A COST/BENEFIT ANALYSIS OF CLEARING PONDED AREAS OF WATER STORAGES FOR CONTROL OF FLOATING AQUATIC WEEDS

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Summary. A study was undertaken to quantify some of the cost/benefits of clearing the ponded areas of water storages for improved control of floating aquatic weeds, in order to make a decision whether or not to clear the Bucca and Gaynadah Weirs in south-east Queensland. The costs of clearing and weed control were quantified for a number of water storages in south-east Queensland. Secondary costs and benefits were investigated and are also discussed. It was concluded that under expected average conditions (i.e. high level of biological but some chemical control of floating weeds) annual savings on weed control (primary benefit) as a result of total clearing would outweigh or balance the annual capital cost of clearing (primary cost). In addition, clearing also produces the secondary benefits of improved operations and maintenance, recreational usability, appearance, water quality and multiple use potential. As such, it was concluded that clearing produced a net benefit. As a result of these findings a recommendation was made to the Commissioner of Water Resources that the ponded areas of Bucca and Gayndah Weirs be totally cleared.

INTRODUCTION

The introduced floating aquatic weeds salvinia, *Salvinia molesta*, water hyacinth, *Eichhornia crassipes*, and water lettuce, *Pistia stratiotes*, have been major problems on watercourses and storages in the Burnett region of south-east Queensland.

Previous observations have shown that where vegetation is cleared from the ponded areas of storages prior to their construction, control of floating quatic weeds is significantly more effective and less expensive than on storages where vegetation has not been cleared. To investigate these observations in greater depth, to quantify some of the cost/benefits of clearing, and to allow an informed decision to be made on whether or not to clear the ponded areas of two weirs (Bucca and Gayndah) under construction in the Burnett region in 1986, a study was completed on the cost/benefits of clearing timber from the ponded area of storages. This paper reports the findings of the study.

METHODS

To establish a benchmark from which to work, the actual costs of clearing and weed control were collated for four existing storages in the Burnett region. Using these costs, projections were made of what it would have cost to clear the two existing storages which had not been cleared, and of the annual costs of weed control with and without clearing. The cost of clearing, and annual costs of weed control with and without clearing were then estimated for Bucca and Gayndah Weirs. All cost projections were based on actual chemical weed control and clearing costs in relation to surface area of the storage, with consideration given to differences between storages in the types and densities of vegetation and the floating quatic weed population present.

As salvinia is the major floating aquatic weed problem in the Burnett region and the biological control agent, *Cyrtobagous salviniae*, was being introduced into the region at the time, cost projections were made for two situations; firstly, where there was no biological control of the salvinia, and secondly,

where there was total biological control.

The cost/benefits of clearing other than the primary cost of clearing and the primary benefit of improved aquatic weed control were investigated and listed. Quantification of these secondary benefits was beyond the means of this study. All data were analysed, and a recommendation for action was made.

RESULTS AND DISCUSSION

Primary cost/benefits. The results of the analyses of clearing and weed control costs are presented in Tables 1 and 2. All costs are shown in 1985/86 dollar values. The annual captial cost of clearing was calculated at 10%, representing the current interest rate on state debt for 40 years, the expected life of the weir. Proposals were being considered for either selective or total clearing. As such, costs were calculated for both. The weed control costs are primarily for herbicide spraying of salvinia, and to a lesser extent water hyacinth, which is not controlled adequately by biological means. Water lettuce is almost entirely biologically controlled. Floating aquatic weeds were not present in the ponded area of Gayndah Weir at the time of the study. However, they are established in nearby areas and are quite likely to enter the ponded area at some stage. As such, cost data for Gayndah Weir are presented for both where weeds are present and not present.

The primary cost of clearing is the expenditure on the clearing operation. The primary benefit is in improved standards and reduced costs of floating aquatic weed control. These benefits can be attributed to a number of factors. Firstly, because floating weeds are not trapped by dead uncleared vegetation they are readily flushed out during high flows in the watercourse. Secondly, because there is no vegetation to restrict boat access or trap weeds, herbicide spraying operations are much more rapid, more effective and use less herbicide. Consequently, labour, machinery and chemical costs are reduced. Thirdly, as a result of better flushing out and more effective herbicide spraying the number of floating weeds surviving is greatly reduced and, therefore, infestations are slower to build to a problem level. This means that herbicide spraying operations are needed less often and are completed with less herbicide, machinery, and labour.

The figures underlined in Table 1 show actual weed control and clearing costs on the storages which were in service at the time of the study. The comparison of weed control costs on a surface area basis shows that, in the absence of biological control of salvinia, total clearing results in an 84 to 88% reduction in costs. The weed control costs for the Burnett barrage show that selective or partial clearing reduces costs by approximately 50%.

The remainder of Table 1 shows projected costs for weed control and clearing under circumstances where there is no biological control of salvinia. This was the situation on the Kolan and Burnett barrages at the time of the study. It represents the situation which would occur if the weevil failed to establish successfully and control salvinia. It also gives some indication of the level of costs during the period 1-3 years from the time of introduction of the weevil to the time it gains control.

Table 1 shows that in the absence of biological control of salvinia, clearing (particularly total clearing) results in large savings in weed control costs over annual capital costs of clearing (i.e. a net benefit).
Table 2 shows weed control costs in an ideal situation. Cost estimates are based on the assumption that salvinia is being totally controlled by the weevil (with no chemical control whatsoever), and that some chemical control

of water hyacinth only is necessary. Under these conditions, clearing also results in a saving in weed control costs. However, the saving is smaller than where there is no biological control of salvinia and there is generally a small net cost as a result of clearing.

This ideal situation does not account for increased costs due to seasonal upsurges in growth of salvinia, hyacinth, or water lettuce, nor the continuing costs of chemical control of salvinia which usually occur during the introduction and establishement of the weevil, or which would be incurred if the weevil were to fail to establish or gain control. The estimates in Table 2 do no allow for the possiblility that the use of 2,4-D for hyacinth control may have to be discontinued as a result of public pressure, resulting in the need to resort to more expensive control measures.

The real situation which is expected to occur on storages in the Burnett Region should lie somewhere between those represented in Tables 1 and 2.

Secondary cost/benefits.

Costs. The only possible secondary cost of clearing which could be identified was the potential for increased soil erosion and siltation. However, in the experience of the Queensland Water Resources Commission no such problems have been encountered.

Benefits. Total clearing prior to construction has the following secondary benefits:

1. Operations and maintenance. Clearing allows good access to the storage by land and free movement on the storage by boat for general operations and maintenance. Uncleared timber in the water restricts boat access, traps weeds, and dies and rots off at or near water level leaving dangerous hazards to boats. In addition, timber debris present a hazard to pumps and valves and to the fabric inflatable dams which are to be fitted to Bucca and Gayndah Weirs at some stage.

2. Recreational use and aesthetic value. Cleared storages provide an attractive and readily usable recreational resource whereas uncleared timber restricts access to and movement on storages, and presents a hazard to swimmers, boats and water skiers. Gayndah Weir, if cleared, would be a very valuable and attractive recreational resource in an area with limited facilities.

   In addition, aesthetic quality of the storage environment is enhanced by clearing. With clearing, the filled storage more closely resembles the original stream environment it replaces.

3. Water quality. In uncleared storages, rotting vegetation and the great quanitities of floating weeds lead to reduced water quality. This affects the aquatic environment and use of the water for irrigation, stock and domestic purposes. Clearing of vegetation greatly reduces this problem.

4. Multiple use potential. The high capital costs of construction of instream storages and the consequent modification of the environment are more acceptable and produce more benefits for the community if the storage satisfies multiple uses rather than a single use such as irrigation. Total clearing before construction, which represents only a small fraction (around 0.5 to 2.5%) of total construction costs, is a cost effective means of providing an attractive storage with multiple use potential.

Table 1. Actual (underlined) and projected costs ($'000s) of clearing and weed control for six water storages in south-east Queensland in the absence of biological control of salvinia

Storage	Surface area (ha)	Capital cost clearing	Annual capital cost of clearing (10% for 40 yrs)	Annual cost of weed control with clearing	Annual cost of weed control without clearing	Annual savings on weed control costs as a result of clearing	Difference between annual savings on weed control costs and annual capital cost of clearing (net primary benefit)
Tinana	110	77.4[t]	7.9	6.0	36.0	30.0[t]	+22.1[t]
Mary	285	200.6[t]	20.5	11.5[t]	90.0	78.5[t]	+58.0[t]
Kolan	219	154.0[t]	15.7	10.0[t]	*55.0*	45.0[t]	+29.3[t]
Burnett	734	33.4[s]	3.4	22.0[s]	43.0*	21.0[s]	+17.6[s]
Bucca	300	80.0[s]	8.2	42.0[s]	80.0	38.0[s]	+29.8[s]
		200.0[t]	20.5	12.0[t]		68.0[t]	+47.5[t]
Gayndah	375	40.0[s]	4.1	34.0[s i]	60.0[i]	26.0[s i]	+21.9[s i]
		70.0[t]	7.2	13.0[t i]		47.0[t i]	+39.8[t i]
				2.0#[n]	2.0#[n]		- 4.1[s n]
							- 7.2[t n]

Table 2. Actual (underlined) and project costs ($'000s) of clearing and weed control for six water storages in south-east Queensland with total biological control of salvinia

Storage	Surface area (ha)	Capital cost clearing	Annual capital cost of clearing (10% for 40 yrs)	Annual cost of weed control With clearing	Annual cost of weed control Without clearing	Annual savings on weed control costs as a result of clearing	Difference between annual savings on weed control costs and annual capital cost of clearing (net primary benefit)
Tinana	110	77.4[t]	7.9	1.4[t]	9.8	8.4[t]	+ 0.5[t]
Mary	285	200.6[t]	20.5	2.0[t]	14.0	12.0[t]	- 8.5[t]
Kolan	219	154.0[t]	15.7	2.0[t]	14.0	12.0[t]	- 3.7[t]
Burnett	734	33.4[s]	3.4	4.0[s]	16.0	12.0[s]	- 8.6[s]
Bucca	300	200.0[t]	20.5	2.4[t]	16.8	14.4[t]	- 6.1
Gayndah	375	70.0[t]	7.2	3.0[t i]	21.0[i]	18.0[t i]	+10.8[t i]
				2.0[t n #]	2.0[n #]		- 7.2[t n]

[n] = costs if not infested with floating weeds
[s] = selective clearing (i.e. removal of all scrubby vegetation and thinning of large trees within the ponded area)
[t] = total clearing (i.e. removal of all vegetation from within the ponded area)
[i] = costs if infested with floating weeds
[#] = cost of regular inspections necessary to prevent major floating weed outbreaks
[*] = cost during first two years of operation, prior to selective clearing