Gippsland Lakes Task Force

BMPs for reducing phosphorus loads to the Gippsland Lakes

Report on Findings from Expert Panel

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Summary

The Gippsland Lakes Task Force aims to reduce nutrient loads to the Gippsland Lakes.

An expert panel approach has confirmed that implementation of Best Management Practices (BMPs) for activities in the Gippsland Lakes Catchment could reduce Phosphorous loads to the Lakes. Based on expert panel estimates of effectiveness and adoption rates for a range of BMPs, **the annual average Phosphorous load to the Lakes could be reduced from 329 t/yr to around 287 t/yr representing a reduction of about 13% of the current average load.**

Table S1 summarises likely reductions in Phosphorous reaching the Gippsland Lakes as the result of implementing BMPs for activities in the Gippsland Lakes Catchment.

Making reasonable allowance for uncertainties inherent in the assumptions, the average reduction could be in the range of about 8% to 20% of current average load.

These full reductions may be difficult and expensive to achieve, but there are indications that further investigations at a finer scale would reveal potential for carefully targeted BMPs to achieve high returns. For example, CSIRO[1] estimate that 70% of the Phosphorous from stream bank erosion comes from only 200 to 500 km of stream banks in the catchment.

Table S1 **Likely reductions in Phosphorous reaching the Gippsland Lakes as the result of implementing BMPs for activities in the Gippsland Lakes Catchment.**

Class of BMP	Average P load to Lakes (%)	Maximum reduction likely from BMPs at full adoption or implementation (%)	Likely extent of adoption or implementation of BMPs (%)*	P load removed at Lakes (t/y)	P load removed at Lakes: % of source	P load removed at Lakes: % of load to Lakes
Irrigated Dairy						
• On farm		70	40	18.2		
• Off farm		25	50	5.9		
Total	**20**			**24.1**	**37%**	**7.3%**
Dryland Agriculture						
• Dissolved P		5	60	2.2		
• Hillslope		50	40	5.2		
• Gully		50	30	1.2		
Total	**33**			**8.6**	**8%**	**2.6%**
Forest						
• Roads		80	10	0.2		
• Plantations		10	100	0.8		
• Other		0	0	0		
Total	**18**			**1**	**2%**	**0.3%**
Streambank	**24**	40	20	**6.3**	**8%**	**1.9%**
Point Sources	**3**	50	50	**2.3**	**25%**	**0.7%**
Other	3			0	0	0
TOTAL				**42.3**		**12.8%**

*Further adoption from existing levels

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1. INTRODUCTION

Context

This paper reports on a project that has used an expert panel approach to estimate the likely reduction in Phosphorous loads to the Gippsland Lakes that could be achieved by implementing “best management practices” (BMPs) for activities in the catchment.

The paper presents the outcomes of an expert panel workshop held on 29th August at Monash University, Clayton together with background information.

Purpose of workshop

The purpose of the workshop was to use the knowledge of the workshop participants supplemented by information provided in the background sections of this paper to develop judgements on:

- the relative importance of the various sources of phosphorous contributing to the Lakes
- the likely effectiveness of nominated BMPs at reducing nutrients reaching the Lakes
- the likely extent of adoption of nominated BMPs

Workshop attendees are listed in Appendix 1.

Structure of this paper

The next section of this report presents a summary of workshop outcomes. The background to workshop deliberations (including an earlier workshop in 2005) are presented as working papers in the attachments. A selection of relevant reports (including those referenced herein) will be available for further information at: users.monash.edu.au/~ladson/bmp until December 2006.

Gaming tool

The workshop was structured around a spreadsheet tool that was developed to allow interactive “gaming” of the likely effectiveness and adoption rates for a range of BMPs. During the workshop, each of the assumptions and options in the model was explored in turn for groups of BMPs. Outputs from this tool are summarised as Table S1.

2. WORKSHOP OUTCOMES

2.1. Sources of Phosphorous in the catchment of the Gippsland Lakes

In October 2005, based on a synthesis of available information, an earlier workshop as part of this project reached consensus on the main sources of phosphorus to the Gippsland Lakes. These sources are:

- Runoff from irrigated dairying
- Runoff from dryland agriculture
- Runoff from roads – mainly in forest areas
- Erosion of banks or sediments in rivers and creeks
- Point sources such as discharges from sewerage treatment works or industry
- Other (including urban and horticulture)

The relative and absolute loads attributable to these sources – as discussed at the workshop and with updating based on the latest CSIRO research[1] and further work by Rodger Grayson[2]– are summarised in Table 1. Note that these are loads reaching the Gippsland Lakes and may differ substantially from loads estimated at the source.

The loads in Table 1 have been adopted for use in the spreadsheet model. Absolute and relative loads can be adjusted in the model if required. There was some debate during the workshop about the choice of categories in Table 1 and the sizes of the phosphorous contributions, but sensitivity analyses during and after the workshop confirm that the overall conclusions remain robust.

Table 1: Source of Phosphorus contribution to the Gippsland Lakes (updated loads Sep 2006[2])

Source	Percentage of total load to the lakes	Approximate annual load (t/yr)
Irrigated Dairy (MID + others)	20%	65
Dryland Agriculture	33%	107
Forest (including roads and road crossings)	18%	60
Streambank erosion	24%	79
Point Sources	3%	9
Other	3%	9
Total	**100%**	**329**

2.2. BMPs available to reduce Phosphorous reaching the Lakes

Attachment 1 provides a compendium of BMPs that may be applicable to Phosphorous reduction in the Gippsland Lakes catchment.

Table 2 provides a summary of applicable BMPs classified by source as used at the workshop.

This classification was modified during the workshop and each class of BMP is then reported separately in Tables 3 to 7 to summarise workshop findings on the contribution that each group of BMPs can make to overall reduction in Phosphorous reaching the Lakes.

Table S1 (in the Summary) presents a consolidation of the likely effects of BMP implementation in the catchment.

2.3. Implementation of BMPs

Targeting of activities is crucial for effective implementation of BMPs. A common finding for BMPs was that high returns can be achieved by targeting BMPs at the “hotspots” within a particular source. For example during the workshop it was reported that:

- 50% of P from road crossings in forests come from 10% of the crossings,
- 70% of the P from streambank erosion comes from only 200 to 500 km of stream bank in the catchment.

While this report identifies likely effects of BMP adoption, and allows some judgements between classes of BMPs, an important further step in promulgating BMPs is to target them at a finer scale to the areas where they will achieve maximum return for effort.

Table 2: Classes of BMPs available to reduce phosphorus reaching the lakes (as used at the workshop).

Source	Class of BMP	Example of BMP
Irrigated Dairy (Macalister Irrigation District + other areas)	On-farm BMPs that reduce runoff from farms (and/or P concentrations in farm runoff)	• Whole farm plans • Fertiliser application • Irrigation management • Conversion to spray • Retention/reuse systems • Soil erosion control • Dairy effluent management • Buffer strips
	BMPs for reducing the volume of drainage water and/or its P concentration once the runoff has reached the channels that drain the irrigation area	• Injecting irrigation channels with drainage water • Irrigation from drains • Modifying drains to increase vegetation and retention times • Constructed wetlands
Dryland Agriculture	General dryland BMPs	• Control of soil erosion • Buffer strips • Stock exclusion from w/ways
	BMPs for managing “hot spots” that generate high P loads e.g Warragul/Moe area	• Control of soil erosion • Fertiliser application • Buffer strips
Forest (including roads and road crossings)	BMPs for managing road runoff	• Management of road-waterway crossings • Drainage to streams via grass swales • Management of trucks and truck traffic • Sediment control via improved road surfacing
	BMPs for managing forests: “Code of Forest Practice”	• Use of machinery • Cultivation practices • Erosion control • Sediment control • Harvesting practices
Stream erosion	BMPs for waterway management	• Riparian revegetation • Bed erosion control • Bank erosion control
Point Sources	BMPs for managing industrial discharges and discharges from wastewater treatment plants	• Ocean outfall • Tertiary treatment of wastewater • Land disposal of waste water

Table 3. Workshop findings on BMPs for Irrigated Dairy

Source	Class of BMP	Example of BMP	Workshop outcomes	Possible reduction in load
Irrigated Dairy (Macalister Irrigation District) **Average 65 t/yr P to Lakes**	On-farm BMPs that reduce runoff from farms (and/or P concentrations in farm runoff)	• Whole farm plans • Fertiliser application • Irrigation management • Conversion to spray • Retention/reuse systems • Soil erosion control • Dairy effluent management • Buffer strips	▪ Reuse systems and conversion to spray are the most effective BMPs. About half the MID is suitable for reuse systems and about half for conversion to spray. ▪ Dairy effluent contributes 4% to 10% of the total P load from the MID. Management of dairy effluent can be considered a regulatory issue rather than a BMP **Effectiveness** ▪ Reuse and conversion to spray can reduce runoff volumes, and therefore loads, from farms by 60% to 80%. ▪ To maximise the reduction of P loads, reuse systems should be operated so they are left empty at the end of an irrigation to maximise the chance of catching runoff caused by rainfall. Many existing reuse systems are not operated in this way. ▪ The effectiveness of reuse systems is increased if 40% or more of the supply catchment can be watered with the captured water. Many existing reuse systems are not designed to command such a large area. **Adoption** ▪ The BMPs (reuse systems and spray conversion) have only been implemented on about 10% of the MID despite incentives and extension effort over the last 7 years so adoption has been slow (reuse about 4000 ha and spray conversion about 2000 ha). ▪ Reuse systems in future expected to be implemented on 2000 ha per year and conversion to spray on 200 ha per year. ▪ Current incentives for reuse systems provide about 42% of the total cost. For conversion to spray the incentive is about 12% of total cost	At 70% effectiveness and 40% adoption, **18.2 t/y** of P will no longer reach the Lakes. This represents a 28% reduction in P from the MID and a 5.5% reduction in overall P to the Lakes. Effectiveness and rates of adoption can be influenced by: ▪ Changes in water availability ▪ Changes in Industry outlook ▪ Price of water ▪ Fuel and power prices ▪ Incentives for adoption • Regulatory regime • Generational change • Technological change.

Table 3. Workshop findings on BMPs for Irrigated Dairy (cont)

Source	Class of BMP	Example of BMP	Workshop outcomes	Possible reduction in load
Irrigated Dairy (Macalister Irrigation District) (continued) **Average 65 t/yr P to Lakes**	BMPs for reducing the volume of drainage water and/or its P concentration once the runoff has reached the channels that drain the irrigation area	• Injecting irrigation channels with drainage water • Irrigation from drains • Modifying drains to increase vegetation and retention times • Constructed wetlands	**Drain diversion and channel injection** ▪ Unlikely to be effective BMPs for reducing P export in the long term. ▪ Unreliability of supply and concerns about water borne contaminants makes them both unsuitable for wide or communal adoption. ▪ These options will become less effective as Total Channel Control (TCC) and the adoption of spray and reuse systems on farms reduces flows.	Further reductions unlikely
			"End of drain" wetlands and "natural" drain treatments ▪ Wetlands and drain treatments strip nutrients by increasing detention times and providing longer contact times with vegetation. ▪ "Natural" drain treatments may reduce the effectiveness of the system for drainage. ▪ Wetlands and drain treatments have the advantage that they strip nutrients from drainage water (almost) regardless of source. However there was a general preference to remove nutrients closer to the source whever possible. ▪ **Effectiveness**. Modelling of a combination of "end of drain" wetlands and "natural" drain treatments (based on current flow regimes) suggests that they may be effective in removing about 30% of residual P from the drainage water. ▪ **Adoption**. Around half the MID drains are candidates for wetlands and/or drain treatment. ▪ Wetlands and drain treatments are likely to be effective in reducing loads and are worth pursuing. However uncertainties remain about perormance as: 1. Modelling was based on urban wetlands 2. Flows and incoming P loads will decrease through adoption of TCC, reuse and conversion to spray 3. Salinity will increases as groundwater inflows become a higher proportion of drain flows	Concern about long term performance lead the workshop to adopt a 25% reduction in nutrient export applying on 50% of the drains. This reduction only applies to the residual Phosphorous in drain water after the on-farm measures. On this basis, a reduction of **5.9 t/y** is possible representing a further 9% reduction in load from the MID and a 1.8% reduction in load to the Lakes.

Table 4 Workshop findings on BMPs for Dryland Agriculture

Source	Class of BMP	Example of BMP	Workshop outcomes	Possible reduction in load
Dryland Agriculture **Average 107 t/yr P to Lakes**	BMPs for managing dissolved P sources	• Timing of fertiliser application • Stock access to waterways	• South west of the catchment near Moe is identified as a significant source of dissolved P • **Effectiveness**. There are few BMPs that are effective in reducing dissolved P export. Only a 5% reduction in P is expected from these BMPs • **Adoption**. Uptake of these BMPs is already occurring.	Effectiveness is limited by availability of BMPs. P to the Lakes can be reduced by **2.2 t/y** or 0.7% of total load.
	BMPs for managing hillslope	• Improved ground cover • Riparian buffer strips • Post wildfire management	• Significant sources include upper Mitchell and Tambo catchments particularly since wildfire. • **Effectiveness**. Maintenance of adequate groundcover is an effective BMP. Riparian buffer zones are also effective where appropriate. A 50% reduction in P export could be expected from areas where BMPs are fully implemented. • **Adoption**. Adoption rates are constrained by existing land use. • Immediate effects of wildfire are difficult to mitigate.	If 40% adoption could be achieved this would reduce P at the Lakes by **5.2 t/y** or 1.6% of total load.
	BMPs for managing gully sources (mainly mid catchment and upper Tambo)	• Structural works • Stock exclusion • Revegetation	• BMPs are generally very effective at reducing P generation. • Major episodes of gullying are diminishing in number and magnitude and are now only a minor source of P. • **Effectiveness**. Targeted application of BMPs is effective. A 50% reduction in P can be expected. • **Adoption**. Not all gullies are suitable for treatment. 30% adoption is assumed.	If 30% of remaining gullies were treated, there would be **1.2 t/y** less P at the Lakes (0.4% of total load)

Table 5 Workshop findings on BMPs for Forestry

Source	Class of BMP	Example of BMP	Workshop outcomes	Possible reduction in load
Forest (including roads and road crossings) **Average 60 t/yr P to Lakes**	BMPs for managing runoff from forestry roads	• Redistribution of concentrated flows • Drainage to streams via overland flow • Management of trucks and truck traffic • Improved road surfacing	▪ Only 1% to 4% of the P from forests comes from road crossings, but it's still important because other P sources in the forest are diffuse. ▪ About 10% of crossings contribute about 50% of the P ▪ Existing road crossings can be retrofitted to substantially reduce P loads at a cost of $1500 to $2000 per crossing. New crossings can be designed to reduce P loads at minimal extra cost. ▪ **Effectiveness**. Treatment of drainage at road crossings can reduce P entering the stream system by 80%. ▪ **Adoption**. Treatment can only realistically be achieved at around 10% of crossings. ▪ Managing the location or roads during fire fighting could reduce erosion and P loads but this would be difficult to implement. Management of road crossings following the 2003 fires has generally been good	The net reduction is estimated at **0.2 t/yr** P at the lakes (0.1%)
	BMPs for plantation forestry	• Minimising disturbance within drainage lines • Riparian buffer zones • Contour planting	▪ Conversion of agricultural land to plantation will lead to overall reduction in P export to Lakes. ▪ Plantation forestry does not have the same requirements for e.g. riparian buffers as non-plantation forestry. BMPs for minimising stream disturbance and for riparian buffers would reduce elevated P discharges during harvest. Average effect on P loads likely to be small because harvest is infrequent. ▪ **Effectiveness**. Reduction in total P export from plantations by implementing BMPs is only expected to be about 10% ▪ **Adoption**. Regulations and/or code of practice could achieve near 100% adoption in plantations	BMPs could account for a **0.8 t/yr** reduction in P at the Lakes or 0.2%.of total load. Conversion of agricultural land to plantations is not considered in the ambit of BMPs and no estimate was made of possible P reduction.
	BMPs for managing forests: "Code of Forest Practice"	• Erosion control • Sediment control • Buffer zones	▪ There is little that can be done to reduce P loads from forests because only a small proportion of the P load can be managed ▪ Control burns that damage riparian vegetation may increase P loads, but may help reduce risk of larger fires and their impacts.	No further reduction in load from forests is expected from BMPs.

Table 6 Workshop findings on BMPs for Streambank Erosion

Source	Class of BMP	Example of BMP	Workshop outcomes	Possible reduction in load
Streambank erosion **Average 79 t/yr P to Lakes**	BMPs for waterway management	• Stock exclusion • Riparian revegetation • Structural erosion control work	▪ Streambank erosion is a significant source of P to the lakes. ▪ 'Hot spots' of erosion contribute most of the P (perhaps 200 to 500 km of stream bank throughout the whole Lakes catchment may contribute 70% of the P load from this source). ▪ 'Hot spots' have been identified by CSIRO modelling – they are widely spread throughout the catchment. Ground truthing is required. ▪ **Effectiveness**. BMPs can reduce P loads from eroding banks by at least 40%. ▪ **Adoption**. Some erosion is in upland areas where treatment is problematic. Also allowing for the likely temporal variability in erosion, it is expected that only 20% of bank sources will be treated although this could be increased by effective targeting of resources.	Treatments can reduce P from this source by **6.3 t/yr.** This represents 1.9% of the total load.

Table 7 Workshop findings on BMPs for Point Sources

Source	Class of BMP	Example of BMP	Workshop outcomes	Possible reduction in load
Point Sources **Average 9 t/yr P to Lakes**	BMPs for managing industrial discharges and discharges from wastewater treatment plants	• Tertiary treatment of wastewater • Land disposal of waste water	• Reductions in point sources has been a major success of the Gippsland Lakes nutrient reduction program to date but there was some discussion about whether it should be treated as a BMP or a regulatory issue. • It is likely that the easy gains have already been made. Further work is required to investigate the cost and feasibility of any additional point source reductions but further easy gains are unlikely • There are uncertainties about the extent that the remaining point sources can be reduced • Some contributions of existing point sources may be overstated because only the total P output has been considered rather than the additional P. That is, point source should be the difference between the P output and the P input into the industrial process/waste water treatment plant rather than just the P output.	In the absence of further knowledge the workshop considered a reasonable estimate to be a 50% reduction from 50% of remaining sources. This provides a reduction at the Lakes of **2.5 t/yr** or 0.7% of total load.

Appendix 1 – Workshop attendees

Chris Barry	Gippsland Coastal Board
Jane Branson	URS Pty Ltd
Paul Byrnes	Southern Rural Water
Peter Cottingham	
Jodie Halliwell	East and West Gippsland CMA
Barry Hart	Monash University
Anna Kelliher	Rendell McGuckian
Tony Ladson	Monash University
Gavan Lamb	DPI, Maffra
David Nash	DPI, Ellinbank
Gary Sheridan	University of Melbourne
Ken Slee	DPI, Maffra
John Tilleard	Moroka Pty Ltd
Scott Wilkinson	CSIRO