
MURRAY FUTURES: COORONG, LOWER LAKES &
MURRAY MOUTH RECOVERY PROJECT

2013/14 MONITORING REVIEW

July 2014



Government of South Australia
Department of Environment,
Water and Natural Resources

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INTRODUCTION

1 Purpose of Plan

This review has been prepared to support the adaptive re-profiling of the CLLMM monitoring program, with changes implemented in 2014/15. It links to the external review provided by Professor Peter Fairweather in the following ways:

- identify and secure the appropriate linkages between the high-level external review recommendations and specific actions for each agreement with CLLMM Service Providers.
- identify Team (= internal) initiatives additional and/or complementary to those recommended in the external review.
- document the rationale and outcomes of any evaluation processes for selecting improvement initiatives to adopt.
- contribute to implementation plans for those improvement initiatives selected for adoption, inclusive of managing the liaison with Service Providers.

This review documents the outcomes from a planning day review workshop on June 6, 2014.

2 Planning Day workshop

The agenda for the planning day is located at the following pathway:

<Z:\Files\Environmental Mgmt\Administration\Planning\CLLMM EIM Planning Day June 2014.doc>

In the morning session, brief presentations were provided, covering the scope, progress, issues and risks for the projects underway, which comprised:

- MA8 (Fishways);
- MA10 (SEFRP Environmental Management);
- MA12 (*Ruppia* Translocation);
- MA15 (Research), and
- MA13 (M&AM abiotic/ecological, location/frequency).

An invited presentation by Professor Peter Fairweather on the progress and interim findings of his external monitoring review was made mid-afternoon, this being bracketed by discussions of the Team Planning and Prioritisation document for monitoring activities in 2014/15. The deliberations on planning and prioritisation were not finalised during the workshop.

OBJECTIVES AND OUTPUTS

3 Overarching information to guide planning of further monitoring, investigation and reporting.

Tables 1 and 2 provide high level summaries of the types of service provider outcomes in relation to their information content/value with respect to ecological issues (Table 1) and to the Ecological Character Description requirements of the Ramsar site (Table 2). Table 1 provides a structured representation of the comments delivered by Prof. Fairweather. These tables may serve as checklists to guide a stocktake or audit of CLLMM monitoring products. Another source for potential consideration is the knowledge gap list in the ECD document, recognising that some opportunities with gaps relating to fish and birds exist.

Table 1. Types of ecological information deliverable by CLLMM monitoring, rows are ordered in increasing quality, in terms of their value to site managers.

Type	Indications or typical information summaries	Examples, comments
Single survey(s) , detailed descriptive treatments, point-in-time analyses (Phenomenological)	Graphs, tables, lists	Introspective, self-contained. Outcomes limited – owing to them not linking to site condition, management drivers and actions MANY REPORTS
Thematic, Contextual, Relative	Time series, distributions	A saline, eutrophic lagoon
Functional (what components are doing)	Hypotheses	Hardyhead present in large numbers
Process (e.g. predator/prey, shorebird feeding)	Focused Conceptual models	A range of size classes present, recapture of released fish (informing Processes of survivorship, recruitment, population dynamics)

Adaptive review	Conceptual models challenged by data and revised / updated	Water level as, or more, significant as salinity in influencing <i>Ruppia</i> dynamics.
Synthesis (Processes linking different key biotic groups, habitat vegetation, hydrological, physical and chemical properties)	Holistic Conceptual models Critical Path Models	Can demonstrate causal links

Table 2. Linkages between CLLMM monitoring and the Ecological Character Description requirements of the Ramsar site.

	Component & associated Processes	Service
CRITICAL	Fish Waterbirds <i>Ruppia</i> Salinity	Biodisparity Near natural wetlands Connectivity Biodiversity Physical habitat for Waterbird breeding Priority wetland species
Supporting	Phytoplankton Invertebrates Amphibians, reptiles, mammals	

4 Detail of Suggestions

[NOTE: In the discussions held, there was some duality of opinions expressed regarding the use of data held to answer questions that are different from those framing their collection. While this is often done, it is not viewed as best practise owing to the increased uncertainty that results. This may be particularly an issue in moving data from the sphere of Components to those of Processes or Services. Best practise is for questions to be addressed with dedicated data collection, analysis and reporting.]

The notation for the recommended actions below is **table_number.row_number**, such that the use of a dashboard for ecological monitoring is an element of Recommendation 3.9.

Table 3. Consolidation of monitoring aspects raised primarily by the CLLMM & TLM teams, inclusive of allied feedback from Prof. Fairweather.

	Aspect	Issue / comment / view	Recommended Actions
1	Phasing of services with transition to close-out	<p>Shift from data collection to trend analysis, integration and review</p> <p>As a Ramsar site, there will need to be ongoing condition monitoring, with reporting each 3 years. JH suggestion that the framework comprise a hierarchy or sliding/switching set of priorities so that monitoring is made in proportion to the investment available (such a design would also accommodate deployment of intervention monitoring as and when the dependent activities occurred). Should consider also being coordinated & complementary with non-DEWNR funded monitoring of the site</p> <p>When do we stop addressing a question?</p>	<p>Determine the timing and cost implications, Make forecasts for each of the monitoring elements</p> <p>Identify/contribute to the framework for this condition monitoring, so as to prescribe a best value approach</p> <p>Pre-state the requirements for an answer being obtained. Rather than satisfaction leading to cessation (for that component, for that provider), an evolutionary or re-framing step occurs (e.g. to</p>

			test a relationship which was hypothesised from monitoring outcomes). This approach mandates a more fluid, dynamic & active approach to project management by CLLMM staff and Service Providers.
2	Phasing of services with transition to close-out	<p>Opportunities for Community or NRM involvement could involve interactions with our service providers. Experience has been that a champion is required for success.</p> <p>Community seen as a competitor by Service Provider</p>	<p>Identify where possible opportunities exist</p> <p>Collection of digital images or water quality data by fishers</p>
3	Information mgmt. system required, as it is an agreed MA13 output	<p>Non-committed funds of \$278K secure for 14/15.</p> <p>Seek to secure additional funds in Mid Program review &, if not funded by MPR, will require redistribution of \$278K</p>	Track MPR, manage expenditure of \$278K and use an iterative approach.
4	Relevance of results to CPS of EC in a lot of reports	<p>Alignment required; monitoring launched ahead of ECD review and CPS identification</p> <p>Components are WHAT IS THERE</p> <p>Processes are WHAT COMPONENTS ARE DOING</p> <p>Contribution of monitoring to critical CPS understanding</p>	<p>Will be a factor in which past activities will continue to be supported.</p> <p>Conceptual models will allow some linkage of Component information to Processes; however, a Process focus will require different evidence & monitoring protocols, which will not require the spatial replication of the pattern detection monitoring (e.g. may rely on a few test cases).</p> <p>Environmental Analysis team to provide feedback on tracking of performance against delivery around particular CPS and future priorities. Some instantaneous suggestions below.</p>

		<p>(from PF) Specificity of monitoring question can drive changes in sampling method. Also, Processes and Services are different styles of research to Components approach, and are connected with different thinking and different data analysis and reporting.</p>	<p>Consider moving to snapshots from regular surveys.</p> <p>Advocate more attention to Processes, Service, particularly Supporting Services. Ensure reporting of monitoring reflects the Services (e.g. area of available habitat) by shifting question. Attempts to integrate Dadd and Dittman data have not had great success in this regard, with better success from Paton data (whose elements are collected contemporaneously).</p> <p>A question example: how many of species A (at a size suitable for their consumption by consumer B) are there & is this sufficient to sustain B?</p> <p>Example used was to match macroinvertebrate collection to the probing depth of foraging waders; however, this is not the way the present sampling is done</p>
5	<p>Mgmt feedback to TLM from benthic macroinvertebrate work for the Coorong</p>	<p>AR commented on value to determine effectiveness of watering when Spring/Summer pulse is released by reporting the extent of that influence upon macroinvertebrates – Sth Lagoon still not completely recovered for benthic bugs (in relation to 2004 abundance & diversity, which did not effectively move for first 2 years). A front of southward-progressing increases in abundance and yearly small increases in diversity. In providing these outcomes, the</p>	<p>Is CLMM data collected from the right locations, could they be shifted south of Villa?</p> <p>What differences come from sampling at different depths, and effect on alignment with TLM dataset? December 2013 results may confirm a data gap.</p> <p>Temporal variation in abundance – large numbers of amphipods in September. [mention made at another time of crab deaths] : are these events sufficiently captured by regular data collection?</p>

		monitoring is useful support for further watering bids.	We don't know what birds eat what benthic bugs.
6	Potential Mgmt feedback from TLM benthic macroinvertebrate work in the Coorong for SE flows	AR commented that frequency and coverage of monitoring in place is unlikely to permit assessment of SE flow increases, as one-off survey, Dec/Jan at conclusion of any pulse delivery and is condition monitoring only. Also, potential for confounding of the influence of northern and southern flows on Sth Lagoon benthic bugs.	More targeted (& before / after events) monitoring would need scheduling to address specific questions. Develop explicit hypotheses and possibly spatially focus on Salt Creek outlet location.
7	Uncertainty around transition to Basin Plan	AR anticipates 2016 transition year for water – less clarity around biota (?). Funding commitments unclear. DEWNR SMK are the key players for Basin Plan reporting of CLLMM region. Decrease in focus on ecological component, more on salt export, water quality, migratory birds, <i>Ruppia</i> waterbirds, fish, connectivity, productivity (where zooplankton may be mid level consumers of greater informative contribution). Lack of clarity within MDBA about measures & responsibility	Track Basin Plan, manage a dovetailing exercise. Assist/advise Service Providers as to their potential future funding streams & required product type
8	Current data availability to inform mgmt. of risk (in Sth Lagoon) of salinity decrease beneath 60 g/L, nutrient mobilisation – promoting	Sept- January coorong monthly WQ monitoring will involve transect & 3 sites in Sthn lagoon with wq, phytoplankton & nutrients, one of these also with zooplankton.	AR suggested aligning data collection programs so as to inform as many hypotheses as possible.

	blooms of <i>Enteromorpha</i> hampering <i>Ruppia</i> recruitment	Nov-Dec 2013 were critical for flows to assist the completion of flowering & seed set. BT - the large flow pulse from Morella Basin is in the range expected to be typical for the augmented scheme (1000 – 1500 ML/day), against present typical rate of 300 ML/day.	
9	Provide a dashboard for ecological monitoring to aid decisions on CLLMM site that functions as effectively as that for Barrage Ops	Complex interactions with Basin Plan, Icon Site & TLM. Usefulness of monthly/quarterly monitoring updates as inputs to a management-relevant information base. More readily delivered if effective data management is in place. Which ecological attributes on a dashboard & why? While it is possible to retrospectively analyse for drivers of an impact, how can forward projections be made? Perhaps include LACs or Mgmt targets for a suite of biota as dashboard components. Easy for political purposes – as they can be readily understood/assimilated by stakeholders without science background.	Upfront critical thinking required, to be in predictive space
10	Data sharing CLMM-TLM	TLM monitoring review has flagged changes for consideration, could be overlap with shared datasets. Should funding be reduced, TLM will fund Intervention monitoring prior to condition monitoring.	Seek to understand changes proposed to TLM share of joint datasets

		Reductions anticipated from TLM monitoring review. TLM Lake level management well-informed by CLLMM Sthn Bellfrog monitoring	
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In her introduction of Peter Fairweather to provide interim feedback on the progress of the external CLLMM Monitoring Review, Liz Barnett provided the Review Scope:

- Is the Program asking the right questions?
- What meaning has come from monitoring to date?
- Where and how can value be added to the Program?
- How might we assemble monitoring together to form an ecosystem-based approach?
- What should be the links between monitoring and the activities associated with revising the Ecological Character Description?
- What processes should be followed to transition or close-out current activities?

Table 4. Consolidation of monitoring aspects raised by Prof. Fairweather, inclusive of allied feedback from the CLLMM & TLM teams. Note that some aspects are “global” pitfalls of monitoring, whereas others are more centrally CLLMM matters.

	Aspect	Issue / comment / view	Recommended Actions
1	abundance and count data	<p>High uncertainty; thus limited utility.</p> <p>Reality that rarely are questions themselves quantitative.</p> <p>Can make some significant time savings by dropping.</p> <p>Good example paragraph for benchmark definition in a David Paton report for 2013, p. 21.</p>	<p>Step away from this in favour of habitat occupancy. Downplay or optimise in data collection where possible.</p> <p>E.g. by visiting more sites.</p> <p>Habitat occupancy more desirable</p>
2	<p>Much scope for “tweaking” (without dramatic changes) the approach & (more importantly) reporting from current contracts so that teams can make use of it to meet different needs & at different times.</p> <p>Reports that are internally focused</p>	<p>Whilst good overall aim, not linked to monitoring objectives as well as possible. E.g. contracts articulated too generally - as “...to monitor {whatever component provider is focussed on}...” or claim more knowledge of an important component is required.</p> <p>Management needs to be based on the learnings of monitoring.</p> <p>Good conception from specialists about what they considered to be there & what is going on, but these are very self-contained, usually limited taxonomically, sometimes habitats but does not link up to site condition, management drivers and actions.</p>	<p>Critically evaluate monitoring objectives for purpose that they discretely and clearly articulate outcomes that will be informative of the condition across all aspects of the site.</p> <p>Ask: are we asking the right set of questions to get what we require?</p> <p>Is a long term data set required to point you in the direction you need to be?</p> <p>How will we attain learning about the system (and avoid just having attained more data)?</p> <p>Obtain statements as to the suitability of the site as a habitat for each component.</p>

	<p>Contingent example: given conditions experienced in last 12 months, is this likely to be the best we can get? If not, how different from expectations, what is wrong or missing? – Bring it into the predictive space, in order to provide an evaluation, given no benchmarks or trigger values/ agreed targets for status being available, noting that where such do exist that they vary widely both among components and purposes of data collection.</p> <p>Related to this is intended SAG meeting action (comment by JH) on ecology thematic experts describing temporal and spatial changes to CLLMM region’s ecological character since 1985 based on a single set of time series of water level and salinity.</p>	<p>Stepping back to ECD components done well, but P & S not so.</p> <p>Phenomenological reports versus evaluations against expectation, or relativity of change and clarifying drivers for change – all of which provide interpretations of greater utility.</p> <p>Moving providers away from their routine approach to reporting; going a step further; delivering an applied product. Naturally/natively/habitually they do not see the need for this tier of information, but can deliver on it when challenged to do so. Give them a licence to do it, as their typical approach is to be cautious and avoid making predictions (owing to risk of prediction being found to be wrong). Can be managed by making many predictions, some of which will be correct. Having them articulate the conceptual models by taking into account the outputs from other providers. E.g. what foraging opportunities for birds given patterns of mudflat exposure? [PROCESS/LINKAGE]</p> <p>Long term data sets need to be evaluated in terms of the extent to</p>	<p>Get buy-in by Service Providers (via “nudging”) to all of the site question groups, not just those directly informed by their hypotheses. All to see & sign on to the set of questions. Promote the value and importance of this output within the service package. Lead them to see that this approach will be much more in focus in future.</p> <p>Change segmentation of reporting (by allowing all related component findings to be made available?) to make providers deliver a second stage, which is a contingent evaluation of what they have found in relation to expectations. Requires integration of information about the sites – may be dependent on when all the other information will be available. Monitoring specialists may need to prepare their summaries for the consideration of other disciplines (i.e. assumptions, caveats, and logical paths disclosed).</p> <p>Develop a series of cross-disciplinary questions. FURTHER EXAMPLES:</p> <p>Why hasn’t an assemblage reappeared?</p> <p>What are sources of colonisation, or food supply?</p> <p>Have we seen a good recruitment year?</p> <p>ANOTHER approach (JH) evaluating against the censused population list (number of taxa or functional groups) known to have inhabited or potentially inhabited an area. Can also be done against the scale of past distributions or relative abundances. An example of a benchmark of true condition. Useful for ECD or Icon site reporting. Use a presence/absence data structure rather than abundances (see Aspect 4).</p>
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		<p>which they are informing the Program (as distinct from service provider's need for understanding). Look carefully at why sites have been visited for a long time.</p>	
3	<p>Process for evaluating if providers have got the right product</p>	<p>Interviews versus contractual clauses, versus a workshop prior to contracts – good values from Rhonda B's Wine Centre workshop.</p> <p>Default mindset among providers that what they offer is what is required, rather than tailoring a product for the program. A big component of this is habit.</p> <p>TLM experience is 1/3 of providers sought out other data.</p> <p>JH suggested transformation of data into shoreline length, habitat area at time of collection (using modelled data where confidence is high)</p>	<p>Meetings, with workshops or working parties as requested may be a good avenue to proceed on, as large workshops can get bogged down or make little headway with the bigger-picture issues.</p> <p>Make data "surfaces" more widely available: get model output early, circulate salinity transect results more widely. These are better than spot measurements collected by individual providers for their analyses to detect suspected interrelationships, as they provide an integrated picture (e.g. salinity for the duration of a process such as chick fledging or larval settling).</p> <p>[this is related to anticipated rates of change – salinity may not vary daily]</p>
4	<p>Discrete predictions of intervention outcomes</p>	<p>Sometimes only anecdotal feedback at present.</p> <p>Example used of when <i>Ruppia</i> identified as the beneficiary of provisioning environmental water - to move it through a life history stage.</p>	<p>Specifically frame the anticipated responses as sets of monitoring questions to provide feedback as to the success of actions, thus making monitoring more operational in nature. Address these as snapshot assessments, collecting semi-quantitative data. Amenable to dashboard reporting.</p>

5	Representativeness	Held up as important for study design, but unproven and difficult to achieve in practise.	Review and undertake optimisation where efforts for data collected in pursuit of representativeness can be reallocated
6	Redundancy in the contributions of information from within and between components	Variation is less, correlations may be present and predictability greater than that considered by monitoring assumptions.	Review frequency of collection and levels of investment by component
7	Assumption that data needs to be collected every year	<p>Need is for sufficient frequency to capture the periodicity of the matter of interest – data need only be collected to maintain a confident track of biological processes – particularly if the process is not expected to occur annually.</p> <p>A corollary is that locations, data collection intervals and trigger levels for data collection are not arbitrarily selected; they should be grounded in some system understanding (through evidence obtained). Goal to obtain an understanding of how quickly things change and where the thresholds for shifts are.</p>	<p>Example is benthic macros for CLLMM - reduction in subsites sampled. C.F. also the framing of 3 in 5 year targets.</p> <p>Free the approach from the rigid one of a need to have regular, systematic data collection (habitually seen to be more scientific) to one of being question-driven, which is better scientific practise.</p>
8	Current activities suit higher flow regime. Changes may be required should low flow/drought conditions return	<p>Untangle questions so that links between sites and issues are mapped, which makes program changes possible during hydrological phases. Examples of question groups are: censused in dry & wet times;</p>	<p>Addressed by Research & ASS activities, Reasonable mapping for MA 13 by contract (perhaps less so for questions/issues)</p> <p>Identify alerts, triggers and break points in hydrological information (inflows, outflows, lake & lagoon levels?)</p>

		informative of dry condition impacts; tracks back to condition at 83/84 Ramsar listing & ECD. Clear questions will assist this.	[observation that this part of the discussion fell (habitually) back into the tangible entities of sites whilst acknowledging that questions are paramount]
9	Keeping conceptual models as mental pets	Missing the opportunities to challenge CMs with data to promote the learning prevents reaping of their potential and making them evolve. Move to an evidence-based approach for model development.	Find ways to encourage model development Develop and test salinity response curves for <i>R. megacarpa</i> and <i>R. tuberosa</i> .
10	Confusion of condition monitoring with investigative monitoring (to evaluate performance of management actions).	One size fits all approach, or view that increasing the intensity of a design will answer more questions. Intermingling of differently-purposed monitoring can result in the confounding of outcomes. If confounding risk can be managed, intermingling may represent a value-add to a monitoring investment.	Ensure explicit, precise purposes are in place for projects
11	Service Providers complete tables on components, addressing questions, hypotheses, objectives	Many hypotheses (recovery-based?) remain same year to year; should some higher-level questions about site condition be added as another layer?	PF found tables integral to understand Service Provider mindset Add another layer on top stating "the uses we are going to make of this for management are...."; could note the opportunities identified for birds to breed, or fish to passage. Few activities will provide a direct answer, most will contribute to an understanding of the process. This requires conceptual models, and where not available, they prevent transition from data to understanding. In the absence of CMs, some datasets can be demoted, paused or not commenced to establish the importance of management-useful outputs.

12	Being responsive to events	Potential events are fish runs, <i>Enteromorpha</i> blooms, crab deaths, <i>Ruppia</i> flowering onset, bird or fish breeding – opportunities to better characterise Processes	
13	Reports address relativity of results, contrasting with the body of experience	Self-generation of benchmarks (e.g. 13 th largest value ever recorded). Assists the predictive approach, as leads to considering prospects for the future – as in how high/low and for how long will the trend run.	Make a reporting requirement in contracts and part of new approach/phase shift discussions with Service Providers
14	Process to best transition or close-out current activities	Many programs are ripe for a stocktake More readily delivered if effective data management is in place	Undertake a hindcasting/data filtering exercise, identifying whether interpretation would be materially different if design had less spatial / temporal / taxonomic effort. Ask if, based on flow hydrographs received by site, whether differences would be detected by present sampling regime? Stocktake priorities identified by CLLMM team (are there trends? are we in consistent times?) Provide stocktake guidelines or objectives to Service Providers together with commission to perform.
15	Meta-analyses	Big picture can emerge from consideration of the many small sets of information. More readily delivered if effective data management is in place	Conduct where possible.

5 Monitoring Reports

Key monitoring results are detailed in each of the Service Providers' reports produced as deliverables of the monitoring program:

Acid sulfate soils

Baker, A.K.M. and Shand, P. 2014. An overview of changes in soil acidity in reflooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia. Prepared for: Department of Environment, Water and Natural Resources, as part of the Coorong, Lower Lakes and Murray Mouth Program.

Wetland Condition

Billows, C., Bachmann, M., Whiterod, N. and Ascah, L. 2014. Coorong, Lower Lakes and Murray Mouth (CLLMM) Wetland Condition Assessments, 2014. Report to the Department of Environment, Water and Natural Resources, Government of South Australia. NGT Consulting, Mount Gambier, South Australia.

Fish

Bice, C., Whiterod, N and Zampatti, B.P. 2013. The critical fish habitat project: Assessment of the success of reintroductions of threatened fish species in the Coorong, Lower Lakes and Murray Mouth region 2011-2014. SARDI Research Report Series No. 792.

Giatas, G and Ye, Q. [DRAFT July 2014] Diet of mulloway and Australian salmon in the Murray estuary and Coorong: Interim Report. Inland Waters and Catchment Ecology, SARDI Aquatics Sciences.

Ye, Q, Bucater, L and Short, D. 2014 Fish response to flows in the Murray Estuary and Coorong during 2013/14. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F201x/000xxx-x. SARDI Research Report Series No. xxx. 65pp.

Birds

O'Connor, J. and Rogers, D. 2013 Cryptic and colonial-nesting waterbirds in the Coorong, Lower Lakes and Murray Mouth: distribution, abundance and habitat associations. 2013 DEWNR Technical report 2014/nn.

Macroinvertebrates

Dittmann, S., Ramsdale, T., Navong, N. and McGuire, A., 2014. Benthic Macroinvertebrate Response Monitoring in the Coorong and Murray Mouth, 2013/14. Report for the Department of Environment, Water and Natural Resources, Flinders University, Adelaide.

Frogs and native rats

Mason, K. 2014. Frog Monitoring in the Coorong, Lower Lakes and Murray Mouth Region 2013/14, Department of Environment Water and Natural Resources, Murray Bridge, South Australia.

Water quality, microalgae and zooplankton

Oliver, RL, Lorenz, Z, Nielsen, DL, and Shiel, RJ 2014. Multivariate Analyses of the Microalgae, Zooplankton and Water Quality Monitoring Data from the Coorong, Lower Lakes and Murray Mouth: Analysing environmental perturbations in a connected river, lake and estuarine system. CSIRO, Land and Water Flagship, Australia.