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# **Riverine Recovery**

# Katfish Reach Hydraulic Modelling 2012–13





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# 1. Introduction and Background

Katfish Reach is a floodplain habitat of the River Murray, located on the western side of the River Murray between Berri and Loxton in South Australia, which is comprised of the Katarapko/Eckert Creek anabranch system. The anabranch bypasses Lock 4, with several inlets into Eckert Creek above Lock 4, with a further inlet into Katarapko Creek existing downstream of Lock 4. The natural hydrological regime of the anabranch has been altered by a number of artificial banks and regulators – including a major stone weir in the upper reach of Katarapko Creek – which has contributed to ecological degradation within the floodplain.

The Katfish Reach element of the Riverine Recovery Project (RRP) involves the construction of environmental regulators and the upgrade and/or removal of existing structures in order to expand floodplain management options to improve the ecological health of the floodplain.

The following report contains the results of modelled scenarios designed to inform engineering designs of the new structures that are intended to be constructed in the Katfish Reach area. Modelling has been conducted using a MIKE FLOOD model originally developed by Water Technology (2010), which has been updated by MDBA and DEWNR to include the latest structure specifications and survey results of the area.

A recalibration of the River Murray section of the model was completed (refer to Section 3) following a finding that the model was overestimating water levels in the river for any given flow, particularly at higher flows. Additionally, the structure 'North Arm Bridge' was found to be incorrectly located approximately 1 km upstream from its actual location, and this was also corrected in the model configuration.

# 2. Model Summary

The following sections summarise the original model configuration details as identified in the 'Katfish Reach Modelling Calibration' report (Water Technology, 2010).

# 2.1 Numerical Modelling System

The MIKE FLOOD modelling system by DHI Software was used for model development. It is a tool that allows coupling of 1 dimensional (1D) with 2 dimensional (2D) hydrodynamic models, providing advantages of each type of model within a single model scheme. For instance, 1D models (developed using the 'MIKE11' module) provide an accurate description of river channels and operating structures, and are less computationally demanding (i.e. shorter run times) than 2D models, while 2D models (developed using the 'MIKE21' module) are useful for providing detailed information of velocity, depths, etc. on floodplains without the need to prescribe flow paths as is the requirement for 1D models. Thus, in-channel flow is described by the 1D portion of the model while overbank flow is described by the 2D portion. Further information of the MIKE FLOOD modelling system is available on the DHI Software website:

http://www.dhisoftware.com/Products/WaterResources/MIKEFLOOD.aspx

# 2.2 Model Establishment

A 1D channel network was developed, including the River Murray section from Lock 5 to Lock 3, and all major creeks including:

- Eckert Creek, Eckert Creek North Arm and Eckert Creek South Arm
- Upstream and downstream section of The Splash
- Katarapko Creek
- Piggy Creek
- Sawmill Creek, and
- Creek supplying Wetland 1541.

A number of structures including weirs, road crossings, culverts, bridges and regulating structures were also included in the 1D network. A map of creeks and structures in Katfish Reach is shown in Figure 1.

Additional floodplain storage was also added along the River Murray section of the 1D network in order to simulate flood routing along the river for high flow events.

1D channel roughness, as Manning's 'n' value, was set between 0.03 and 0.06, with the latter value representing heavily weeded sections of the network (i.e. Eckert Creek North and South Arms).

The 2D section of the model was created from 2 m LiDAR data, converted to a 10 m grid resolution. Creeks present in the grid that were modelled in the 1D network were "filled in" to avoid duplication of storage.





A 2D roughness map was constructed using a combination of vegetation mapping data and aerial photographs, with Manning's 'n' estimated between 0.03 and 0.05. Losses were accounted for in evaporation and seepage parameters. Potential evaporation was estimated from Bureau of Meteorology online evaporation maps, which were derived from Class A pan evaporation records from 1975 to 2005. A seepage map was also developed using soil mapping data; where data was available, seepage was estimated between 0.5 and 2.0 mm/d, while areas with no soil data were set to 0.8 mm/d for potentially flooded areas and 0 mm/d for areas outside the floodplain (N.B. it is unclear from DEWNR review of the model where the seepage map is applied to model calculations – it appears that the main source of loss from the model is implemented as an evaporation map only, varying from 1.7 to 3.7 mm/d).

1D and 2D model sections were coupled into the MIKE FLOOD model by assigning the smaller creeks to the 1D network and allowing the 2D grid to account for inundation of larger inline wetlands (e.g. Eckert Creek Wide Water and The Splash). A total of 5 standard links were used to connect the ends of 1D branches to the 2D grid while 32 lateral links were used to link the 1D channel lengths to the 2D grid to allow overbank flow to spread onto the floodplain.

## 2.3 Model Calibration

Two high flow events were used as the basis for testing the model calibration, each event providing two separate opportunities for comparison as indicated in Table 1. Satellite imagery at each applicable date was used to compare model outputs with recorded inundation extent, while continuous and/or daily monitored data at nearby gauging stations were used to compare numerical model outputs of water level and flow. Note that monitoring data used for calibration was confined to River Murray stations as no applicable data was available for any of the Katfish Reach creeks.

Dates of Flood Event	Satellite Capture of Flood Extent	Flow at Lock 5
		(ML/d)
July to December 1996	21/09/1996	46,600
	10/12/1996	59,100
August to December 2000	27/11/2000	30,700
	13/12/2000	45,300

#### Table 1: Selected events for model calibration.

### 2.4 Calibration Results

Results from the calibration process were analysed, with inundation extents, and flow and water level distributions considered reasonable (i.e. water level generally calculated within 0.1 m) at Lock 5 flows below approximately 40,000 ML/d. At flows exceeding this level, modelled results were deemed to possess reduced accuracy, which was attributed to the activation of wetlands along the River Murray that are not explicitly included in the model.

Uncertainty of flows through the inlets to Katfish Reach due to lack of monitoring data was identified as a limitation to the calibration process, with only River Murray levels and flows available for comparison.

# 3. Model Recalibration and Reconfiguration

Initial modelling runs with the updated MIKE FLOOD model showed that water levels in the River Murray below Locks 4 and 5 were overestimated when compared with monitoring data, particularly at higher flows e.g. at 30,000 ML/d at Lock 5 the water level downstream of Lock 4 was calculated at approximately 13.1 m AHD, compared to an actual level in the range of approximately 12.1 to 12.4 m AHD. This is despite the Katarapko Creek stone weir crest level being lowered from the current level (approximately 10.53 m AHD) to 10.24 m AHD, which would be expected to reduce Lock 4 downstream water level from current values. Note that these findings are in contradiction to the original calibration report which stated that water level downstream of Lock 4 was slightly underestimated at flows less than 30,000 ML/d. These discrepancies were expected to adversely impact on scenarios used to inform structure designs, in particular for the Katarapko Creek stone weir.

The overestimation of water level indicated that bed resistances used in the 1D portion of the model for the River Murray (i.e. Manning's 'n' value of 0.030) required a reduction to reduce the water levels to those consistent with actual levels. Recorded water levels downstream of Locks 4 and 5 for corresponding river flows (based on lock ratings) are shown in Figure 2 and summarised in Table 2.



Lock 4 & 5 D/S WL (m AHD) vs Rated Flow (ML/d)

Figure 2: Recorded water levels downstream of Locks 4 and 5 versus corresponding rated lock flows. Modelled water levels also included for comparison.

Rated Lock 4/5 Flow (ML/d)	Lock 4 D/S WL (m AHD)	Lock 5 D/S WL (m AHD)
5,000	10.35 – 10.58	13.28 - 13.49
10,000	10.88 - 11.08	13.56 - 13.83
20,000	11.58 - 11.81	13.97 – 14.56
30,000	12.16 - 12.38	14.71 - 14.94

#### Table 2: Summary of recorded water levels downstream of Locks 4 and 5 against rated lock flows.

Recalibration was conducted by first resetting the Katarapko Creek stone weir to the existing crest level (i.e. 10.53 m AHD with no fishway) and setting Bank J flow to 62 ML/d (i.e. approximate existing flow). The optimum bed resistance in the River Murray was then determined on a trial and error basis by estimating a Manning's 'n' value and running the model at 5,000 ML/d and 30,000 ML/d at Lock 5, with results compared to actual water levels downstream of Locks 4 and 5 at each flow, adjusting bed resistance if required. The optimum Manning's 'n' value was found to be 0.024, providing the best match in downstream water levels at both 5,000 ML/d and 30,000 ML/d downstream of Lock 5 (refer to Figure 2).

It should be noted that the modelled water level downstream of Lock 4 at 30,000 ML/d is overestimated by between approximately 0.1 to 0.3 m. This difference may be attributed to the assumed inflow to the floodplain, which was set at 62 ML/d (i.e. same as for 5,000 ML/d River Murray flow) for the purposes of the calibration. This assumption may understate actual inflows to the floodplain under this higher river flow scenario, with a greater inflow resulting in a reduced level downstream of Lock 4 (note that the water level downstream of Lock 5 is consistent with observed levels at 30,000 ML/d).

In addition to overestimation of River Murray water levels, an additional error was encountered with the placement of the Eckert Creek North Arm Bridge in an incorrect location, approximately 1 km upstream from its actual location. These alternative placements were located on either side of the confluence of Eckert Creek North Arm and 'Bank K Creek', indicating that the incorrect location could impact on modelling results. The model was hence reconfigured to reflect the actual placement of the bridge.

# 4. Scenarios for Informing Engineering Designs of New Environmental Regulators

The following section details the results from modelled scenarios for the Katfish Reach area. A total of 12 scenarios have been designed with the aim of confirming data calculated with previous versions of the model while also informing engineering designs for new structures to be constructed in Katfish Reach, in particular for Bank J Regulator and Eckert's Creek Log Crossing Regulator.

## 4.1 Model Simulations

The 12 scenarios identified for testing are presented in Table 3. All scenarios were configured with the following attributes:

- All new structures in place.
- Eckerts Creek and North Arm Bridges are replaced and full cross-sections restored.
- The stone weir in Katarapko Creek is at the new crest level of 10.24 m AHD, including a trapezoidal fishway embedded in the right abutment of the weir (N.B. flows through the fishway are combined with the total flow over the stone weir and cannot be reported separately).
- Results are reported under steady state conditions in the system.

Boundary conditions for each modelled scenario included setting the desired flow into the model at Lock 5, and an upper pool level at Lock 3 of 9.8 m AHD (i.e. at the model outlet). Upstream level at Lock 4 could then be independently set to the desired level for the scenario in question.

Note that fishways at Bank J Regulator and Eckert's Creek Log Crossing are not included in the model explicitly as flows through these structures are low in comparison to flow through each regulator. Modelling of internal hydraulics of fishways requires finer scale modelling approaches to that undertaken in this work.

Results are presented in maps showing depth and extent of inundation with detailed hydraulic parameters at key reporting locations throughout the system. In particular flows and water levels immediately upstream and downstream of the various proposed structures are reported for the purposes of engineering design. The following sections summarise the results from each scenario.

### Table 3: Modelled scenarios to inform engineering designs.

Scenario	Scenario Description	Lock 5 Flow (ML/d)	Lock 4 UPL (m AHD)	Lock 3 UPL (m AHD)	Bank J Regulator Flow (ML/d) & Status	Bank K Channel Status	Bank N Regulator Status	South Arm Road Crossing Regulator Status	Log Crossing Regulator Flow (ML/d) and Status	Stone Weir Trapezoidal Fishway Status	Stone Weir Crest Level (m AHD)
1	62 ML/d regulated Bank J Regulator flow (i.e. existing flow) with all other new structures in place and open	5000	13.20	9.80	62 ML/d approx (dropboards in place)	open	open	open	open	open	10.24 (new)
2	200 ML/d regulated Bank J Regulator e-flow with all other new structures in place and open	5000	13.20	9.80	200 ML/d approx (dropboards in place)	open	open	open	open	open	10.24 (new)
3	All new structures in place and fully open	5000	13.20	9.80	open	open	open	open	open	open	10.24 (new)
4	200 ML/d regulated Bank J Regulator e-flow with all other new structures in place and fully open. Diversion flow to Sawmill Creek upstream of Log Crossing	5000	13.20	9.80	200 ML/d approx (dropboards in place)	open	open	open	passing 150 ML/d & upstream water level at 11.68 m AHD	open	10.24 (new)
5	400 ML/d regulated Bank J Regulator e-flow with all other new structures in place and open. Diversion flow to Sawmill Creek upstream of Log Crossing	5000	13.20	9.80	400 ML/d approx (dropboards in place)	open	open	open	passing 300 ML/d & upstream water level at 11.80 m AHD	open	10.24 (new)
6	400 ML/d regulated Bank J Regulator e-flow with all other new structures in place and open	5000	13.20	9.80	400 ML/d approx (dropboards in place)	open	open	open	open	open	10.24 (new)
7	600 mm rise in Lock 4 upper pool level (UPL) with all new structures in place and fully open	10000	13.80 (UPL +0.6m)	9.80	open	open	open	open	open	open	10.24 (new)

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Scenario	Scenario Description	Lock 5 Flow (ML/d)	Lock 4 UPL (m AHD)	Lock 3 UPL (m AHD)	Bank J Regulator Flow (ML/d) & Status	Bank K Channel Status	Bank N Regulator Status	South Arm Road Crossing Regulator Status	Log Crossing Regulator Flow (ML/d) and Status	Stone Weir Trapezoidal Fishway Status	Stone Weir Crest Level (m AHD)
8	600 mm rise in Lock 4 upper pool level (UPL) with all new structures in place and fully open	11500	13.80 (UPL +0.6m)	9.80	open	open	open	open	open	open	10.24 (new)
9	600 mm rise in Lock 4 upper pool level (UPL) with all new structures in place and fully open	13000	13.80 (UPL +0.6m)	9.80	open	open	open	open	open	open	10.24 (new)
10	Increased flow in river to 10000 ML/d with all new structures fully open	10000	13.20	9.80	open	open	open	open	open	open	10.24 (new)
11	Increased flow in river to 20000 ML/d with all new structures fully open	20000	13.20	9.80	open	open	open	open	open	open	10.24 (new)
12	Increased flow in river to 30000 ML/d with all new structures fully open	30000	13.20	9.80	open	open	open	open	open	open	10.24 (new)

## 4.2 Results

Key reporting locations for hydraulic results are shown in Figure 3. These locations are referred to in tables presented under each scenario in the following sections.



Figure 3: Key reporting locations for hydraulic modelling results.

### 4.2.1 Scenario 1

Scenario 1 is set up at existing flow conditions through Bank J Regulator (i.e. approximately 62 ML/d) with all other new structures in place and open. River Murray flow is set to 5000 ML/d at Lock 5 with a normal upper pool level at Lock 4 of 13.2 m AHD. Hydraulic results are shown in Table 4, while inundation extent and depth is shown in Figure 4.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 96 ML/d. The water levels directly upstream and downstream of Bank J regulator are approximately 13.20 and 12.12 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 109 ML/d (water levels at 10.98 m AHD upstream and 10.96 m AHD downstream of the structure), with no flow present in Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is approximately 79 ha and the volume of inundation is 308 ML.

Flow over the Katarapko Creek stone weir (including fishway) at the lowered crest level is at approximately 488 ML/d. Note that lowering the crest level of the stone weir results in a marginal fall of downstream water level at Lock 4 from approximately 10.42 m AHD (at existing weir crest level of 10.53 m AHD) to 10.35 m AHD (at new crest level of 10.24 m AHD).

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.20	1.58	0.72	62	0.02	0.02
2	Eckert Ck 1	10.28	11.97	1.69	0.74	64	0.05	0.01
3	Eckert Ck 1	10.42	11.22	0.80	1.15	99	0.27	0.65
4	Eckert Ck 1	10.37	10.99	0.62	1.27	109	0.05	0.10
5	Log Crossing	10.20	10.98	0.78	1.27	109	0.10	0.20
6	The Splash 1	10.24	10.96	0.72	1.27	109	0.11	0.24
7	The Splash 1	10.08	10.87	0.79	1.27	109	0.07	0.78
8	The Splash 1	9.81	10.85	1.04	1.26	109	0.09	0.11
9	The Splash 2	9.84	10.27	0.43	1.26	109	0.23	1.08
10	The Splash 2	9.56	9.86	0.30	1.26	109	0.20	0.52
11	Eckert Ck North Arm	12.80	13.20	0.40	0.16	14	0.07	0.15
12	Eckert Ck North Arm	12.36	12.78	0.42	0.16	14	0.11	1.21
13	Eckert Ck North Arm	12.10	12.58	0.48	0.41	35	0.27	3.24
14	Eckert Ck North Arm	11.31	11.88	0.57	0.41	35	0.13	0.80
15	Bank K Ck	12.80	13.20	0.40	0.25	21	0.09	0.12
16	Bank K Ck	12.87	13.03	0.16	0.25	21	0.44	2.45
17	Eckert Ck South Arm	11.60	12.07	0.47	0.10	8	0.14	2.04
17a	Eckert Ck South Arm	10.77	11.55	0.79	0.13	11	0.04	0.06
18	Eckert Ck South Arm	11.17	11.48	0.31	0.13	11	0.11	0.51
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	10.98	0.11	0.00	0	0.00	0.00
22	Sawmill Ck	10.30	10.50	0.20	0.00	0	0.00	0.00
23	Katarapko Ck	6.36	10.30	3.94	5.64	488	0.04	0.01
24	Katarapko Ck / Stone Weir	4.69	10.30	5.61	5.64	488	0.02	0.00
25	Katarapko Ck	4.04	9.86	5.82	5.64	488	0.02	0.00
26	Katarapko Ck	3.77	9.86	6.09	5.64	488	0.02	0.00
27	Katarapko Ck	4.50	9.86	5.36	6.91	597	0.03	0.01
28	Katarapko Ck	5.63	9.86	4.23	6.91	597	0.04	0.01
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 4: Scenario 1 hydraulic results from key reporting locations.



Figure 4: Inundation extent and depth for Scenario 1.

### 4.2.2 Scenario 2

Scenario 2 is set up similar to Scenario 1 but with 200 ML/d instead flowing through Bank J Regulator. Hydraulic results at key reporting locations are shown in Table 5, while inundation extent and depth is shown in Figure 5.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 235 ML/d. The water levels directly upstream and downstream of Bank J regulator are approximately 13.20 and 12.45 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 216 ML/d (water levels at 11.17 m AHD upstream and 11.14 m AHD downstream of the structure), with approximately 18 ML/d flow in Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 86 ha and the volume of inundation is 437 ML.

Flow over the Katarapko Creek stone weir and fishway is at approximately 472 ML/d. This is marginally less than that from Scenario 1, due primarily to the reduced Lock 4 downstream water level of approximately 10.33 m AHD under the increased flow through Bank J.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.20	1.58	2.32	200	0.08	0.20
2	Eckert Ck 1	10.28	12.16	1.88	1.93	167	0.10	0.06
3	Eckert Ck 1	10.42	11.42	1.00	2.34	202	0.33	1.13
4	Eckert Ck 1	10.37	11.18	0.82	2.71	234	0.08	0.17
5	Log Crossing	10.20	11.17	0.97	2.50	216	0.14	0.33
6	The Splash 1	10.24	11.14	0.90	2.50	216	0.17	0.48
7	The Splash 1	10.08	10.96	0.88	2.50	216	0.12	1.87
8	The Splash 1	9.81	10.91	1.10	2.35	203	0.16	0.32
9	The Splash 2	9.84	10.40	0.56	2.50	216	0.24	1.26
10	The Splash 2	9.56	9.87	0.31	2.50	216	0.38	1.86
11	Eckert Ck North Arm	12.80	13.20	0.40	0.16	14	0.07	0.15
12	Eckert Ck North Arm	12.36	12.78	0.42	0.16	14	0.11	1.21
13	Eckert Ck North Arm	12.10	12.58	0.48	0.41	35	0.26	3.26
14	Eckert Ck North Arm	11.31	12.00	0.69	0.41	35	0.09	0.39
15	Bank K Ck	12.80	13.20	0.40	0.25	21	0.09	0.12
16	Bank K Ck	12.87	13.03	0.16	0.25	21	0.44	2.45
17	Eckert Ck South Arm	11.60	12.28	0.68	0.38	33	0.31	6.46
17a	Eckert Ck South Arm	10.77	11.77	1.00	0.38	33	0.07	0.14
18	Eckert Ck South Arm	11.17	11.64	0.47	0.38	33	0.18	1.13
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.17	0.30	0.21	18	0.15	0.50
22	Sawmill Ck	10.30	10.89	0.59	0.21	18	0.31	2.06
23	Katarapko Ck	6.36	10.29	3.93	5.25	453	0.04	0.01
24	Katarapko Ck / Stone Weir	4.69	10.29	5.60	5.46	472	0.02	0.00
25	Katarapko Ck	4.04	9.86	5.82	5.46	472	0.02	0.00
26	Katarapko Ck	3.77	9.86	6.09	5.46	472	0.02	0.00
27	Katarapko Ck	4.50	9.86	5.36	7.95	687	0.03	0.01
28	Katarapko Ck	5.63	9.86	4.23	7.95	687	0.04	0.02
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 5: Scenario 2 hydraulic results from key reporting locations.



dmocullough

pxu

Figure 5: Inundation extent and depth for Scenario 2.

### 4.2.3 Scenario 3

Scenario 3 is set up similar to Scenarios 1 and 2 but with Bank J Regulator fully open. Hydraulic results are shown in Table 6, while inundation extent and depth is shown in Figure 6.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 752 ML/d. Flow through Bank J Regulator is 717 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.19 and 13.14 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 620 ML/d (water levels at 11.64 m AHD upstream and 11.57 m AHD downstream of the structure), with approximately 131 ML/d flow in Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 120 ha and the volume of inundation is 827 ML.

Flow over the Katarapko Creek stone weir and fishway is at approximately 431 ML/d, which is less than that of the previous scenarios. This difference can be attributed to the lower Lock 4 downstream water level of approximately 10.27 m AHD under the much larger flow through Bank J in its fully open state.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.19	1.57	8.33	719	0.28	2.64
2	Eckert Ck 1	10.28	12.50	2.22	6.36	549	0.24	0.36
3	Eckert Ck 1	10.42	11.93	1.50	6.33	547	0.39	1.67
4	Eckert Ck 1	10.37	11.67	1.30	8.72	753	0.14	0.41
5	Log Crossing	10.20	11.64	1.44	7.19	621	0.23	0.69
6	The Splash 1	10.24	11.57	1.33	7.19	621	0.31	1.13
7	The Splash 1	10.08	11.22	1.14	6.24	539	0.23	3.83
8	The Splash 1	9.81	11.09	1.28	5.68	491	0.28	0.97
9	The Splash 2	9.84	10.71	0.87	6.09	526	0.26	1.30
10	The Splash 2	9.56	9.92	0.36	7.18	620	1.26	8.99
11	Eckert Ck North Arm	12.80	13.20	0.40	0.16	14	0.07	0.15
12	Eckert Ck North Arm	12.36	12.78	0.42	0.16	14	0.11	1.20
13	Eckert Ck North Arm	12.10	12.58	0.48	0.41	35	0.22	3.61
14	Eckert Ck North Arm	11.31	12.34	1.03	0.41	35	0.04	0.03
15	Bank K Ck	12.80	13.20	0.40	0.25	21	0.09	0.12
16	Bank K Ck	12.87	13.03	0.15	0.25	21	0.44	2.44
17	Eckert Ck South Arm	11.60	12.77	1.17	1.70	147	0.53	12.02
17a	Eckert Ck South Arm	10.77	12.34	1.57	1.97	170	0.16	0.64
18	Eckert Ck South Arm	11.17	12.05	0.89	1.97	170	0.34	3.48
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.64	0.77	1.52	132	0.28	1.00
22	Sawmill Ck	10.30	11.34	1.04	1.52	132	0.73	9.66
23	Katarapko Ck	6.36	10.23	3.88	3.46	299	0.02	0.00
24	Katarapko Ck / Stone Weir	4.69	10.23	5.55	4.98	431	0.02	0.00
25	Katarapko Ck	4.04	9.89	5.85	4.98	431	0.02	0.00
26	Katarapko Ck	3.77	9.89	6.12	4.98	431	0.01	0.00
27	Katarapko Ck	4.50	9.89	5.39	12.16	1051	0.05	0.02
28	Katarapko Ck	5.63	9.89	4.26	12.16	1051	0.06	0.04
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 6: Scenario 3 hydraulic results from key reporting locations.

![](_page_20_Figure_1.jpeg)

Figure 6: Inundation extent and depth for Scenario 3.

### 4.2.4 Scenario 4

Scenario 4 is set up with all new structures in place and fully open, with the exception of Bank J Regulator set to pass 200 ML/d and the Log Crossing Flow Regulator which is set to pass approximately 150 ML/d. Hydraulic results at key reporting locations are shown in Table 7, while inundation extent and depth is shown in Figure 7.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 235 ML/d. Water levels directly upstream and downstream of the Bank J Regulator are approximately 13.20 and 12.45 m AHD respectively. At 157 ML/d through Eckert's Creek Log Crossing Regulator the steady state water levels are at 11.49 m AHD upstream and 11.03 m AHD downstream of the structure, with approximately 85 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 86 ha and the volume of inundation is 549 ML.

Water level downstream of Lock 4 is at approximately 10.34 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 480 ML/d at the new crest level of 10.24 m AHD.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.20	1.58	2.32	200	0.08	0.20
2	Eckert Ck 1	10.28	12.16	1.88	1.93	167	0.10	0.06
3	Eckert Ck 1	10.42	11.57	1.15	2.34	202	0.25	0.64
4	Eckert Ck 1	10.37	11.49	1.13	2.71	234	0.05	0.06
5	Log Crossing	10.20	11.49	1.29	1.75	151	0.07	0.06
6	The Splash 1	10.24	11.03	0.79	1.75	152	0.14	0.34
7	The Splash 1	10.08	10.90	0.82	1.74	150	0.09	1.21
8	The Splash 1	9.81	10.87	1.06	1.71	147	0.12	0.19
9	The Splash 2	9.84	10.32	0.48	1.73	150	0.24	1.20
10	The Splash 2	9.56	9.86	0.31	1.73	150	0.27	0.95
11	Eckert Ck North Arm	12.80	13.20	0.40	0.16	14	0.07	0.15
12	Eckert Ck North Arm	12.36	12.78	0.42	0.16	14	0.11	1.21
13	Eckert Ck North Arm	12.10	12.58	0.48	0.41	35	0.26	3.26
14	Eckert Ck North Arm	11.31	12.01	0.70	0.41	35	0.09	0.38
15	Bank K Ck	12.80	13.20	0.40	0.25	21	0.09	0.12
16	Bank K Ck	12.87	13.03	0.16	0.25	21	0.44	2.45
17	Eckert Ck South Arm	11.60	12.28	0.68	0.38	33	0.31	6.47
17a	Eckert Ck South Arm	10.77	11.78	1.01	0.38	33	0.07	0.14
18	Eckert Ck South Arm	11.17	11.66	0.49	0.38	33	0.17	0.99
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.48	0.61	0.98	84	0.25	0.87
22	Sawmill Ck	10.30	11.22	0.92	0.97	84	0.60	6.77
23	Katarapko Ck	6.36	10.30	3.94	4.59	396	0.03	0.01
24	Katarapko Ck / Stone Weir	4.69	10.30	5.61	5.56	480	0.02	0.00
25	Katarapko Ck	4.04	9.86	5.82	5.56	480	0.02	0.00
26	Katarapko Ck	3.77	9.86	6.09	5.56	480	0.02	0.00
27	Katarapko Ck	4.50	9.86	5.36	7.29	630	0.03	0.01
28	Katarapko Ck	5.63	9.86	4.23	7.29	630	0.04	0.01
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 7: Scenario 4 hydraulic results from key reporting locations.

![](_page_22_Figure_1.jpeg)

Figure 7: Inundation extent and depth for Scenario 4.

### 4.2.5 Scenario 5

Scenario 5 is set up similar to Scenario 4 but with Bank J Regulator set to pass 400 ML/d and the Log Crossing Flow Regulator set to pass approximately 300 ML/d. Hydraulic results at key reporting locations are shown in Table 8, while inundation extent and depth is shown in Figure 8.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 438 ML/d. Water levels directly upstream and downstream of the Bank J Regulator are approximately 13.20 and 12.78 m AHD respectively. At approximately 300 ML/d through Eckert's Creek Log Crossing Regulator the steady state water levels are at 11.65 m AHD upstream and 11.25 m AHD downstream of the structure, with approximately 134 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is approximately 104 ha and the volume of inundation is approximately 706 ML.

Water level downstream of Lock 4 is at approximately 10.32 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 460 ML/d at the new crest level of 10.24 m AHD.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.20	1.58	4.67	403	0.16	0.81
2	Eckert Ck 1	10.28	12.33	2.05	3.77	326	0.17	0.17
3	Eckert Ck 1	10.42	11.79	1.37	4.18	361	0.31	1.04
4	Eckert Ck 1	10.37	11.66	1.30	5.02	434	0.08	0.14
5	Log Crossing	10.20	11.65	1.45	3.43	297	0.11	0.16
6	The Splash 1	10.24	11.25	1.01	3.48	301	0.21	0.68
7	The Splash 1	10.08	11.02	0.94	3.36	291	0.15	2.44
8	The Splash 1	9.81	10.95	1.14	3.11	269	0.19	0.49
9	The Splash 2	9.84	10.48	0.64	3.29	284	0.24	1.24
10	The Splash 2	9.56	9.88	0.32	3.46	299	0.52	3.32
11	Eckert Ck North Arm	12.80	13.20	0.40	0.16	14	0.07	0.15
12	Eckert Ck North Arm	12.36	12.78	0.42	0.16	14	0.11	1.21
13	Eckert Ck North Arm	12.10	12.58	0.48	0.41	35	0.25	3.38
14	Eckert Ck North Arm	11.31	12.17	0.86	0.41	35	0.06	0.07
15	Bank K Ck	12.80	13.20	0.40	0.25	21	0.09	0.12
16	Bank K Ck	12.87	13.03	0.16	0.25	21	0.44	2.45
17	Eckert Ck South Arm	11.60	12.49	0.89	0.86	74	0.45	10.13
17a	Eckert Ck South Arm	10.77	12.02	1.25	0.86	74	0.11	0.29
18	Eckert Ck South Arm	11.17	11.84	0.68	0.86	74	0.23	1.68
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.64	0.77	1.55	134	0.28	1.00
22	Sawmill Ck	10.30	11.34	1.04	1.55	134	0.74	9.79
23	Katarapko Ck	6.36	10.28	3.92	3.81	329	0.03	0.01
24	Katarapko Ck / Stone Weir	4.69	10.28	5.59	5.36	463	0.02	0.00
25	Katarapko Ck	4.04	9.87	5.83	5.36	463	0.02	0.00
26	Katarapko Ck	3.77	9.87	6.10	5.36	463	0.02	0.00
27	Katarapko Ck	4.50	9.87	5.37	8.82	762	0.03	0.01
28	Katarapko Ck	5.63	9.87	4.24	8.82	762	0.04	0.02
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 8: Scenario 5 hydraulic results from key reporting locations.

![](_page_24_Figure_1.jpeg)

Figure 8: Inundation extent and depth for Scenario 5.

### 4.2.6 Scenario 6

Scenario 6 is set up similar to Scenario 2 but with 400 ML/d instead flowing through Bank J Regulator. Hydraulic results at key reporting locations are shown in Table 9, while inundation extent and depth is shown in Figure 9.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 438 ML/d. The water levels directly upstream and downstream of Bank J regulator are approximately 13.20 and 12.77 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 375 ML/d (water levels at 11.38 m AHD upstream and 11.34 m AHD downstream of the structure), with approximately 59 ML/d flow in Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 98 ha and the volume of inundation is 594 ML.

Flow over the Katarapko Creek stone weir and fishway is at approximately 455 ML/d. This is approximately 20 ML/d less than that from Scenario 2, due primarily to the reduced Lock 4 downstream water level of approximately 10.31 m AHD under the increased flow through Bank J.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.20	1.58	4.67	403	0.16	0.81
2	Eckert Ck 1	10.28	12.33	2.05	3.77	326	0.17	0.17
3	Eckert Ck 1	10.42	11.65	1.23	4.18	361	0.38	1.56
4	Eckert Ck 1	10.37	11.40	1.04	5.02	434	0.11	0.28
5	Log Crossing	10.20	11.38	1.18	4.34	375	0.19	0.49
6	The Splash 1	10.24	11.34	1.10	4.34	375	0.24	0.85
7	The Splash 1	10.08	11.07	1.00	4.10	354	0.18	2.86
8	The Splash 1	9.81	10.98	1.17	3.76	325	0.22	0.63
9	The Splash 2	9.84	10.55	0.70	3.98	344	0.25	1.27
10	The Splash 2	9.56	9.88	0.32	4.33	375	0.64	4.85
11	Eckert Ck North Arm	12.80	13.20	0.40	0.16	14	0.07	0.15
12	Eckert Ck North Arm	12.36	12.78	0.42	0.16	14	0.11	1.21
13	Eckert Ck North Arm	12.10	12.58	0.48	0.41	35	0.25	3.37
14	Eckert Ck North Arm	11.31	12.16	0.85	0.41	35	0.06	0.07
15	Bank K Ck	12.80	13.20	0.40	0.25	21	0.09	0.12
16	Bank K Ck	12.87	13.03	0.16	0.25	21	0.44	2.45
17	Eckert Ck South Arm	11.60	12.49	0.89	0.86	74	0.45	10.12
17a	Eckert Ck South Arm	10.77	12.01	1.24	0.86	74	0.11	0.30
18	Eckert Ck South Arm	11.17	11.81	0.64	0.86	74	0.25	2.00
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.37	0.50	0.68	59	0.23	0.79
22	Sawmill Ck	10.30	11.13	0.83	0.68	59	0.51	5.06
23	Katarapko Ck	6.36	10.27	3.91	4.59	397	0.03	0.01
24	Katarapko Ck / Stone Weir	4.69	10.27	5.58	5.27	455	0.02	0.00
25	Katarapko Ck	4.04	9.87	5.83	5.27	455	0.02	0.00
26	Katarapko Ck	3.77	9.87	6.10	5.27	455	0.02	0.00
27	Katarapko Ck	4.50	9.87	5.37	9.61	830	0.04	0.01
28	Katarapko Ck	5.63	9.87	4.24	9.61	830	0.05	0.02
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 9: Scenario 6 hydraulic results from key reporting locations.

![](_page_26_Figure_1.jpeg)

Figure 9: Inundation extent and depth for Scenario 6.

### 4.2.7 Scenario 7

Scenario 7 is set up similar to Scenario 3 but with 10,000 ML/d at Lock 5 and a 0.6 m rise in normal Lock 4 upper pool level to 13.8 m AHD. Hydraulic results are shown in Table 10, while inundation extent and depth is shown in Figure 10.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 1716 ML/d. Flow through Bank J Regulator is 1322 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.80 and 13.68 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 1385 ML/d (water levels at 12.25 m AHD upstream and 12.08 m AHD downstream of the structure), with approximately 455 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 241 ha and the volume of inundation is 1954 ML.

Water level downstream of Lock 4 is at approximately 10.8 m AHD, a rise of approximately 0.5 m from Scenario 3 due to the doubling of river flow. This higher elevation results in flow over the Katarapko Creek stone weir and fishway at approximately 1061 ML/d.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.80	2.18	15.32	1323	0.35	3.24
2	Eckert Ck 1	10.28	12.91	2.63	11.48	992	0.31	0.62
3	Eckert Ck 1	10.42	12.54	2.12	12.15	1050	0.41	1.80
4	Eckert Ck 1	10.37	12.29	1.92	21.41	1850	0.21	0.78
5	Log Crossing	10.20	12.26	2.06	16.10	1391	0.32	1.05
6	The Splash 1	10.24	12.09	1.85	16.10	1391	0.42	1.88
7	The Splash 1	10.08	11.66	1.58	15.36	1327	0.39	5.89
8	The Splash 1	9.81	11.44	1.63	12.61	1090	0.38	1.47
9	The Splash 2	9.84	11.11	1.27	13.81	1193	0.32	1.61
10	The Splash 2	9.56	10.22	0.67	19.88	1718	1.13	9.70
11	Eckert Ck North Arm	12.80	13.81	1.01	2.03	175	0.21	0.62
12	Eckert Ck North Arm	12.36	13.52	1.16	2.03	175	0.30	2.15
13	Eckert Ck North Arm	12.10	13.24	1.14	4.75	410	0.55	7.18
14	Eckert Ck North Arm	11.31	12.85	1.54	3.96	342	0.19	0.62
15	Bank K Ck	12.80	13.81	1.01	2.72	235	0.31	1.13
16	Bank K Ck	12.87	13.47	0.59	2.72	235	0.47	4.95
17	Eckert Ck South Arm	11.60	13.36	1.76	3.60	311	0.46	7.64
17a	Eckert Ck South Arm	10.77	13.02	2.25	7.24	625	0.31	1.47
18	Eckert Ck South Arm	11.17	12.52	1.35	5.38	465	0.43	5.10
19	Ngak Indau	12.60	13.46	0.85	0.39	34	0.18	0.24
20	Ngak Indau	12.15	13.48	1.32	1.11	96	0.39	0.16
21	Sawmill Ck	10.87	12.25	1.38	5.32	459	0.42	1.80
22	Sawmill Ck	10.30	11.81	1.51	5.44	470	1.21	23.47
23	Katarapko Ck	6.36	10.73	4.37	6.74	583	0.04	0.01
24	Katarapko Ck / Stone Weir	4.69	10.73	6.04	12.19	1053	0.04	0.01
25	Katarapko Ck	4.04	10.20	6.16	12.19	1053	0.04	0.02
26	Katarapko Ck	3.77	10.20	6.43	12.19	1053	0.03	0.01
27	Katarapko Ck	4.50	10.20	5.70	32.07	2771	0.11	0.13
28	Katarapko Ck	5.63	10.19	4.56	32.07	2771	0.15	0.22
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 10: Scenario 7 hydraulic results from key reporting locations.

![](_page_28_Figure_1.jpeg)

Figure 10: Inundation extent and depth for Scenario 7.

### 4.2.8 Scenario 8

Scenario 8 is set up similar to Scenario 7 but with additional flow at Lock 5 (i.e. 11,500 ML/d) to provide flow of approximately 2,000 ML/d over the combined stone weir and fishway. Hydraulic results are shown in Table 11, while inundation extent and depth is shown in Figure 11.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 1725 ML/d. Flow through Bank J Regulator is 1327 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.80 and 13.68 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 1389 ML/d (water levels at 12.25 m AHD upstream and 12.09 m AHD downstream of the structure), with approximately 458 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 246 ha and the volume of inundation is 1968 ML.

Water level downstream of Lock 4 is at approximately 10.9 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 2023 ML/d. Levels upstream and downstream of the stone weir are approximately 10.8 and 10.4 m AHD, respectively.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.80	2.18	15.38	1329	0.35	3.25
2	Eckert Ck 1	10.28	12.91	2.63	11.50	994	0.31	0.62
3	Eckert Ck 1	10.42	12.54	2.12	12.21	1055	0.41	1.80
4	Eckert Ck 1	10.37	12.29	1.93	21.49	1857	0.21	0.79
5	Log Crossing	10.20	12.26	2.06	16.14	1395	0.32	1.05
6	The Splash 1	10.24	12.09	1.85	16.14	1395	0.42	1.88
7	The Splash 1	10.08	11.66	1.58	15.44	1334	0.39	5.90
8	The Splash 1	9.81	11.44	1.63	12.67	1095	0.38	1.47
9	The Splash 2	9.84	11.11	1.27	13.86	1198	0.32	1.60
10	The Splash 2	9.56	10.39	0.83	20.00	1728	0.81	4.73
11	Eckert Ck North Arm	12.80	13.82	1.02	2.05	177	0.21	0.62
12	Eckert Ck North Arm	12.36	13.52	1.16	2.05	177	0.30	2.16
13	Eckert Ck North Arm	12.10	13.25	1.15	4.79	414	0.55	7.19
14	Eckert Ck North Arm	11.31	12.85	1.54	3.99	345	0.19	0.63
15	Bank K Ck	12.80	13.81	1.01	2.74	237	0.31	1.14
16	Bank K Ck	12.87	13.47	0.60	2.74	237	0.47	4.95
17	Eckert Ck South Arm	11.60	13.36	1.76	3.62	313	0.46	7.61
17a	Eckert Ck South Arm	10.77	13.02	2.25	7.28	629	0.31	1.48
18	Eckert Ck South Arm	11.17	12.52	1.36	5.40	466	0.43	5.09
19	Ngak Indau	12.60	13.46	0.86	0.39	34	0.18	0.24
20	Ngak Indau	12.15	13.48	1.33	1.12	97	0.39	0.17
21	Sawmill Ck	10.87	12.25	1.38	5.35	462	0.42	1.81
22	Sawmill Ck	10.30	11.81	1.51	5.47	473	1.21	23.44
23	Katarapko Ck	6.36	10.81	4.45	17.85	1542	0.09	0.07
24	Katarapko Ck / Stone Weir	4.69	10.81	6.12	23.32	2015	0.07	0.04
25	Katarapko Ck	4.04	10.38	6.34	23.32	2015	0.07	0.06
26	Katarapko Ck	3.77	10.38	6.61	23.32	2015	0.06	0.03
27	Katarapko Ck	4.50	10.38	5.88	43.32	3742	0.14	0.21
28	Katarapko Ck	5.63	10.36	4.72	43.31	3742	0.19	0.36
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 11: Scenario 8 hydraulic results from key reporting locations.

![](_page_30_Figure_1.jpeg)

Figure 11: Inundation extent and depth for Scenario 8.

### 4.2.9 Scenario 9

Scenario 9 is set up similar to Scenario 8 but with additional flow at Lock 5 (i.e. 13,000 ML/d) to provide flow of approximately 3,000 ML/d over the combined stone weir and fishway. Hydraulic results are shown in Table 12, while inundation extent and depth is shown in Figure 12.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 1737 ML/d. Flow through Bank J Regulator is 1335 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.80 and 13.68 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 1394 ML/d (water levels at 12.26 m AHD upstream and 12.09 m AHD downstream of the structure), with approximately 461 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 252 ha and the volume of inundation is 1989 ML.

Water level downstream of Lock 4 is at approximately 11.0 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 2982 ML/d. Levels upstream and downstream of the stone weir are approximately 10.9 and 10.6 m AHD, respectively.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.80	2.18	15.46	1336	0.35	3.27
2	Eckert Ck 1	10.28	12.91	2.63	11.53	996	0.31	0.62
3	Eckert Ck 1	10.42	12.55	2.12	12.27	1060	0.41	1.81
4	Eckert Ck 1	10.37	12.30	1.93	21.58	1864	0.21	0.79
5	Log Crossing	10.20	12.26	2.06	16.20	1400	0.32	1.05
6	The Splash 1	10.24	12.10	1.86	16.20	1400	0.42	1.88
7	The Splash 1	10.08	11.67	1.59	15.52	1341	0.39	5.90
8	The Splash 1	9.81	11.45	1.64	12.74	1101	0.38	1.47
9	The Splash 2	9.84	11.12	1.28	13.90	1201	0.32	1.56
10	The Splash 2	9.56	10.57	1.01	20.13	1739	0.63	2.42
11	Eckert Ck North Arm	12.80	13.82	1.02	2.07	179	0.21	0.63
12	Eckert Ck North Arm	12.36	13.53	1.17	2.07	179	0.30	2.17
13	Eckert Ck North Arm	12.10	13.25	1.15	4.84	418	0.55	7.22
14	Eckert Ck North Arm	11.31	12.85	1.54	4.03	348	0.19	0.63
15	Bank K Ck	12.80	13.82	1.02	2.77	240	0.32	1.15
16	Bank K Ck	12.87	13.47	0.60	2.77	240	0.47	4.94
17	Eckert Ck South Arm	11.60	13.37	1.77	3.63	313	0.46	7.57
17a	Eckert Ck South Arm	10.77	13.02	2.25	7.28	629	0.31	1.48
18	Eckert Ck South Arm	11.17	12.53	1.36	5.42	468	0.43	5.09
19	Ngak Indau	12.60	13.46	0.86	0.39	34	0.18	0.24
20	Ngak Indau	12.15	13.48	1.33	1.13	98	0.39	0.17
21	Sawmill Ck	10.87	12.26	1.39	5.38	465	0.42	1.81
22	Sawmill Ck	10.30	11.82	1.52	5.51	476	1.21	23.40
23	Katarapko Ck	6.36	10.89	4.54	28.90	2497	0.15	0.16
24	Katarapko Ck / Stone Weir	4.69	10.89	6.20	34.41	2973	0.10	0.08
25	Katarapko Ck	4.04	10.57	6.53	34.41	2973	0.10	0.11
26	Katarapko Ck	3.77	10.56	6.79	34.41	2973	0.08	0.07
27	Katarapko Ck	4.50	10.56	6.06	54.54	4712	0.17	0.30
28	Katarapko Ck	5.63	10.53	4.90	54.54	4712	0.22	0.51
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 12: Scenario 9 hydraulic results from key reporting locations.

![](_page_32_Figure_1.jpeg)

Figure 12: Inundation extent and depth for Scenario 9.

### 4.2.10 Scenario 10

Scenario 10 is set up with all new structures fully open, 10,000 ML/d at Lock 5 and normal upper pool level of 13.2 m AHD at Lock 4. Hydraulic results at key reporting locations are shown in Table 13, while inundation extent and depth is shown in Figure 13.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 766 ML/d. Flow through Bank J Regulator is 728 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.20 and 13.15 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 631 ML/d (water levels at 11.65 m AHD upstream and 11.58 m AHD downstream of the structure), with approximately 134 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 122 ha and the volume of inundation is 840 ML.

Water level downstream of Lock 4 is at approximately 10.9 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 1,705 ML/d at the new crest level of 10.24 m AHD.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.20	1.58	8.45	730	0.28	2.67
2	Eckert Ck 1	10.28	12.51	2.23	6.43	555	0.25	0.37
3	Eckert Ck 1	10.42	11.94	1.51	6.41	554	0.39	1.67
4	Eckert Ck 1	10.37	11.68	1.31	8.88	767	0.14	0.42
5	Log Crossing	10.20	11.65	1.45	7.32	633	0.24	0.70
6	The Splash 1	10.24	11.58	1.34	7.32	633	0.31	1.15
7	The Splash 1	10.08	11.22	1.15	6.34	547	0.23	3.86
8	The Splash 1	9.81	11.09	1.28	5.76	497	0.29	0.98
9	The Splash 2	9.84	10.72	0.88	6.18	534	0.26	1.28
10	The Splash 2	9.56	10.15	0.59	7.31	632	0.45	1.92
11	Eckert Ck North Arm	12.80	13.22	0.42	0.18	15	0.07	0.17
12	Eckert Ck North Arm	12.36	12.79	0.43	0.18	15	0.12	1.32
13	Eckert Ck North Arm	12.10	12.59	0.49	0.44	38	0.23	3.52
14	Eckert Ck North Arm	11.31	12.35	1.04	0.44	38	0.04	0.03
15	Bank K Ck	12.80	13.21	0.41	0.27	23	0.09	0.13
16	Bank K Ck	12.87	13.03	0.16	0.27	23	0.44	2.53
17	Eckert Ck South Arm	11.60	12.78	1.18	1.72	149	0.53	11.91
17a	Eckert Ck South Arm	10.77	12.35	1.58	2.03	175	0.16	0.65
18	Eckert Ck South Arm	11.17	12.06	0.89	2.03	175	0.34	3.54
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.65	0.78	1.56	135	0.28	1.01
22	Sawmill Ck	10.30	11.35	1.05	1.56	135	0.74	9.76
23	Katarapko Ck	6.36	10.79	4.43	18.17	1570	0.10	0.07
24	Katarapko Ck / Stone Weir	4.69	10.79	6.10	19.73	1704	0.06	0.03
25	Katarapko Ck	4.04	10.14	6.10	19.73	1704	0.07	0.05
26	Katarapko Ck	3.77	10.14	6.37	19.73	1704	0.05	0.03
27	Katarapko Ck	4.50	10.14	5.64	27.03	2336	0.10	0.09
28	Katarapko Ck	5.63	10.13	4.50	27.03	2336	0.13	0.16
29	Piggy Ck	11.00	11.00	0.00	0.00	0	0.00	0.00
30	Piggy Ck	10.27	10.27	0.00	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 13: Scenario 10 hydraulic results from key reporting locations.

![](_page_34_Figure_1.jpeg)

Figure 13: Inundation extent and depth for Scenario 10.

### 4.2.11 Scenario 11

Scenario 11 is set up similar to Scenario 10 but with 20,000 ML/d at Lock 5 (with normal upper pool level of 13.2 m AHD at Lock 4). Hydraulic results at key reporting locations are shown in Table 14, while inundation extent and depth is shown in Figure 14.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 828 ML/d. Flow through Bank J Regulator is 775 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.24 and 13.18 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 677 ML/d (water levels at 11.72 m AHD upstream and 11.65 m AHD downstream of the structure), with approximately 150 ML/d flow into Sawmill Creek. The total area inundated in the system (excluding River Murray and Katarapko Creek) is 151 ha and the volume of inundation is 1159 ML.

Water level downstream of Lock 4 is at approximately 11.5 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 7,780 ML/d at the new crest level of 10.24 m AHD.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
		mAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1	Eckert Ck 1	11.62	13.24	1.62	9.00	778	0.29	2.79
2	Eckert Ck 1	10.28	12.53	2.25	6.73	581	0.25	0.39
3	Eckert Ck 1	10.42	11.99	1.57	6.70	579	0.38	1.59
4	Eckert Ck 1	10.37	11.75	1.38	9.53	823	0.14	0.41
5	Log Crossing	10.20	11.72	1.52	7.86	679	0.24	0.68
6	The Splash 1	10.24	11.65	1.41	7.86	679	0.31	1.10
7	The Splash 1	10.08	11.39	1.32	6.47	559	0.20	2.30
8	The Splash 1	9.81	11.32	1.51	5.99	518	0.21	0.48
9	The Splash 2	9.84	11.27	1.43	7.13	616	0.14	0.28
10	The Splash 2	9.56	11.23	1.67	7.84	678	0.13	0.04
11	Eckert Ck North Arm	12.80	13.27	0.47	0.25	22	0.09	0.25
12	Eckert Ck North Arm	12.36	12.84	0.48	0.25	22	0.15	1.76
13	Eckert Ck North Arm	12.10	12.63	0.53	0.61	52	0.27	3.11
14	Eckert Ck North Arm	11.31	12.38	1.07	0.61	52	0.06	0.06
15	Bank K Ck	12.80	13.26	0.46	0.35	30	0.11	0.17
16	Bank K Ck	12.87	13.06	0.18	0.35	30	0.47	2.92
17	Eckert Ck South Arm	11.60	12.83	1.23	1.83	158	0.53	11.46
17a	Eckert Ck South Arm	10.77	12.41	1.64	2.28	197	0.17	0.73
18	Eckert Ck South Arm	11.17	12.10	0.93	2.27	197	0.36	3.81
19	Ngak Indau	12.60	12.60	0.00	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.15	0.00	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	11.72	0.85	1.73	150	0.28	0.92
22	Sawmill Ck	10.30	11.47	1.17	1.73	150	0.62	7.41
23	Katarapko Ck	6.36	11.35	4.99	88.33	7632	0.37	1.02
24	Katarapko Ck / Stone Weir	4.69	11.34	6.65	90.07	7782	0.24	0.42
25	Katarapko Ck	4.04	11.24	7.20	90.07	7782	0.22	0.48
26	Katarapko Ck	3.77	11.23	7.46	90.07	7782	0.19	0.34
27	Katarapko Ck	4.50	11.22	6.72	97.91	8459	0.27	0.69
28	Katarapko Ck	5.63	11.16	5.53	97.91	8459	0.33	1.10
29	Piggy Ck	11.00	11.23	0.23	0.00	0	0.00	0.00
30	Piggy Ck	10.27	11.23	0.96	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

#### Table 14: Scenario 11 hydraulic results from key reporting locations.

![](_page_36_Figure_1.jpeg)

Figure 14: Inundation extent and depth for Scenario 11.

### 4.2.12 Scenario 12

Scenario 12 is set up similar to Scenario 11 but with 30,000 ML/d at Lock 5 (with normal Lock 4 upper pool level of 13.2 m AHD). Hydraulic results are shown in Table 15, while inundation extent and depth is shown in Figure 15.

The total inflow into the system through Main Eckert's Creek, North Arm and Bank K Creek is 922 ML/d. Flow through Bank J Regulator is 842 ML/d, while the water levels directly upstream and downstream of the regulator are approximately 13.31 and 13.24 m AHD respectively. Flow through Eckert's Creek Log Crossing Regulator in a fully open state is approximately 680 ML/d (water levels at 12.40 m AHD upstream and 12.37 m AHD downstream of the structure). The total area inundated in the system (excluding River Murray and Katarapko Creek) is approximately 365 ha and the volume of inundation is approximately 3220 ML.

Water level downstream of Lock 4 is at approximately 12.53 m AHD, resulting in flow over the Katarapko Creek stone weir and fishway at approximately 13,770 ML/d at the new crest level of 10.24 m AHD. Flow at this level also results in a marginal reversal of flow from the river into Sawmill Creek at approximately 7 ML/d (N.B. flow and velocity is shown as a negative value in Table 15 for reverse flow). This reversed flow has contributed to flow through Eckert Creek (location no. 4) being reduced compared to that for Scenario 11 due to backwater effects.

No.	Branch	Bed Level	WL	d	Q	Q	V	τ
-	Esternt Ob 1	MAHD	m AHD	m	m³/s	ML/d	m/s	N/m <sup>2</sup>
1		11.62	13.31	1.69	9.77	844	0.30	2.89
2		10.28	12.66	2.38	7.06	610	0.24	0.35
3		10.42	12.46	2.04	6.40	553	0.23	0.57
4	Eckert Ck I	10.37	12.40	2.04	7.87	680	0.07	0.09
5	Log Crossing	10.20	12.40	2.20	7.91	683	0.14	0.20
6	The Splash 1	10.24	12.37	2.13	7.91	683	0.10	0.25
/	The splash I	10.08	12.33	2.25	7.90	683	0.13	0.38
8	The splash 1	9.81	12.32	2.51	/.88	681	0.11	0.10
9	The Splash 2	9.84	12.32	2.47	8.65	748	0.07	0.07
10	The Splash 2	9.56	12.31	2.75	8.65	/48	0.07	0.01
11	Eckert Ck North Arm	12.80	13.35	0.55	0.40	35	0.11	0.37
12	Eckert Ck North Arm	12.36	12.91	0.55	0.40	35	0.18	1.31
13	Eckert Ck North Arm	12.10	12.72	0.62	0.93	80	0.28	3.38
14	Eckert Ck North Arm	11.31	12.59	1.28	0.92	79	0.06	0.07
15	Bank K Ck	12.80	13.33	0.53	0.53	46	0.13	0.25
16	Bank K Ck	12.87	13.10	0.22	0.53	46	0.49	3.53
17	Eckert Ck South Arm	11.60	12.92	1.32	1.97	170	0.50	9.50
17a	Eckert Ck South Arm	10.77	12.60	1.83	2.66	230	0.17	0.66
18	Eckert Ck South Arm	11.17	12.44	1.27	2.04	176	0.18	0.97
19	Ngak Indau	12.60	12.74	0.14	0.00	0	0.00	0.00
20	Ngak Indau	12.15	12.74	0.59	0.00	0	0.00	0.00
21	Sawmill Ck	10.87	12.40	1.53	-0.06	-5	0.00	0.00
22	Sawmill Ck	10.30	12.40	2.10	-0.06	-5	-0.01	0.00
23	Katarapko Ck	6.36	12.40	6.04	159.40	13772	0.46	1.49
24	Katarapko Ck / Stone Weir	4.69	12.39	7.70	159.34	13767	0.32	0.71
25	Katarapko Ck	4.04	12.34	8.30	159.34	13767	0.30	1.06
26	Katarapko Ck	3.77	12.32	8.55	159.33	13766	0.28	0.86
27	Katarapko Ck	4.50	12.30	7.80	167.98	14514	0.37	1.59
28	Katarapko Ck	5.63	12.18	6.55	167.99	14515	0.44	2.43
29	Piggy Ck	11.00	12.32	1.32	0.00	0	0.00	0.00
30	Piggy Ck	10.27	12.32	2.04	0.00	0	0.00	0.00
31	Carpark Lagoon out	11.92	11.95	0.03	0.00	0	0.00	0.00

Table 15: Scenario 12 hydraulic results from key reporting locations.

![](_page_38_Figure_1.jpeg)

Figure 15: Inundation extent and depth for Scenario 12.

# 5. Conclusions

- Modelling was conducted to provide data for informing engineering design of regulating structures planned for construction in Katfish Reach.
- The base model developed by Water Technology was updated to include the latest survey data and apply corrections to the model configuration, including recalibration of the River Murray component of the model and correcting the location of the Eckert North Arm Bridge structure.
- All modelled scenarios (12 in total) were completed to steady state conditions, and water level, flow, velocity and bed shear stress values were reported at various reporting locations consistent with those used previously by Water Technology.
- At 5,000 ML/d River Murray Flow at Lock 5, increasing the flow through Bank J, from 62 ML/d (approximate current inflow) to a fully open state (~720 ML/d), caused total inflow (through upgraded Banks J, K and N) to rise from approximately 100 ML/d to 750 ML/d, respectively. This rise in inflow caused inundation extent within the floodplain to increase from approximately 80 ha to 120 ha, respectively.
- For these cases, partially closing the upgraded Log Crossing structure allowed diversion of some flow through Sawmill Creek. For instance, at 200 ML/d through Bank J, reducing flow through Log Crossing from fully open (~220 ML/d) to 150 ML/d caused flow into Sawmill Creek to increase from approximately 20 ML/d to 85 ML/d, respectively.
- Raising the Lock 4 weir pool by 0.6 m (to 13.8 m AHD) caused a significant increase in possible inflow to the floodplain. For instance, at River Murray flow of 10,000 ML/d, raising the weir pool caused inflows to increase from ~770 ML/d to ~1,720 ML/d, respectively, while inundation extent also approximately doubled, from ~120 ha to 240 ha, respectively.
- High flow events of 20,000 and 30,000 ML/d with all new structures fully open had approximately 39-46% of the river flow occurring through Katarapko Creek under the upgraded Stone Weir, with total inflow to the floodplain up to approximately 920 ML/d. At 30,000 ML/d, raised water level downstream of Lock 4 caused a flow reversal in Sawmill Creek, with flow entering from the river at a minor rate of less than 10 ML/d. At this flow, inundation extent increased to the highest coverage extent of all scenarios tested, at 365 ha.

# 6. References

Water Technology, 2010. *Katfish Reach Modelling Calibration and Scenarios*, Report no. J874/R03, prepared for Department for Environment and Heritage, Berri.

#### www.murrayfutures.sa.gov.au

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