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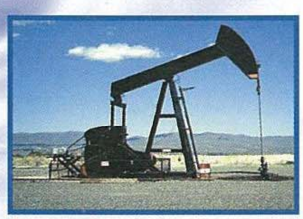
LOCK 3 TO MORGAN ACCOUNTABLE SALINITY DEBITS AND CREDITS- GROUNDWATER MODELLING SCENARIOS



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LOCK 3 TO MORGAN ACCOUNTABLE SALINITY DEBITS AND CREDITS - GROUNDWATER MODELLING SCENARIOS

Document Status

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A	22-6-07	Draft for client comment
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The MDBC-accredited groundwater flow model for the Lock 3 to Morgan area (Middlemis, *et al*, 2005), has been used to quantify groundwater flux and salt load contributions to the River Murray as a consequence of irrigation developments and implementation of salt interception schemes (SIS) between Cadell and Woolpunda.

No changes have been made to the model grid, boundary conditions or surface-groundwater interaction features (apart from a minor change to the irrigation efficiency assumptions for the pre-1988 scenarios, as described below) and thus the model parameters, calibration performance and limitations remain essentially unchanged. However, for all scenarios except for the dryland clearing scenario itself (scenario 2), the dryland clearing recharge zones have been replaced by the uncleared recharge rate of 0.1 mm/yr. This is consistent with the approach applied to the DWLBC Border to Lock 3 model. Another change relates to the calculated salt loads, which were previously calculated by the net flux method (flow into river minus flow out of river). For the purpose of this study and following discussions with DWLBC, it was decided that only the “flow in” component would be used to calculate salt loads into a particular river reach. All recent DWLBC models apply this assumption. Regardless of the change made to salt load calculation methodology, the modelled salt loads still give a good match to measured history as shown in Table ES1. Part of the reason why the model over-estimates the salt load is because the model does not include evapotranspiration on the floodplain (i.e. all modelled flows reporting to the floodplain end up in the river), as this limitation has not yet been addressed by model upgrades (although it is recommended). Other significant changes to the results reported in Middlemis, *et al*, 2005 include the discretization of the zones used for calculating modelled flux to the River Murray (and subsequently salt load) to specifically represent the Cadell reach, and the inclusion of three new scenarios (Scenario 8a, 8b and 8c) which were created to help quantify saltload reductions to the River due to the operation of specific SIS.

A summary of the predicted salt loads entering the River Murray is given in Tables ES2 to ES5, while Table ES6 summarises the model scenarios of the accountable irrigation and management actions.

Table ES1
Lock 3 to Morgan Model Run-of-River Measurements & Modelled Salt Load (2007)

Reach	Cadell (t/d)		Qualco (t/d)		Waikerie (t/d)		Woolpunda (t/d)	
Date	**Measured**	**Modelled**	**Measured**	**Modelled**	**Measured**	**Modelled**	**Measured**	**Modelled**
1988	19	49	84	83	114	134	201	250
June 1998	34	46	91	96	18	67	14	40
June 2001	13	45	91	93	15	72	14	50
June 2003	12	43	39	80.3	23	54	13	61

Table ES2
Summary of predicted salt load (t/day) entering the River Murray in the Qualco Reach

Scenario	1988	2000	2007	2050	2107
S-1	13.3	13.3	13.3	13.3	13.3
S-2	17.2	20.9	21.9	35.1	46.8
S-3A	82.9	100.1	123.5	145.5	151.7
S-3B	82.9	100.1	108.3	104.8	103.4
S-4	82.9	100.0	108.3	117.5	120.8
S-5	82.9	100.0	108.3	117.8	121.5
S-8	82.9	96.2	86.0	71.0	70.4
S-8a	82.9	100.6	111.8	119.6	125.1
S-8b	82.9	94.9	98.2	114.7	119.9
S-8c	82.9	94.9	94.6	90.3	91.6

Table ES3
Summary of predicted salt load (t/day) entering the River Murray in the Waikerie Reach

Scenario	1988	2000	2007	2050	2107
S-1	6.5	6.5	6.5	6.5	6.5
S-2	11.6	15.4	16.4	27.5	40.0
S-3A	133.8	143.1	125.6	113.0	114.8
S-3B	133.8	142.9	124.0	90.5	90.2
S-4	133.8	142.9	123.9	98.2	99.6
S-5	133.8	142.9	123.9	101.6	105.7
S-8	133.8	71.3	68.0	22.6	24.8
S-8a	133.8	139.1	121.6	100.2	105.2
S-8b	133.8	64.5	68.4	30.4	33.9
S-8c	133.8	64.5	72.6	29	32

Table ES4
Summary of predicted salt load (t/day) entering the River Murray in the Woolpunda Reach

Scenario	1988	2000	2007	2050	2107
S-1	246.9	246.9	246.9	246.9	246.9
S-2	247.6	246.9	257.5	263.9	288.0
S-3A	249.6	249.8	249.6	278.6	281.5
S-3B	249.6	249.8	249.6	278.7	275.4
S-4	249.6	249.8	249.6	306.6	338.4
S-5	249.6	249.8	249.6	316.2	359.9
S-8	249.6	44.6	72.6	57.7	77.5

Table ES5
Summary of predicted salt load (t/day) entering the River Murray in the Cadell Reach

Scenario	1988	2000	2007	2050	2107
S-1	14.2	14.2	14.2	14.2	14.2
S-2	16.4	17.5	18	24.9	32.4
S-3A	48.7	44.9	47.1	54.3	57.4
S-3B	48.7	44.9	42.3	43.4	44.1
S-4	48.7	44.9	42.5	50.6	53.3
S-5	48.7	44.9	42.5	51.6	54.7
S-8	48.7	44.9	42.5	49.0	50.4
S-8a	48.7	44.7	43.3	52.0	55.9
S-8b	48.7	44.7	42.3	52.1	55.7
S-8c	48.7	44.7	41.6	49.6	52.0

Table ES6
Summary of modelling scenarios

Scenario	Name	Model Run	Irrigation development area	IIP[1]	RH[2]	SIS[3]
S–1	Natural system	Steady State	None	–	–	–
S–2	Mallee clearance	1920–2107	None (but includes Mallee clearance area)	–	–	–
S–3A	Pre-1988, no IIP, no RH	<1988–2107	Pre-1988	No	No	–
S–3B	Pre-1988, with IIP, no RH	<1988–2107	Pre-1988	Yes	No	–
S–3C	Pre-1988, with IIP and with RH	<1988–2107	Pre-1988	Yes	Yes	–
S–4	Current irrigation	1880–2107	Pre-1988 + Post-1988	Yes	Yes	No
S–5	Current plus future irrigation	2006–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	No
S-8	As Constructed SIS	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8a	Wool SIS only	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8b	Wool + Waik 1 SIS only	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8c	Wool + Waik1 + Qualco SIS	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes

Note: 1 Improved Irrigation Practices 2 Rehabilitation 3 Salt Interception Scheme.

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SECTION 1 - GROUNDWATER MODELLING

1.1 OBJECTIVES AND MODEL COMPLEXITY

The objective of this study is to use the MDBC-accredited groundwater flow model for the Lock 3 to Morgan area (Middlemis, et al, 2005) to quantify groundwater flux and salt load contributions to the River Murray under a range of irrigation and SIS (Salt Interception Scheme) scenarios. This is required to meet obligations under the MDBC Basin Salinity Management Strategy (BSMS), on the basis of SA developing a suite of accredited MODFLOW groundwater models to bring entries forward to the BSMS Salinity Registers.

1.2 CONCEPTUAL HYDROGEOLOGICAL MODEL

Figure 1 is a schematic of the conceptual hydrogeological model. The hydrogeology and conceptualisation is unchanged from that reported in Middlemis, *et al* 2005.

1.3 NUMERICAL MODEL AND LAYER STRUCTURE

The MODFLOW numerical groundwater flow modelling package was used for this work, operating under the Processing Modflow Pro v7.0.15 Graphical User Interface (WebTech 360, 2003).

The existing groundwater model structure of 7 layers (Figure 1) adequately represents the major unconfined and confined aquifers that exist in the Lock 1 to Lock 3 area.

1.4 MODEL GRID AND BOUNDARY CONDITIONS

The model extent, grid and boundary conditions are essentially unchanged from the configuration in the original model. The finite difference grid consists of 342 rows x 534 columns, covering an area of approximately 70 x 45 km. The grid cells covering the floodplain and irrigation areas in the Qualco-Waikerie region are 75 x 75 m in size to provide a more detailed representation of the river, irrigation development and SIS abstraction wells.

The grid expands to 200 m x 75 m in the Woolpunda reach, to reduce the dimensionality of the model, and because the increased bore spacing in this area makes it feasible. Regionally, the grid expands to a maximum of 265 m x 580 m. A scaling factor of 1.5 is used for cell size transitions.

The head-dependant flow boundary (or General Head Boundary “GHB”) package and the constant-head boundary package of Modflow were used to simulate groundwater inflow and outflow along the model boundaries.

1.5 SURFACE-GROUNDWATER INTERACTION

1.5.1 River Features

The surface water levels in the River and anabranches provide an important control on the groundwater flow regime and the potential salt impacts to the river. Specified head boundaries are used to represent the fixed weir pool elevations along the river Murray. The river boundary condition is unchanged from the original model.

1.5.2 Drain Features

The existing drain cell configuration is unchanged, representing cliff seepage between the highland and floodplain areas.

1.5.3 Evapotranspiration

The evapotranspiration feature in the model remains unchanged. It extends only over the area of Stockyard Basin at a maximum rate of 1.1 mm/day, which is effective when the water table reaches the specified topographic surface, and it decreases to zero at an extinction depth of 3 m below that surface. Evaporation has not been activated in the floodplain area due to the lack of topography data that existed in the area at the time of original model development. This is an acknowledged model limitation that should be addressed during the next 5-year review.

1.5.4 Groundwater Pumping

The well feature representing SIS in the model is unchanged from the 2005 model prior to December 2003. The model calibration period has been extended to December 2006 and pumping data has been incorporated accordingly, with pumping data averaged over 6-month periods to suit the model stress period set up, based on detailed data supplied by SA Water. The future pumping regime (post December 2006) at Qualco and Waikerie adopts the historical (average) rates from September to December 2003. The modelled SIS rates at Woolpunda adopt the historical (average) rates based on the first half of the 1997 calendar year. These rates were selected because they represent a period of quite steady pumping and quasi-steady pumping water levels, which is associated with highly effective interception.

1.6 IRRIGATION DEVELOPMENT

Irrigation development in the Cadell, Qualco and Waikerie area is believed to have begun in the 1930’s, 1960’s and the 1910’s respectively (pers.comm. Matt Miles, DEH) and has occurred mainly within the highland areas (except in the Cadell region where irrigation occurs mainly in the floodplain). Irrigation development in the Woolpunda area began later, during the early 1970’s.

Recharge due to deep leakage (or root zone drainage “RZD”) under irrigation areas is a key process in the model, and is essentially unchanged, apart from a minor change to the irrigation efficiency assumptions for the pre-1988 scenarios, as described in section 1.7.

The Cadell, Qualco and Waikerie area has seen little post-1988 irrigation development, as shown in Figure 2. However, the irrigation growth seen at Woolpunda is dominated by post 1988 development. Furthermore, expansion or “prior commitment” areas are generally concentrated in the Woolpunda area (Figure 2). The prior commitment scenario (scenario 5) assumes that all future irrigation areas are activated at the year 2015 with an assumed recharge rate of 100 mm/yr to the water table (described further in section 2.7).

1.7 RECHARGE AND TIME LAGS

1.7.1 Recharge in Irrigation Areas

The irrigation recharge zones and time series rates are unchanged from the existing model, ranging from a maximum of approximately 300 mm/yr for early irrigation developments, and around 120 mm/yr in recent times.

The irrigation area recharge model is based on:

- GIS Information of irrigation scheme growth in area terms [Ha] at generally decadal intervals since 1890;
- Available monitoring information of total irrigation scheme diversions [ML];
- Assumptions regarding irrigation water use efficiency and root zone drainage [%]; and
- SIMRAT model time lags for irrigation root zone drainage to reach the water table [years].

The **lag time** is dependent on several factors including the drainage rate through the root zone, the depth to groundwater and the thickness of the intervening Blanchetown Clay (URS *et al*, 2005, cited in Middlemis *et al*, 2005)). The time lags calculated by the Department of Environment and Heritage (DEH) using the SIMRAT/SIMPACT model (URS *et al*, 2005) range from zero to 40 years across the Qualco-Waikerie area, with lag times reaching up to 60 years in the Woolpunda reach (Figure 3).

Across Cadell, Qualco, Waikerie and Woolpunda, the irrigation schemes comprise piped conveyance of water pumped from the River. The Lock 3 to Morgan model adopts the argument that at earlier times, relatively low efficiency irrigation practices and technology results in more than 15% root zone drainage (RZD), and that, over time, more efficient irrigation practices have been implemented (Middlemis *et al*, 2005). This results in irrigation efficiencies in the order of 80% at the commencement of irrigation, increasing to 90% currently. This assumption differs from other DWLBC (Department of Water, Land and Biodiversity) numerical models including the Pike-Murtho model and the Berri-Renmark model, which assumed an irrigation efficiency of 85% for all time which includes conveyance and other losses. Recharge to the water table comprised the remainder of the irrigation applications, at an assumed rate of 15% of the irrigation volume in terms of ML/Ha (plus rainfall).

These issues were discussed at a workshop organised by the Victorian DPI and the MDBC in Mildura on 24 June, 2005. While it was suggested at that workshop that a value of 15% RZD may be appropriate as a universal simple model, this has not been discussed and agreed by the State Jurisdictions (especially regarding implications for SIMRAT). Future modelling programs may need to revise the recharge data to retain consistency with accepted wisdom on irrigation recharge.

Once the assumptions on irrigation efficiencies were defined, the recharge rates are calculated in terms of m/day for input to the model. The rates were then applied to the areas irrigated (based on the GIS coverage data provided by DEH), at the times consistent with the adopted time lag estimates based on SIMRAT. Note that the SIMRAT timelags are constant with time in the Lock 3 to Morgan model for all but scenario 5 (the prior commitments run). In the case of scenario 5, it can be argued that the theoretical lag times should be reduced as water table mounds have already developed under irrigation in some areas (ie. the depth to water table has decreased substantially) where prior commitment areas are also assumed to be sited.

Applying the above assumptions to the Lock 3 to Morgan model has resulted in the estimation of a range of irrigation recharge rates across the Qualco-Waikerie area from a maximum of about 300 mm/yr in the 1960's-1970's, to about 120 mm/yr in the early 2000's (these dates do not allow for time lags).

1.7.2 Recharge in Prior-Commitment Areas

A total of nine new zones have been identified and approved by the Commission to be irrigated (figure 2). These new irrigated zones or "Prior- Commitment" areas form the basis of the future irrigation scenario (scenario 5). All zones are assumed to commence irrigation at the year 2015 with a rate of 100 mm/yr to the water table, and with an appropriate time lag applied. The majority of the prior commitment areas occur in the Woolpunda reach, resulting in large time lags ranging from ~ 5 to 60 years (figure 3). Lag-times are based on the SIMRAT/SIMPACT model; however some lag-times have been adjusted for zones that are located in areas that have already experienced long-term irrigation. This is based on the assumption that depth to water table has been substantially reduced and thus the lag-times are reduced. This assumption is consistent with DWLBC's Border to Lock 3 models.

1.7.3 Recharge in Dryland Areas

The widespread clearance of native vegetation in the dryland region of the projects area has resulted in a reduction in the evapotranspiration rate and an increase in the rate of drainage of rainfall past the root zone to the water table. Dryland recharge rates for cleared zones in the project area have been supplied by DEH, which are based on studies by DWLBC and CSIRO during development of the SIMPRAT/SIMPACT models. The recharge rate prior to clearing is estimated to be 0.1 mm/yr. Post clearing recharge rates in the dryland parts of the project area vary up to 10 mm/yr, depending upon lag time. The dryland recharge rates adopted in the model are consistent with research in the Mallee zone (Cook *et al,* 2004, cited in Middlemis *et al*, 2005)). The dryland recharge was also specified with time lags applied from when the action occurred on "ground" until the recharge flux reached the water table. These arrangements are unchanged from the accredited model.

1.8 MODEL CALIBRATION

Model calibration performance is consistent with best practice guidelines, and is unchanged from the accredited model in terms of adopted parameter values and history match performance.

1.9 MODEL COMPARISON TO SALT LOADS

Salt load calculations were undertaken as a further check on model calibration. The modelled salt loads were calculated by applying a specified salinity concentration to the model to quantify both lateral and vertical groundwater flows to the main river channel (i.e not just to the edge of the floodplain). Figure 2 shows the Cadell, Qualco, Waikerie and Woolpunda reaches that the salt load calculations were based on.

In the Cadell area, the lateral flow is from the Monoman Formation and the vertical flow is from the Glenforslan Formation. In the Qualco and Waikerie area, the lateral flow is from the Glenforslan Formation (via the Monoman Formation in the floodplain) and the vertical flow is from the pressurised confined Mannum Formation via the overlying Finniss Formation. In the Woolpunda region, the horizontal flow is from the Mannum Formation and the vertical flow is from the Ettrick Formation.

The salt load comparison results from Aquaterra's 2005 model (Middlemis *et al* 2005) are summarised in Table 1, which includes salt loads estimated from Run-of-River data. These modelled salt loads were calculated by the net flux (flow into river minus flow out of river) that reports to the model cells hosting the river. For the purpose of this study, and after discussions with DWLBC, it was decided that only the "flow in" component would be used to calculate saltload into a particular river reach. All other recent DWLBC models apply this assumption. Adopting this approach results in the revised history match salt loads shown in Table 2.

Table 1
Lock 3 to Morgan Model Run-of-River Measurements and Modelled Salt Load (2005), using the net inflow method

Reach	Cadell (t/d)		Qualco (t/d)		Waikerie (t/d)		Woolpunda (t/d)	
Date	**Measured**	**Modelled**	**Measured**	**Modelled**	**Measured**	**Modelled**	**Measured**	**Modelled**
1988 (see note)	19	N/A	84	83	114	135	201	253
June 1998	34	N/A	91	93	18	68	14	41
June 2001	13	N/A	91	96	15	78	14	58
June 2003	12	N/A	39	98	23	61	13	76

Note: Due to missing data in both the Cadell and Qualco reaches in 1988, reported run-of-river measurement has been taken from April 1987 for Cadell, and the average of the two 1987 surveys for Qualco. For Waikerie, the June 1988 (complete) survey is listed. There are no Woolpunda measurements for 1988, so the average of the pre-scheme surveys is listed. Modelled data in 1988 is for January 1988. The Cadell reach was not reported in Middlemis et al 2005.

Table 2
Lock 3 to Morgan Model Run-of-River Measurements & Modelled Salt Load (2007), using the raw inflow method

Reach	Cadell (t/d)		Qualco (t/d)		Waikerie (t/d)		Woolpunda (t/d)	
Date	**Measured**	**Modelled**	**Measured**	**Modelled**	**Measured**	**Modelled**	**Measured**	**Modelled**
1988	19	49	84	83	114	134	201	250
June 1998	34	46	91	96	18	67	14	40
June 2001	13	45	91	93	15	72	14	50
June 2003	12	43	39	80.3	23	54	13	61

The slight differences between the 2005 and 2007 modelled results is due to the (raw) “flow in” flux component only being used for salt load calculations (as mentioned above, and noting its consistency with DWLBC’s Border to Lock 3 models). However, it is also due to the dryland clearing recharge rate being replaced by the uncleared rate of 0.1 mm/yr for all time (with the exception scenario 2). Additional small differences could be due to small adjustments made to the zone budget set-up which discounts salt load contributions from cliff seepage. Greater efforts in implementing re-wetting effectively in the model can also result in slightly different salt loads since the flow paths may be different with more effective re-wetting.

1.10 MODEL SENSITIVITY ANALYSES

Sensitivity and non-uniqueness assessment was undertaken during the previous study (Middlemis *et al*, 2005).

1.11 MODEL LIMITATIONS

The following points on model limitations (referenced from Section 6.2 of Middlemis *et al*, 2005) are still applicable:

- There are no detailed features for floodplain flow processes in the Lock 3 to Morgan model, due mainly to a lack of detailed understanding at the present time (the modelled fluxes and hence salt loads for the Cadell reach are overestimated due to no evapotranspiration processes operating on the floodplain in the model, which is discussed further in Section 3. This also means that there is no salt accumulation feature in the model, nor any process to represent the process of salt mobilisation from the floodplain to the river under flood and post-flood conditions. As understanding of these processes improves, the model should be refined accordingly.
- It is argued in Sections 5.10 and 5.11 of Middlemis *et al* (2005) that the model is suitable for quantifying the salinity credit impacts of the schemes, notably because of reasonable matches to the run-of-river salt loads, and because the differences between simulations with and without the SIS schemes match measurements of the effects of the schemes. It is recommended that further detailed modelling work be undertaken during future projects, particularly to analyse in detail the modelled flows and salt loads to the River per kilometre rather than per reach, and to draw comparisons between the model results and the run-of-river and NanoTEM results.
- The layer elevations specified in the model were based on the data from the Morgan-Border model generated by AWE in 1998 (Barnett et al, 2002), as agreed with DWLBC. The layer elevations were devised from drill hole information, but there are acknowledged inconsistencies in the logging interpretations, recent revisions to the regional stratigraphic model and nomenclature, and likely limitations with the quality of the original information. A detailed study is required to devise a comprehensive layer elevation data set, as described in the Data/Monitoring Needs section of Middlemis *et al* (2005).

- Future model prediction scenarios also need detailed information on the long term stage level of the Stockyard Plain basin for the different irrigation/SIS scenarios. This requires a review and revision of the water balance for the basin using the results of Middlemis *et al*, (2005). In the absence of this information, the assumption has been made that the basin operates at full capacity.
- Comparison of the model based on salt load comparisons is hampered by the limited availability of groundwater salinity data for the floodplain. The large range in floodplain salinity values, coupled with an ill-defined spatial pattern, creates uncertainty in salt load calculations. However, a simplified salinity distribution in the model is appropriate for assessing associated debits and credits.
- Re-wetting problems continue to be an issue with the Lock 3 to Morgan model. Re-wetting is needed in the model because the regional water table is originally located in the Glenforslan Formation for the Qualco and Waikerie area and the Mannum Formation for the Woolpunda region. As the irrigated induced groundwater mounds grow with time, the water table rises into the above layers and thus previously dry model cells need to become wet. This "re-wetting" requirement generally causes the model to become numerically unstable. Future modelling effort should employ the use of the Modflow-Surfact code which is not affected by re-wetting problems.
- The "steady state" model scenario is in fact a pseudo-steady-state (long-term transient) simulation. When the model is run in true steady state mode, the natural water table mound south and north of Woolpunda dissipates, and it has not been possible with the current model setup to match the recorded levels with a steady state simulation. A long term transient simulation does allow a reasonable match, but that suffers slightly from the problem that the mound dissipates slightly with time (ie. the resulting fluxes and salt loads to the river are not steady with time). The suitable value for the (pseudo-steady) flux to the river was identified from the long term transient simulation to represent the pre-development (pre-clearing, post-locking) conditions. A review of the current conceptual model, boundary conditions, recharge and aquifer parameters should be undertaken during the next modelling program, with the aim of devising a valid steady state model run.

SECTION 2 - MODELLED SALT LOADS DUE TO PRE- AND POST-1988 ACTIONS

2.1 SCENARIOS

The model scenarios are summarised in Table 3, and are discussed in detail below. The adopted scenario structure has been developed progressively in response to requests by the State (DWLBC) and the MDBC to:

1. Evaluate the impact of various accountable actions, to be recorded on the MDBC salinity registers 'A' and 'B', including:

    a. Impact of the various pre-and post-1988 actions on the groundwater flux and salt load entering the River Murray.

    b. Impact of improved irrigation practices (IIP), the rehabilitation (RH) of distribution systems, and,

    c. Construction of SIS on the groundwater flux and salt load entering the River Murray.

2. Determine the State and Federal responsibility for cost sharing.
3. Satisfy the reporting requirements of:

    d. Schedule 'C' of the Murray-Darling Basin Agreement 1992.

    e. Basin Salinity Management Strategy Operational Protocols 2003.

The scenarios include the application of the following important conditions, which are based on the specifications for modelling developed by DWLBC (DWLBC, April 2007):

Pre-1988 irrigation	Irrigation development area and recharge that occurred prior to 01/01/1988
Post-1988 irrigation	Irrigation development area and recharge that occurred between 01/01/1988 and 01/01/2006.
Future Development	Future irrigation development area and recharge (assuming recharge of 100 mm/yr to the watertable) resulting from activation of already allocated water that is assumed to occur in 2015.
Mallee Clearance	Clearance of natural vegetation assumed to commence from the 1920s, resulting in increased recharge to the groundwater table in dry-land areas. It is assumed that no major clearing of native vegetation occurred after 1988.
Improved Irrigation Practices (IIP)	Advancements in irrigation efficiency include the use of sprinkler and drip systems (replacing flood irrigation via earth channels) and the greatly improved technology, monitoring and management of irrigation systems. These measures have resulted in improvements in efficiency and reduced recharge to the groundwater table.
Rehabilitation (RH)	Replacement of leaky concrete water distribution channels with pipelines resulting in reduced conveyance losses, which are reflected by reduced recharge to the table. Note: RH does not occur in the Qualco, Waikerie and Woolpunda area.
SIS	Salt Interception Schemes designed to intercept the (maximum) groundwater flux and salt load resulting from the pre-1988, post-1988 and future development irrigation.

Table 3
Summary of Modelled Scenarios

Scenario	Name	Model Run	Irrigation development area	IIP	RH	SIS
S–1	Natural system	Steady State	None	–	–	–
S–2	Mallee clearance	1920–2107	None (but includes Mallee clearance area)	–	–	–
S–3A	Pre-1988, no IIP, no RH	<1988–2107	Pre-1988	No	No	–
S–3B	Pre-1988, with IIP, no RH	<1988–2107	Pre-1988	Yes	No	–
S–3C*	Pre-1988, with IIP and with RH	<1988–2107	Pre-1988	Yes	Yes	–
S–4◊	Current irrigation	1880–2107	Pre-1988 + Post-1988	Yes	Yes	No
S–5	Current plus future irrigation	2006–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	No
S-8	As Constructed SIS	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8a	Wool SIS only	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8b	Wool + Waik 1 SIS only	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8c	Wool + Waik1 + Qualco SIS	<1988–2107	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes

* Scenario-3C is not applicable since no rehabilitation has occurred in the Lock 3 to Morgan Area.
◊ Scenario 4 includes the historical calibration run.

2.2 SCENARIO-1: NATURAL SYSTEM

The (pseudo) Steady State Scenario-1 models the pre-development groundwater flux and salt load entering the River Murray.

Scenario-1: Conditions

The following conditions are applied to the steady state model:

- Time period is pseudo-steady state (i.e. long term average)
- Post-regulation of the River Murray. (i.e with weir pool stage elevations modelled).
- Pre-irrigation development.

Scenario-1: Modelling Results

The results given in Table 4 indicate the modelled flux and salt load entering the River Murray from both sides of the river in the Lock 3 to Morgan area for the pre-development scenario-1

Table 4
Modelled Groundwater Flux and Salt Load in the Lock 3 – Morga Area (Scenario Natural System)

	Qualco	Waikerie	Woolpunda	Cadell
Flux (ML/day)	1.1	0.3	9.3	1.2
Salt load (t/day)	13.3	6.5	247	14.2

2.3 SCENARIO-2: MALLEE CLEARANCE

Scenario-2 models the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur due to the clearance of the native mallee vegetation (by comparison with Scenario-1) and the subsequent increase in recharge rates.

Scenario-2: Conditions

The following conditions are applied to the transient model:

- Time period is from 1920 to 2107.
- Post-regulation of the River Murray.
- No irrigation development.
- Mallee clearance zones commencing in 1920. (assumes clearing ceases at 1988)
- Within the Mallee clearance zones, application of recharge rates >= 0.1 mm/year, increasing in some areas to ~11 mm/year after a period of 200 years, with changes (representing lag-times) occurring every 10 years (data provided by DEH).
- Outside the Mallee clearance zones, application of the uncleared Mallee recharge rate of 0.1 mm/year.

Scenario-2: Prediction Results

The results given in Tables 5a to 5d summarise the predicted flux and salt load entering the River Murray from the both sides of the river in the Lock 3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A.

Table 5a.
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-2 Mallee Clearance)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	1.4	1.8	1.8	2.9	3.9
Salt load (t/day)	17.2	20.9	21.9	35.1	46.8

Table 5b.
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-2 Mallee Clearance)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	0.5	0.7	0.7	1.0	1.4
Salt load (t/day)	11.6	15.4	16.4	27.5	40.0

Table 5c.
Predicted Groundwater Flux and Salt Load in the Woolpunda Reach (Scenario-2 Mallee Clearance)

Woolpunda Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	9.3	9.3	9.9	10.1	10.9
Salt load (t/day)	246.9*	246.9	257.5	263.9	288.0

salt load at 2000 is assumed to be a representative steady state value for the Woolpunda reach (see section 1.11 for details).

Table 5d.
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-2 Mallee Clearance)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	1.4	1.5	1.5	2.1	2.7
Salt load (t/day)	16.4	17.5	18	24.9	32.4

2.4 SCENARIO-3A: PRE-1988, NO IIP, NO RH

Transient Scenario–3A predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur between 1988 and 2107 assuming pre-1988 irrigation development with no mitigation in terms of improvements to irrigation practices (IIP) and rehabilitation (RH).

Scenario-3a: Conditions

The following conditions are applied to the transient model:

- Time period is from 1988 to 2107.
- The potentiometric head distribution output from Scenario-4 at 1 January 1988 used as the starting point for the prediction run.
- Pre-1988 irrigation development area applied between 1988 and 2107.
- Pre-1988 recharge rates and lag times (from the historical model) applied between 1988 and 2107. This assumes irrigation efficiency of 85% at Cadell, Qualco, Toolunka, Talyorville, Markaranka and Golden Heights, 86% at Waikerie and Woolpunda.

Scenario-3A: Prediction Results

The results given in Tables 6a to 6d summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A.

Table 6a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-3A)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.5	10.4	12.2	12.7
Salt load (t/day)	82.9	100.1	123.5	145.5	151.7

Table 6b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-3A)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	4.3	3.9	3.7	3.7
Salt load (t/day)	133.8	143.1	125.6	113.0	114.8

Table 6c
Predicted Groundwater Flux and Salt Load in the Woolpunda Reach (Scenario-3A)

Woolpunda Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	9.3	9.3	9.3	10.6	10.7
Salt load (t/day)	249.6	249.8	249.6	278.6	281.5

Table 6d
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-3A)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.9	4.5	4.8
Salt load (t/day)	48.7	44.9	47.1	54.3	57.4

2.5 SCENARIO-3B: PRE-1988, WITH IIP, NO RH

Transient Scenario-3B predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur between 1988 and 2107 assuming pre-1988 irrigation development with improvements in irrigation practices (IIP). This scenario evaluates the reduction in salt load (by comparison with Scenario–3A) resulting from the implementation of IIP.

Scenario-3b: Conditions

The following conditions are applied to the transient model:

- Time period is from 1988 to 2107.
- The potentiometric head distribution output from the historical model at 1 January 1988 used as the starting point for the prediction run until 2107.
- Pre-1988 irrigation development area applied between 1988 and 2107.
- IIP-Recharge rates decreasing from the late 1970s to the early 2000’s, in accordance with calibrated (history match) IIP.
- Recharge rates of 120 mm/yr were adopted by the early 2000’s which assumes an increase in irrigation efficiency to ~ 90%.

Scenario-3b: Prediction Results

The results given in Tables 7a to 7d summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A.

Table 7a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-3B)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.5	9.1	8.8	8.7
Salt load (t/day)	82.9	100.1	108.3	104.8	103.4

Table 7b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-3B)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	4.3	3.8	2.9	2.9
Salt load (t/day)	133.8	142.9	124.0	90.5	90.2

Table 7c
Predicted Groundwater Flux and Salt Load in the Woolpunda Reach (Scenario-3B)

Woolpunda Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	9.3	9.3	9.3	10.6	10.5
Salt load (t/day)	249.6	249.8	249.6	278.7	275.4

Table 7d
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-3B)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.5	3.6	3.7
Salt load (t/day)	48.7	44.9	42.3	43.4	44.1

2.6 SCENARIO-4: CURRENT IRRIGATION

Transient Scenario-4 predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur 2006–2107 assuming the current irrigation condition (pre-1988 plus post-1988 irrigation development with IIP and RH), but without SIS. This scenario predicts the likely future salt load if the current conditions remain unchanged in the future, based on the historical effects up until the end of calendar 2006.

Scenario-4: Conditions

The following conditions are applied to the transient model:

- Time period is from irrigation commencement, i.e. 1880 to 2107.
- The potentiometric head distribution output from the historical model at 1988 used as the starting point for the prediction run until 2107.
- Pre-1988 + post-1988 development area applied up to 1st January, 2007 and then areas held constant until 2107.
- IIP - Recharge rates decreasing from the late 1970s to the early 2000's, in accordance with calibrated (history match) IIP.
- Historical/existing SIS operations not modelled.

Scenario-4: Prediction Results

The results given in Tables 8a to 8d summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A.

Table 8a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-4)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.5	9.1	9.8	10.1
Salt load (t/day)	82.9	100.0	108.3	117.5	120.8

Table 8b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-4)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	4.3	3.8	3.1	3.2
Salt load (t/day)	133.8	142.9	123.9	98.2	99.6

Table 8c
Predicted Groundwater Flux and Salt Load in the Woolpunda Reach (Scenario-4)

Woolpunda Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	9.3	9.3	9.3	11.7	12.7
Salt load (t/day)	249.6	249.8	249.6	306.6	338.4

Table 8d
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-4)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.5	4.2	4.4
Salt load (t/day)	48.7	44.9	42.5	50.6	53.3

2.7 SCENARIO-5: CURRENT PLUS FUTURE IRRIGATION

Transient Scenario-5 predicts the hydrological changes, and the (maximum) groundwater flux and salt load entering the River Murray that would be expected to occur between 2007–2107 assuming the current irrigation (pre-1988 plus post-1988 irrigation development with IIP) plus prior commitment irrigation area, but with no SIS. This scenario tests the maximum increases in salt load (by comparison with Scenario-4) resulting from future irrigation development.

Table 9 below summaries the prior commitment zones in terms of size (Ha) and lag-times (yrs) and Figure 2 shows the adopted prior commitment footprint.

Table 9
Summary of Prior Commitment Zones

License	Area (Ha)	Simrat lag-time (yrs)	Adopted lag-time (yrs)	Year recharge is applied to water-table
127	40	20	5	2020
2104	40	20	20	2035
300	160	20	20	2035
2839	84	30	20	2035
2320	329	30	28	2043
45/826/1418	650	45	28	2043
1957	24	35	35	2050
1708	4	55	53	2068
481	106	60	58	2073

Scenario-5: Conditions

The following conditions are applied to the transient model:

- Time period is from 2007 to 2107.
- The potentiometric head distribution output from the Scenario-4 model at 2007 used as the starting point for the prediction run with future irrigation development area being invoked at 2015.
- Pre-1988 + post-1988 irrigation area applied up to 1st January 2007, with the effect of time-lags causing irrigation areas to become active though the 2007 to 2107 period.
- IIP - Recharge rates decrease in accordance with calibrated (history match) IIP. Irrigation efficiency is ~ 90% by the early 2000's.
- Recharge from future irrigation development areas operating from 2015 (with DEH estimated lag time) to 2107, assuming 85% efficiency. Future irrigation development is concentrated in the Woolpunda reach and the recharge rates are fixed at 100mm/yr.
- Historical/existing SIS not modelled.

Scenario-5: Prediction Results

The results given in Tables 10a to 10d summarise the predicted maximum flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A.

Table 10a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-5)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.5	9.1	9.9	10.2
Salt load (t/day)	82.9	100.0	108.3	117.8	121.5

Table 10b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-5)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	4.3	3.8	3.4	3.6
Salt load (t/day)	133.8	142.9	123.9	101.6	105.7

Table 10c
Predicted Groundwater Flux and Salt Load in the Woolpunda Reach (Scenario-5)

Woolpunda Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	9.3	9.3	9.3	11.8	13.3
Salt load (t/day)	249.6	249.8	249.6	316.2	359.9

Table 10d
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-5)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.5	4.3	4.6
Salt load (t/day)	48.7	44.9	42.5	51.6	54.7

2.8 SCENARIO-8: CURRENT PLUS FUTURE IRRIGATION WITH “AS CONSTRUCTED” SIS

Transient Scenario-8 predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur from 2007 to 2107 assuming that both current irrigation plus prior commitment irrigation area is active with current SIS configuration. This scenario tests the maximum salt load that could be intercepted based on current SIS infrastructure (by comparison with Scenario-5).

Scenario-8: Conditions

The following conditions are applied to the transient model:

- Time period for predictive simulations is from 2007 to 2107.
- Pre-1988 and post-1988 irrigation areas are applied up to 1st January 2007, with the effect of time-lags causing recharge from irrigation areas to reach the water table at various times though the 2007 to 2107 period.
- The potentiometric head distribution output from Scenario-4 at 1988 was used as the starting point for the prediction run with future irrigation development area being invoked at 2015 (the 1988 conditions from Scenario-4 were used, given that there is no pre-1988 SIS in this area.
- IIP - Recharge rates decrease in accordance with calibrated (history match) IIP. Irrigation efficiency is ~ 90% by the early 2000's.
- Recharge from future irrigation development areas operating from 2015 (with DEH estimated lag time) to 2107, assuming 85% efficiency. Future irrigation development is concentrated in the Woolpunda reach and the recharge rates are fixed at 100mm/yr.
- Historical SIS is applied from commissioning (all schemes in this area were commissioned post-1988).
- Future SIS applied at Woolpunda post 1st January 2007 is based on the average historical rates measured during the period of 30th September 2003 to 31st of December 2003.
- Future SIS applied at Qualco and Waikerie post 1st January 2007 is based on the average historical rates measured during the period of 1st January 1997 to 30th of June 1997.

Scenario-8: Prediction Results

The results given in Tables 11a to 11d summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A.

Table 11a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-8)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.1	7.3	6.1	6.0
Salt load (t/day)	82.9	94.9	86.0	71.0	70.4

Table 11b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-8)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	2.4	2.3	1.3	1.5
Salt load (t/day)	133.8	64.5	68.0	22.6	24.8

Table 11c
Predicted Groundwater Flux and Salt Load in the Woolpunda Reach (Scenario-8)

Woolpunda Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	9.3	1.7	3.1	2.5	3.3
Salt load (t/day)	249.6	39.1	72.6	57.7	77.5

Table 11d
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-8)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.5	4.1	4.2
Salt load (t/day)	48.7	44.9	42.5	49.0	50.4

2.9 SCENARIO-8A: CURRENT PLUS FUTURE IRRIGATION WITH "WOOLPUNDA" SIS ONLY

Transient Scenario-8a predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur between 2007–2107 assuming that both current irrigation plus prior commitment irrigation area is active and only the Woolpunda SIS configuration is active. This scenario tests the salt load that could be intercepted if only the Woolpunda SIS infrastructure was active (by comparison with Scenario-5).

Scenario-8a: Conditions

The following conditions are applied to the transient model:

- Time period for predictive simulation is from 2007 to 2107.
- Pre-1988 and post-1988 irrigation areas are applied up to 1st January 2007, with the effect of time-lags causing recharge from irrigation areas to reach the water table at various times though the 2007 to 2107 period.
- The potentiometric head distribution output from the Scenario-4 model at 1988 was used as the starting point for the prediction run with future irrigation development area being invoked at 2015 (the 1988 conditions from Scenario-4 were used, given that there is no pre-1988 SIS in this area).
- IIP - Recharge rates decrease in accordance with calibrated (history match) IIP. Irrigation efficiency is assumed to be ~ 90% by the early 2000's.
- Recharge from future irrigation development areas operating from 2015 (with DEH estimated lag time) to 2107, assuming 85% efficiency. Future irrigation development is concentrated in the Woolpunda reach and the recharge rates are fixed at 100mm/yr.
- Historical SIS for Woolpunda is applied from commissioning (Woolpunda scheme is commissioned post-1988).
- Future SIS applied at Woolpunda post 1st January 2007 is based on the average historical rates measured during the period of 30th September 2003 to 31st of December 2003.
- SIS at Qualco and Waikerie stage 1 and 2 are deactivated for all time (historical and prediction period).

Scenario-8a: Prediction Results

The results given in Tables 12a to 12c summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A. Results of Scenario 8a are not shown for the Woolpunda reach since salt load impacts caused by other SIS schemes (Qualco and Waikerie 1 and 2) are not significant to Woolpunda.

Table 12a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-8a)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.5	9.4	10.0	10.5
Salt load (t/day)	82.9	100.6	111.8	119.6	125.1

Table 12b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-8a)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	4.2	3.7	3.3	3.5
Salt load (t/day)	133.8	139.1	121.6	100.2	105.2

Table 12c
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-8a)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.6	4.3	4.7
Salt load (t/day)	48.7	44.7	43.3	52.0	55.9

2.10 SCENARIO-8B: CURRENT PLUS FUTURE IRRIGATION with “woolpunda +waikerie 1” sis only

Transient Scenario-8b predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur between 2007–2107 assuming that both current irrigation plus prior commitment irrigation area is active and only the Woolpunda and Waikerie 1 SIS configuration is active (i.e. Qualco and Waikerie 2 SIS schemes are deactivated). This scenario tests the salt load that could be intercepted if only the Woolpunda and Waikerie 1 SIS infrastructure was active (by comparison with Scenario-5).

Scenario-8b: Conditions

The following conditions are applied to the transient model:

- Time period for predictive simulations is from 2007 to 2107.
- Pre-1988 and post-1988 irrigation areas applied up to 1st January 2007, with the effect of time-lags causing recharge from irrigation areas to reach the water table at various times though the 2007 to 2107 period.

- The potentiometric head distribution output from Scenario-4 at 1988 was used as the starting point for the prediction run with future irrigation development area being invoked at 2015 (the 1988 conditions from Scenario-4 were used, given that there is no pre-1988 SIS in this area).
- IIP - Recharge rates decrease in accordance with calibrated (history match) IIP. Irrigation efficiency is ~ 90% by the early 2000's.
- Recharge from future irrigation development areas operating from 2015 (with DEH estimated lag time) to 2107, assuming 85% efficiency. Future irrigation development is concentrated in the Woolpunda reach and the recharge rates are fixed at 100mm/yr.
- Historical SIS for the Woolpunda and Waikerie 1 schemes is applied from commissioning (Woolpunda and Waikerie 1 schemes are both commissioned post-1988).
- Future SIS applied at Woolpunda post 1st January 2007 is based on the average historical rates measured during the period of 30th September 2003 to 31st of December 2003.
- Future SIS applied at Waikerie post 1st January 2007 is based on the average historical rates measured during the period of 1st January 1997 to 30th of June 1997.
- SIS at Qualco and Waikerie stage 2 is deactivated for all time (historical and prediction period)

Scenario-8b: Prediction Results

The results given in Tables 13a to 13c summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A. Results of Scenario 8b are not shown for the Woolpunda reach since salt load impacts caused by other SIS schemes (Qualco and Waikerie 1 and 2) are not significant to Woolpunda.

Table 13a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-8b)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.1	8.3	9.6	10.0
Salt load (t/day)	82.9	94.9	98.2	114.7	119.9

Table 13b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-8b)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	2.4	2.3	1.5	1.7
Salt load (t/day)	133.8	64.5	68.7	30.4	33.9

Table 13c
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-8b)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.5	4.3	4.6
Salt load (t/day)	48.7	44.7	42.3	52.1	55.7

2.11 SCENARIO-8C: CURRENT PLUS FUTURE IRRIGATION WITH “WOOLPUNDA +WAIKERIE 1 + QUALCO” SIS ONLY

Transient Scenario-8c predicts the hydrological changes, groundwater flux and salt load entering the River Murray that would be expected to occur between 2007 and 2107, assuming that both current irrigation plus prior commitment irrigation area is active and only the Woolpunda, Waikerie 1 and Qualco SIS configuration are active (ie Waikerie stage 2 is deactivated). This scenario tests the salt load that could be intercepted if only the Woolpunda, Waikerie 1 and Qualco SIS infrastructure were active (by comparison with Scenario-5).

Scenario-8c: Conditions

The following conditions are applied to the transient model:

- Time period for predictive simulations is from 2007 to 2107.
- Pre-1988 + post-1988 irrigation area applied up to 1st January 2007, with the effect of time-lags causing irrigation areas to become active though the 2007 to 2107 period.
- The potentiometric head distribution output from Scenario-8 at 2000 (The conditions from Scenario-8 at 2000 were used given that no pre-2000 SIS scheme exists for Waikerie stage 1) was used as the starting point for the prediction run, with future irrigation development area being invoked at 2015.
- IIP - Recharge rates decrease in accordance with calibrated (history match) IIP. Irrigation efficiency is ~ 90% by the early 2000’s.
- Recharge from future irrigation development areas operating from 2015 (with DEH estimated lag time) to 2107, assuming 85% efficiency. Future irrigation development is concentrated in the Woolpunda reach and the recharge rates are fixed at 100mm/yr.
- Historical SIS for the Woolpunda, Waikerie 1 and Qualco schemes is applied from commissioning (Woolpunda and Waikerie 1 schemes are both commissioned post-1988).
- Future SIS applied at Woolpunda post 1st January 2007 is based on the average historical rates measured during the period of 30th September 2003 to 31st of December 2003.
- Future SIS applied at Waikerie 1 and Qualco post 1st January 2007 is based on the average historical rates measured during the period of 1st January 1997 to 30th of June 1997.
- SIS for the Waikerie stage 2 scheme is deactivated for all time (historical and prediction period).

Scenario-8c: Prediction Results

The results given in Tables 14a to 14c summarise the predicted flux and salt load entering the River Murray from both sides of the river in the Lock3 to Morgan area. Complete results of the predicted flux of saline groundwater and salt load are given in Appendix A. Results of Scenario 8c are not shown for the Woolpunda reach since salt load impacts caused by other SIS schemes (Qualco and Waikerie stage 1) are not significant to Woolpunda.

Table 14a
Predicted Groundwater Flux and Salt Load in the Qualco Reach (Scenario-8c)

Qualco Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	7.1	8.1	8.0	7.6	7.7
Salt load (t/day)	82.9	94.9	94.6	90.3	91.6

Table 14b
Predicted Groundwater Flux and Salt Load in the Waikerie Reach (Scenario-8c)

Waikerie Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.0	2.4	2.4	1.5	1.7
Salt load (t/day)	133.8	64.5	72.6	29.0	32.0

Table 14c
Predicted Groundwater Flux and Salt Load in the Cadell Reach (Scenario-8c)

Cadell Area	Year				
	1988	2000	2007	2050	2107
Flux (ML/day)	4.1	3.7	3.5	4.1	4.3
Salt load (t/day)	48.7	44.7	41.6	49.6	52.0

The accredited model has been used to predict the flux of saline groundwater (salt load) entering the River Murray under different irrigation practices and development scenarios. Model results (salt loads) can be seen in Figures 4 to 10 and in Tables 15 to 18.

For the **Qualco** region, the predicted salt loads are identical for scenarios S3B, S4 and S5 up until 2011, from which time salt loads diverge due to the effects of (lagged) post-1988 area growth. Due to the relatively short lag times involved in this area and small post-1988 area growth, the divergence of the pre-1988 (S3B) salt load from the post-1988 (S4) is small for all time with a maximum difference of 18 t/d by 2107. Salt load comparisons between the post-1988 (S4) scenario and the prior commitment scenario (S5) are near identical for all time with a maximum difference of only 0.7 t/d by 2107. This is due to the prior commitment areas predominantly existing in the Woolpunda reach.

For the **Waikerie** region, the predicted salt loads are identical for scenarios S3B, S4 and S5 up until 2008, at which time salt loads diverge due to the effects of (lagged) post-1988 area growth. Due to the relatively small post-1988 area growth, the divergence of the pre-1988 (S3B) salt load from the post-1988 (S4) is small for all time with a maximum difference of ~9 t/d by 2107. Salt load comparisons between the post-1988 (S4) scenario and the prior commitment scenario (S5) are identical up to the year 2044 at which time the S5 salt load diverges away from the S4 salt load with a maximum difference of ~6 t/d by 2107. The small salt load increase due to the prior commitment areas is again due these irrigation zones predominantly existing in the Woolpunda reach.

Under the current modelling assumptions, it is interesting to observe that predicted SIS at Waikerie (scenario S8) is capable of not only interception S3B, S4 and S5 salt load, but it is also capable of intercepting part of the Mallee clearing salt load (S2) by the year 2027 (refer to Figure 6). However, caution must be applied when interpreting such results since mallee recharge has not been applied to the S3A, S3B, S4, S5 and S8 scenarios and thus these modelled salt loads could potentially be under-estimated. A discussion paper is in preparation for submission to the MDBC, and it is expected that a workshop will be held in 2007 to discuss and agree the approaches that should be applied in regard to mallee clearing.

For the **Woolpunda** region, the predicted salt loads are identical for scenarios S3B, S4 and S5 up until 2029, at which time salt loads diverge due to the effects of post-1988 area growth. The divergence of the pre-1988 (S3B) salt load from the post-1988 (S4) occurs later at Woolpunda compared to Qualco and Waikerie due to the larger adopted time-lags (refer to Figure 3). The predicted salt load difference of 63 t/d by the year 2107 is also significantly greater than the other regions due to the large post-1988 area growth experienced at Woolpunda. Salt load comparisons between the post-1988 (S4) scenario and the prior commitment scenario (S5) are also greater with a maximum difference of ~21 t/d by 2107. This is due to the prior commitment areas predominantly existing in the Woolpunda reach.

For the **Cadell** region, the predicted salt loads are identical for scenarios S3B, S4 and S5 up until 2006, from which time salt loads diverge due to the effects of (lagged) post-1988 area growth. Due to the relatively short lag times involved in this area and small post-1988 area growth, the divergence of the pre-1988 (S3B) salt load from the post-1988 (S4) is small for all time with a maximum difference of 9.2 t/d by 2107. Salt load comparisons between the post-1988 (S4) scenario and the prior commitment scenario (S5) are near identical for all time with a maximum difference of only 1.4 t/d by 2107. This is due to the prior commitment areas predominantly existing in the Woolpunda reach.

Comparison of model results with Run-of River results indicate that the model may be overestimating salt load to the River, with reasonable agreement obtained in 1998 but with poorer matches obtained in 1988, 2001 and 2003. This is likely to be due to the irrigation district being situated both on and directly adjacent to the floodplain. As the model does not apply evapotranspiration in this region, all of the calculated model flux is reported directly to the River. In reality, a significant amount of this flux will be lost through evapotranspiration processes within a shallow floodplain environment and salt will be accumulated within the floodplain sediments until such time that flooding will facilitate the flushing of excess salt accumulation from the profile. During and after periods of flooding, we would expect to see much larger Run-of-River measurements, which would help to account for the over estimated modelled salt load which obviously does not account for processes such as flooding.

It is recommended that future model upgrades apply evapotranspiration in the floodplain, which will effectively control both hydraulic gradients across the floodplain and the calculated flux reported to the river. Further refinement of salinity values applied to the calculated flux outside of the model may also account for the effects of flushing which is likely to occur in irrigated areas with a shallow depth to watertable and thin saturated aquifer thickness, typical of aquifers occurring within the floodplain.

Under the current modelling assumptions, the modelled salt loads at Woolpunda for the S2 salt load scenario (Figure 5) is greater than the other pre- and post-1988 scenarios between the period from 2002 to 2012. By definition, the salt load due to mallee clearance should never be greater than the other pre- and post-1988 irrigation scenarios, but rather those scenarios should “stack-up” on top of the S2 scenario (ie. S3, S4 and S5 represent the increase in salt load to the river due irrigation development, which occurred after mallee clearing). The salt load difference between S2 and either S3, S4 or S5 should always result in a salinity debit and not a salinity credit (as suggested in Figure 5) during the modelled period 2002 to 2012. This result is caused by mallee recharge not being applied to the other pre- and post-1988 scenarios as explained above for Waikerie. A similar case is observed post modelled year 2090 when the S2 salt load trend increases past the S3A and S3B salt load series. A discussion paper is in preparation for submission to the MDBC, and it is expected that a workshop will be held in 2007 to discuss and agree the approaches that should be applied in regard to mallee clearing.

The salt loads estimated by the model are highly dependant on the assumption that the river is gaining and the assumed distribution of groundwater salinity values, as discussed in more detail in Middlemis *et al* (2005). The salt loads reporting to the river with time are also highly dependant on the adopted time-lags spatially applied to the model.

Table 15
Summary of predicted salt load (t/day) entering the River Murray in the Qualco Reach

Scenario	1988	2000	2007	2050	2107
S-1	13.3	13.3	13.3	13.3	13.3
S-2	17.2	20.9	21.9	35.1	46.8
S-3A	82.9	100.1	123.5	145.5	151.7
S-3B	82.9	100.1	108.3	104.8	103.4
S-4	82.9	100.0	108.3	117.5	120.8
S-5	82.9	100.0	108.3	117.8	121.5
S-8	82.9	96.2	86.0	71.0	70.4
S-8a	82.9	100.6	111.8	119.6	125.1
S-8b	82.9	94.9	98.2	114.7	119.9
S-8c	82.9	94.9	94.6	90.3	91.6

Table 16
Summary of predicted salt load (t/day) entering the River Murray in the Waikerie Reach

Scenario	1988	2000	2007	2050	2107
S-1	6.5	6.5	6.5	6.5	6.5
S-2	11.6	15.4	16.4	27.5	40.0
S-3A	133.8	143.1	125.6	113.0	114.8
S-3B	133.8	142.9	124.0	90.5	90.2
S-4	133.8	142.9	123.9	98.2	99.6
S-5	133.8	142.9	123.9	101.6	105.7
S-8	133.8	71.3	68.0	22.6	24.8
S-8a	133.8	139.1	121.6	100.2	105.2
S-8b	133.8	64.5	68.4	30.4	33.9
S-8c	133.8	64.5	72.6	29.0	32.0

Table 17
Summary of predicted salt load (t/day) entering the River Murray in the Woolpunda Reach

Scenario	1988	2000	2007	2050	2107
S-1	246.9	246.9	246.9	246.9	246.9
S-2	247.6	246.9	257.5	263.9	288.0
S-3A	249.6	249.8	249.6	278.6	281.5
S-3B	249.6	249.8	249.6	278.7	275.4
S-4	249.6	249.8	249.6	306.6	338.4
S-5	249.6	249.8	249.6	316.2	359.9
S-8	249.6	44.6	72.6	57.7	77.5

Table 18
Summary of predicted salt load (t/day) entering the River Murray in the Cadell Reach

Scenario	1988	2000	2007	2050	2107
S-1	14.2	14.2	14.2	14.2	14.2
S-2	16.4	17.5	18	24.9	32.4
S-3A	48.7	44.9	47.1	54.3	57.4
S-3B	48.7	44.9	42.3	43.4	44.1
S-4	48.7	44.9	42.5	50.6	53.3
S-5	48.7	44.9	42.5	51.6	54.7
S-8	48.7	44.9	42.5	49.0	50.4
S-8a	48.7	44.7	43.3	52.0	55.9
S-8b	48.7	44.7	42.3	52.1	55.7
S-8c	48.7	44.7	41.6	49.6	52.0

SECTION 4 - REFERENCES

Middlemis, H., Jolly, I., Georgiou, J. and Walker, G. (2005). Groundwater Modelling of Salt Interception Schemes in the Woolpunda-Cadell Reach of the Murray River. Report prepared by Rural Solutions and Aquaterra for the Department of Water, Land and Biodiversity Conservation. August 2005.

Georgiou, J. and Middlemis, H. (2007). Waikerie-Lock 2 salt interception Options- Groundwater Model Scenarios. Report prepared by Aquaterra for the Department of Water, Land and Biodiversity Conservation. January 2007.

Department of Water, Land and Biodiversity Conservation (2007). Specification for numerical Groundwater Modelling Scenarios to Determine the Origin of Salt Entering the River Murray in South Australia. April 2007

FIGURES

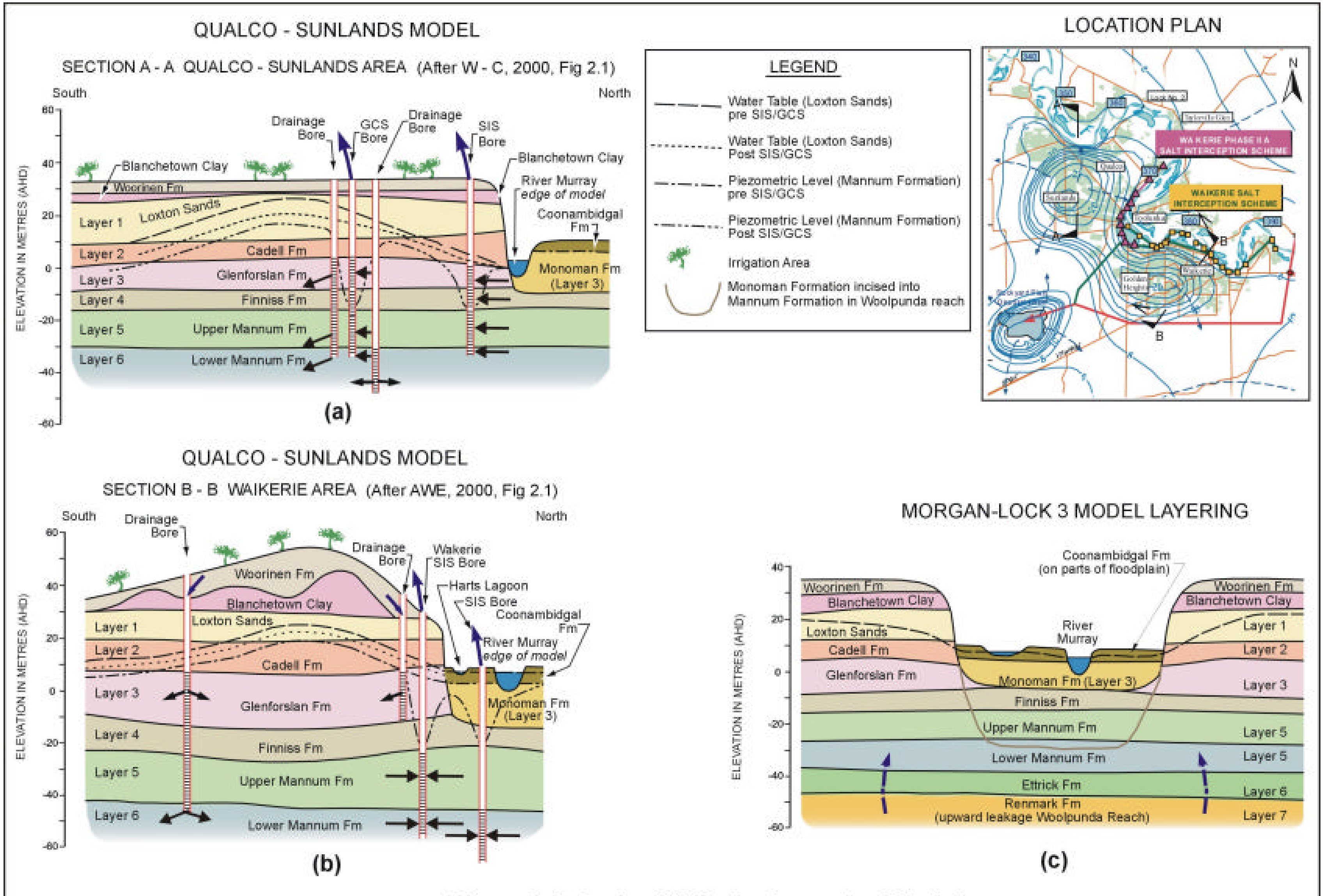
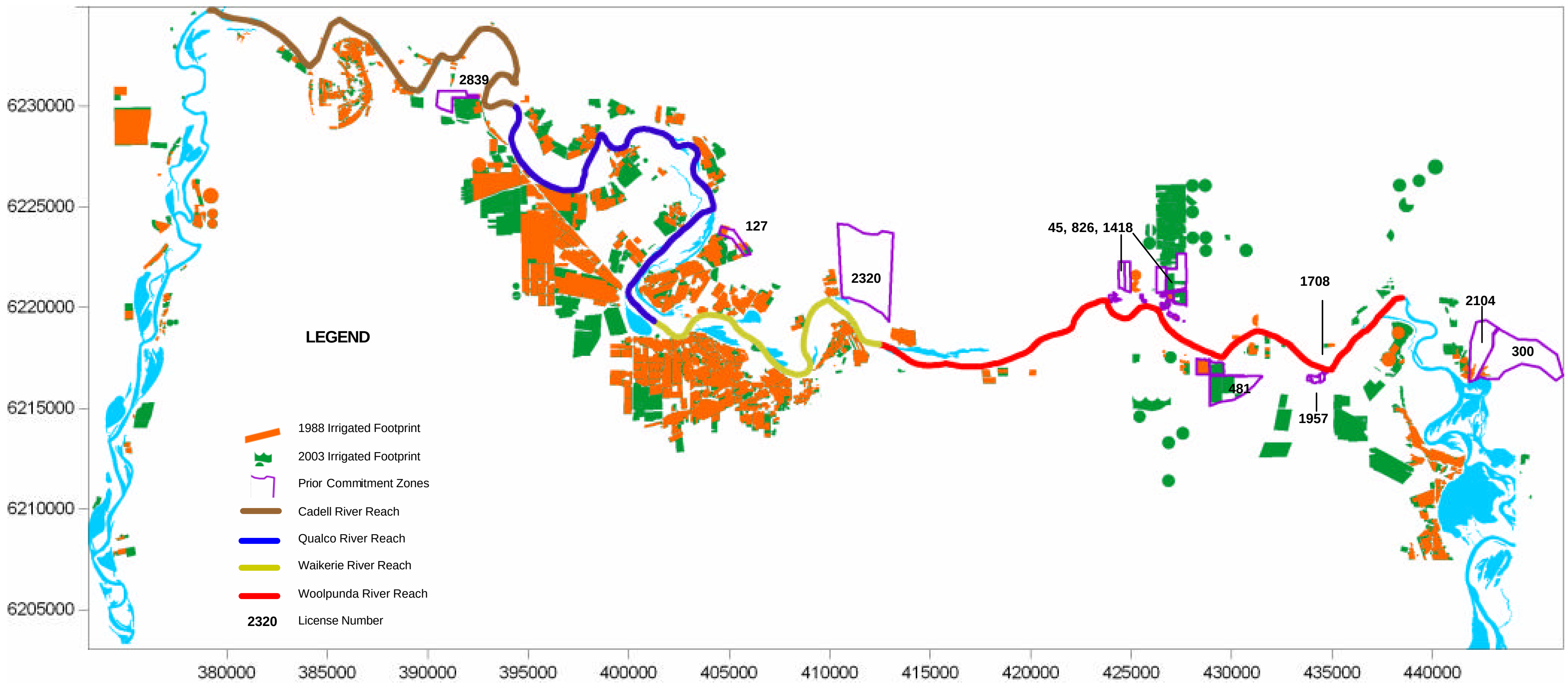


Figure 4.1. Qualco-Waikerie Conceptual Model.

Lock 3 to Morgan Conceptual Model (refer to sketch (c))
Figure 1



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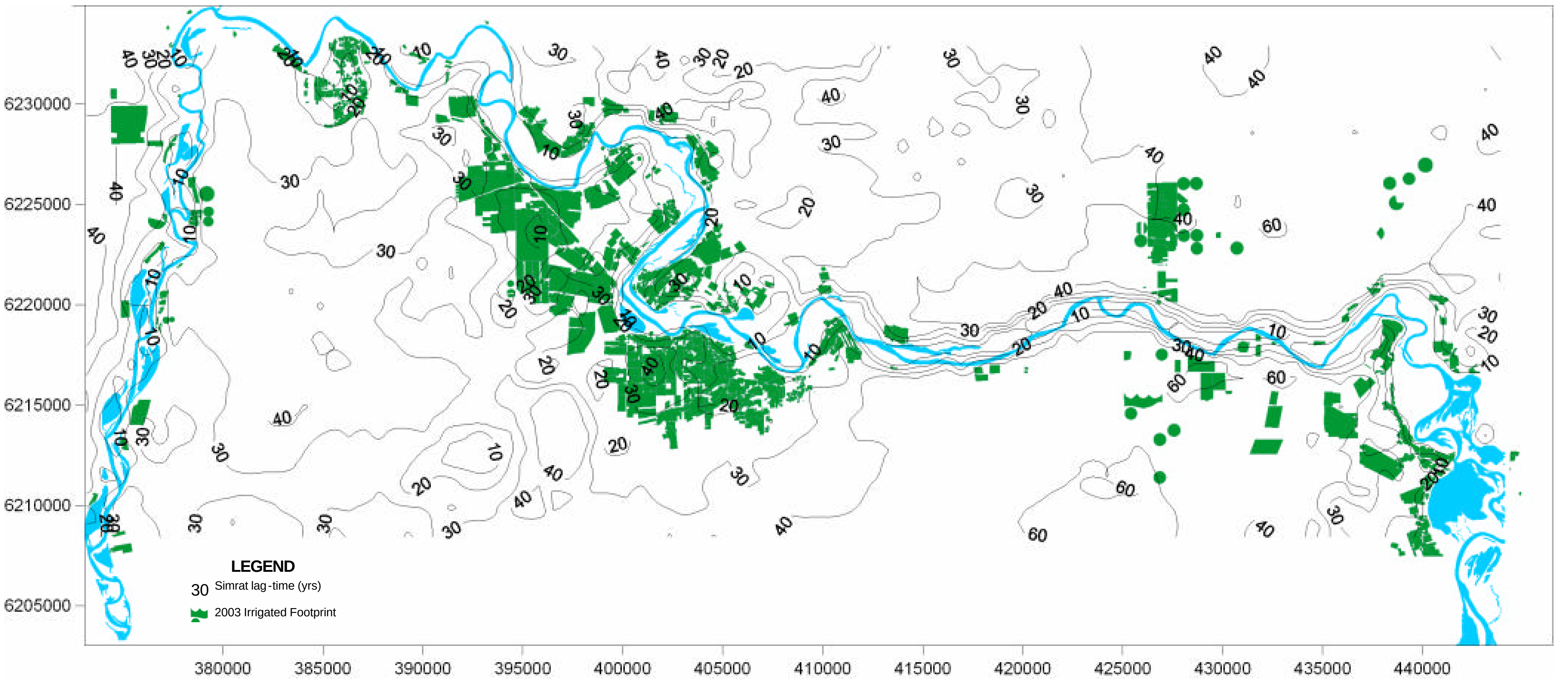
1988, 2003 and Prior-Commitment Irrigation Footprints with Defined River Reaches
Figure 2



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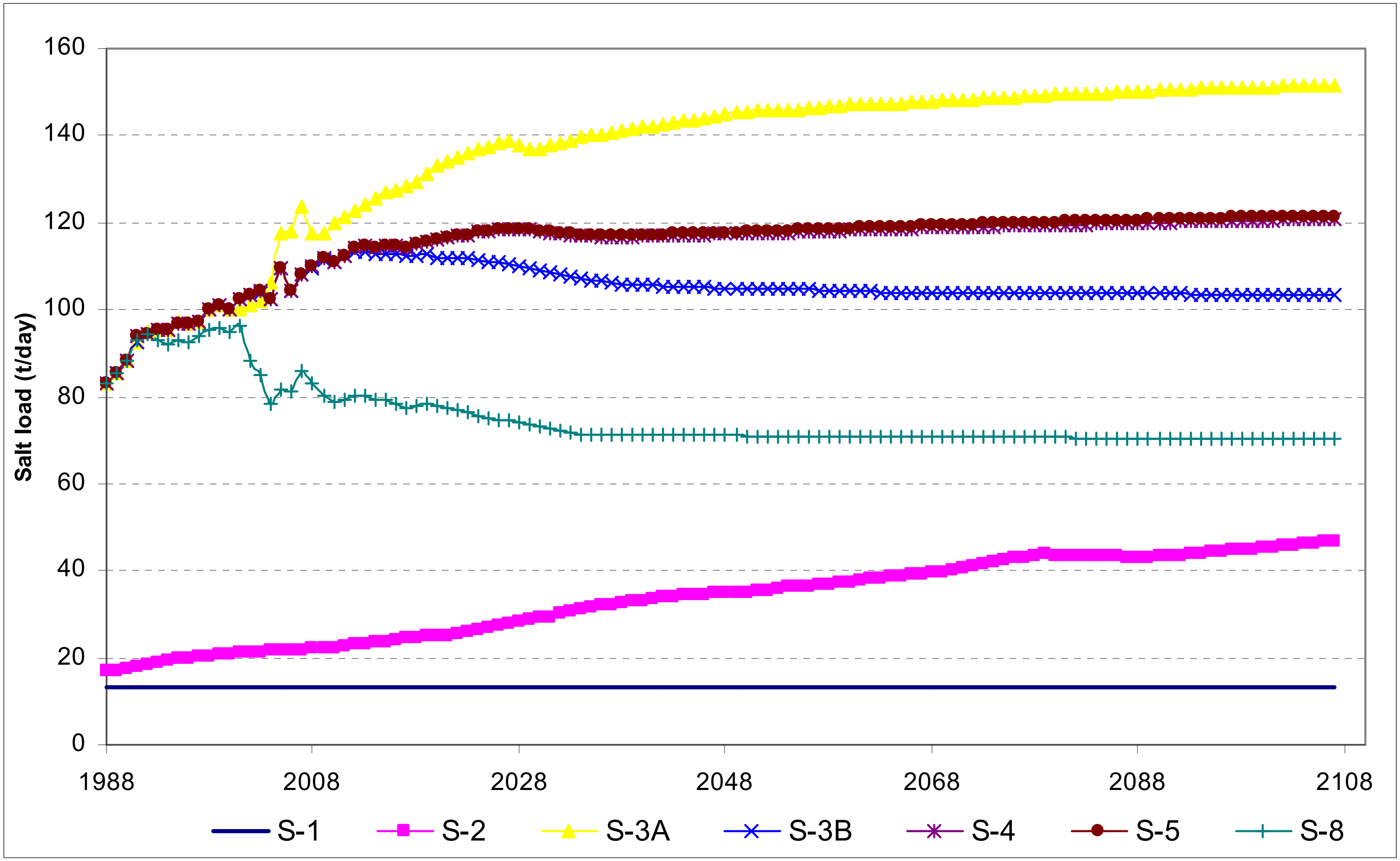
Simrat lag-times (yrs)
Figure 3



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Modelled salinity impacts for the Qualco Reach (t/day)
Figure 4

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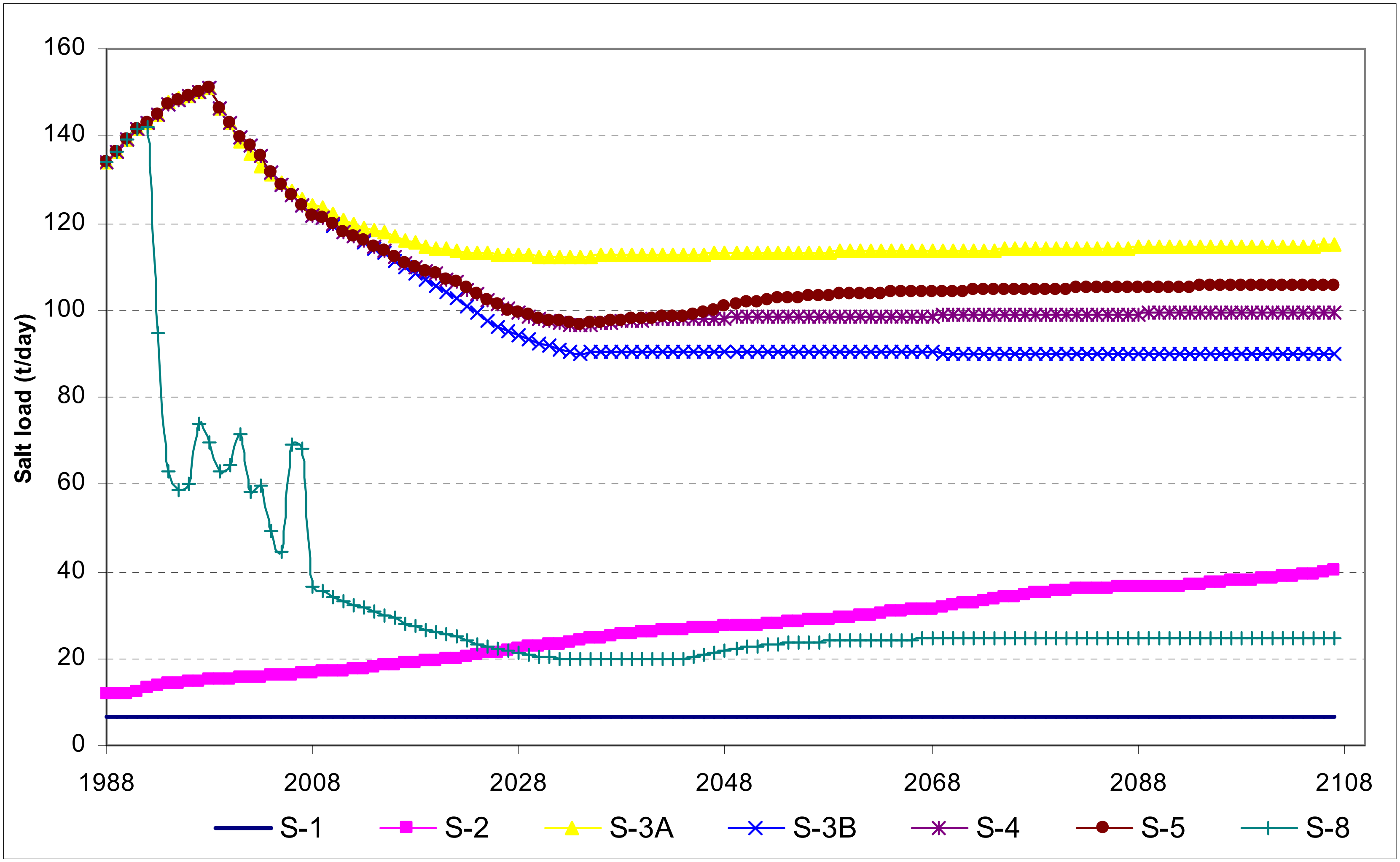

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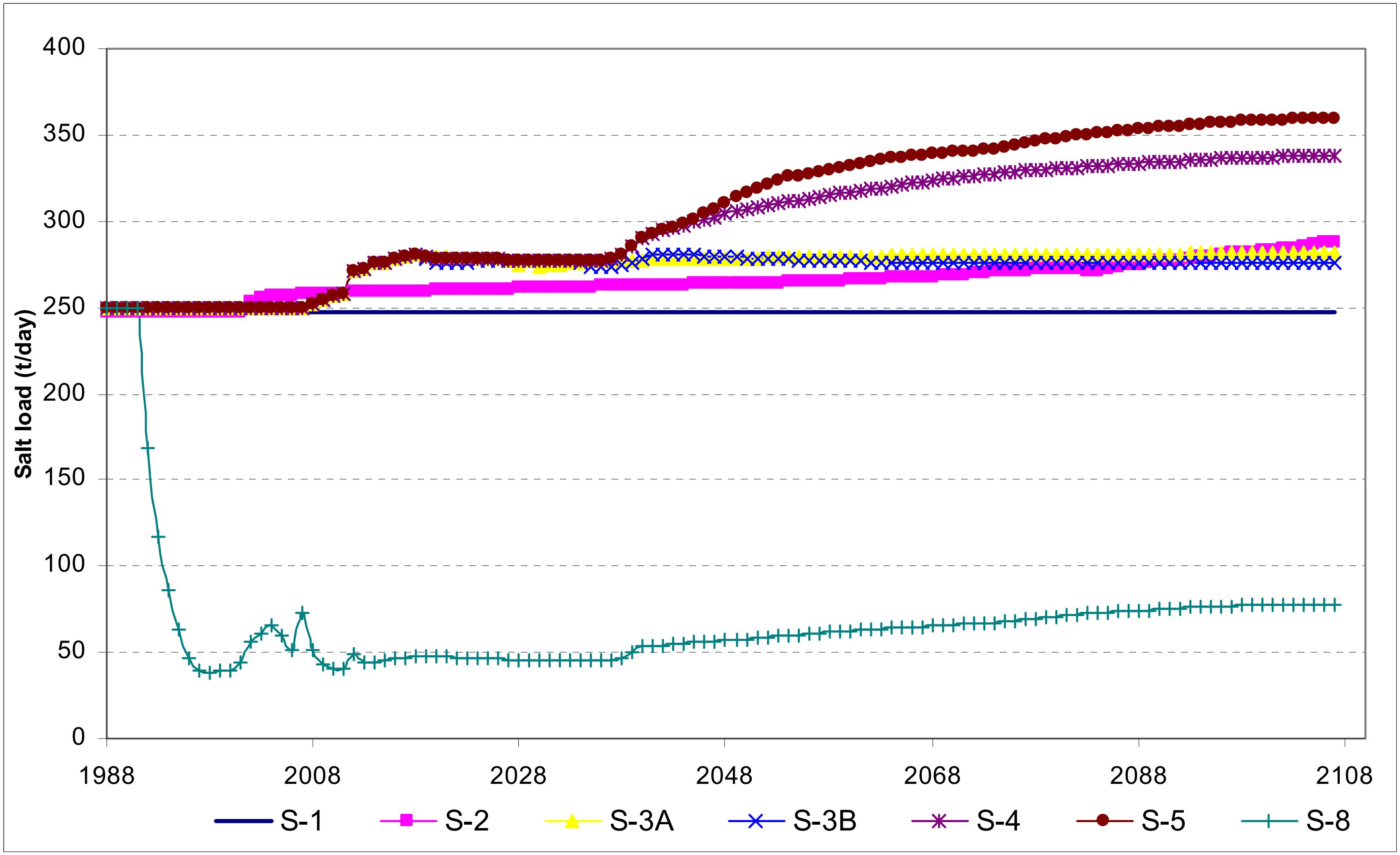
Modelled salinity impacts for the Waikerie reach (t/day)

Figure 5



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Modelled salinity impacts for the Woolpunda Reach (t/day)

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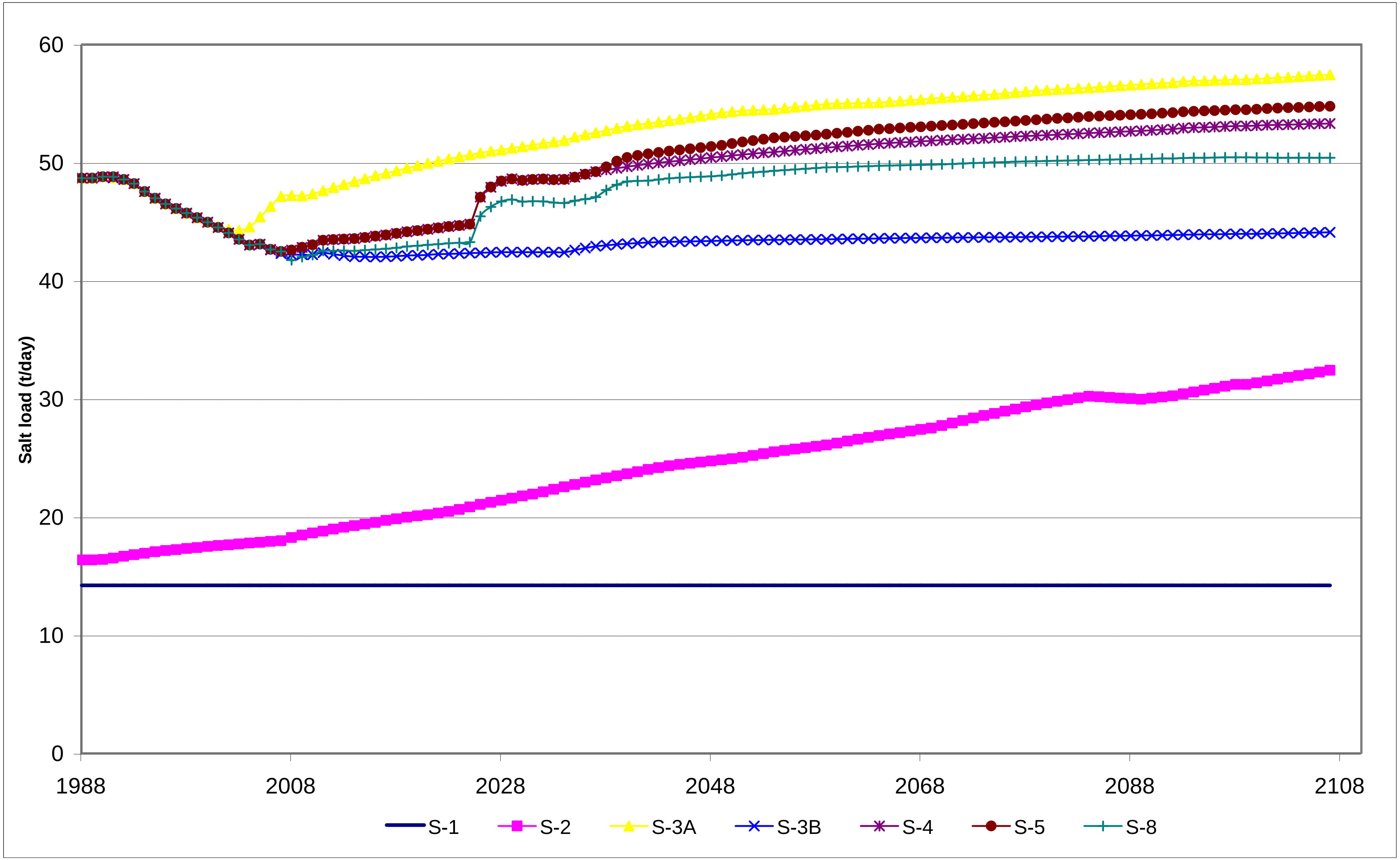
Figure 6



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Modelled salinity impacts for the Cadell Reach (t/day)

Figure 7

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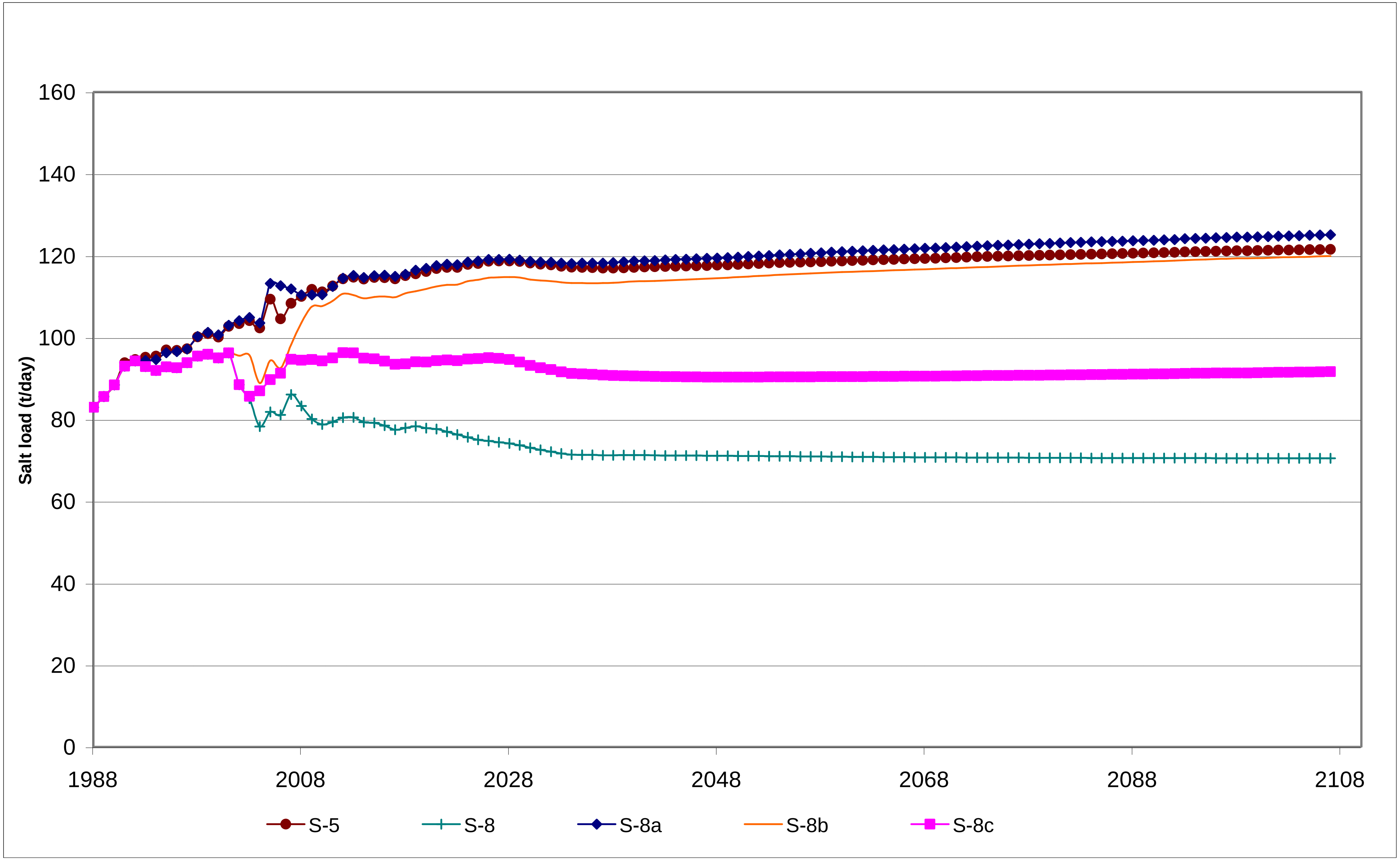

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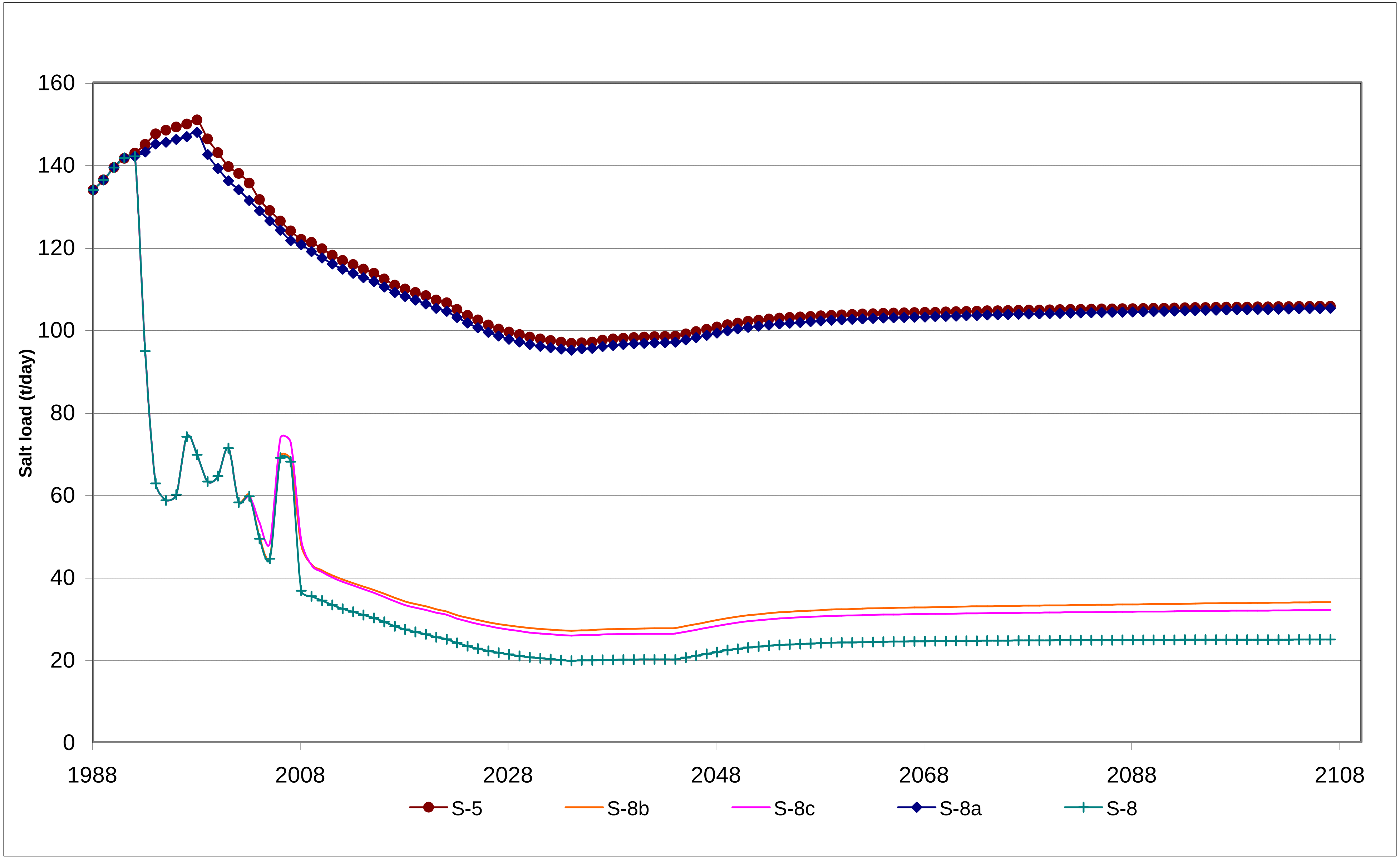
Modelled salinity impacts for SIS scenarios in the Qualco Reach (t/day)

Figure 8



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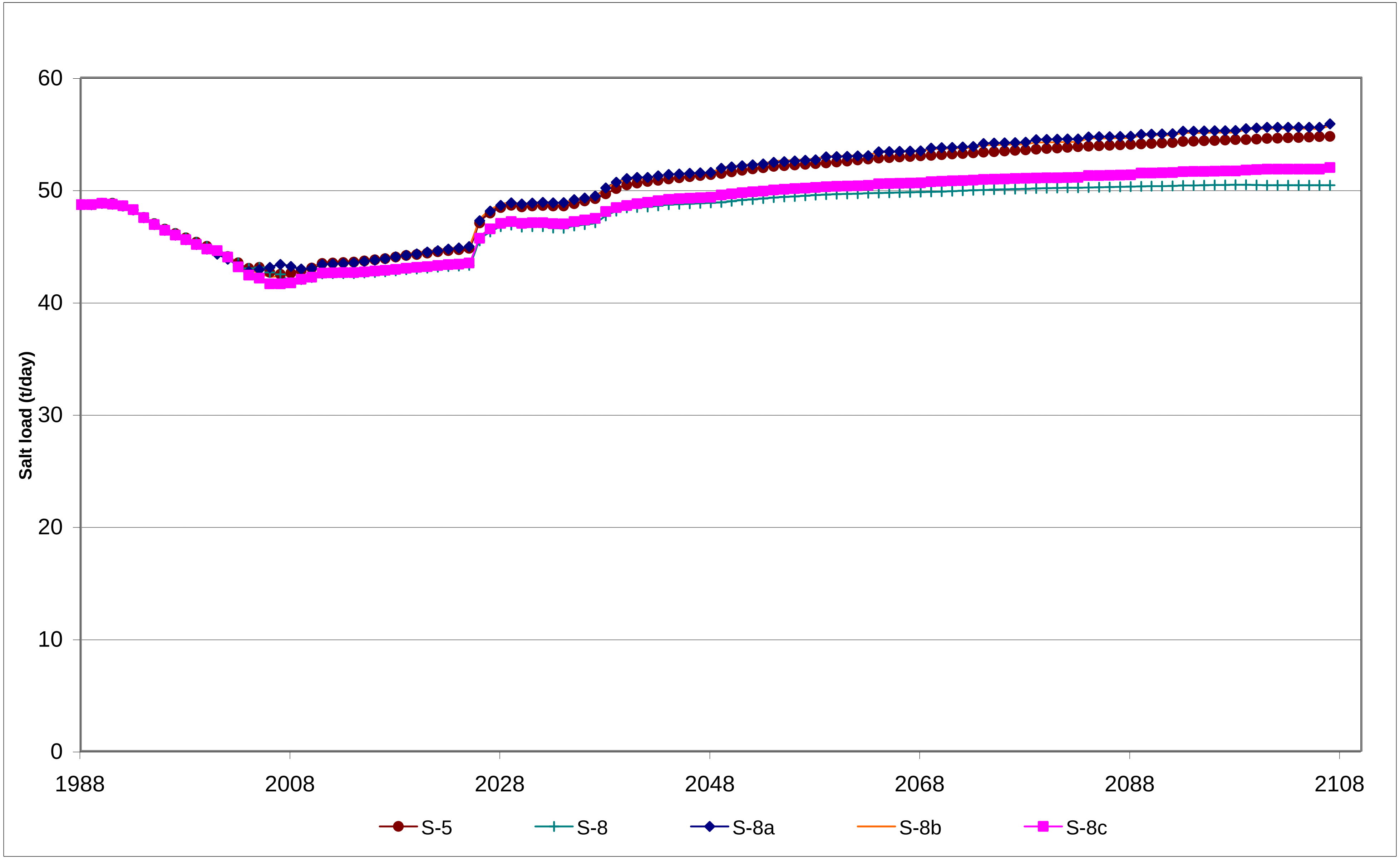
Modelled salinity impacts for SIS scenarios in the Waikerie Reach (t/day)

Figure 9



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Modelled salinity impacts for SIS scenarios in the Cadell Reach (t/day)

Figure 10

APPENDIX A

Modelled Salt Loads

Annual Salt Loads for Qualco (t/day)

Time	S-1	S-2	S-3A	S-3B	S-4	S-5	S-8	S-8a	S-8b	S-8c
1988	13.3	17.2	82.9	82.9	82.9	82.9	82.9	82.9	82.9	82.9
1989	13.3	17.2	85.5	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1990	13.3	17.2	88.3	88.3	88.4	88.4	88.4	88.4	88.4	88.4
1991	13.3	17.9	92.6	92.6	93.8	93.8	92.9	92.9	92.9	92.9
1992	13.3	18.4	94.7	94.6	94.6	94.6	94.2	94.2	94.2	94.2
1993	13.3	18.9	95.2	95.1	95.1	95.1	92.8	94.3	92.8	92.8
1994	13.3	19.3	95.5	95.4	95.4	95.4	91.9	94.6	91.9	91.9
1995	13.3	19.7	97.0	96.9	96.9	96.9	92.8	96.2	92.8	92.8
1996	13.3	19.9	96.9	96.8	96.8	96.8	92.6	96.5	92.6	92.6
1997	13.3	20.2	97.3	97.2	97.2	97.2	93.8	97.1	93.8	93.8
1998	13.3	20.5	100.2	100.1	100.1	100.1	95.4	100.2	95.4	95.4
1999	13.3	20.7	100.9	100.9	100.9	100.9	95.9	101.2	95.9	95.9
2000	13.3	*20.9*	*100.1*	*100.1*	*100.0*	*100.0*	*94.9*	*100.6*	*94.9*	*94.9*
2001	13.3	21.0	100.0	102.6	102.6	102.6	96.2	103.0	96.2	96.2
2002	13.3	21.2	100.9	103.3	103.4	103.4	88.4	104.1	95.5	88.4
2003	13.3	21.4	101.9	104.0	104.1	104.1	85.0	104.8	95.6	85.6
2004	13.3	21.6	106.2	102.3	102.3	102.3	78.2	103.5	88.8	86.9
2005	13.3	21.7	117.6	109.3	109.3	109.3	81.8	113.2	94.4	89.7
2006	13.3	21.8	118.0	104.5	104.5	104.5	81.1	112.6	92.5	91.2
2007	13.3	21.9	123.5	108.3	108.3	108.3	86.0	111.8	98.2	94.6
2008	13.3	22.1	117.5	109.7	110.0	110.0	83.2	110.4	103.6	94.4
2009	13.3	22.3	117.4	111.4	111.7	111.7	80.0	110.4	107.5	94.6
2010	13.3	22.4	119.9	111.1	111.1	111.1	78.7	110.4	107.6	94.3
2011	13.3	22.6	121.1	112.6	112.6	112.6	79.3	112.4	108.9	94.9
2012	13.3	22.9	122.8	113.1	114.3	114.3	80.4	114.5	110.7	96.2
2013	13.3	23.2	124.3	113.3	114.7	114.7	80.4	115.1	110.3	96.2
2014	13.3	23.4	125.4	112.7	114.2	114.2	79.3	114.6	109.5	94.9
2015	13.3	23.7	126.7	112.9	114.6	114.6	79.1	115.1	109.9	94.7
2016	13.3	23.9	127.6	112.7	114.6	114.6	78.4	115.1	110.0	94.2
2017	13.3	24.3	128.4	112.3	114.3	114.3	77.5	114.9	109.8	93.4
2018	13.3	24.5	129.4	112.3	115.1	115.1	77.9	115.4	110.7	93.5
2019	13.3	24.8	131.3	112.7	115.5	115.5	78.3	116.4	111.3	94.0
2020	13.3	25.0	132.9	111.9	116.0	116.0	77.8	116.8	111.8	94.0
2021	13.3	25.2	134.2	111.9	116.8	116.8	77.6	117.5	112.5	94.3
2022	13.3	25.5	135.2	111.9	117.1	117.1	76.9	117.8	112.8	94.5
2023	13.3	25.8	136.0	111.8	117.1	117.1	76.2	117.7	112.9	94.3
2024	13.3	26.4	136.7	111.3	117.8	117.8	75.6	118.4	113.7	94.7
2025	13.3	27.1	137.4	111.0	118.0	118.0	75.0	118.6	114.0	94.8
2026	13.3	27.6	138.1	110.8	118.6	118.6	74.7	119.0	114.6	95.0
2027	13.3	28.0	138.7	110.5	118.5	118.7	74.3	119.0	114.7	94.9
2028	13.3	28.4	137.8	110.1	118.5	118.6	74.1	119.1	114.7	94.5
2029	13.3	28.8	136.6	109.7	118.4	118.5	73.7	118.9	114.6	94.0
2030	13.3	*29.1*	*136.9*	*109.0*	*118.0*	*118.1*	*73.0*	*118.6*	*114.1*	*93.1*
2031	13.3	29.4	137.6	108.5	117.7	117.9	72.5	118.4	113.9	92.6
2032	13.3	30.0	138.5	108.0	117.5	117.7	72.1	118.4	113.7	92.1
2033	13.3	30.6	138.9	107.5	117.1	117.3	71.6	118.1	113.4	91.6
2034	13.3	31.1	139.5	107.1	116.9	117.1	71.3	118.0	113.2	91.2
2035	13.3	31.4	140.0	106.6	116.9	117.1	71.3	118.1	113.3	91.0
2036	13.3	31.9	140.4	106.4	116.8	117.0	71.3	118.1	113.2	91.0
2037	13.3	32.2	140.7	106.1	116.8	116.9	71.2	118.1	113.3	90.8
2038	13.3	32.6	141.2	105.9	116.7	116.9	71.2	118.3	113.3	90.7
2039	13.3	32.8	141.5	105.8	116.8	117.0	71.2	118.4	113.5	90.6
2040	13.3	33.2	141.9	105.7	116.8	117.1	71.2	118.6	113.6	90.5
2041	13.3	33.5	142.2	105.6	116.9	117.2	71.2	118.7	113.7	90.5
2042	13.3	34.0	142.5	105.4	117.0	117.2	71.2	118.8	113.8	90.4
2043	13.3	34.2	142.9	105.4	117.0	117.3	71.1	118.9	113.9	90.4
2044	13.3	34.4	143.3	105.3	117.1	117.4	71.1	119.0	114.0	90.4
2045	13.3	34.5	143.7	105.2	117.1	117.4	71.1	119.1	114.1	90.3
2046	13.3	34.7	144.1	105.1	117.2	117.5	71.1	119.2	114.2	90.3
2047	13.3	34.8	144.5	105.0	117.3	117.5	71.1	119.3	114.4	90.3
2048	13.3	34.9	144.9	104.9	117.4	117.6	71.1	119.4	114.5	90.3
2049	13.3	35.0	145.3	104.8	117.4	117.7	71.0	119.4	114.6	90.3
2050	13.3	*35.1*	*145.5*	*104.8*	*117.5*	*117.8*	*71.0*	*119.6*	*114.7*	*90.3*
2051	13.3	35.3	145.6	104.8	117.5	117.9	71.0	119.7	114.8	90.3
2052	13.3	35.6	145.7	104.7	117.6	118.0	71.0	119.9	115.0	90.3
2053	13.3	35.9	145.8	104.7	117.7	118.1	71.0	120.0	115.1	90.3
2054	13.3	36.2	145.8	104.6	117.7	118.2	71.0	120.1	115.3	90.3
2055	13.3	36.4	146.1	104.6	117.8	118.3	70.9	120.3	115.4	90.3
2056	13.3	36.6	146.3	104.6	117.9	118.4	70.9	120.4	115.5	90.3
2057	13.3	36.7	146.5	104.5	118.0	118.4	70.9	120.5	115.6	90.3
2058	13.3	36.9	146.8	104.5	118.1	118.5	70.9	120.7	115.7	90.4
2059	13.3	37.1	147.0	104.5	118.2	118.6	70.9	120.8	115.8	90.4
2060	13.3	37.4	147.0	104.4	118.2	118.6	70.8	120.9	115.9	90.4
2061	13.3	37.7	147.1	104.3	118.3	118.7	70.8	121.0	116.0	90.4
2062	13.3	38.0	147.1	104.1	118.4	118.8	70.8	121.1	116.1	90.4
2063	13.3	38.4	147.2	104.0	118.5	118.9	70.8	121.2	116.2	90.4
2064	13.3	38.7	147.2	103.9	118.6	119.0	70.7	121.3	116.3	90.4
2065	13.3	38.9	147.4	103.9	118.6	119.0	70.7	121.4	116.4	90.5
2066	13.3	39.1	147.5	103.9	118.7	119.1	70.7	121.5	116.5	90.5
2067	13.3	39.3	147.7	103.9	118.7	119.2	70.7	121.6	116.6	90.5
2068	13.3	39.5	147.9	103.9	118.8	119.2	70.7	121.7	116.6	90.5
2069	13.3	39.7	148.0	103.9	118.8	119.3	70.7	121.8	116.7	90.5
2070	13.3	40.2	148.1	103.9	118.9	119.4	70.7	121.9	116.8	90.5
2071	13.3	40.7	148.2	103.9	119.0	119.5	70.7	122.0	116.9	90.6
2072	13.3	41.2	148.3	103.9	119.0	119.6	70.6	122.2	117.0	90.6
2073	13.3	41.7	148.4	103.9	119.1	119.7	70.6	122.3	117.1	90.6
2074	13.3	42.2	148.5	103.9	119.1	119.8	70.6	122.4	117.2	90.6
2075	13.3	42.5	148.7	103.9	119.2	119.8	70.6	122.5	117.3	90.7
2076	13.3	42.8	148.8	103.9	119.2	119.9	70.6	122.6	117.4	90.7
2077	13.3	43.1	149.0	103.9	119.3	119.9	70.6	122.7	117.5	90.7
2078	13.3	43.4	149.1	103.9	119.4	120.0	70.6	122.8	117.6	90.7
2079	13.3	43.7	149.3	103.8	119.4	120.0	70.6	122.9	117.7	90.7
2080	13.3	43.6	149.4	103.8	119.5	120.1	70.6	122.9	117.8	90.8
2081	13.3	43.5	149.5	103.8	119.5	120.1	70.6	123.0	117.8	90.8
2082	13.3	43.4	149.6	103.8	119.6	120.2	70.6	123.1	117.9	90.8
2083	13.3	43.4	149.6	103.8	119.6	120.2	70.5	123.2	118.0	90.8
2084	13.3	43.3	149.7	103.8	119.7	120.3	70.5	123.3	118.1	90.9
2085	13.3	43.2	149.8	103.8	119.7	120.4	70.5	123.4	118.2	90.9
2086	13.3	43.2	149.9	103.7	119.8	120.4	70.5	123.4	118.2	90.9
2087	13.3	43.2	150.0	103.7	119.9	120.5	70.5	123.5	118.3	91.0
2088	13.3	43.1	150.1	103.7	119.9	120.5	70.5	123.6	118.4	91.0
2089	13.3	43.1	150.3	103.7	120.0	120.6	70.5	123.6	118.5	91.0
2090	13.3	43.2	150.4	103.7	120.0	120.6	70.5	123.7	118.6	91.0
2091	13.3	43.3	150.5	103.6	120.1	120.7	70.5	123.8	118.6	91.1
2092	13.3	43.4	150.6	103.6	120.2	120.8	70.5	123.9	118.7	91.1
2093	13.3	43.7	150.8	103.5	120.3	120.9	70.5	124.1	118.9	91.2
2094	13.3	44.0	150.8	103.5	120.3	120.9	70.5	124.2	119.0	91.2
2095	13.3	44.2	150.9	103.5	120.4	121.0	70.5	124.2	119.0	91.2
2096	13.3	44.5	150.9	103.5	120.4	121.0	70.5	124.3	119.1	91.2
2097	13.3	44.8	150.9	103.5	120.4	121.1	70.5	124.4	119.2	91.3
2098	13.3	45.0	151.0	103.5	120.5	121.1	70.5	124.5	119.3	91.3
2099	13.3	45.0	151.0	103.5	120.5	121.1	70.5	124.5	119.3	91.3
2100	13.3	*45.2*	*151.1*	*103.5*	*120.5*	*121.2*	*70.5*	*124.6*	*119.4*	*91.3*
2101	13.3	45.4	151.2	103.5	120.6	121.3	70.5	124.6	119.4	91.4
2102	13.3	45.7	151.3	103.5	120.6	121.3	70.5	124.7	119.5	91.4
2103	13.3	45.9	151.4	103.5	120.6	121.3	70.5	124.8	119.6	91.5
2104	13.3	46.1	151.4	103.5	120.7	121.4	70.4	124.9	119.6	91.5
2105	13.3	46.3	151.5	103.5	120.7	121.4	70.4	124.9	119.7	91.5
2106	13.3	46.5	151.6	103.5	120.7	121.4	70.4	125.0	119.8	91.6
2107	13.3	46.8	151.7	103.4	120.8	121.5	70.4	125.1	119.9	91.6

Scenario	Name	Model Run	Irrigation development area	IIP	RH	SIS
S-1	Natural system	Steady State	None	-	-	-
S-2	Mallee clearance	1920 - CY100	None (but includes Mallee clearance area)	-	-	-
S-3A	Pre-1988, no IIP, no RH	1988 – CY100	Pre-1988	No	No	-
S-3B	Pre-1988, with IIP, no RH	1988 – CY100	Pre-1988	Yes	No	-
S-3C	Pre-1988, with IIP and with RH	1988 – CY100	Pre-1988	Yes	Yes	-
S-4	Current irrigation	CY – CY100	Pre-1988 + Post-1988	Yes	Yes	No
S-5	Current plus future irrigation	CY – CY100		Yes	Yes	No
S-8	current SIS	CY – CY100	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8a	Wool SIS only	CY – CY100		Yes	Yes	Yes
S-8b	Wool + Waik 1 SIS only	CY – CY100		Yes	Yes	Yes
S-8c	Wool + Waik1 + Qualco SIS	CY – CY100		Yes	Yes	Yes

IIP = improved irrigation practices   RH = Rehabilitation of irrigation distribution networks   SIS = Saltl interception scheme

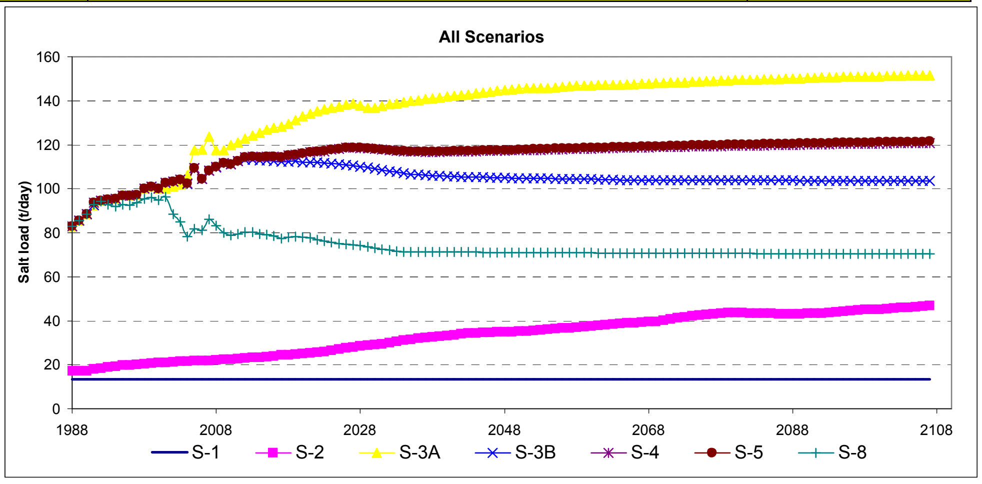
CY = current year   CY100 = 100 yrs from the current year

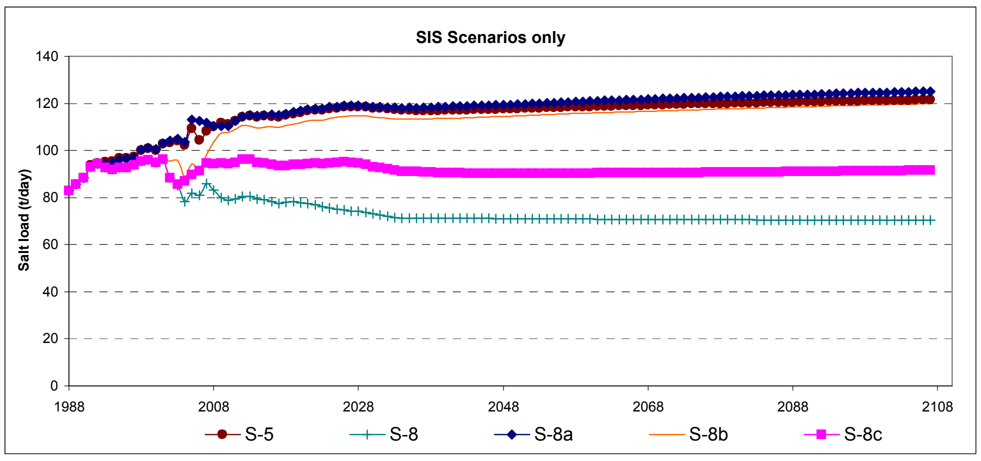
Note:
- Current SIS includes actual pumping data to Dec 2006
- Future SIS rates at Woolpunda (S8 to S-8c only) is based on the average historical rates of the 1st half of the1997 calendar year

  (ie total rates of approx 210 L/s)
- Future SIS rates at Qualco and Waikerie are based on the last quarter of the 2003 calendar year

The tables below are designed to help MDBC choose the correct inputs to BIGMOD and show the impact of each of the individual accountable actions.

	Accountable actions (t/day)					
	Debits				Credits	
	S2 - S1	S3A - S2	S4 - S3B	S5 - S4	S5 - S8	S3A - S4
2000	*7.6*	*79.2*	0.0	0.0	*5.1*	*0.0*
2005	8.4	95.9	0.0	0.0	27.5	8.3
2006	8.5	96.2	0.0	0.0	23.4	13.4
2007	8.6	101.6	0.0	0.0	22.3	15.2
2008	8.8	95.4	0.3	0.0	26.7	7.5
2009	9.0	95.2	0.3	0.0	31.7	5.7
2010	9.1	97.5	0.0	0.0	32.4	8.9
2011	9.3	98.5	0.0	0.0	33.2	8.5
2012	9.6	99.9	1.1	0.0	33.9	8.5
2013	9.9	101.1	1.4	0.0	34.2	9.6
2014	10.1	102.1	1.5	0.0	34.9	11.2
2015	*10.4*	*103.1*	1.7	0.0	35.5	12.1
2016	10.6	103.7	1.9	0.0	36.2	13.0
2017	11.0	104.1	2.0	0.0	36.8	14.1
2018	11.2	104.8	2.7	0.0	37.2	14.3
2019	11.5	106.4	2.9	0.0	37.2	15.8
2020	11.7	107.9	4.1	0.0	38.2	16.9
2021	11.9	109.0	4.9	0.0	39.2	17.4
2022	12.2	109.6	5.2	0.0	40.2	18.1
2023	12.5	110.2	5.3	0.0	40.9	18.9
2024	13.1	110.4	6.5	0.0	42.2	19.0
2025	13.8	110.3	7.0	0.0	43.0	19.4
2026	14.3	110.5	7.8	0.0	43.9	19.5
2027	14.7	110.7	8.1	0.1	44.3	20.1
2028	15.1	109.4	8.4	0.1	44.5	19.3
2029	15.5	107.9	8.8	0.1	44.9	18.2
2030	15.8	107.7	9.0	0.1	45.1	18.9
2031	16.1	108.2	9.2	0.2	45.3	19.9
2032	16.7	108.5	9.5	0.2	45.6	21.0
2033	17.3	108.3	9.6	0.2	45.7	21.7
2034	17.8	108.4	9.9	0.2	45.8	22.6
2035	18.1	108.5	10.3	0.2	45.8	23.1
2036	18.6	108.5	10.4	0.2	45.7	23.5
2050	*21.8*	*110.3*	*12.7*	*0.3*	46.8	28.0
2100	*31.9*	*105.9*	*17.0*	*0.7*	50.7	30.6





Summary of predicted salt load (t/day) entering the River Murray in the Qualco Area

	1988	2000	2007	2050	2107
S-1	13.3	13.3	13.3	13.3	13.3
S-2	17.2	20.9	21.9	35.1	46.8
S-3A	82.9	100.1	123.5	145.5	151.7
S-3B	82.9	100.1	108.3	104.8	103.4
S-4	82.9	100.0	108.3	117.5	120.8
S-5	82.9	100.0	108.3	117.8	121.5
S-8	82.9	94.9	86.0	71.0	70.4
S-8a	82.9	100.6	111.8	119.6	125.1
S-8b	82.9	94.9	98.2	114.7	119.9
S-8c	82.9	94.9	94.6	90.3	91.6

Register A & B accountable Debits and Credits for the Qualco Reach (t/day)

Figure A.1

Annual Salt Loads for Waikerie (t/day)

Time	S-1	S-2	S-3A	S-3B	S-4	S-5	S-8	S-8a	S-8b	S-8c
1988	6.5	11.6	133.8	133.8	133.8	133.8	133.8	133.8	133.8	133.8
1989	6.5	11.7	136.3	136.3	136.3	136.3	136.3	136.3	136.3	136.3
1990	6.5	11.8	139.2	139.2	139.3	139.3	139.3	139.3	139.3	139.3
1991	6.5	12.5	141.3	141.3	141.5	141.5	141.6	141.6	141.6	141.6
1992	6.5	13.1	142.9	142.8	142.8	142.8	142.0	142.0	142.0	142.0
1993	6.5	13.6	145.0	144.9	144.9	144.9	94.8	143.0	94.8	94.8
1994	6.5	14.0	147.6	147.5	147.5	147.5	62.7	145.0	62.7	62.7
1995	6.5	14.3	148.4	148.3	148.3	148.3	58.6	145.5	58.6	58.6
1996	6.5	14.5	149.2	149.2	149.2	149.2	60.0	146.1	60.0	60.0
1997	6.5	14.8	150.0	149.9	149.9	149.9	74.0	146.8	74.0	74.0
1998	6.5	15.0	151.0	150.8	150.8	150.8	69.7	147.9	69.7	69.7
1999	6.5	15.2	146.3	146.2	146.2	146.2	63.1	142.5	63.1	63.1
2000	*6.5*	*15.4*	*143.1*	*142.9*	*142.9*	*142.9*	*64.5*	*139.1*	*64.5*	*64.5*
2001	6.5	15.5	138.7	139.5	139.5	139.5	71.3	136.1	71.3	71.2
2002	6.5	15.7	135.8	137.8	137.9	137.9	58.1	133.9	58.3	58.2
2003	6.5	15.8	133.2	135.5	135.5	135.5	59.6	131.3	60.0	59.6
2004	6.5	16.0	131.0	131.5	131.5	131.5	49.3	128.8	49.7	53.2
2005	6.5	16.1	129.3	128.8	128.8	128.8	44.5	126.4	44.9	48.2
2006	6.5	16.2	127.5	126.3	126.3	126.3	68.9	124.1	69.3	73.7
2007	6.5	16.4	125.6	124.0	123.9	123.9	68.0	121.6	68.4	72.6
2008	6.5	16.7	123.9	121.9	121.9	121.9	36.7	120.6	47.8	48.9
2009	6.5	16.9	123.4	121.1	121.1	121.1	35.3	118.9	43.1	42.9
2010	6.5	17.1	122.0	119.5	119.6	119.6	34.3	117.4	41.6	41.3
2011	6.5	17.2	120.8	118.1	118.1	118.1	33.2	115.9	40.4	39.9
2012	6.5	17.5	119.8	116.7	116.8	116.8	32.3	114.7	39.4	38.8
2013	6.5	17.7	118.9	115.5	115.8	115.8	31.6	113.7	38.5	38.0
2014	6.5	18.0	118.2	114.2	114.7	114.7	30.8	112.6	37.7	37.0
2015	*6.5*	*18.2*	*117.7*	*113.0*	*113.7*	*113.7*	*30.1*	*111.6*	*36.8*	*36.2*
2016	6.5	18.5	116.8	111.5	112.3	112.3	29.1	110.3	35.9	35.2
2017	6.5	18.9	116.0	109.9	110.8	110.8	28.1	109.0	34.9	34.1
2018	6.5	19.1	115.3	108.2	109.8	109.8	27.3	108.0	34.1	33.2
2019	6.5	19.3	114.7	106.9	109.0	109.0	26.7	107.2	33.4	32.6
2020	6.5	19.5	114.3	105.5	108.2	108.2	26.1	106.2	32.9	32.0
2021	6.5	19.7	113.9	104.0	107.2	107.2	25.4	105.2	32.2	31.3
2022	6.5	19.9	113.6	102.9	106.5	106.5	24.9	104.5	31.7	30.9
2023	6.5	20.2	113.3	101.0	104.8	104.9	24.0	103.0	30.7	29.9
2024	6.5	20.6	113.1	99.2	103.5	103.5	23.3	101.6	30.1	29.3
2025	6.5	21.2	113.0	97.6	102.3	102.3	22.6	100.4	29.6	28.7
2026	6.5	21.5	112.9	96.2	101.1	101.1	22.1	99.3	29.0	28.1
2027	6.5	21.8	112.7	95.2	100.1	100.1	21.6	98.4	28.6	27.6
2028	6.5	22.2	112.7	94.1	99.4	99.4	21.2	97.7	28.3	27.3
2029	6.5	22.5	112.5	93.3	98.6	98.8	20.9	97.0	27.9	26.9
2030	*6.5*	*22.8*	*112.3*	*92.4*	*98.0*	*98.2*	*20.6*	*96.4*	*27.6*	*26.6*
2031	6.5	23.0	112.2	91.7	97.5	97.7	20.3	96.0	27.4	26.3
2032	6.5	23.4	112.2	91.1	97.2	97.3	20.1	95.6	27.2	26.1
2033	6.5	23.8	112.2	90.5	96.8	97.0	19.9	95.3	27.1	25.9
2034	6.5	24.2	112.2	90.0	96.5	96.7	19.7	95.0	27.0	25.8
2035	6.5	24.5	112.4	90.2	96.7	96.8	19.8	95.3	27.1	25.9
2036	6.5	24.8	112.5	90.3	97.0	97.0	19.8	95.4	27.1	25.9
2037	6.5	25.1	112.5	90.4	97.2	97.4	19.9	95.9	27.3	26.1
2038	6.5	25.4	112.6	90.5	97.4	97.7	19.9	96.2	27.4	26.1
2039	6.5	25.6	112.6	90.5	97.5	97.9	20.0	96.4	27.4	26.2
2040	6.5	25.8	112.6	90.6	97.7	98.1	20.0	96.6	27.5	26.2
2041	6.5	26.1	112.7	90.6	97.8	98.2	20.0	96.7	27.5	26.2
2042	6.5	26.4	112.7	90.6	97.9	98.3	20.0	96.8	27.6	26.3
2043	6.5	26.5	112.7	90.6	98.0	98.3	20.0	96.9	27.6	26.3
2044	6.5	26.7	112.8	90.6	98.0	98.4	20.0	96.9	27.6	26.3
2045	6.5	26.8	112.8	90.5	98.1	98.9	20.5	97.5	28.1	26.8
2046	6.5	27.0	112.9	90.5	98.1	99.5	20.9	98.1	28.6	27.2
2047	6.5	27.1	112.9	90.5	98.2	100.1	21.4	98.6	29.1	27.7
2048	6.5	27.2	113.0	90.5	98.2	100.6	21.8	99.2	29.6	28.1
2049	6.5	27.4	113.0	90.5	98.2	101.2	22.3	99.7	30.0	28.6
2050	*6.5*	*27.5*	*113.0*	*90.5*	*98.2*	*101.6*	*22.6*	*100.2*	*30.4*	*29.0*
2051	6.5	27.6	113.0	90.5	98.3	102.0	22.9	100.6	30.7	29.3
2052	6.5	27.9	113.1	90.5	98.3	102.3	23.1	100.9	31.0	29.5
2053	6.5	28.1	113.1	90.5	98.3	102.5	23.3	101.1	31.2	29.8
2054	6.5	28.4	113.1	90.5	98.3	102.8	23.5	101.4	31.5	30.0
2055	6.5	28.6	113.2	90.4	98.3	102.9	23.6	101.6	31.6	30.1
2056	6.5	28.7	113.2	90.4	98.4	103.1	23.8	101.8	31.7	30.2
2057	6.5	28.9	113.3	90.4	98.4	103.2	23.9	101.9	31.9	30.3
2058	6.5	29.1	113.3	90.4	98.4	103.3	24.0	102.1	32.0	30.5
2059	6.5	29.3	113.4	90.4	98.4	103.5	24.1	102.3	32.1	30.6
2060	6.5	29.5	113.4	90.4	98.5	103.6	24.1	102.4	32.2	30.7
2061	6.5	29.8	113.4	90.3	98.5	103.7	24.2	102.5	32.3	30.7
2062	6.5	30.1	113.4	90.3	98.5	103.8	24.2	102.6	32.3	30.8
2063	6.5	30.3	113.4	90.2	98.6	103.9	24.3	102.7	32.4	30.8
2064	6.5	30.6	113.4	90.2	98.6	104.0	24.3	102.8	32.5	30.9
2065	6.5	30.8	113.5	90.2	98.6	104.0	24.3	102.9	32.5	30.9
2066	6.5	31.0	113.5	90.2	98.6	104.1	24.4	103.0	32.6	31.0
2067	6.5	31.2	113.6	90.2	98.7	104.1	24.4	103.0	32.6	31.0
2068	6.5	31.5	113.6	90.2	98.7	104.1	24.4	103.1	32.7	31.0
2069	6.5	31.7	113.7	90.2	98.7	104.2	24.5	103.2	32.7	31.1
2070	6.5	32.1	113.7	90.2	98.7	104.3	24.5	103.2	32.7	31.1
2071	6.5	32.5	113.7	90.2	98.8	104.3	24.5	103.3	32.8	31.1
2072	6.5	32.9	113.8	90.2	98.8	104.4	24.5	103.4	32.8	31.2
2073	6.5	33.3	113.8	90.2	98.8	104.5	24.5	103.5	32.9	31.2
2074	6.5	33.7	113.8	90.2	98.8	104.5	24.6	103.5	32.9	31.3
2075	6.5	34.0	113.9	90.2	98.8	104.6	24.6	103.6	33.0	31.3
2076	6.5	34.3	113.9	90.1	98.9	104.6	24.6	103.7	33.0	31.3
2077	6.5	34.6	114.0	90.1	98.9	104.7	24.6	103.7	33.0	31.3
2078	6.5	34.9	114.0	90.1	98.9	104.7	24.6	103.8	33.1	31.4
2079	6.5	35.2	114.1	90.1	98.9	104.7	24.7	103.9	33.1	31.4
2080	6.5	35.4	114.1	90.1	99.0	104.8	24.7	103.9	33.1	31.4
2081	6.5	35.6	114.1	90.1	99.0	104.8	24.7	104.0	33.2	31.4
2082	6.5	35.8	114.1	90.1	99.0	104.9	24.7	104.0	33.2	31.4
2083	6.5	36.0	114.2	90.1	99.0	104.9	24.7	104.1	33.2	31.5
2084	6.5	36.2	114.2	90.1	99.1	104.9	24.7	104.1	33.3	31.5
2085	6.5	36.2	114.2	90.1	99.1	105.0	24.7	104.2	33.3	31.5
2086	6.5	36.2	114.3	90.1	99.1	105.0	24.7	104.2	33.3	31.5
2087	6.5	36.2	114.3	90.1	99.1	105.0	24.7	104.3	33.4	31.6
2088	6.5	36.3	114.3	90.1	99.2	105.1	24.7	104.3	33.4	31.6
2089	6.5	36.3	114.4	90.1	99.2	105.1	24.7	104.3	33.4	31.6
2090	6.5	36.4	114.4	90.1	99.2	105.2	24.8	104.4	33.4	31.6
2091	6.5	36.5	114.4	90.1	99.3	105.2	24.8	104.4	33.5	31.7
2092	6.5	36.6	114.5	90.1	99.3	105.2	24.8	104.5	33.5	31.7
2093	6.5	36.8	114.5	90.1	99.4	105.3	24.8	104.6	33.5	31.7
2094	6.5	37.0	114.5	90.1	99.4	105.4	24.8	104.6	33.6	31.8
2095	6.5	37.2	114.6	90.1	99.4	105.4	24.8	104.7	33.6	31.8
2096	6.5	37.5	114.6	90.1	99.4	105.4	24.8	104.7	33.6	31.8
2097	6.5	37.7	114.6	90.1	99.4	105.4	24.8	104.8	33.7	31.8
2098	6.5	37.9	114.6	90.1	99.5	105.5	24.8	104.8	33.7	31.8
2099	6.5	37.9	114.6	90.1	99.5	105.5	24.8	104.8	33.7	31.8
2100	*6.5*	*38.1*	*114.6*	*90.1*	*99.5*	*105.5*	*24.8*	*104.9*	*33.7*	*31.9*
2101	6.5	38.4	114.7	90.1	99.5	105.5	24.8	104.9	33.8	31.9
2102	6.5	38.7	114.7	90.1	99.5	105.6	24.8	105.0	33.8	31.9
2103	6.5	38.9	114.7	90.1	99.5	105.6	24.8	105.0	33.8	31.9
2104	6.5	39.2	114.8	90.1	99.5	105.6	24.8	105.0	33.8	31.9
2105	6.5	39.5	114.8	90.1	99.5	105.6	24.8	105.1	33.9	32.0
2106	6.5	39.8	114.8	90.1	99.6	105.6	24.8	105.1	33.9	32.0
2107	6.5	40.0	114.8	90.2	99.6	105.7	24.8	105.2	33.9	32.0

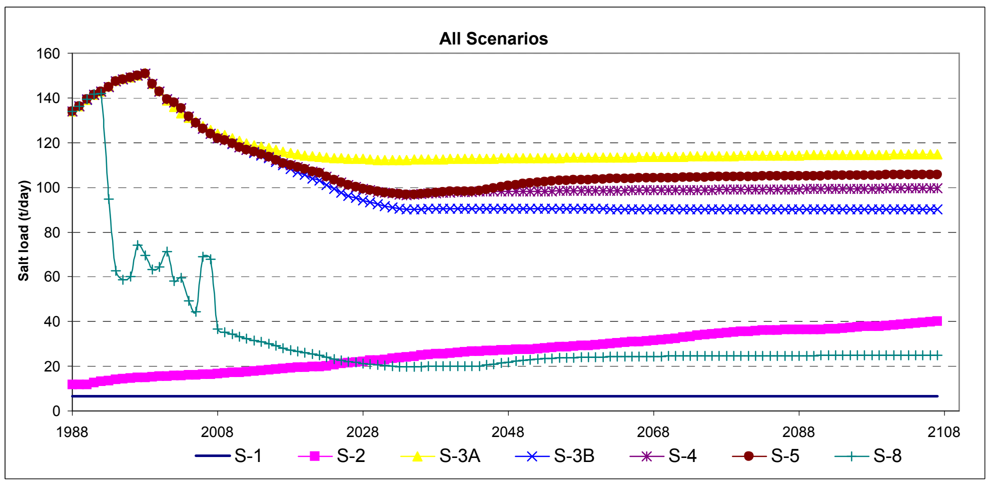
Scenario	Name	Model Run	Irrigation development area	IIP	RH	SIS
S-1	Natural system	Steady State	None	-	-	-
S-2	Mallee clearance	1920 - CY100	None (but includes Mallee clearance area)	-	-	-
S-3A	Pre-1988, no IIP, no RH	1988 – CY100	Pre-1988	No	No	-
S-3B	Pre-1988, with IIP, no RH	1988 – CY100	Pre-1988	Yes	No	-
S-3C	Pre-1988, with IIP and with RH	1988 – CY100	Pre-1988	Yes	Yes	-
S-4	Current irrigation	CY – CY100	Pre-1988 + Post-1988	Yes	Yes	No
S-5	Current plus future irrigation	CY – CY100		Yes	Yes	No
S-8	current SIS	CY – CY100	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8a	Wool SIS only	CY – CY100		Yes	Yes	Yes
S-8b	Wool + Waik 1 SIS only	CY – CY100		Yes	Yes	Yes
S-8c	Wool + Waik1 + Qualco SIS	CY – CY100		Yes	Yes	Yes

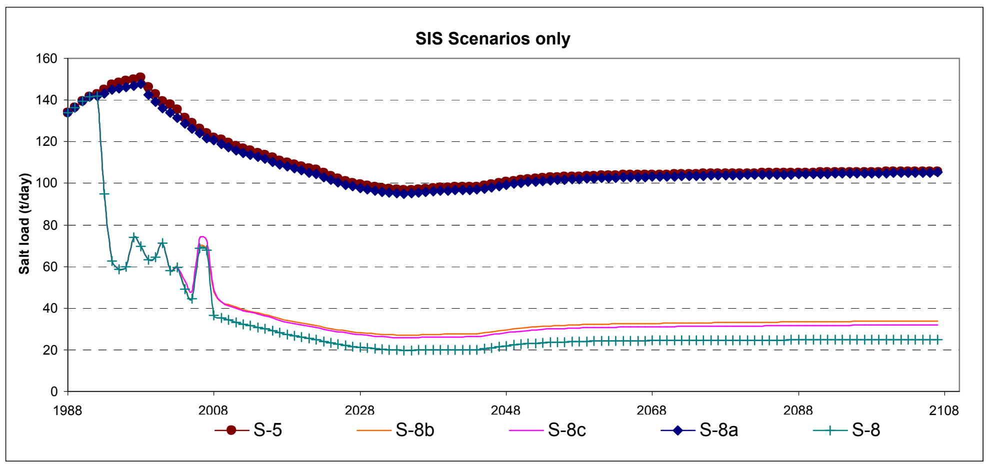
IIP = improved irrigation practices RH = Rehabilitation of irrigation distribution networks SIS = Saltl interception scheme
CY = current year CY100 = 100 yrs from the current year

Note:
- Current SIS includes actual pumping data to Dec 2006
- Future SIS rates at Woolpunda (S8 to S-8c only) is based on the average historical rates of the 1st half of the1997 calendar year (ie total rates of approx 210 L/s)
- Future SIS rates at Qualco and Waikerie are based on the last quarter of the 2003 calendar year

The tables below are designed to help MDBC choose the correct inputs to BIGMOD and show the impact of each of the individual accountable actions.

	Accountable actions (t/day)					
	Debits				Credits	
	S2 - S1	S3A - S2	S4 - S3B	S5 - S4	S5 - S8	S3A - S4
2000	*8.9*	*127.8*	*0.0*	*0.0*	*78.4*	*0.2*
2005	9.6	113.2	0.0	0.0	84.4	0.5
2006	9.7	111.2	0.0	0.0	57.4	1.2
2007	9.9	109.2	0.0	0.0	56.0	1.7
2008	10.2	107.1	0.0	0.0	85.2	2.0
2009	10.4	106.5	0.0	0.0	85.8	2.2
2010	10.6	105.0	0.1	0.0	85.3	2.4
2011	10.7	103.6	0.0	0.0	84.8	2.7
2012	11.0	102.3	0.0	0.0	84.5	3.0
2013	11.2	101.2	0.3	0.0	84.2	3.1
2014	11.5	100.3	0.5	0.0	83.9	3.6
2015	*11.7*	*99.4*	*0.7*	*0.0*	*83.6*	*4.0*
2016	12.0	98.3	0.8	0.0	83.2	4.6
2017	12.4	97.1	0.9	0.0	82.7	5.2
2018	12.6	96.2	1.6	0.0	82.5	5.5
2019	12.8	95.4	2.1	0.0	82.3	5.7
2020	13.0	94.8	2.7	0.0	82.0	6.1
2021	13.2	94.3	3.2	0.0	81.7	6.8
2022	13.4	93.7	3.6	0.0	81.6	7.1
2023	13.7	93.2	3.8	0.1	80.9	8.5
2024	14.1	92.5	4.2	0.0	80.2	9.7
2025	14.7	91.8	4.8	0.0	79.7	10.7
2026	15.0	91.3	4.9	0.0	79.0	11.8
2027	15.3	90.9	4.9	0.0	78.5	12.6
2028	15.7	90.5	5.2	0.0	78.1	13.3
2029	16.0	90.0	5.4	0.2	77.9	13.8
2030	*16.3*	*89.6*	*5.6*	*0.2*	*77.6*	*14.3*
2031	16.5	89.3	5.9	0.2	77.4	14.7
2032	16.9	88.8	6.1	0.1	77.3	15.0
2033	17.3	88.4	6.3	0.2	77.1	15.4
2034	17.7	88.0	6.4	0.2	77.0	15.7
2035	18.0	87.9	6.6	0.1	77.0	15.6
2036	18.3	87.7	6.7	0.0	77.1	15.5
2050	*21.0*	*85.6*	*7.8*	*3.3*	*79.0*	*14.8*
2100	*31.6*	*76.5*	*9.4*	*6.0*	*80.7*	*15.2*





Summary of predicted salt load (t/day) entering the River Murray in the Waikerie Area

	1988	2000	2007	2050	2107
S-1	6.5	6.5	6.5	6.5	6.5
S-2	11.6	15.4	16.4	27.5	40.0
S-3A	133.8	143.1	125.6	113.0	114.8
S-3B	133.8	142.9	124.0	90.5	90.2
S-4	133.8	142.9	123.9	98.2	99.6
S-5	133.8	142.9	123.9	101.6	105.7
S-8	133.8	71.3	68.0	22.6	24.8
S-8a	133.8	139.1	121.6	100.2	105.2
S-8b	133.8	64.5	68.4	30.4	33.9
S-8c	133.8	64.5	72.6	29.0	32.0

Register A & B accountable Debits and Credits for the Waikeire Reach (t/day)

Annual Salt Loads for Woolpunda (t/day)

Time	S-1	S-2	S-3A	S-3B	S-4	S-5	S-8
1988	246.9	247.6	249.6	249.6	249.6	249.6	249.6
1989	246.9	247.5	249.6	249.6	249.6	249.6	249.6
1990	246.9	247.5	249.6	249.6	249.6	249.6	249.6
1991	246.9	247.5	249.6	249.6	249.6	249.6	249.6
1992	246.9	247.4	249.7	249.7	249.7	249.7	168.8
1993	246.9	247.3	249.7	249.7	249.7	249.7	116.5
1994	246.9	247.3	249.7	249.7	249.7	249.7	86.2
1995	246.9	247.2	249.8	249.8	249.8	249.8	63.5
1996	246.9	247.2	249.8	249.8	249.8	249.8	46.9
1997	246.9	247.1	249.9	249.9	249.9	249.9	39.5
1998	246.9	247.0	249.9	249.9	249.9	249.9	38.5
1999	246.9	247.0	249.9	249.9	249.9	249.9	39.4
2000	*246.9*	*246.9*	*249.8*	*249.8*	*249.8*	*249.8*	*39.1*
2001	246.9	246.9	249.6	249.6	249.6	249.6	44.6
2002	246.9	253.4	249.5	249.6	249.6	249.6	55.5
2003	246.9	255.1	249.5	249.5	249.5	249.5	60.4
2004	246.9	256.2	249.4	249.4	249.4	249.4	65.2
2005	246.9	256.8	249.4	249.5	249.5	249.5	59.5
2006	246.9	257.2	249.6	249.6	249.6	249.6	51.9
2007	246.9	257.5	249.6	249.6	249.6	249.6	72.6
2008	246.9	257.8	251.6	251.6	251.6	251.6	51.8
2009	246.9	258.0	254.9	254.9	254.9	254.9	42.7
2010	246.9	258.2	256.8	256.8	256.8	256.8	41.1
2011	246.9	258.3	258.1	258.2	258.1	258.1	40.4
2012	246.9	258.6	271.2	271.2	271.2	271.2	48.4
2013	246.9	258.7	272.2	272.2	272.2	272.2	43.7
2014	246.9	258.8	275.4	275.4	275.4	275.4	44.2
2015	*246.9*	*259.0*	*276.1*	*276.1*	*276.1*	*276.1*	*45.2*
2016	246.9	259.2	277.8	277.8	277.8	277.8	46.2
2017	246.9	259.3	279.4	279.4	279.4	279.4	46.9
2018	246.9	259.5	280.8	280.8	280.8	280.8	47.6
2019	246.9	259.6	279.2	277.8	278.9	278.9	47.5
2020	246.9	259.8	279.1	275.8	278.5	278.5	47.4
2021	246.9	259.8	278.9	276.2	278.3	278.3	47.2
2022	246.9	260.1	278.6	276.4	278.3	278.3	46.9
2023	246.9	260.2	278.0	276.2	278.0	278.0	46.7
2024	246.9	260.5	278.0	276.4	277.9	277.9	46.4
2025	246.9	260.6	278.2	277.5	277.9	277.9	46.2
2026	246.9	260.8	277.8	277.3	277.7	277.7	46.0
2027	246.9	260.9	277.4	277.0	277.4	277.4	45.8
2028	246.9	261.0	274.5	276.7	277.2	277.2	45.6
2029	246.9	261.1	277.5	277.5	277.5	277.5	45.6
2030	*246.9*	*261.2*	*273.7*	*276.8*	*277.3*	*277.3*	*45.5*
2031	246.9	261.3	274.2	276.9	277.2	277.2	45.4
2032	246.9	261.6	275.0	276.8	277.2	277.2	45.3
2033	246.9	261.7	275.3	276.6	277.0	277.0	45.2
2034	246.9	261.9	275.9	276.4	276.9	276.9	45.1
2035	246.9	262.0	276.5	274.0	276.7	276.7	45.1
2036	246.9	262.1	277.0	273.5	276.6	276.6	45.1
2037	246.9	262.3	277.5	273.8	278.4	278.4	45.3
2038	246.9	262.4	277.3	274.6	280.4	280.4	46.8
2039	246.9	262.5	277.3	276.3	285.6	285.6	49.9
2040	246.9	262.6	277.6	278.5	290.2	290.2	53.5
2041	246.9	262.7	277.9	280.1	293.0	293.0	54.0
2042	246.9	263.0	278.1	280.8	294.7	294.7	54.3
2043	246.9	263.1	278.3	280.7	296.3	296.4	54.8
2044	246.9	263.2	278.5	280.6	297.9	298.0	55.3
2045	246.9	263.3	278.5	280.3	299.4	301.1	55.7
2046	246.9	263.4	278.5	279.9	300.9	304.2	56.1
2047	246.9	263.5	278.5	279.6	302.5	307.3	56.4
2048	246.9	263.6	278.5	279.2	304.0	310.4	56.8
2049	246.9	263.7	278.5	278.9	305.6	313.5	57.2
2050	*246.9*	*263.9*	*278.6*	*278.7*	*306.6*	*316.2*	*57.7*
2051	246.9	264.0	278.7	278.5	307.7	318.8	58.2
2052	246.9	264.2	278.9	278.3	308.8	321.0	58.7
2053	246.9	264.4	279.0	278.0	310.0	323.2	59.2
2054	246.9	264.7	279.1	277.8	311.2	325.5	59.7
2055	246.9	264.8	279.3	277.6	312.2	326.4	60.2
2056	246.9	265.0	279.4	277.5	313.1	327.3	60.7
2057	246.9	265.1	279.6	277.3	314.1	328.3	61.1
2058	246.9	265.3	279.7	277.2	315.0	329.2	61.6
2059	246.9	265.5	279.9	277.0	316.0	330.2	62.1
2060	246.9	265.8	279.9	276.8	316.8	331.5	62.5
2061	246.9	266.0	279.9	276.6	317.6	332.8	62.9
2062	246.9	266.3	279.9	276.4	318.5	334.1	63.3
2063	246.9	266.6	280.0	276.2	319.3	335.5	63.7
2064	246.9	266.9	280.0	276.0	320.1	336.8	64.1
2065	246.9	267.2	280.1	276.0	321.0	337.3	64.4
2066	246.9	267.4	280.1	275.9	321.9	337.8	64.7
2067	246.9	267.7	280.2	275.9	322.7	338.2	65.0
2068	246.9	268.0	280.3	275.8	323.6	338.7	65.3
2069	246.9	268.2	280.3	275.8	324.4	339.2	65.6
2070	246.9	268.7	280.4	275.8	325.0	339.8	66.0
2071	246.9	269.1	280.4	275.7	325.6	340.3	66.3
2072	246.9	269.6	280.4	275.7	326.2	340.9	66.7
2073	246.9	270.1	280.5	275.6	326.8	341.4	67.0
2074	246.9	270.5	280.5	275.6	327.4	342.0	67.4
2075	246.9	270.9	280.6	275.6	327.9	343.0	68.0
2076	246.9	271.2	280.6	275.6	328.4	343.9	68.6
2077	246.9	271.6	280.7	275.5	329.0	344.9	69.2
2078	246.9	271.9	280.7	275.5	329.5	345.9	69.8
2079	246.9	272.3	280.7	275.5	330.0	346.9	70.4
2080	246.9	272.1	280.8	275.5	330.4	347.7	70.9
2081	246.9	271.9	280.8	275.5	330.7	348.5	71.4
2082	246.9	271.7	280.8	275.4	331.1	349.3	71.8
2083	246.9	271.5	280.9	275.4	331.4	350.2	72.3
2084	246.9	271.3	280.9	275.4	331.8	351.0	72.7
2085	246.9	272.3	280.9	275.4	332.2	351.5	73.1
2086	246.9	273.2	281.0	275.4	332.6	352.1	73.4
2087	246.9	274.1	281.0	275.4	333.0	352.6	73.8
2088	246.9	275.0	281.0	275.4	333.4	353.2	74.1
2089	246.9	276.0	281.1	275.4	333.8	353.7	74.5
2090	246.9	276.5	281.1	275.4	334.1	354.2	74.8
2091	246.9	277.0	281.1	275.3	334.4	354.6	75.1
2092	246.9	277.5	281.2	275.3	334.7	355.1	75.4
2093	246.9	278.6	281.2	275.3	335.4	356.0	76.0
2094	246.9	279.2	281.2	275.3	335.6	356.3	76.2
2095	246.9	279.9	281.3	275.3	335.9	356.7	76.4
2096	246.9	280.6	281.3	275.3	336.1	357.1	76.6
2097	246.9	281.2	281.3	275.4	336.4	357.4	76.8
2098	246.9	281.9	281.3	275.4	336.7	357.8	77.1
2099	246.9	281.9	281.3	275.4	336.7	357.8	77.1
2100	*246.9*	*282.5*	*281.3*	*275.4*	*336.9*	*358.1*	*77.2*
2101	246.9	283.1	281.4	275.4	337.2	358.4	77.4
2102	246.9	283.9	281.4	275.4	337.4	358.6	77.4
2103	246.9	284.7	281.4	275.4	337.6	358.9	77.5
2104	246.9	285.5	281.4	275.4	337.8	359.1	77.5
2105	246.9	286.4	281.5	275.4	338.0	359.4	77.5
2106	246.9	287.2	281.5	275.4	338.2	359.6	77.5
2107	246.9	288.0	281.5	275.4	338.4	359.9	77.5

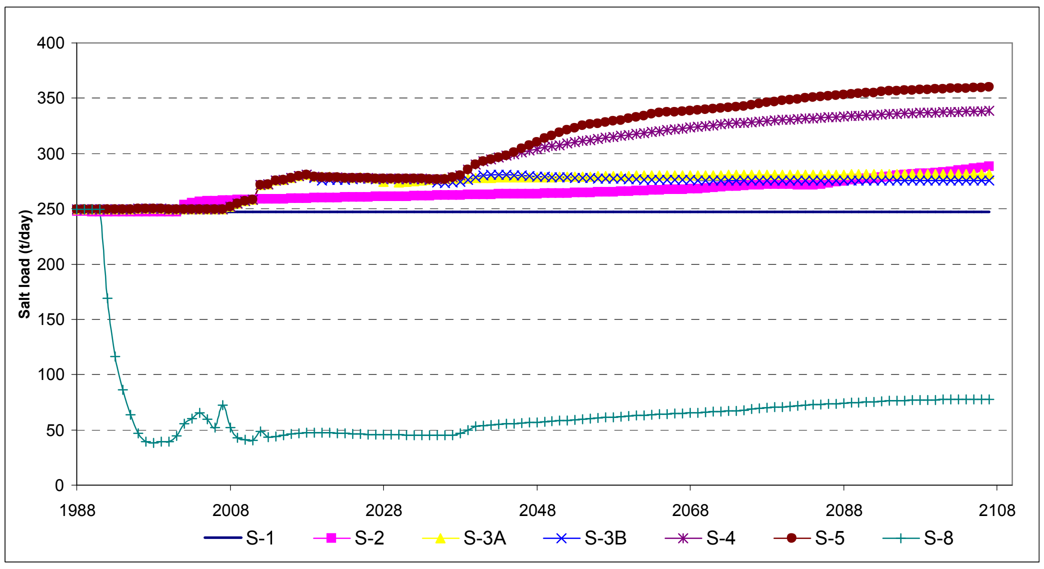
Scenario	Name	Model Run	Irrigation development area	IIP	RH	SIS
S-1	Natural system	Steady State	None	-	-	-
S-2	Mallee clearance	1920 - CY100	None (but includes Mallee clearance area)	-	-	-
S-3A	Pre-1988, no IIP, no RH	1988 – CY100	Pre-1988	No	No	-
S-3B	Pre-1988, with IIP, no RH	1988 – CY100	Pre-1988	Yes	No	-
S-3C	Pre-1988, with IIP and with RH	1988 – CY100	Pre-1988	Yes	Yes	-
S-4	Current irrigation	CY – CY100	Pre-1988 + Post-1988	Yes	Yes	No
S-5	Current plus future irrigation	CY – CY100	Pre-1988 + Post-1988 + Future development	Yes	Yes	No
S-8	current SIS with max rate of 210 L/s at woolpunda post Dec 2006	CY – CY100	Pre-1988 + Post-1988	Yes	Yes	Yes

IIP = improved irrigation practices — RH = Rehabilitation of irrigation distribution networks — SIS = Saltl interception scheme
CY = current year — CY100 = 100 yrs from the current year

Note:
- Current SIS includes actual pumping data to Dec 2006
- Future SIS rates at Woolpunda (S8 to S-8c only) is based on the average historical rates of the 1st half of the1997 calendar year (ie total rates of approx 210 L/s)
- Future SIS rates at Qualco and Waikerie are based on the last quarter of the 2003 calendar year

The tables below are designed to help MDBC choose the correct inputs to BIGMOD and show the impact of each of the individual accountable actions.

Accountable actions (t/day)	Debits				Credits	
	S2 - S1	S3A - S2	S4 - S3B	S5 - S4	S5 - S8	S3A - S4
2000	*0.0*	*2.9*	*0.0*	*0.0*	*210.6*	*0.0*
2005	9.9	-7.4	0.0	0.0	189.9	0.0
2006	10.3	-7.7	0.0	0.0	197.7	0.0
2007	10.6	-7.9	0.0	0.0	177.0	0.0
2008	10.9	-6.3	0.0	0.0	199.7	0.0
2009	11.1	-3.1	0.0	0.0	212.2	0.0
2010	11.3	-1.4	0.0	0.0	215.6	0.0
2011	11.4	-0.2	0.0	0.0	217.7	0.0
2012	11.7	12.7	0.0	0.0	222.9	0.0
2013	11.8	13.5	0.0	0.0	228.5	0.0
2014	11.9	16.6	0.0	0.0	231.2	0.0
2015	*12.1*	*17.1*	*0.0*	*0.0*	*230.9*	*0.0*
2016	12.3	18.7	0.0	0.0	231.6	0.0
2017	12.4	20.0	0.0	0.0	232.5	0.0
2018	12.6	21.3	0.0	0.0	233.2	0.0
2019	12.7	19.6	1.1	0.0	231.3	0.3
2020	12.9	19.4	2.7	0.0	231.1	0.6
2021	12.9	19.0	2.1	0.0	231.2	0.5
2022	13.2	18.6	1.9	0.0	231.3	0.4
2023	13.3	17.8	1.9	0.0	231.4	0.0
2024	13.6	17.6	1.5	0.0	231.5	0.1
2025	13.7	17.6	0.4	0.0	231.7	0.3
2026	13.9	17.0	0.4	0.0	231.7	0.1
2027	14.0	16.6	0.4	0.0	231.5	0.1
2028	14.1	13.5	0.5	0.0	231.6	-2.7
2029	14.2	16.4	0.0	0.0	232.0	0.0
2030	*14.3*	*12.5*	*0.5*	*0.0*	*231.8*	*-3.6*
2031	14.4	12.9	0.3	0.0	231.8	-3.0
2032	14.7	13.4	0.4	0.0	231.8	-2.2
2033	14.8	13.6	0.5	0.0	231.8	-1.7
2034	15.0	14.0	0.5	0.0	231.8	-1.0
2035	15.1	14.5	2.7	0.0	231.6	-0.2
2036	15.2	14.9	3.1	0.0	231.5	0.4
2050	*17.0*	*14.8*	*27.9*	*9.5*	*258.5*	*-28.0*
2100	*35.6*	*-1.1*	*61.6*	*21.2*	*280.8*	*-55.6*



Summary of predicted salt load (t/day) entering the River Murray in the Woolpunda Area

	1988	2000	2007	2050	2107
S-1	246.9	246.9	246.9	246.9	246.9
S-2	247.6	246.9	257.5	263.9	288.0
S-3A	249.6	249.8	249.6	278.6	281.5
S-3B	249.6	249.8	249.6	278.7	275.4
S-4	249.6	249.8	249.6	306.6	338.4
S-5	249.6	249.8	249.6	316.2	359.9
S-8	249.6	44.6	72.6	57.7	77.5

Register A & B accountable Debits and Credits for the Woolpunda Reach (t/day)

Annual Salt Loads for Cadell (t/day)

Time	S-1	S-2	S-3A	S-3B	S-4	S-5	S-8	S-8a	S-8b	S-8c
1988	14.2	16.4	48.7	48.7	48.7	48.7	48.7	48.7	48.7	48.7
1989	14.2	16.4	48.7	48.7	48.7	48.7	48.7	48.7	48.7	48.7
1990	14.2	16.4	48.8	48.8	48.8	48.8	48.8	48.8	48.8	48.8
1991	14.2	16.5	48.7	48.7	48.8	48.8	48.8	48.7	48.7	48.7
1992	14.2	16.6	48.5	48.5	48.5	48.5	48.5	48.6	48.6	48.6
1993	14.2	16.8	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2
1994	14.2	16.9	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5
1995	14.2	17.0	47.0	47.0	47.0	47.0	47.0	46.9	46.9	46.9
1996	14.2	17.1	46.5	46.5	46.5	46.5	46.5	46.4	46.4	46.4
1997	14.2	17.2	46.1	46.1	46.1	46.1	46.1	45.9	45.9	45.9
1998	14.2	17.3	45.7	45.7	45.7	45.7	45.7	45.5	45.5	45.5
1999	14.2	17.4	45.3	45.3	45.3	45.3	45.3	45.1	45.1	45.1
2000	14.2	17.5	44.9	44.9	44.9	44.9	44.9	44.7	44.7	44.7
2001	14.2	17.6	44.6	44.5	44.5	44.5	44.5	44.3	44.6	44.6
2002	14.2	17.6	44.4	44.0	44.0	44.0	44.0	43.8	44.1	44.0
2003	14.2	17.7	44.2	43.5	43.5	43.5	43.5	43.2	43.4	43.1
2004	14.2	17.8	44.5	43.0	43.0	43.0	43.0	42.7	42.9	42.4
2005	14.2	17.8	45.4	43.1	43.1	43.1	43.1	42.9	42.6	42.1
2006	14.2	17.9	46.3	42.6	42.6	42.6	42.6	43.1	42.2	41.6
2007	14.2	18.0	47.1	42.3	42.5	42.5	42.5	43.3	42.3	41.6
2008	14.2	18.2	47.2	42.2	42.6	42.6	41.7	43.2	42.4	41.7
2009	14.2	18.5	47.2	42.2	42.8	42.8	42.0	42.9	42.8	42.0
2010	14.2	18.6	47.3	42.2	43.0	43.0	42.2	43.0	43.1	42.2
2011	14.2	18.8	47.6	42.4	43.4	43.4	42.5	43.3	43.5	42.6
2012	14.2	18.9	47.9	42.2	43.5	43.5	42.5	43.4	43.6	42.6
2013	14.2	19.1	48.1	42.1	43.5	43.5	42.5	43.4	43.6	42.6
2014	14.2	19.2	48.4	42.0	43.5	43.5	42.5	43.5	43.6	42.6
2015	14.2	19.4	48.6	42.0	43.6	43.6	42.6	43.6	43.8	42.7
2016	14.2	19.5	48.9	42.0	43.7	43.7	42.6	43.7	43.9	42.7
2017	14.2	19.7	49.1	42.0	43.9	43.9	42.7	43.9	44.0	42.8
2018	14.2	19.8	49.3	42.1	44.0	44.0	42.8	44.0	44.1	42.9
2019	14.2	20.0	49.5	42.1	44.1	44.1	42.9	44.2	44.3	43.0
2020	14.2	20.1	49.7	42.1	44.2	44.2	42.9	44.3	44.4	43.1
2021	14.2	20.2	49.9	42.2	44.3	44.3	43.0	44.4	44.5	43.1
2022	14.2	20.3	50.1	42.2	44.5	44.5	43.1	44.6	44.7	43.2
2023	14.2	20.4	50.3	42.3	44.6	44.6	43.2	44.7	44.8	43.3
2024	14.2	20.6	50.5	42.3	44.7	44.6	43.2	44.8	44.9	43.4
2025	14.2	20.8	50.6	42.3	44.8	44.8	43.3	44.9	45.0	43.5
2026	14.2	21.0	50.8	42.3	47.1	47.0	45.4	47.2	47.3	45.7
2027	14.2	21.2	50.9	42.4	47.9	47.9	46.2	48.1	48.2	46.5
2028	14.2	21.4	51.0	42.4	48.4	48.4	46.7	48.6	48.7	47.0
2029	14.2	21.6	51.2	42.4	48.6	48.6	46.8	48.8	48.9	47.2
2030	14.2	21.8	51.3	42.4	48.5	48.5	46.7	48.7	48.7	47.0
2031	14.2	21.9	51.5	42.4	48.6	48.5	46.7	48.8	48.8	47.0
2032	14.2	22.1	51.6	42.4	48.6	48.6	46.7	48.9	48.9	47.0
2033	14.2	22.3	51.7	42.4	48.5	48.5	46.6	48.8	48.9	47.0
2034	14.2	22.5	51.9	42.4	48.6	48.5	46.6	48.8	48.9	46.9
2035	14.2	22.7	52.1	42.6	48.7	48.7	46.8	49.1	49.1	47.1
2036	14.2	22.9	52.3	42.7	49.0	49.0	46.9	49.3	49.3	47.3
2037	14.2	23.1	52.5	42.9	49.2	49.2	47.1	49.4	49.4	47.4
2038	14.2	23.3	52.7	43.0	49.4	49.6	47.7	50.2	50.1	48.1
2039	14.2	23.5	52.9	43.1	49.5	50.1	48.1	50.7	50.6	48.4
2040	14.2	23.6	53.1	43.1	49.6	50.4	48.4	51.0	50.9	48.6
2041	14.2	23.8	53.2	43.2	49.8	50.6	48.4	51.1	50.9	48.7
2042	14.2	24.0	53.3	43.2	49.9	50.7	48.5	51.1	51.0	48.9
2043	14.2	24.2	53.4	43.2	50.0	50.8	48.6	51.2	51.2	49.0
2044	14.2	24.3	53.5	43.3	50.1	50.9	48.7	51.4	51.3	49.1
2045	14.2	24.4	53.7	43.3	50.1	51.0	48.7	51.4	51.4	49.2
2046	14.2	24.5	53.8	43.3	50.2	51.1	48.7	51.4	51.4	49.2
2047	14.2	24.6	53.9	43.3	50.3	51.2	48.8	51.5	51.5	49.3
2048	14.2	24.7	54.1	43.3	50.4	51.3	48.8	51.5	51.5	49.3
2049	14.2	24.8	54.2	43.4	50.5	51.4	48.9	51.9	51.9	49.5
2050	14.2	24.9	54.3	43.4	50.6	51.6	49.0	52.0	52.1	49.6
2051	14.2	25.0	54.4	43.4	50.7	51.7	49.1	52.1	52.2	49.7
2052	14.2	25.2	54.4	43.4	50.7	51.8	49.1	52.2	52.3	49.8
2053	14.2	25.3	54.5	43.4	50.8	51.9	49.2	52.3	52.3	49.9
2054	14.2	25.5	54.5	43.4	50.9	52.1	49.3	52.4	52.5	50.0
2055	14.2	25.6	54.6	43.4	51.0	52.1	49.3	52.5	52.6	50.0
2056	14.2	25.7	54.7	43.5	51.0	52.2	49.4	52.6	52.6	50.1
2057	14.2	25.8	54.8	43.5	51.1	52.2	49.5	52.6	52.7	50.1
2058	14.2	26.0	54.9	43.5	51.2	52.3	49.5	52.7	52.8	50.2
2059	14.2	26.1	54.9	43.5	51.2	52.4	49.6	52.9	53.0	50.3
2060	14.2	26.2	55.0	43.5	51.3	52.5	49.6	52.9	53.0	50.3
2061	14.2	26.4	55.0	43.5	51.4	52.5	49.6	53.0	53.0	50.3
2062	14.2	26.6	55.0	43.5	51.4	52.6	49.6	53.0	53.0	50.3
2063	14.2	26.7	55.0	43.5	51.5	52.7	49.7	53.0	53.1	50.4
2064	14.2	26.9	55.1	43.6	51.6	52.8	49.7	53.4	53.3	50.5
2065	14.2	27.0	55.1	43.6	51.6	52.9	49.7	53.4	53.3	50.5
2066	14.2	27.1	55.2	43.6	51.7	52.9	49.7	53.4	53.4	50.6
2067	14.2	27.3	55.3	43.6	51.7	53.0	49.8	53.4	53.4	50.6
2068	14.2	27.4	55.3	43.6	51.8	53.0	49.8	53.5	53.4	50.6
2069	14.2	27.5	55.4	43.6	51.8	53.1	49.8	53.7	53.6	50.7
2070	14.2	27.7	55.5	43.6	51.9	53.1	49.8	53.7	53.6	50.7
2071	14.2	27.9	55.5	43.6	51.9	53.2	49.9	53.8	53.7	50.8
2072	14.2	28.1	55.6	43.6	52.0	53.2	49.9	53.8	53.7	50.8
2073	14.2	28.4	55.6	43.6	52.0	53.3	49.9	53.8	53.7	50.8
2074	14.2	28.6	55.7	43.6	52.0	53.3	50.0	54.1	53.9	50.9
2075	14.2	28.7	55.8	43.7	52.1	53.4	50.0	54.1	54.0	50.9
2076	14.2	28.9	55.8	43.7	52.1	53.4	50.0	54.2	54.0	51.0
2077	14.2	29.1	55.9	43.7	52.2	53.5	50.1	54.2	54.0	51.0
2078	14.2	29.3	56.0	43.7	52.2	53.5	50.1	54.2	54.0	51.0
2079	14.2	29.5	56.1	43.7	52.3	53.6	50.1	54.4	54.2	51.0
2080	14.2	29.6	56.1	43.7	52.3	53.7	50.1	54.5	54.2	51.0
2081	14.2	29.8	56.2	43.7	52.3	53.7	50.1	54.5	54.2	51.1
2082	14.2	29.9	56.2	43.7	52.4	53.8	50.2	54.5	54.2	51.1
2083	14.2	30.1	56.3	43.7	52.4	53.8	50.2	54.5	54.3	51.1
2084	14.2	30.2	56.3	43.7	52.5	53.9	50.2	54.7	54.5	51.2
2085	14.2	30.1	56.4	43.8	52.5	53.9	50.2	54.7	54.6	51.3
2086	14.2	30.1	56.4	43.8	52.5	53.9	50.2	54.7	54.6	51.3
2087	14.2	30.0	56.5	43.8	52.6	54.0	50.3	54.7	54.6	51.3
2088	14.2	30.0	56.5	43.8	52.6	54.0	50.3	54.8	54.6	51.3
2089	14.2	29.9	56.6	43.8	52.7	54.1	50.3	54.9	54.8	51.5
2090	14.2	30.0	56.7	43.8	52.7	54.1	50.3	54.9	54.8	51.5
2091	14.2	30.1	56.7	43.8	52.8	54.2	50.3	55.0	54.9	51.5
2092	14.2	30.2	56.7	43.8	52.8	54.2	50.3	55.0	54.9	51.5
2093	14.2	30.4	56.8	43.9	52.9	54.3	50.4	55.2	55.0	51.6
2094	14.2	30.6	56.9	43.9	52.9	54.3	50.4	55.2	55.1	51.6
2095	14.2	30.7	56.9	43.9	52.9	54.3	50.4	55.2	55.1	51.6
2096	14.2	30.9	56.9	43.9	53.0	54.4	50.4	55.2	55.1	51.6
2097	14.2	31.0	57.0	43.9	53.0	54.4	50.4	55.3	55.1	51.7
2098	14.2	31.2	57.0	43.9	53.1	54.4	50.4	55.3	55.1	51.7
2099	14.2	31.2	57.0	43.9	53.1	54.4	50.4	55.4	55.3	51.7
2100	14.2	31.3	57.1	44.0	53.1	54.5	50.4	55.5	55.4	51.8
2101	14.2	31.5	57.1	44.0	53.1	54.5	50.4	55.6	55.4	51.8
2102	14.2	31.6	57.2	44.0	53.2	54.6	50.4	55.6	55.4	51.8
2103	14.2	31.8	57.2	44.0	53.2	54.6	50.4	55.6	55.4	51.8
2104	14.2	31.9	57.3	44.0	53.2	54.6	50.4	55.6	55.4	51.8
2105	14.2	32.1	57.3	44.0	53.2	54.7	50.4	55.5	55.4	51.8
2106	14.2	32.2	57.4	44.1	53.3	54.7	50.4	55.5	55.4	51.8
2107	14.2	32.4	57.4	44.1	53.3	54.7	50.4	55.9	55.7	52.0

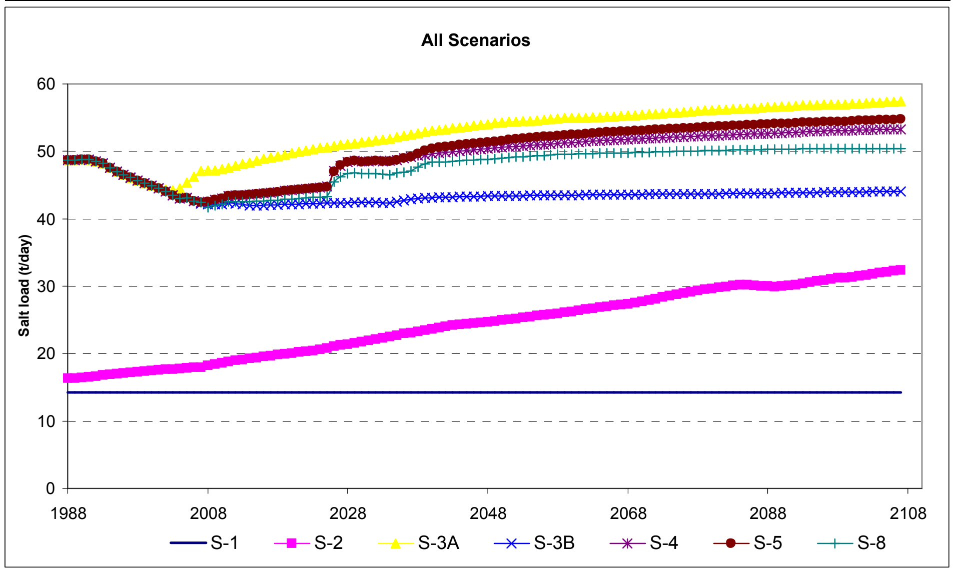
Scenario	Name	Model Run	Irrigation development area	IIP	RH	SIS
S-1	Natural system	Steady State	None	-	-	-
S-2	Mallee clearance	1920 - CY100	None (but includes Mallee clearance area)	-	-	-
S-3A	Pre-1988, no IIP, no RH	1988 – CY100	Pre-1988	No	No	-
S-3B	Pre-1988, with IIP, no RH	1988 – CY100	Pre-1988	Yes	No	-
S-3C	Pre-1988, with IIP and with RH	1988 – CY100	Pre-1988	Yes	Yes	-
S-4	Current irrigation	CY – CY100	Pre-1988 + Post-1988	Yes	Yes	No
S-5	Current plus future irrigation	CY – CY100		Yes	Yes	No
S-8	current SIS	CY – CY100		Yes	Yes	Yes
S-8a	Wool SIS only	CY – CY100	Pre-1988 + Post-1988 + Future development	Yes	Yes	Yes
S-8b	Wool + Waik 1 SIS only	CY – CY100		Yes	Yes	Yes
S-8c	Wool + Waik1 + Qualco SIS	CY – CY100		Yes	Yes	Yes

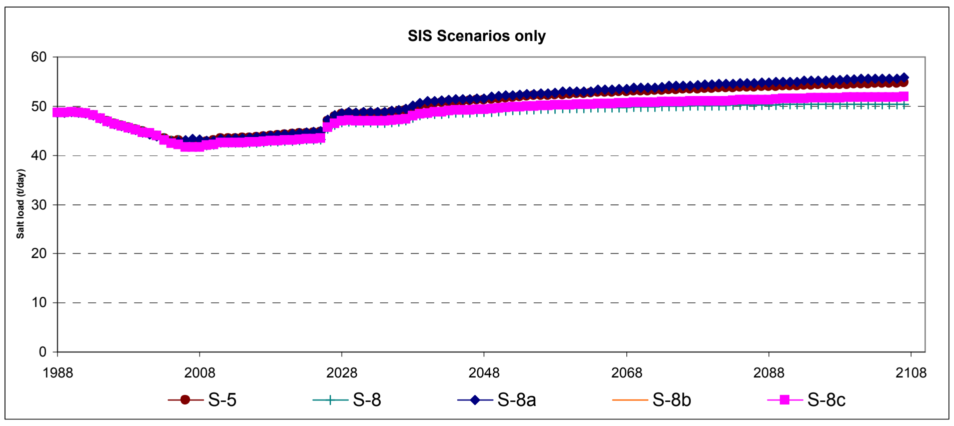
IIP = improved irrigation practices RH = Rehabilitation of irrigation distribution networks SIS = Saltl interception scheme
CY = current year CY100 = 100 yrs from the current year

Note:
- Current SIS includes actual pumping data to Dec 2006
- Future SIS rates at Woolpunda (S8 to S-8c only) is based on the average historical rates of the 1st half of the1997 calendar year (ie total rates of approx 210 L/s)
- Future SIS rates at Qualco and Waikerie are based on the last quarter of the 2003 calendar year

Accountable actions (t/day)

	Debits				Credits	
	S2 - S1	S3A - S2	S4 - S3B	S5 - S4	S5 - S8	S3A - S4
2000	3.3	27.4	0.0	0.0	0.0	0.0
2005	3.6	27.5	0.0	0.0	0.0	2.3
2006	3.7	28.4	0.0	0.0	0.0	3.6
2007	3.8	29.1	0.2	0.0	0.0	4.7
2008	4.0	29.0	0.4	0.0	0.9	4.6
2009	4.3	28.7	0.6	0.0	0.8	4.4
2010	4.4	28.7	0.8	0.0	0.8	4.3
2011	4.6	28.8	1.0	0.0	0.9	4.2
2012	4.7	28.9	1.2	0.0	1.0	4.4
2013	4.9	29.0	1.4	0.0	1.0	4.6
2014	5.0	29.1	1.5	0.0	1.0	4.8
2015	5.2	29.2	1.6	0.0	1.1	5.0
2016	5.3	29.3	1.8	0.0	1.1	5.1
2017	5.5	29.4	1.8	0.0	1.2	5.2
2018	5.6	29.5	1.9	0.0	1.2	5.3
2019	5.8	29.5	2.0	0.0	1.3	5.4
2020	5.9	29.6	2.1	0.0	1.3	5.5
2021	6.0	29.7	2.2	0.0	1.3	5.6
2022	6.1	29.8	2.2	0.0	1.4	5.7
2023	6.2	29.9	2.3	0.0	1.4	5.7
2024	6.4	29.9	2.4	0.0	1.5	5.8
2025	6.6	29.8	2.5	0.0	1.5	5.9
2026	6.8	29.8	4.7	0.0	1.6	3.7
2027	7.0	29.7	5.5	0.0	1.7	3.1
2028	7.2	29.6	6.0	0.0	1.7	2.7
2029	7.4	29.6	6.2	0.0	1.7	2.6
2030	7.6	29.6	6.1	0.0	1.8	2.9
2031	7.7	29.6	6.2	0.0	1.8	2.9
2032	7.9	29.5	6.2	0.0	1.9	3.0
2033	8.1	29.4	6.1	0.0	1.9	3.2
2034	8.3	29.3	6.2	0.0	2.0	3.3
2035	8.5	29.4	6.2	0.0	2.0	3.4
2036	8.7	29.4	6.2	0.0	2.1	3.4
2050	10.7	29.4	7.2	1.0	2.6	3.7
2100	17.1	25.7	9.2	1.4	4.1	3.9





Summary of predicted salt load (t/day) entering the River Murray in the Cadell Area

	1988	2000	2007	2050	2107
S-1	14.2	14.2	14.2	14.2	14.2
S-2	16.4	17.5	18.0	24.9	32.4
S-3A	48.7	44.9	47.1	54.3	57.4
S-3B	48.7	44.9	42.3	43.4	44.1
S-4	48.7	44.9	42.5	50.6	53.3
S-5	48.7	44.9	42.5	51.6	54.7
S-8	48.7	44.5	42.5	49.0	50.4
S-8a	48.7	44.7	43.3	52.0	55.9
S-8b	48.7	44.7	42.3	52.1	55.7
S-8c	48.7	44.7	41.6	49.6	52.0

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Register A & B accountable Debits and Credits for the Cadell Reach (t/day)

Figure A4