

# Derivation of Local Turbidity and Secchi Depth Guidelines for the Fitzroy River Estuary, Central Queensland

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Andrew Moss, 2011. Derivation of local turbidity and Secchi depth guidelines for the Fitzroy River estuary, Central Queensland. Brisbane: Department of Environment and Resource Management, Queensland Government

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#29903

## **Introduction**

This short paper has been prepared to outline the process used in deriving local turbidity and Secchi depth water quality guidelines for the Fitzroy River estuary, Central Queensland. The guidelines discussed in this paper are for the 'aquatic ecosystem' environmental value only, and do not apply to human uses (for example irrigation, recreation). Outputs from this review have been used in the development of scheduled environmental values and water quality objectives under the Environmental Protection (Water) Policy 2009. Other water quality indicators that have not been considered in this paper are addressed in the Environmental Protection (Water) Policy 2009 schedule documents, based on relevant Queensland or national water quality guidelines. The Queensland water quality guidelines and documents scheduled under the Environmental Protection (Water) Policy 2009 are available from <[www.derm.qld.gov.au](http://www.derm.qld.gov.au)>.

## **Turbidity and Secchi depth in the Fitzroy estuary: background**

During significant freshwater floods, the Fitzroy estuary receives catchment inflows containing high levels of fine particulates. As a result, in immediate post-flood periods the estuary is highly turbid, with turbidity levels between 500 and 1000 Nephelometric Turbidity Units (NTU) not uncommon. Water clarity as measured by Secchi depth is correspondingly very low, with values often <0.1m. Turbidity during these periods is highly variable and it is not possible to derive any consistent guidelines for these conditions.

In subsequent baseflow periods, turbidity levels in the estuary decrease due to sedimentation and dispersion of the particulates. However, the Fitzroy estuary is ~60km long and has a spring tidal range >4.0m. As a result, it experiences strong tidal currents along much of its length. These currents ensure that a residual proportion of the sediments remain more or less permanently in suspension so that, even in dry weather, the estuary retains naturally quite high levels of turbidity (and conversely poor clarity—as measured by Secchi depth). The actual level of turbidity varies with the neap-spring tidal cycle but the extent of variability under baseflow conditions is much less than during wet weather. This means that it is possible to characterise typical turbidity ranges and hence derive some baseflow guidelines. Because of the inherent variability, the guidelines need to be conservative and incorporate wide margins of error. Nevertheless it is possible to provide some guidance on what ranges of turbidity can be expected in the estuary in dry weather. Because turbidity naturally varies along the estuary it is necessary to specify different guidelines for mid and upper estuary reaches. In the lower estuarine reaches, turbidity is so high and variable that it is not considered useful to derive guidelines.

## **Deriving turbidity and clarity guidelines**

Given that we have no idea what pre-European turbidity levels were in the Fitzroy estuary, guidelines have had to be based on current condition. Initially, the study team compiled turbidity and conductivity data (monthly data from 1994 to 2011) for each of the 13 routinely monitored sites in the Fitzroy estuary. The turbidity data at each site was then plotted against the conductivity values at that site. A typical plot is shown in Figure 1 below.

**Figure 1: Plot of turbidity and conductivity showing effect of freshwater inflows on turbidity values**

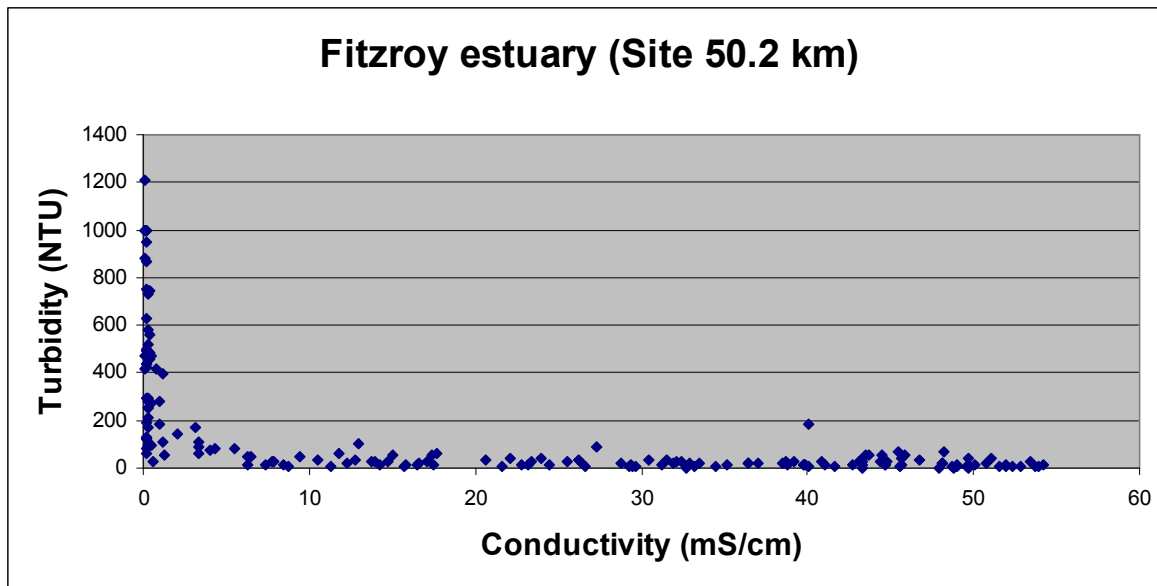


Figure 1 clearly illustrates the wet/dry divide, with high and very variable turbidity values at conductivity values of <5 millisiemens per centimetre (mS/cm) (i.e. periods of freshwater inflow), and lower and more stable values in dryer (higher conductivity) baseflow periods.

This type of plot was prepared for all sites. Based on these plots, it was determined that a conductivity value of 5mS/cm was a good wet/dry dividing point for the upper reaches of the estuary (45km to 60km from the mouth) whilst a value of 10mS/cm was more appropriate for the more saline mid to lower reaches of the estuary (20km to 45km from the mouth). Downstream of 20km, turbidity was too variable to derive guidelines.

These conductivity cut-off points were then used to define 'dry' weather data sets for both turbidity and Secchi Depth for each site. The 80th and 50th percentiles of the dry weather data sets for each site were then calculated – see Table 1. (Note that sites are identified as distance from the estuary mouth, following the Adopted Middle Thread Distance [AMTD] protocol).

**Table 1: Dry weather turbidity and Secchi percentiles for sites in the Fitzroy River estuary**

Site	Turbidity (NTU) percentiles		Secchi (m) percentiles	
	80th	50th	20th	50th
Km from mouth (AMTD)				
20.0	159	91	0.1	0.4
28.1	61	34	0.25	0.4
33.8	124	73	0.15	0.2
39.6	76	35	0.2	0.35
45.2	32	17	0.4	0.6
50.2	35	18	0.35	0.5
52.6	28	17	0.4	0.55
55.1	25	15	0.4	0.55
57.3	22	13	0.5	0.6
59.6	18	10	0.5	0.75

The data show that sites fall roughly into two groups, an upper estuary group (sites 45.2km to 59.6km AMTD) which has substantially lower turbidity levels than a mid/lower estuary group (sites 20km to 39.6km AMTD). These natural groups were used to define the two zones for the guidelines i.e. 20km to 45km and 45km to 60km.

The 80th percentile turbidity values of the upper estuary group varied between 18 and 35 NTU so a value of 30 NTU was selected as being representative of that group. The current median values would all meet that guideline.

The 80th percentile turbidity values in the mid/lower estuary group were much more variable. A best judgement decision was made to select a central value of 100 NTU as a guideline. Again, the median values at all sites would currently meet this guideline.

Using a similar approach, guideline values for Secchi depth of 0.4m and 0.2m were selected respectively for the upper and mid/lower estuary reaches.

The guideline values are summarised in Table 2 below.

**Table 2: Summary of Turbidity and Secchi Depth guideline values for the Fitzroy River estuary**

Estuary Reach (Km from mouth)	Guideline value	
	Turbidity (NTU)	Secchi Depth (m)
0 - 20	No guideline	No guideline
20 – 45	100	0.2
45 - 60	30	0.4