



“In – Bank” Streamflow Measurements

to confirm the

DNRM Ratings Tables

of the

Lower Balonne River Gauging Stations

Jan/Feb 2004



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1 December 2009

Ref: SR_GR_012004

SmartRivers
PO Box 448
St. George Qld 4487
Ph: (07) 4625 1211
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Attn: Mr. Richard Lomans

Dear Richard,

Re: Streamflow Gaugings of Jan/ Feb 2004

Greenspan was requested to conduct a set of Stream Gaugings in the Lower Balonne System as part of our offer to gauge “in-bank” river flows during a predetermined release from Beardmore Dam.

This is to be used to validate the Ratings used by DNRM in monitoring the release of waters for Environmental and Agricultural purposes.

Some delays were encountered in order to fully supply the measured results and comparative information to SmartRivers. These were:

1. Awaiting DNRM’s supply of Rating Table advice for each of the 5 streams in the Lower Balonne
2. Awaiting DNRM’s supply of verified stream height data that allowed cross referencing of Greenspan’s measurements (visible gauge boards may not always be accurate, depending on their age, condition and levelled status)
3. My redeployment from the business for 3 months working on the Karun Project in Iran

Summary of Findings:

Gauging Station	DNRM Rating Table	Assessment
Culgoa @ Woolerbilla	6	accurate for “in-bank”flows
Briarie Ck @ H/W Rd	16	accurate for “in-bank” flows
Ballandool Rv @ H/W Rd DNRM	25	in need of review by the
Bokhara Rv @ Hebel	8	accurate for “in-bank” flows
Narran Rv @ D/H Rd metres	38	in need of review above 4.35

422208A Culgoa River @ Woolerbilla

The Streamgauging section established during the measurement cycle was some 10 metres downstream of the river crossing. This crossing provided an excellent section for gauging that allowed for the Chinaman channel to have joined the main channel. This is not the case at the Gauging Station, some 300 metres upstream.

Gauge heights read during the gaugings, were verified against calibrated results provided by the DNRM.

The DNRM are currently operating Rating Table No. 6. This has been applied from the 4th February 2003.

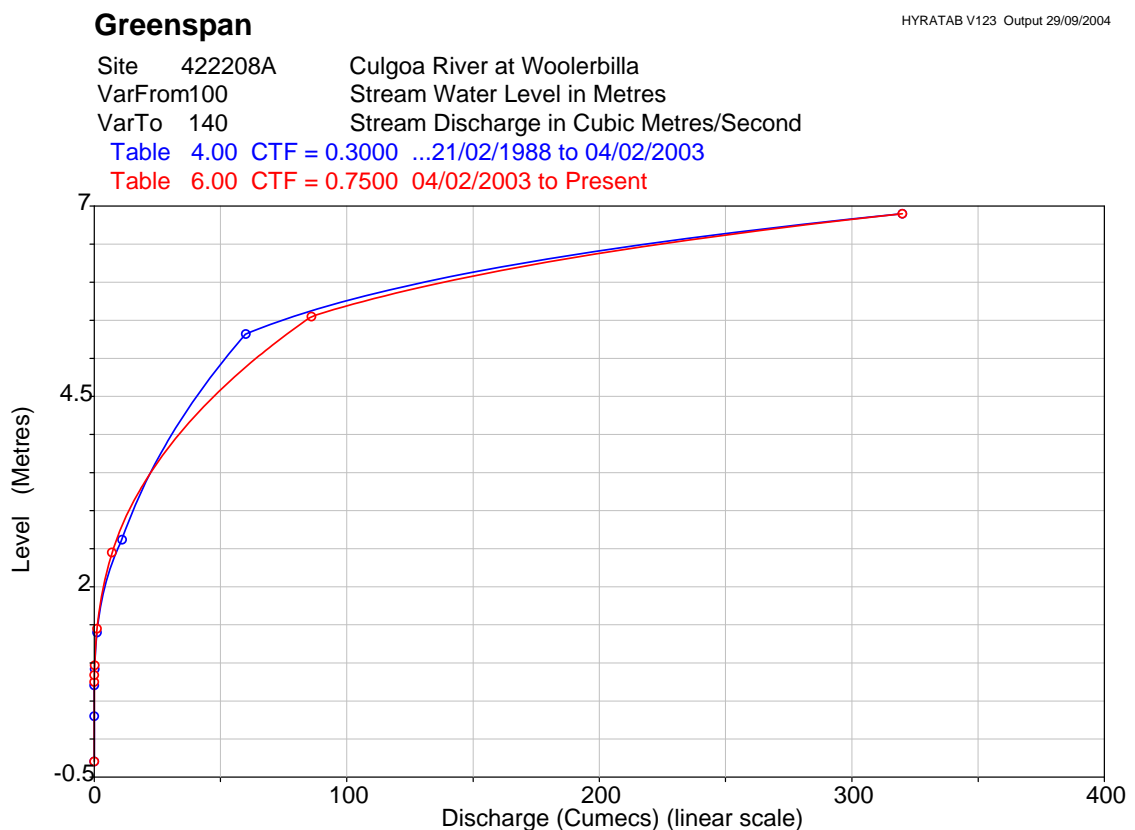


Fig 1. Plot of the of Rating Curve applied for 15 years – Table 4 (blue) and the new Rating Curve – Table 6 (red), applied since 4/2/2003.

Rating Curve 6 shows a maximum variation from Rating Curve 4 of flows at 5.0 metres gauge height of 23%.

While this rating change was performed prior to the gaugings being conducted in January 2004, Greenspan notes the significant change in the rating that has been made to the mid section of the curve.

Greenspan understands the Gauging Station at Woolerbilla had been decommissioned on 30th August 1988 and recommissioned on 4th February 2003. This would explain the rating alteration made to the Woolerbilla gauge.

Greenspan conducted 8 gaugings during the measurement period.
Summary as follows

Date (m/s)	Gauge Height (m)	Area (m2)	Discharge (m3/s)	Mean Velocity
22/01/04	4.339	81.854	38.445	0.482
23/01/04	4.125	73.168	34.976	0.498
24/01/04	3.880	66.06	29.706	0.475
25/01/04	3.505	53.643	22.362	0.443
29/01/04	4.580	87.605	50.266	0.574
30/01/04	4.755	90.035	51.693	0.574
31/01/04	4.547	83.868	45.231	0.539
12/02/04	3.335	45.785	18.897	0.4133.

The deviation from Rating Table No.6 is at worst 6 percent.

Greenspan would consider in-bank flows to be inclusive up to 5 metres gauge height. This being referenced back to the Woolerbilla Gaugeline.

At 4.75 metres waters from the Culgoa were preparing to cross the floodplain defined by the roadway. Already at this height the Culgoa had backed up from downstream of the roadway filling depressions on the eastern approach road below the Turkey's Nest.

The DNRM Rating Table No.6 is considered to be an accurate representation up to 5 metres.

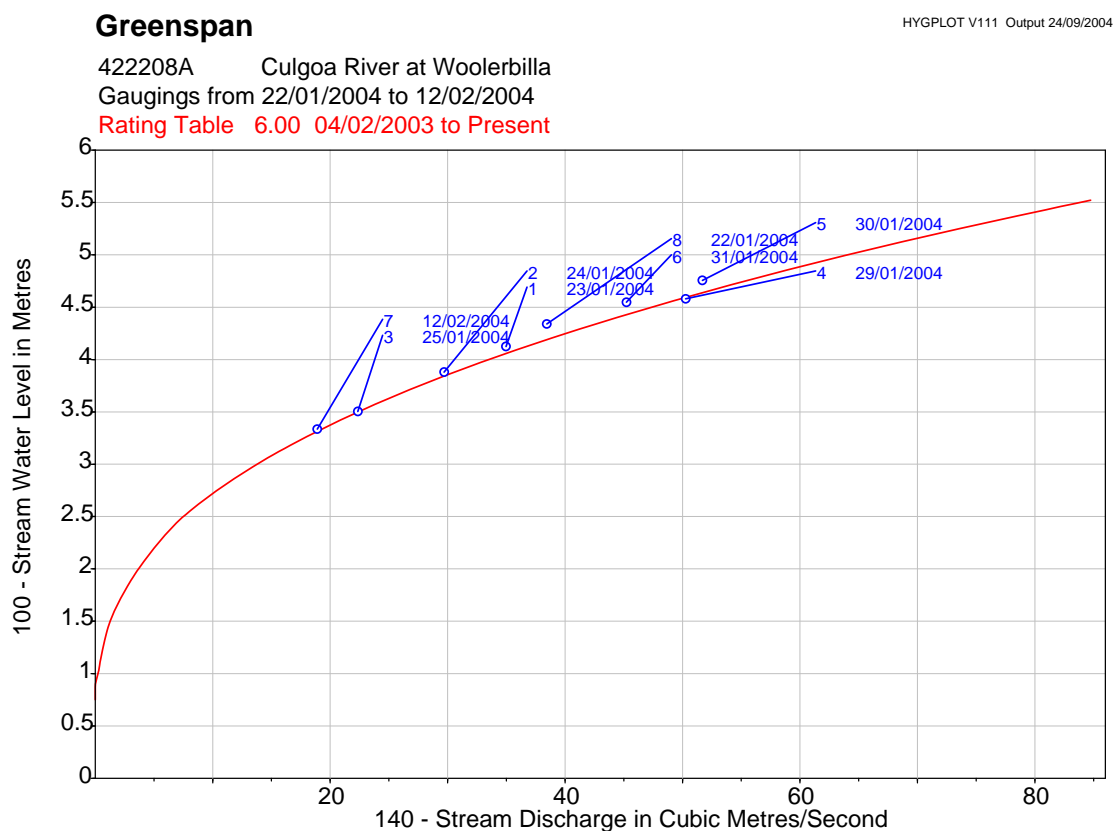


Fig 2. Showing gaugings as plotted against the current DNRM Rating Curve No.6

422211A Briarie Creek @ Hebel – Woolerbilla Road

The Gauging section established during the measurement cycle was some 20 metres upstream of the river crossing. This section provided an excellent section for gauging that allowed for good laminar flows. The velocity profile was excellent throughout the cross section.

Gauge heights read during the gaugings, were verified against calibrated results provided by the DNRM.

The DNRM are currently operating Rating Table No. 16. This has been applied from the 29th January 2004.

The Rating Table was modified after the January flow event. This would have been partly due to the infrequent nature of being able to conduct gaugings on Briarie Creek.

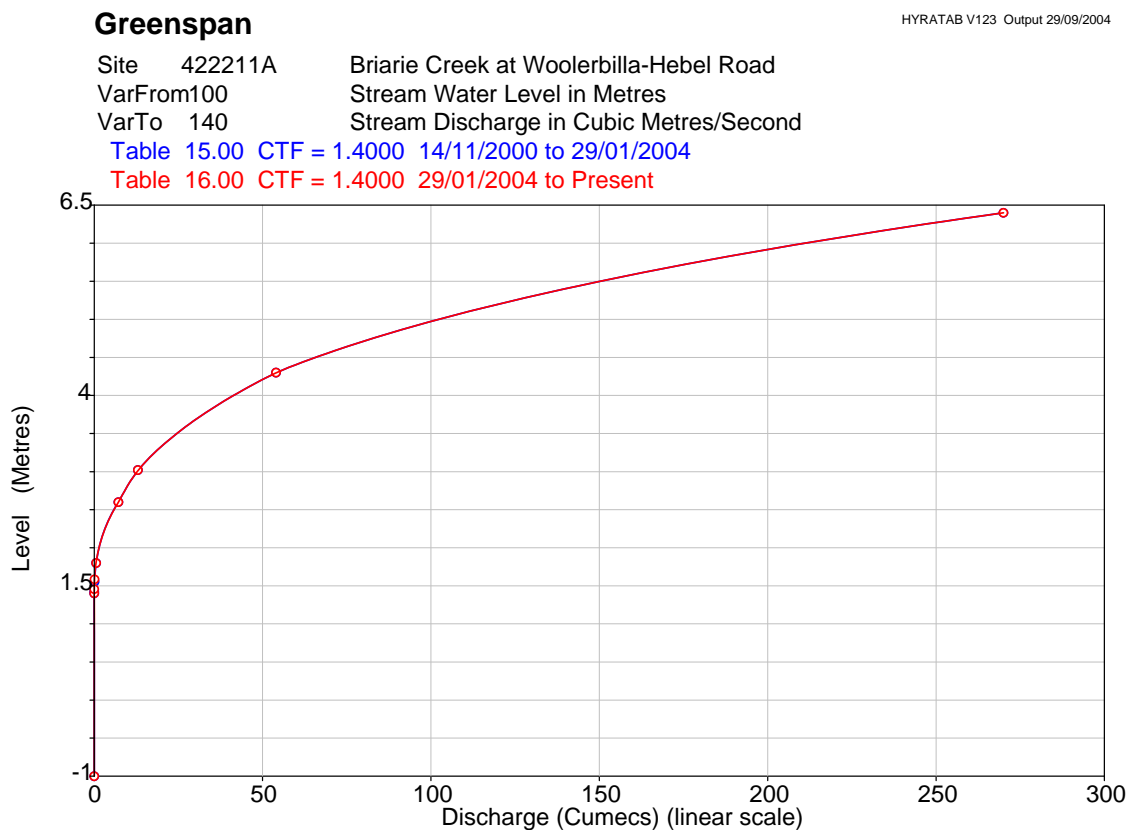


Fig.3 Only minor changes have been applied to Rating Curve 16 from 15. These changes were all at the bottom end – below 1.6 metres.

Rating Curve 15 had been applied since 14/11/2000. Rating Curve 16 from 29/01/2004. No alteration has been made to the mid to top section of the Rating Curve.

Greenspan conducted 11 gaugings during the measurement period.
Summary as follows:

Date (m/s)	Gauge Height (m)	Area (m ²)	Discharge (m ³ /s)	Mean Velocity (m/s)
22/01/04	1.448	0.012	0.001	
23/01/04	1.446	0.01	0.001	
24/01/04	1.448	0.012	0.001	
27/01/04	3.170	36.59	16.026	0.437
27/01/04	3.400	48.27	21.301	0.441
28/01/04	3.930	85.893	41.400	0.482
29/01/04	4.095	88.53	42.702	0.482
30/01/04	3.85	76.88	33.589	0.437
31/01/04	3.445	59.431	22.006	0.370
01/02/04	2.940	23.35	10.88	0.466
12/02/04	3.335	45.785	18.897	0.4133.

The deviation across the Rating is at worst 6%.

Greenspan would consider in-bank flows to be inclusive up to 4.25 metres gauge height. A breakout on the western side of the causeway was approaching on the 29th January

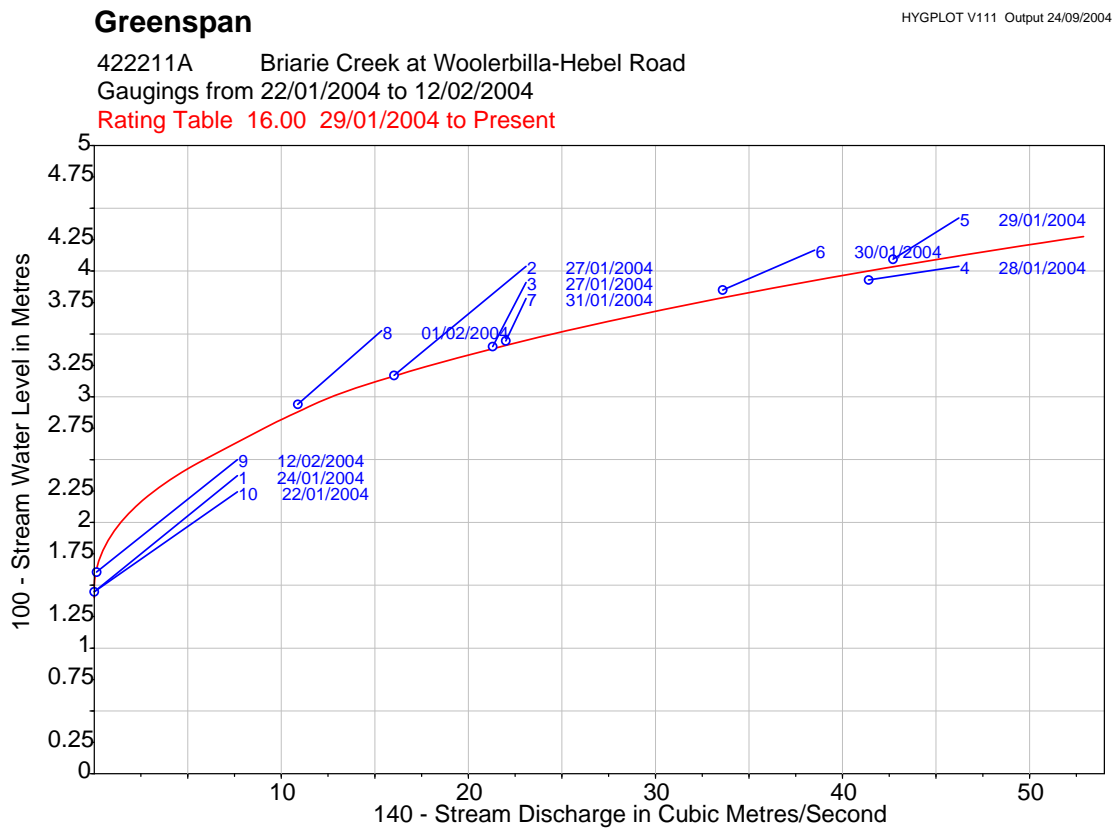


Fig 4. Showing gaugings as plotted against the current DNRM Rating Curve No.16

Rating Table No.16 is considered an accurate representation of flows up to 4.250 metres.

422207A Ballandool Creek @ Hebel – Woolerbilla Road

The Gauging section established during the measurement cycle was some 30 metres downstream stream of the river crossing. This section was the best available after the gauge pool downstream of the Gauging Station. The gauge pool upstream is substantially influenced by the rock weir. The velocity profile was excellent across the full profile.

Gauge heights read during the gaugings, were verified against calibrated results provided by the DNRM.

The DNRM are currently operating Rating Table No. 25. This has been applied from the 26th May 2003.

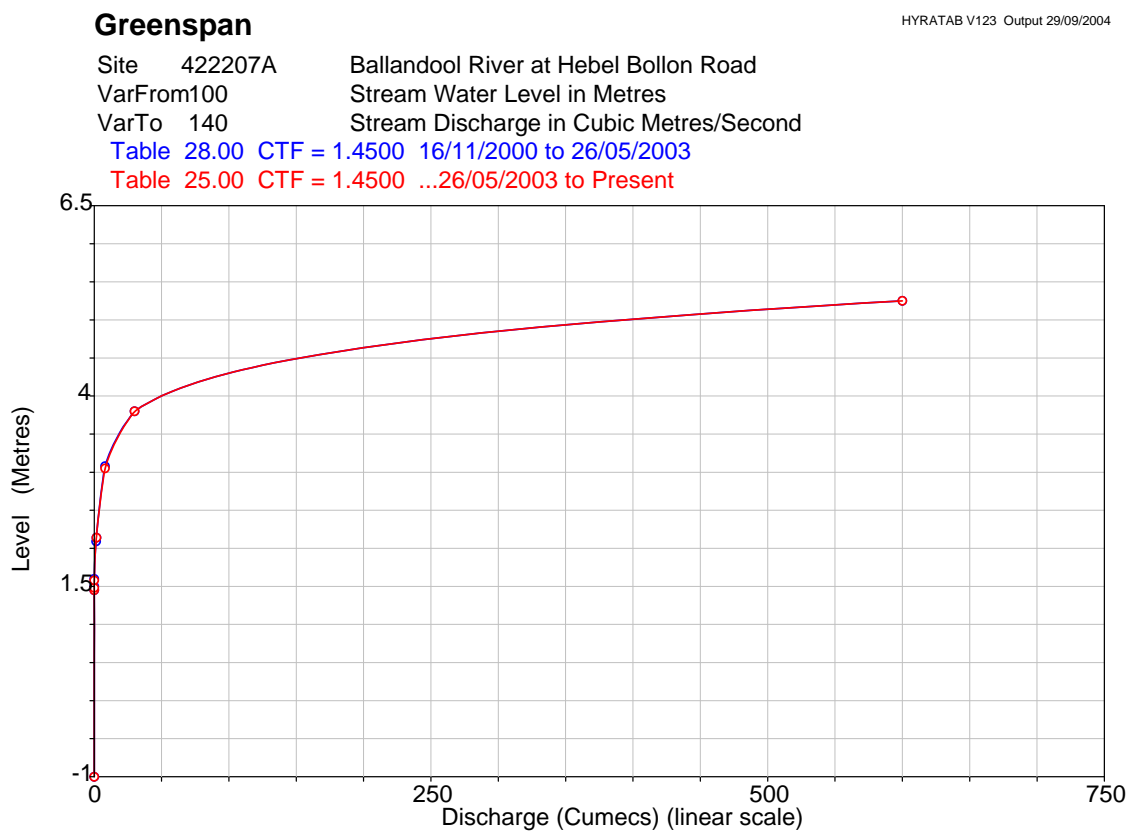


Fig 5. Only minor changes have been applied to Rating Curve 28 from 25. These changes were all at the bottom end – below 2.5 metres. These changes will more than likely be associated with grass growth, general scouring from an event flow or debris deposition at the control.

Rating Curve 28 had been applied since 16/11/2000. Rating Curve 25 from 29/01/2004. No alteration has been made to the mid to top section of the Rating Curve.

Flows down the Ballandool were of a lesser magnitude than those of the Culgoa, Briarie and Narran during the January / February 2004 event. As a result only a small spread of gaugings were undertaken.

Greenspan conducted 8 gaugings during the measurement period.

Summary as follows:

Date (m/s)	Gauge Height (m)	Area (m2)	Discharge (m3/s)	Mean Velocity
22/01/04	1.960	1.895	0.460	0.243
23/01/04	1.820	1.460	0.332	0.227
24/01/04	2.100	5.795	1.397	0.241
25/01/04	2.535	28.348	4.867	0.172
27/01/04	2.710	36.84	5.555	0.151
29/01/04	2.825	41.35	6.385	0.154
30/01/04	2.895	44.51	7.324	0.165
12/02/04	2.105	4.651	1.299	0.279.

The deviation across the Rating at worst approaching 11 percent.

Greenspan would consider in-bank flows to be inclusive up to 3.75 metres gauge height.

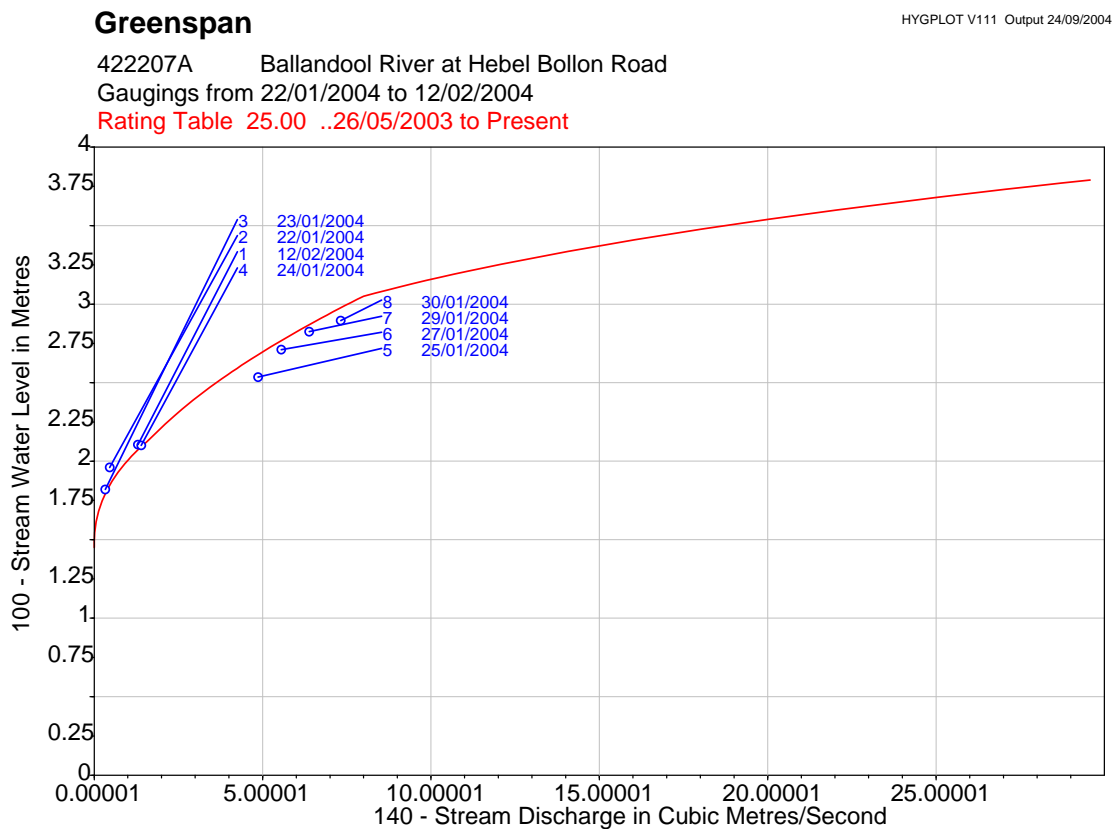


Fig 6. Gaugings plotting on the underside of the Rating Curve indicate that Table No.25 is understating the flowrate.

Rating Table No.25 is considered in need of review by the DNRM.

422209A Bokhara Creek @ Hebel

The Gauging section established during the measurement cycle was across the weir control. This section is simply the best available as the river section downstream of the gauge pool is not conducive to good velocity profiles. The weir is reasonably wide and provided a good perpendicular line is held the velocity profile across the weir is considered very good.

Gauge heights read during the gaugings, were verified against calibrated results provided by the DNRM.

The DNRM are currently operating Rating Table No. 8. This has been applied from the 31st January 2004. The Rating Table was modified after the January flow event. The weir control is very stable, so I am unsure what has driven the modification – possibly tree growth on the weir itself .

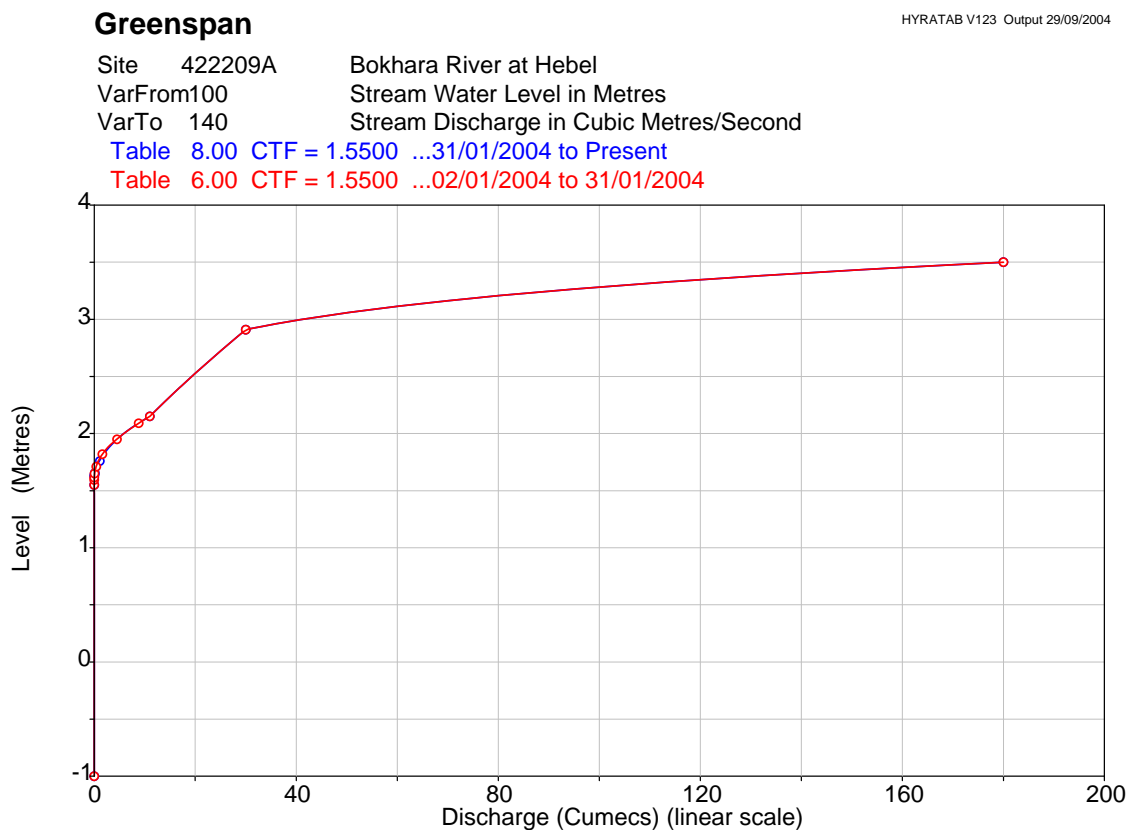


Fig 7. Only minor changes have been applied to Rating Curve 6 from 8. These changes were all at the bottom end – below 2.00 metres. These changes will more than likely be associated with grass growth, possible damage to the weir wall or debris deposition at the control.

Flows down the Bokhara were of lesser magnitude than those of the Culgoa, Briarie and Narran. As a result only a small spread of gaugings were able to be undertaken.

Greenspan conducted 7 gaugings during the measurement period.

Summary as follows:

Date (m/s)	Gauge Height (m)	Area (m2)	Discharge (m3/s)	Mean Velocity
22/01/04	1.702	1.548	0.283	0.183
23/01/04	1.704	1.333	0.389	0.292
24/01/04	1.845	3.730	2.222	0.596
25/01/04	1.935	6.183	4.196	0.679
27/01/04	1.960	7.010	5.395	0.769
29/01/04	2.005	8.08	6.289	0.778
30/01/04	2.030	7.848	6.863	0.874

The deviation across the Rating at worst was approaching 9 percent.

Greenspan would consider in-bank flows to be inclusive up to 2.25 metres gauge height.

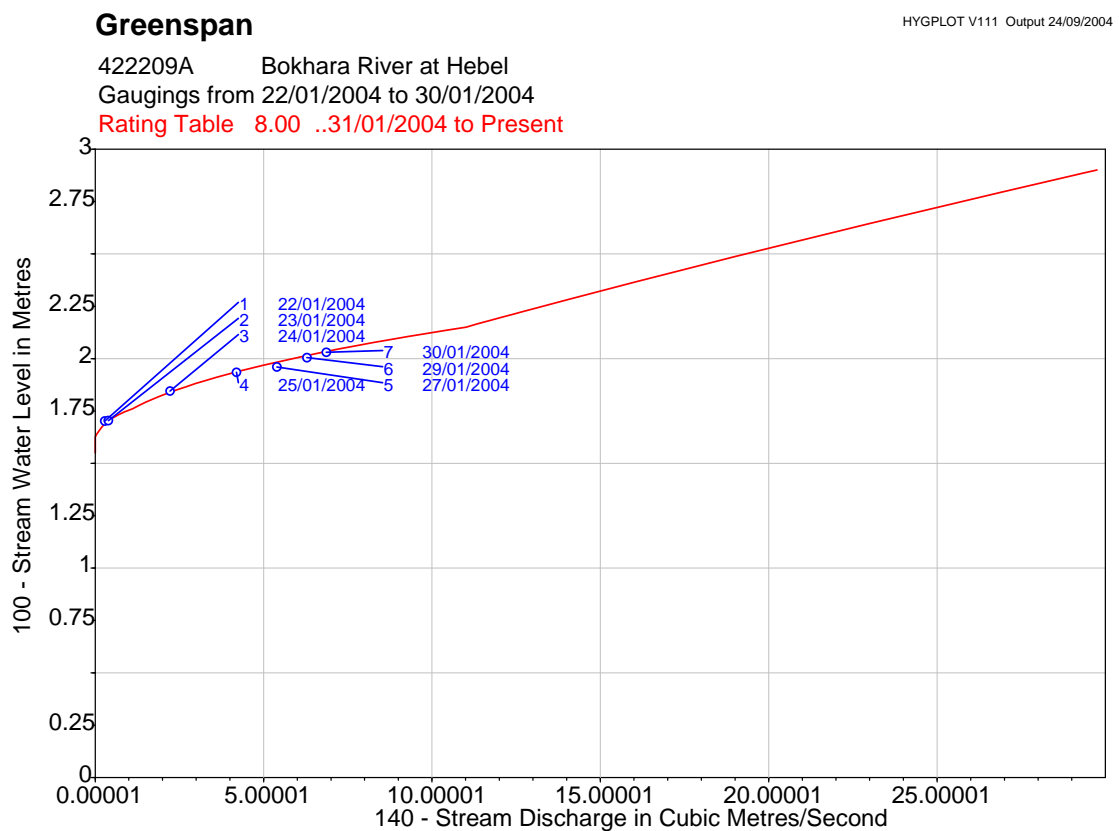


Fig 8. Showing gaugings as plotted against the current DNRM Rating Curve No.16. Rating considered accurate for "in-bank" flows.

Rating Table No.8 for "in - bank" flows is considered to be an accurate representation.

422206A Narran River @ Dirranbandi – Hebel Road

The Gauging section established during the measurement cycle was immediately downstream of the road bridge. This section provided the best velocity profile within close proximity of the Gauging Station for the main channel.

Hamesh McIntyre was able to give some of his time to clarify the nature of the breakouts attributable to the Narran. As a result only waters from the Cavillon Diversion south were measured. Water from Donnegri Creek was assessed but not measured due to its return into the Narran system. All breakout water was measured as it crossed the Dirranbandi to Hebel Road. This included water over the road and through the culverts.

Gauge heights read during the gaugings, were verified against calibrated results provided by the DNRM. Significant errors exist with the Gauge boards at the Gauging Station.

The DNRM are currently operating Rating Table No. 38. This has been applied from the 31st January 2004. The Rating Table was modified after the January flow event. Reasons for modification may be attributable to the upstream heavy vehicle crossing – this is only a suggestion from observations made at the time.

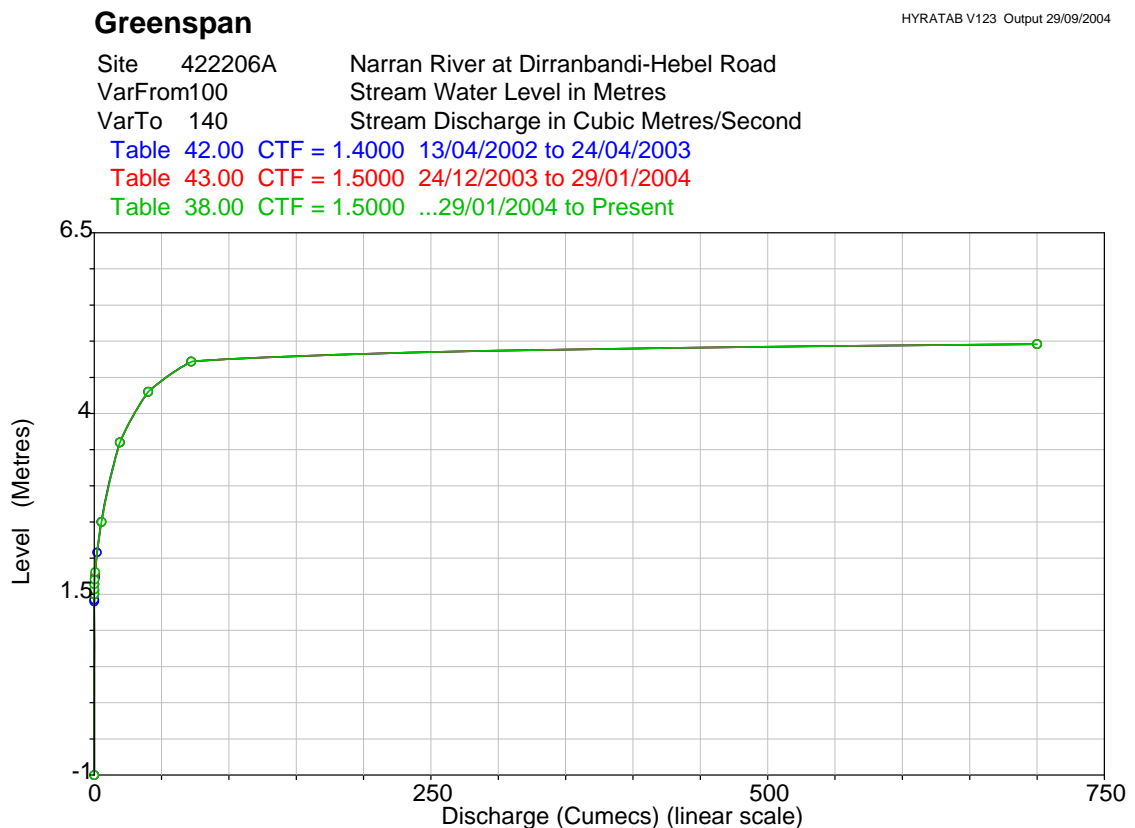


Fig 9. Only minor changes have been applied to Rating Curves 42, 43 & 38. These changes were all at the bottom end – below 2.50 metres. These changes will more than likely be associated with the upstream heavy vehicle low level crossing, erosive forces or debris deposition at the control. Tables 42 and 43 are plotted directly behind Table 38, hence are not visible.

Greenspan conducted 7 gaugings during the measurement period.

Summary as follows:

Date	Gauge Height (m)	Area (m ²)	Discharge (m ³ /s)	Mean Velocity (m/s)
22/01/04	3.770	54.75	22.962	0.382
23/01/04	4.068	60.987	34.499	0.566
24/01/04	4.350	68.138	43.882	0.644
25/01/04	4.450	90.995	48.751	0.536
27/01/04	4.540	135.14	67.728	0.501
29/01/04	2.375	19.77	4.956	0.251
30/01/04	2.345	19.42	4.239	0.218

The deviation across the Rating at worst is approaching 6 percent for the “in-bank” measurements.

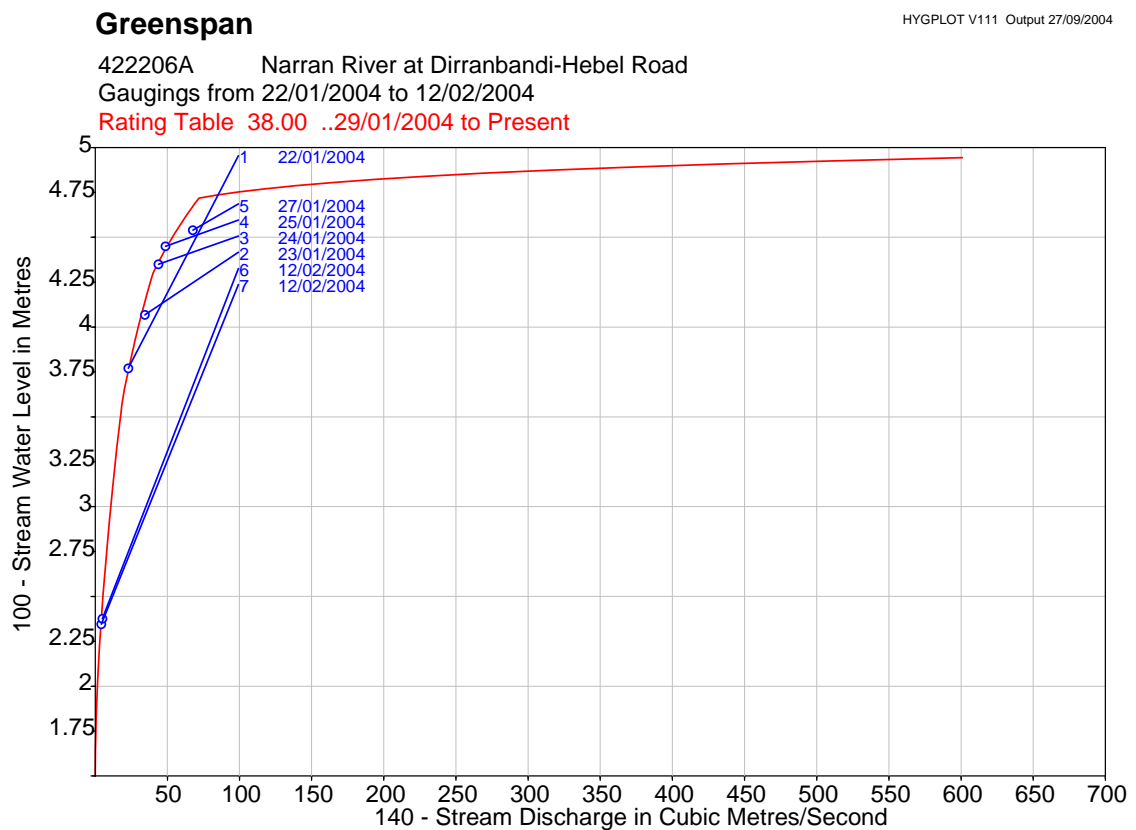


Fig 10. Showing gaugings as plotted against the current DNRM Rating Curve No.38. Rating considered accurate for “in-bank” flows up to 3.75 metres .

The gauging on the 27th January is approaching 20%. This certainly indicates a review is required of the rating around this R.L. of 4.50metres. This is a clear indicator of the Rating Curve showing substantially less water. This may be as a result of changing overflow conditions. It would indicate that the DNRM would need to review the Rating of the Narran River between 4.3 to 5 metres gauge height.

At 4.54 metres gauge height, over 25% of the gauged flow is now attributable to overbank flow. This figure will continue to rise expansively. Such overbank influence results in a small change in gauge height leading to a significant change in flow.

Greenspan would consider in-bank flows to be inclusive up to 3.75 metres gauge height.

Rating Table No.38 is considered to be accurate up to 45 cumecs. It would be reasonable to request a review of the rating above this value by the DNRM.

Considerations & Conclusions:

1. The Rating Curves presented above for each Station, is that currently being used by the DNRM. You would generally only get alterations to the curve after a significant flow event or physical change /impediment to the stream in the vicinity of the respective Gauging Stations.
2. Streamflow Gaugings that plot to the topside of the curve are showing less water for the same gauge height.
3. Streamflow Gaugings that plot on the bottom side of the curve are showing more water for the same gauge height
4. The current DNRM Rating Curves in use for the Culgoa, Briarie and Bokhara systems are considered to be accurate for “in-bank” flows.
5. The Rating Curve for the Ballandool River is considered to be in need of review. It is recognised that such a review will only provide a small additional flow rate, but this is a significant proportion to current recorded flow.
6. The Rating Curve for the Narran River is also in need of review. We were fortunate enough to encounter a reasonable overbank flow event down this system. Overbank flow can be inconsistent due to variable seasonal forces (good / poor pastures) as well as development activity. The Gaugings show the Rating Curve in need of review in the band of 4.40 metres to 4.75 metres. It would seem the Rating Curve needs to be drawn from Gauging No.4 through No.5 and then merge with the existing rating. This merge point will be critical as at this level a small increase in Gauge height results in a significant increase in flow. This section of the Rating Curve represents a significant proportion of water that needs to be considered.
7. To enable a full assessment of the DNRM Rating Tables for each River, it would now be prudent to consider the measurement of a maximum flood event in order to confirm the top end of each respective Curve. It will be necessary to assess incoming waters from the Balonne and Maranoa as early as possible in order to get teams in place for the duration of the measurements.

Quality Assurance:

Greenspan conducted both Boat and Wading gaugings at the 5 Gauging Stations in accordance with Australian Standard 3778.3.1 – 1990 Measurement of Water Flow in Open Channels.

All measuring equipment is controlled under our Quality Assurance Program. Greenspan is currently ISO 9001-2000 certified. This process allows for our current meters to be calibrated yearly as per AS 3778.6.1 – 1992.

Please contact me should you require any further information regarding the above report

Yours sincerely,

Steve Bird
Greenspan