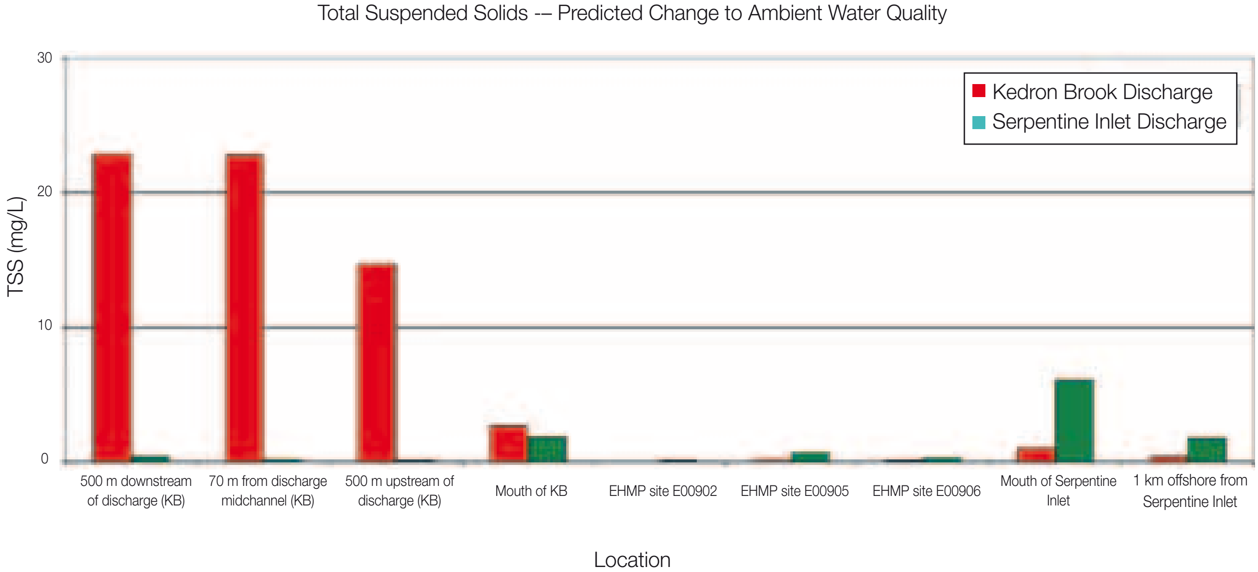


Table 8.7e: Total Suspended Solids Annual Median Concentrations (mg/L).

Location	Kedron Brook discharge – Predicted change to current water quality	Serpentine Inlet discharge – Predicted change to current water quality	Ambient Kedron Brook (2005 median)	Ambient Bramble Bay (2005 Median)	Ambient Serpentine Inlet (2005 median)	WQO
500 m downstream of discharge (KB)	22.85	0.35	41.5			15
70 m from discharge mid-channel (KB)	22.76	0.15	41.5			15
500 m upstream of discharge (KB)	14.59	0.05	41.5			15
Mouth of KB	2.65	1.85	41.5			15
EHMP site E00902	0.02	0.04		NA		N/A
EHMP site E00905	0.15	0.66		NA		N/A
EHMP site E00906	0.08	0.27		NA		N/A
Mouth of Serpentine Inlet	0.95	6.05			33.5	15
1 km offshore from Serpentine Inlet	0.34	1.75			33.5	15

N/A – Data not available/not collected

Figure 8.7u: *Total Suspended Solids Scenario Predictions.*



The results show that, as indicated by the time series, localised impacts in the vicinity of the discharge are likely to occur only during the discharge period, however minimal impacts are observed at the areas of complete mixing (Mouth of Kedron Brook and EHMP monitoring sites). What is also shown by the ambient median values and WQOs at both Kedron Brook and Serpentine Inlet is that, as discussed in the Existing Environment section, for the majority of parameters, the ambient concentrations are already significantly higher than the water quality objectives for those locations.

If the predicted changes to median concentrations for the discharge scenarios are considered, it can be seen that at the Kedron Brook Floodway it is likely in the vicinity of discharge that concentrations will be considerably elevated above background, with the exception of Total Nitrogen, as it is predicted to be a zone of poor mixing. It is therefore considered that at those locations, compliance with water quality objectives is not likely to be achieved for total phosphorus and turbidity, though compliance with total suspended solids may be possible depending on actual ambient concentrations. The modelling predicts that Total Nitrogen concentrations may reduce in Kedron Brook during discharge from the sedimentation pond as existing nitrogen concentrations in the Brisbane River (which will be the dominant influence of nitrogen concentrations in the discharged water) are less than that in Kedron Brook Floodway, resulting in possible slight dilution of the nitrogen with the Floodway.

When moving out into zones of more complete mixing, the localised impacts reduce significantly. Of both discharges, the Kedron Brook discharge appears to have lesser impact on the EHMP monitoring sites than the Serpentine Inlet discharge, and this may be due to the tidal discharge of the latter, as it is anticipated to only occur when the sea level is higher than mean sea level. This may cause concentrations to be more elevated over shorter time periods than if a continuous discharge occurred, however constant discharge at Serpentine Inlet is not desirable from an ecological perspective in terms of potential scour as discussed in Chapter B5.

It must be stressed in considering these impacts that existing ambient concentrations for a range of parameters at both Kedron Brook and Serpentine Inlet locations already do not meet water quality objectives, hence the construction phase water quality is not likely to be a major cause of non-compliance with WQOs. The results also indicate that the construction phase water quality impacts are not likely to result in non-compliance with WQOs for any of the parameters where compliance is currently being achieved.

In terms of impacts further out in Moreton Bay and on the annual EHMP report card rating, the model was examined at locations in the central bay, however no changes in concentrations at this location due to the construction phase were predicted. As such, the concentrations at these locations are expected to be influenced much more significantly by catchment and wastewater treatment plant inputs than any discharges from the construction or operation phases of the NPR project. On an annual basis, a 'report card' is generated for the waterways of South East Queensland. In Moreton Bay, the report card ratings are based not only on water quality, but also on several other ecological parameters (e.g. seagrass depth range). As such, it is not possible to accurately predict likely report card ratings simply from water quality modelling. That being said, the key input into the report card from the modelling is total phosphorus results. Given that the modelling results outlined above show minimal, if any, change in total phosphorus at the closest three EHMP monitoring sites, it is considered very unlikely that any change in report card rating could be attributed to the NPR project.

Sensitivity testing of the discharge period was also undertaken and median values for scenarios of extended discharge duration were obtained from additional model runs. These scenarios were developed to examine if discharging over a longer duration (possible if a smaller dredge than that considered for the modelling is used), it was assumed that the equivalent total discharge would occur over a nine month period rather than six months to determine sensitivity of the median values to this change as it was felt that given the median represents the 50^{th} percentile value, and that the discharge was occurring for 50 percent of the model time period, any extension of discharge may have significantly changed the results. In this case, median concentrations for the 6 month and 9 month discharge scenarios are given below (rather than the difference to ambient concentrations given above):

Table 8.7f: Total Nitrogen Median Concentrations (mg/L) 6 and 9 month Discharge Scenarios.

Location	KB 6 month discharge	KB 9 month discharge	SI 6 month discharge	SI 9 month discharge
500 m downstream of discharge (KB)	0.77	0.63	1.01	1.01
70 m from discharge midchannel (KB)	0.83	0.66	1.08	1.09
500 m upstream of discharge (KB)	0.96	0.78	1.16	1.16
Mouth of KB	0.44	0.44	0.42	0.43
Mouth of Serpentine Inlet	0.40	0.39	0.43	0.43
1 km offshore from Serpentine Inlet	0.35	0.35	0.36	0.36
EHMP site E00902	0.27	0.27	0.27	0.27
EHMP site E00905	0.32	0.32	0.32	0.32
EHMP site E00906	0.34	0.34	0.34	0.34

Table 8.7g: Total Phosphorus Median Concentrations (mg/L) 6 and 9 month Discharge Scenarios.

Location	KB 6 month discharge	KB 9 month discharge	SI 6 month discharge	SI 9 month discharge
500 m downstream of discharge (KB)	0.153	0.148	0.080	0.079
70 m from discharge mid-channel (KB)	0.153	0.149	0.083	0.082
500 m upstream of discharge (KB)	0.143	0.143	0.089	0.087
Mouth of KB	0.094	0.094	0.083	0.082
Mouth of Serpentine Inlet	0.090	0.091	0.118	0.119
1 km offshore from Serpentine Inlet	0.083	0.084	0.087	0.086
EHMP site E00902	0.044	0.044	0.044	0.043
EHMP site E00905	0.068	0.068	0.069	0.068
EHMP site E00906	0.092	0.093	0.093	0.091

Table 8.7h: Turbidity Median Concentrations (NTU) 6 and 9 month Discharge Scenarios.

Location	KB 6 month discharge	KB 9 month discharge	SI 6 month discharge	SI 9 month discharge
500 m downstream of discharge (KB)	61.8	56.7	4.4	4.4
70m from discharge mid-channel (KB)	61.6	58.9	3.9	3.9
500 m upstream of discharge (KB)	40.8	48.2	3.7	3.7
Mouth of KB	17.1	17.6	15.1	17.4
Mouth of Serpentine Inlet	21.4	21.1	34.4	44.2
1 km offshore from Serpentine Inlet	12.3	12.2	15.9	17.2
EHMP site E00902	4.1	4.2	4.2	4.5
EHMP site E00905	8.6	8.6	9.9	10.5
EHMP site E00906	10.7	10.7	11.2	11.3

Table 8.7i: Total Suspended Solids Median Concentrations (mg/L) 6 and 9 month Discharge Scenarios.

Location	KB 6mth discharge	KB 9mth discharge	SI 6mth discharge	SI 9mth discharge
500 m downstream of discharge (KB)	24.2	22.2	1.7	1.7
70 m from discharge mid-channel (KB)	24.1	23.1	1.5	1.5
500 m upstream of discharge (KB)	16.0	18.9	1.4	1.4
Mouth of KB	6.7	6.9	5.9	6.8
Mouth of Serpentine Inlet	8.4	8.3	13.5	17.3
1 km offshore from Serpentine Inlet	4.8	4.8	6.2	6.7
EHMP site E00902	1.6	1.6	1.6	1.8
EHMP site E00905	3.4	3.4	3.9	4.1
EHMP site E00906	4.2	4.2	4.4	4.4

These results show that the extension of the discharge from six months to nine months (though the same overall volume of discharge) is not likely have significantly different impacts from the six month discharge scenario.

8.7.4.9 Summary – Construction Phase Impacts

Existing, ambient, concentrations at the proposed supernatant discharge locations in Kedron Brook Floodway and Serpentine Inlet are elevated and in the majority of cases, exceed relevant water quality objectives most likely due to catchment and wastewater treatment plant inputs. The model predictions indicate that for most parameters, some impact at locations close to the discharge points are expected, however these reduce significantly at locations where some mixing has occurred. For each parameter, it is likely that the construction operations will have a negligible impact on the receiving waters of Bramble Bay and given the negligible change in concentrations, are not anticipated to exacerbate existing water quality issues in Bramble Bay such as algal blooms or seagrass loss. The existing water quality is such that water quality objectives are not being achieved for a range of parameters and the modelling results show that while some localised, short term impacts are expected, these are not likely to cause long term water quality issues.

8.7.4.10 Construction Phase Impacts – Monitoring

Chapter B14 (Environmental Management Framework) outlines water quality monitoring requirements that are proposed to validate modelling results and to measure impacts during the construction implementation phase. A more detailed water quality monitoring plan is proposed to be developed as part of the detailed design phase of the project based on the requirements summarised below:

Table 8.7j: Water Quality Monitoring Plan Summary.

<table>
<tr><td>Management Objective</td><td colspan="3">Minimise changes to water quality from construction activities.</td></tr>
<tr><td>Statutory Requirement</td><td colspan="3">• Environmental Protection and Biodiversity Conservation Act, 1999
• Environmental Protection Act, 1994
• Environmental Protection (Water) Policy, 1997
• Coastal Protection and Management Act, 1995 and coastal management plans.</td></tr>
<tr><td>Performance Criteria</td><td colspan="3">• Compliance with the management provisions in the Construction (EMP).
• The TSS weekly monitoring at the outlet of the sediment pond will be based on the 80th percentile expected basin performance TSS concentration. For the sedimentation pond configuration, this has been calculated as 80 mg/L.
• No change in Annual EHMP Report Card rating for EHMP sites E00902, E00905 and E00906.</td></tr>
<tr><td>Implementation Strategy</td><td colspan="3">• Ensure best practice erosion and sediment controls used on-site to minimise excess sediment being liberated during storm events.
• Ensure sediment ponds are operating at optimum efficiency.</td></tr>
<tr><td rowspan="9">Monitoring</td><td colspan="3">• Monitoring of supernatant discharge from sediment ponds (at the weir outlet) to be conducted on a daily basis for pH, Dissolved Oxygen and Turbidity and on a weekly basis for total iron, total nitrogen, total phosphorus and total suspended solids as tabulated below.
• In addition, visual observations will be conducted to check for scum formation, oil films etc which may suggest spillage of construction materials/substances.
• Weekly monitoring of locations at the mouth of Kedron Brook and Serpentine Inlet and at EHMP monitoring sites E00905, E00906 and E00902 for turbidity, total suspended solids, total nitrogen and total phosphorus for the first two months of construction, thereafter relying on routine monthly sampling as part of the EHMP monitoring episodes conducted by the Queensland EPA.</td></tr>
<tr><td></td><td>Test type</td><td>Frequency</td></tr>
<tr><td>Total Iron (Fe)</td><td>Laboratory</td><td>Weekly</td></tr>
<tr><td>Total Nitrogen (TN)</td><td>Laboratory</td><td>Weekly</td></tr>
<tr><td>Total Phosporus (TP)</td><td>Laboratory</td><td>Weekly</td></tr>
<tr><td>Total Suspended Solids (TSS)</td><td>Laboratory</td><td>Weekly</td></tr>
<tr><td>pH</td><td>On-site</td><td>Daily</td></tr>
<tr><td>Dissolved Oxygen (O_2)</td><td>On-site</td><td>Daily</td></tr>
<tr><td>Turbidity (NTU)</td><td>On-site</td><td>Daily</td></tr>
<tr><td>Auditing and Reporting</td><td colspan="3">• Weekly reporting of pH, Dissolved Oxygen and Turbidity to the BAC Project Manager for review.
• Monthly reporting of Total Fe, TN, TP and TSS to BAC Project Manager for review.
• A post-construction monitoring report will be prepared at the end of the reclamation process.</td></tr>
<tr><td>Corrective Action</td><td colspan="3">• The normal procedure will be to discharge the supernatant directly over the weir outlet.
• If exceedance of the 80th percentile TSS concentration is noted for two consecutive days then the following hierarchy of contingency will be implemented:
- Allow supernatant from the filling cells to be redirected to the sediment pond via other cells to allow further settlement before discharge.
- Continue monitoring. If further exceedance of the 80th percentile objective is noted on the subsequent day, then install silt curtains where the filling cell is being discharged into subsequent cells, and at the inlet to the sediment pond.
- Continue monitoring. If exceedance is still occurring on the subsequent day then flocculation of the sediment pond and/or subsequent cells will be performed.
- Continue monitoring. If exceedance of the 80th percentile is still occurring on the subsequent day, consider ceasing or reducing dredging to allow further settlement.</td></tr>
<tr><td>Responsibility</td><td colspan="3">Construction Contractor</td></tr>
<tr><td>Timing</td><td colspan="3">Throughout construction phase.</td></tr>
</table>

8.7.4.11 *Operational Phase Impacts*

The operational phase of the NPR is expected to be very similar to existing operations on the Airport site. A recent study by QUT researchers investigated the quality of stormwater from these existing operations and provides useful background information for the impact assessment. The study also investigated the performance of stormwater management measures used on the Airport site to manage stormwater quality and concluded that minimal impacts to water quality are expected.

As part of detailed engineering design of the NPR project, the project design team completed a Stormwater Quality Report (Maunsell, June 2006) which is contained in **Appendix B**. The Report outlined the best management practices which would minimise the water quality impacts from stormwater during the operational phase of the project. The report stated that the most likely contaminants from runway and taxiway operations would include:

- Inorganic solid particulates (sediments) from atmospheric deposition, runway pavement aggregates and adjacent vegetated areas;
- Organic particulates from adjacent vegetated areas;
- Rubber particles from aircraft landing;
- Organic compounds (including volatile compounds) from aircraft emissions; and
- Heavy metals from aircraft components.

It should be noted that given the nature of operations on the Airport site, constraints on the type of stormwater quality management measures to be able to be used include:

- Physical constraints limiting the use of significant vegetation structure (e.g. trees);
- Minimising the potential for creation of bird and other fauna habitats;
- Consideration of the conveyance capacity given the low-lying and flat nature of the site; and
- Optimisation of the measures to reduce maintenance burdens given accessibility issues through the airfield given that it is in continuous operation.

As such, best management practices such as grassed buffers and grassed swales (which are currently in use on the existing runway site) were considered most suitable for the NPR project as they best addressed the stormwater quality improvement requirements whilst also falling within the constraints outlined above.

To assess the impacts of the site, two MUSIC models were developed to simulate stormwater run-off draining to Kedron Brook and Bramble Bay (through Serpentine Inlet) respectively. MUSIC, the Model for Urban Stormwater Improvement Conceptualisation, was developed by the Cooperative Research Centre for Catchment Hydrology and is now supported by the eWater CRC. MUSIC is a continuous simulation model that allows users to develop ‘node-link’ style networks simulating run-off and pollutant sources, treatment measures, drainage links and receiving waters. It is especially suited to assessing the performance of Water Sensitive Urban Design (WSUD) measures such as grassed swales and buffer strips.

As developed, the MUSIC models contained a network of source nodes, buffer strip and grassed swale treatment nodes and a receiving node. At this receiving node, the model was interrogated to quantify the performance of the treatment measures selected. **Table 8.7k** and **8.7l** list the results that were acheived.

Table 8.7k: Kedron Brook Outlet MUSIC Results.

Parameter	% Reduction Load	Median Concentration (mg/L)	Relevant WQO* mg/L
Total Suspended Solids	59.0	14.0	15.0
Total Phosphorous	67.0	0.17	0.02
Total Nitrogen	63.0	2.1	0.2

Table 8.7l: Serpentine Inlet Outlet MUSIC Results.

Parameter	% Reduction Load	Median Concentration (mg/L)	Relevant WQO* mg/L
Total Suspended Solids	82.0	14.0	15.0
Total Phosphorous	85.0	0.13	0.02
Total Nitrogen	63.0	1.5	0.2

** From Schedule 1 Environmental Protection (Water) Policy 1997*

The above results show that the treatment measures selected significantly reduce pollutant loads from the NPR site and that the relevant water quality objectives for Total Suspended Solids is achieved. As discussed earlier in this report, stormwater monitoring undertaken by QUT has shown that currently, discharges from the Airport apron contain low levels of suspended solids and these would be further reduced by the treatment measures proposed, as shown in the MUSIC results above. The nature of the NPR filling process will result in considerable infiltration of stormwater during rainfall events given the sand substrate which will be present across much of the site. This will result in stormwater flows only during larger rainfall events. As such, results from MUSIC modelling have not been used as input parameters into the Moreton Bay receiving water quality model as it is not anticipated that the minimal change in stormwater quality from the Airport site would be quantifiable given the much higher pollutant loads from the major off-airport catchments draining into Moreton Bay during large rainfall events. It is therefore concluded that the operational phase impacts on the receiving waters of Kedron Brook and Moreton Bay will be negligible.

8.8 Cumulative and Interactive Effects

As seen by the concentrations at the EHMP monitoring sites, the interactive effects of discharges with the receiving waters of Bramble Bay and the remainder of Moreton Bay are likely to be minimal and would only occur during the period of discharge. Given that the changes concentrations at the EHMP sites during the construction phase are very small, and within the range of natural variation expected at those locations, it is unlikely that any cumulative effects will be detectable. It should also be realised that the WQOs used for assessment of compliance are considered the desirable long term water quality to achieve Environmental Values. For most waterways within the urbanised regions of South East Queensland, these objectives are not currently being achieved, but have been set to provide long term goals.

As stated earlier, it is highly likely that discharges from the Luggage Point Wastewater Treatment Plant will reduce significantly or even cease altogether if current efforts to reuse this treated wastewater are realised. This would mean that both nitrogen and phosphorus at the mooring point where water will be source for fluidisation will have considerably lower concentrations than that used in the modelling.
As such, the results predicted for both nitrogen and phosphorus should be considered very conservative estimates should wastewater reuse be completed.

8.9 Mitigation Measures

8.9.1 Sediment

The mitigation measures proposed for the component works revolve around the reduction in sediment discharge off-site through the utilisation of sedimentation ponds. The performance of these ponds has been derived through analysis by design staff to achieve a discharge quality of the order of 50 mg/L defined as a median concentration to be achieved through the construction phase, which is consistent with other performance data for these types of measures (ARQ 2006, BCC 2001). Obviously, reductions in this concentration would result in lesser impacts in terms of turbidity and total suspended solids in both the vicinity of the discharge and at the EHMP monitoring locations. Wherever practical, opportunities to limit entrainment of on-site sediments during the construction process will be undertaken, consistent with best practice erosion and sediment controls.

8.9.2 Nutrients

While localised nutrient impacts are predicted to be observed in the vicinity of the discharges, the source of these nutrients is the dissolved nutrients in Brisbane River water at the point of extraction for use in the fluidisation process, and as such this analysis has been highly conservative (i.e. nutrient loads from the Brisbane River to 'compensate' for the transfer of water from the River, through the Airport and subsequently into Kedron Brook and Serpentine Inlet have not been removed). This Brisbane River water and associated nutrient load will be presently influencing water quality levels at the EHMP monitoring sites.

Also considered was a form of biological treatment of these tailwaters to reduce their inherent nutrient levels, however given the salinity of this water, conventional nutrient reduction practices such as wetlands, grassed swales and bioretention systems will not be possible given the difficulty of establishing suitable vegetation in these measures that could tolerate the elevated salinity. This is currently observable in areas around the Airport where salt scalding is present in areas of continuous saline water inundation and in areas under wetting and drying regimes such as tidal drains. There are currently no known practical, cost-effective treatments for reducing nutrient concentrations in saline water associated with large scale construction projects such as that proposed for the NPR.

8.10 Residual Effects

Residual effects from the discharge of supernatant water from the site are likely to be constrained to deposition of sediments over the localised sea bed. This is expected to be a gradual settling from the discharge, reducing as it moves further offshore. Quantification of the depth of deposition has not been determined, or has it been able to be compared against existing sediment deposition given the current elevated ambient suspended solids concentrations as outlined in the existing environment sections and discussed above. This is an existing area of both high sedimentation and sediment resuspension (due to wind wave action), and such localised effects are not expected to be detectable beyond several months after the completion of the capital works program.

8.11 Assessment Summary Matrix

Based on the above assessments, a summary of potential impacts is provided in the following matrix.

Table 8.11: Assessment Summary Matrix.

EIS Area: Water Quality Feature/ description	Current Value + Substitutable Y:N	Description of Impact			Additional Compensation (Beyond Standard Practice)
		Impact	Mitigation Inherent in Design/ Standard Practice Amelioration	Significance Criteria	
Bramble Bay and Kedron Brook water quality	Impacts would affect Bramble Bay and Kedron Brook. Not substitutable	Water quality within Bramble Bay or Kedron Brook Floodway area is temporarily impacted such that mitigation measures prevent changes to water quality over an annual period, though short term exceedences may occur during construction activities.	Sedimentation ponds proposed to manage turbidity and suspended solids in discharge. Best practice erosion and sediment controls to be undertaken to limit entrainment of on-site sediments during the reclamation and filling process.	Minor to negligible, -ve, D, T	Nil

Key:
Significance Criteria: Major, High, Moderate, Minor; Negligible
+ve positive; -ve negative
D – direct; I – indirect
C – cumulative; P – permanent; T – temporary
ST – short term; MT – medium term; LT long term

References

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