



ARCHWAY GROUP

NUTRIENT CONTAINMENT

Archway Group Weeping Wall System Cost Benefit Analysis

Archway Weeping Wall Definition:

A Passive, non-mechanical solids separation system made from concrete with a warranty of 20 years.



Independently researched by:

Dr Debbie Care

PhD, MSc 1st class hons, Member of the NZIPIM

AgVice Ltd has been offering independent advice in the on farm environmental space since it was formed in 2009. Dr Debbie Care is a managing director of AgVice Ltd, with previous experience including 5 years at DairyNZ where she was developing solutions for farmers and the dairy industry on sustainable effluent management practices, and 25 years at AgResearch as a scientist – she is able to take an independent and analytical approach to your Farm Dairy Effluent (FDE) system. She has completed the Intermediate & Advanced Sustainable Nutrient Management (currently in the accreditation programme), FDE design and FDE hydraulics courses. Debbie was on the technical panel that developed the Effluent Industry Code of Practice (CoP) for FDE system design. She currently chairs the accreditation review panel for companies wishing to become accredited designers against the CoP and was a key contributor in the development of the WoF programme with DairyNZ (and currently teaches the training course for people wishing to become certified WoF assessors).

AgVice offers risk assessment of the whole FDE system and components. Our independence and ability to integrate the farm system, people management and technical assessment are key to the value we can add to your farming enterprise.

Peer reviewed by:



Andy Johnson, OPUS

Andy Johnson (CPEng) Senior Environmental Engineer Opus International Consultants Ltd

Objective of undertaking a Cost Benefit Analysis:

Matt and Amanda Hodgson of Archway Group commissioned Dr Debbie Care of AgVice LTD and Andy Johnson of OPUS to undertake a cost benefit review of the solids separation systems in the market place and to provide unbiased feedback around the economics of running the different systems in comparison with the Archway Weeping Wall System.

Summary:

In summary the overall findings are as followed:

1. On an annual basis the Archway Weeping Wall has 60-70% lower operating costs than the Mechanical System and the Pond only System.
2. After only 4 years the Archway Weeping Wall System becomes more cost effective than the other two systems.
3. The Archway Weeping Wall system has a warranty for 20 Years, and a concrete Warranty for 50 years.

Average Cost of Capital Expenditure – competed installation

- Archway Weeping Wall System \$ 159,501
- Mechanical Solids Separation System \$ 192,607
- Pond Only System \$ 109,400

Average Annual Operating Costs

- Archway Weeping Wall System \$ 15,644.54 per annum
- Mechanical Solids Separation System \$ 52,267.08 per annum
- Pond Only System \$ 38,270.38 per annum

In the first 5 years of operation your system will cost the following:

Archway Weeping Wall System:

Capital Cost	\$ 159,501
Operating Cost 5 years	\$ 78,222.70
Total	\$ 237,723.70

Mechanical Solids Separation System:

Capital Cost	\$ 192,607.66
Operating Cost 5 years	\$ 261,335.40
Total	\$ 459,643.06

Pond Only System:

Capital Cost	\$ 109,400
Operating Cost 5 years	\$ 191,351.90
Total	\$ 300,751.90

SCENARIO

The scenario farm is based in the King Country. It is a 500 cow operation on twice a day milking and has a feed pad. It milks for 300 days a year, and has a range of soil types on farm. The effluent area is a mixture of high and low risk, but is dominated by the high risk areas. The feed pad is used all year and is not diverted at all. The yard is not diverted but the shed roof is. Green water recycling is to be used on the feed pad. New storage of approx. 3000m³ working volume is to be installed. In the pond only version it is assumed the feed pad will be washed with clean water at the rate of 50m³ /day so the pond needs to be larger.

Effluent volume is 15333m³ annually and approx. 50 m³ of effluent and wash down water generated each day of the milking season, which means that there is another 15000m³ that must be processed through the separators adding to total cost and wear and tear.

Figures used in the cost benefit are a mix of farmer feedback and direct quotes from suppliers. Where there has been a range of values an “average” or median value has been used (and range given where appropriate).

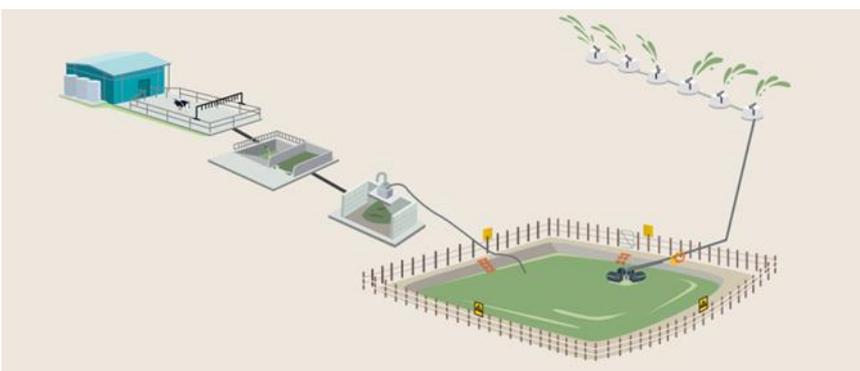
The diagrams below give a visual representation of the scenarios tested. They have been adapted from DairyNZ publications.

ARCHWAY WEeping WALL SYSTEM



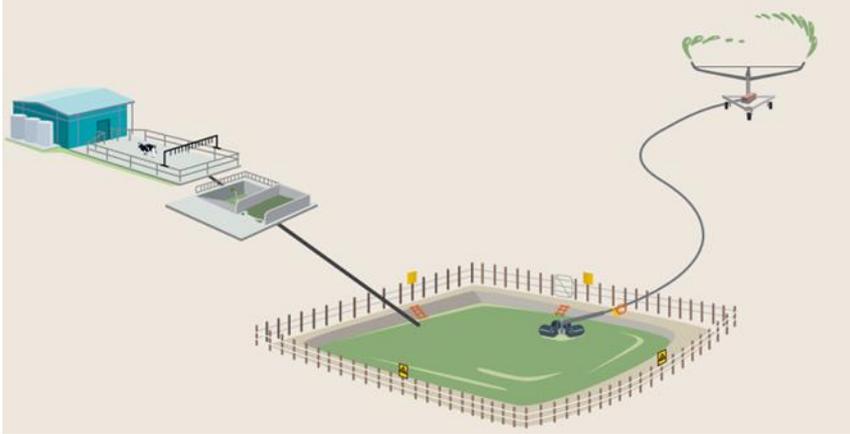
The effluent flows from the shed and is then gravity feed to a passive separator where the solids are removed. The liquid flows by gravity to storage and irrigated to land.

MECHANICAL SOLIDS SEPARATION SYSTEM



The effluent flows from the shed, through a stone trap to a mixing sump and is then pumped to a mechanical separator where the solids are removed. The liquid flows by gravity to storage and irrigated to land.

POND ONLY SYSTEM



The effluent flows from the shed straight to a sump. The liquid flows by gravity to storage and irrigated to land.



ARCHWAY WEEPING WALL CAPITAL EXPENDITURE:

<u>Gravity Fed Weeping Wall</u>	\$	<u>Weeping Wall with Sump</u>	\$	Depreciation (%)	
Capital Cost:		Capital Cost:			
Weeping Wall 42m x 12.3m (2 bunkers) with stainless panels and posts	\$ 93,550.96	Weeping Wall 42m x 12.3m (2 bunkers) with stainless panels and posts	\$ 93,550.96	4	\$ 3,742.04
		Sump	\$ 8,400.00	4	\$ 1,092.00
		Pump	\$ 2,500.00	20	\$ 100.00
Transport/freight	\$ 4,000.00	Transport/freight	\$ 4,000.00		
Pond Cost with no stirrer needed,	\$ 51,500.00	Pond Cost with no stirrer needed, but including pump	\$ 51,500.00	5	\$ 2,060.00
Pump on pond	\$ 5,000.00		\$ 5,000.00	20	\$ 200.00
*allowing for 1000m ³ of emergency storage if needed		*allowing for 1000m ³ of emergency storage if needed			
	\$ 154,051		\$ 164,951		

Please note: A Weeping Wall that requires a sump, is for a system that has no fall. The sump collects the liquid and then a pump is required to pump effluent up into a pond.

ARCHWAY WEEPING WALL ANNUAL OPERATING EXPENDITURE:

<u>Gravity Fed Weeping Wall</u>	\$	<u>Weeping Wall with Sump</u>	\$
Annual Operating Cost		Annual Operating Cost	
Power	NA	Power (Submersible pump)	\$ 863.00
Labour (if watched for total run time)	\$ 3,000.00	Labour (if watched for total run time)	\$ 3,150.00
(if watched and slats cleaned half an our a day)	\$ 600.00	(if watched and slats cleaned half an our a day, pump checked)	\$ 630.00
		Repairs (estimates after various discussions)	\$ 350.00
Maintainance	NA	Maintainance	\$ 400.00
Pump on pond R & M	\$ 350.00	Pump on pond R & M	\$ 350.00
Empty Cost	\$ 2,000.00	Empty Cost	\$ 2,000.00
Spreading Cost	\$ 2,400.00	Spreading Cost	\$ 2,400.00
Depreciation	\$ 5,802.04	Depreciation	\$ 6,994.04
Total annual operating costs	\$ 14,152.04	Total annual operating costs	\$ 17,137.04

ARCHWAY WEeping WALL SYSTEM COMMENTS:

- 20 Year warranty
- Minimal labour
- No moving parts
- No stone traps
- Captured nutrient value in solids
- Lower application rates possible due to the removal of solids
- Increased rainwater catchment due to large surface areas
- Less irrigator blockages due to minimal solid content
- Reuse of green water for washdown – Variation 6 (Variation 6 applies to WRC only)
- Very low chance of system failure in weather events due to storable volume and no pumps

	<u>Gravity Fed Weeping Wall</u>	<u>Weeping Wall with Sump</u>
Cost	low	low to medium
Solids consistency	Moist solids	Moist solids
Power consumption	nil	low
Ideal environment	dairy & feedpad	dairy & feedpad
Maintenance	low	low
Power for recycled green wash	low	low
Water consumption	nil	nil
Warranty (years)	20	20

The effluent flows from the shed and is then gravity feed to a passive separator where the solids are removed. The liquid flows by gravity to storage from where it is irrigated to land.



MECHANICAL SOLIDS SEPARATION SYSTEM CAPITAL EXPENDITURE:

<u>Capital Cost:</u>	<u>Slope Screen</u>	<u>Rotary Drum</u>	<u>Screw Press</u>				
				%	Slope Screen	Rotary Drum	Screw Press
Stone Trap and Tailings Bunker 4m x 8m	\$ 15,000.00	\$ 15,000.00	\$ 15,000.00	5	\$ 750.00	\$ 750.00	\$ 750.00
Separator	\$ 37,000.00	\$ 39,000.00	\$ 42,000.00	13	\$ 4,810.00	\$ 5,070.00	\$ 5,460.00
Mixing Sump 200m ³	\$ 48,000.00	\$ 48,000.00	\$ 48,000.00	5	\$ 2,400.00	\$ 2,400.00	\$ 2,400.00
Stirrer in sump (4kw)	\$ 5,300.00	\$ 5,300.00	\$ 5,300.00	13	\$ 689.00	\$ 689.00	\$ 689.00
Pump in Sump	\$ 15,000.00	\$ 4,000.00	\$ 4,000.00	20	\$ 3,000.00	\$ 800.00	\$ 800.00
Total kw of system	19	5.5	9.5		\$ -	\$ -	\$ -
Solids Bunker 15m x 8m x 2m	\$ 20,796.00	\$ 20,796.00	\$ 20,796.00	5	\$ 1,039.80	\$ 1,039.80	\$ 1,039.80
Pond Cost with no stirrer needed,	\$ 51,500.00	\$ 51,500.00	\$ 51,500.00	5	\$ 2,575.00	\$ 2,575.00	\$ 2,575.00
Pump on pond	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	20	\$ 1,000.00	\$ 1,000.00	\$ 1,000.00
Total Cost	\$ 197,615	\$ 188,602	\$ 191,606				

MECHANICAL SOLIDS SEPARATION SYSTEM ANNUAL OPERATING EXPENDITURE:

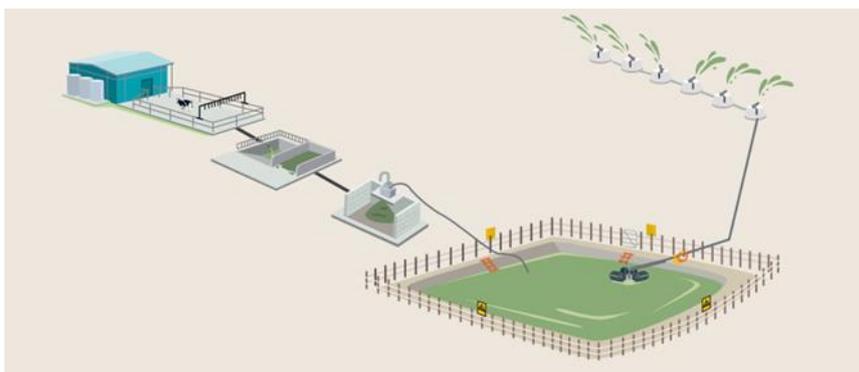
<u>Annual Operating Cost</u>	<u>Slope Screen</u>	<u>Rotary Drum</u>	<u>Screw Press</u>
Power (for pump on pond)	\$ 6,946.88	\$ 6,946.88	\$ 6,946.88
Pump on pond R & M	\$ 350.00	\$ 350.00	\$ 350.00
Power (separator)	\$ 1,432.13	\$ 1,243.69	\$ 1,503.74
Labour (if watched for total run time)	\$ 8,798.00	\$ 20,394.29	\$ 15,176.00
(if watched for 20% of the time)	\$ 1,759.60	\$ 4,078.86	\$ 3,035.20
Separator Repairs (estimates after various discussions)	\$ 1,000.00	\$ 800.00	\$ 1,500.00
Separator Maintainance	\$ 360.00	\$ 360.00	\$ 3,500.00
Empty/Spread Cost (240m ³ to be emptied x5/year)	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00
Number trips for 10m ³ muck spreader at \$200/h	12	12	12
Depreciation	\$ 15,263.80	\$ 13,323.80	\$ 13,713.80
Total annual operating costs	\$ 51,124.41	\$ 51,115.22	\$ 54,561.62

MECHANICAL SOLIDS SEPARATION SYSTEM COMMENTS:

- Only one year warranty
- Higher labour requirement
- Requires a stone trap and a mixing sump
- Many moving parts
- Nutrient value captured in solids
- Lower application rates possible due to the removal of solids
- Less irrigator blockages due to minimal solids content
- Reuse green water for washdown – Variation 6 (Variation 6 only applies to Waikato Regional Council)
- Increased risk – in storm events or due to mechanical breakdown, over flow of the sump can lead to Regional Council Fines
- Power and maintenance costs involved
- Higher depreciation rates
- Higher risk of mechanical failure

	<u>Slope Screen</u>	<u>Rotary Drum</u>	<u>Screw Press</u>
Cost	Medium	Medium	Medium to high
Solids consistency	Moist solids	Dryer than Static Screen	Driest solids
Power consumption	No mechanical parts	Low	Higher
Ideal environment	Need large size for feed pads	Dairy + feed pad effluent	Dairy + feed pad effluent
Maintenance	Screen maintenance	No screen maintenance	High annual costs
Power for recycled green wash	yes	yes	yes
Water consumption	medium (approx 1.5m ³ water per hour running)	medium (approx 0.7 m ³ water per hour running)	none
Warranty (years)	1	1	1

The effluent flows from the shed, through a stone trap to a mixing sump and is then pumped to a mechanical separator where the solids are removed. The liquid flows by gravity to storage and is then irrigated to land using a pump.





POND ONLY SYSTEM CAPITAL EXPENDITURE:

NB: Pond size bigger than separated solids pond due to introduced solids and no recycled greenwash

Pond Only	\$	Depreciation (%)	
Capital Cost:			
Stone Trap and Tailings Bunker 4mx8m	\$ 15,000.00	5	\$ 750.00
Pond excavation (5000m3 approx)	\$ 29,000.00	0	\$ -
Pond Lining, including geotextile and gas venting	\$ 45,000.00	5	\$ 2,250.00
Pump (18.5kw)	\$ 6,900.00	20	\$ 1,380.00
(range \$5000-\$20,000)			\$ -
Horizontal Stirrer (15 hp/12 kw)	\$ 13,500.00	13	\$ 1,755.00
(range \$5000-\$20,000)			
Have to pump twice as long as no greenwater able to be used on feedpad so another 50m ³ a day going into the system that has to be irrigated, so have doubled R & M			
Total Cost	\$ 109,400.00		

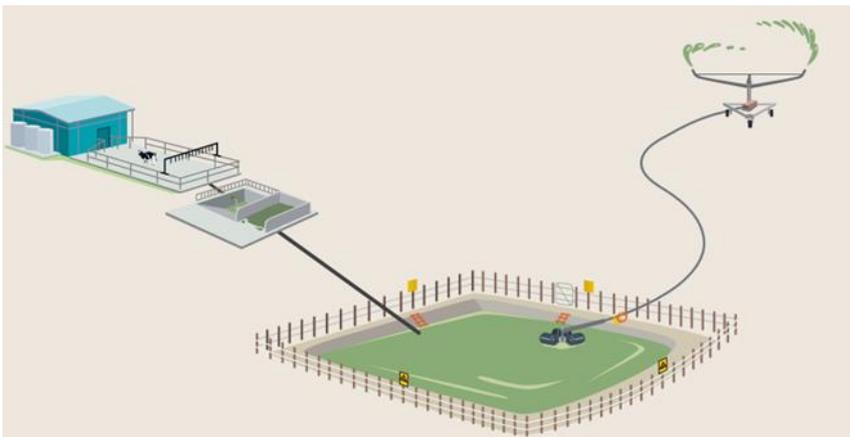
POND ONLY SYSTEM ANNUAL OPERATING EXPENDITURE:

Annual Operating Cost	\$
Power (Pump on pond)	\$ 17,015.38
Labour	\$ -
Pump R & M (grittier liquid)	\$ 900.00
Maintainance (0.5 hr monthly)	\$ 720.00
Empty and Spreading Cost (At 15% solids, with 5% in stonetrap, means 3400m3 annually could accumulate which is 2.5m depth of sludge, so have to empty annually. . Would have to still pump approx 5000m3 to get it moving. Pumping 100m3/hr would take 50 hours to empty, at approx 225/hr. Tractor hire for the stirrer at \$40/hr)	\$ 14,250.00
Depreciation	\$ 5,385.00
Total annual operating costs	\$ 38,270.38

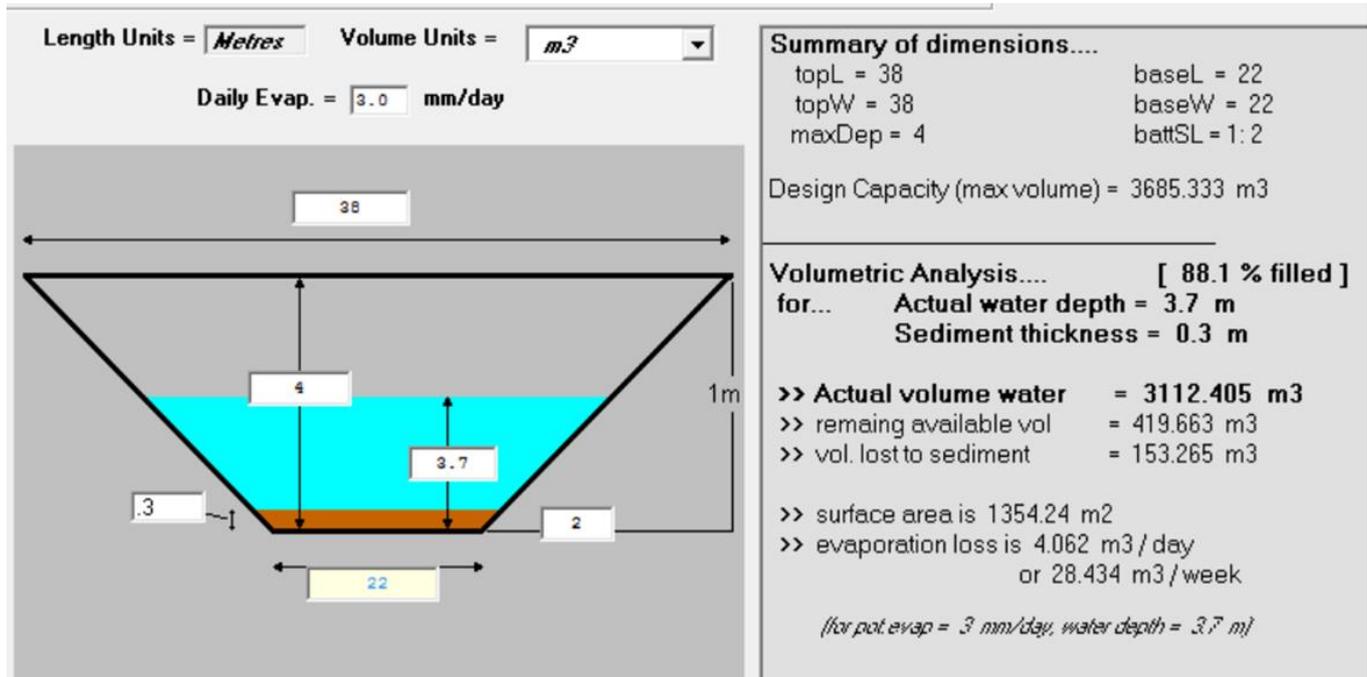
POND ONLY SYSTEM COMMENTS:

- Bigger pond needed to allow for infill from solids content
- Solids build up in pond more likely
- Difficult and costly to completely empty out
- Possibly higher depth applied due to type of irrigator that has to be used
- Time lost clearing blockages due to no separation
- Harder to stir bigger ponds
- Power costs as machinery needs to be larger to handle friction losses due to higher solids content
- Less options available for pumps due to solids content
- Longer between irrigation times needed as cows won't eat the grass
- Soil filtration rate decreases over time reducing application rates before ponding will occur

The effluent flows from the shed straight to a sump. The liquid flows by gravity to storage and is then irrigated to land.

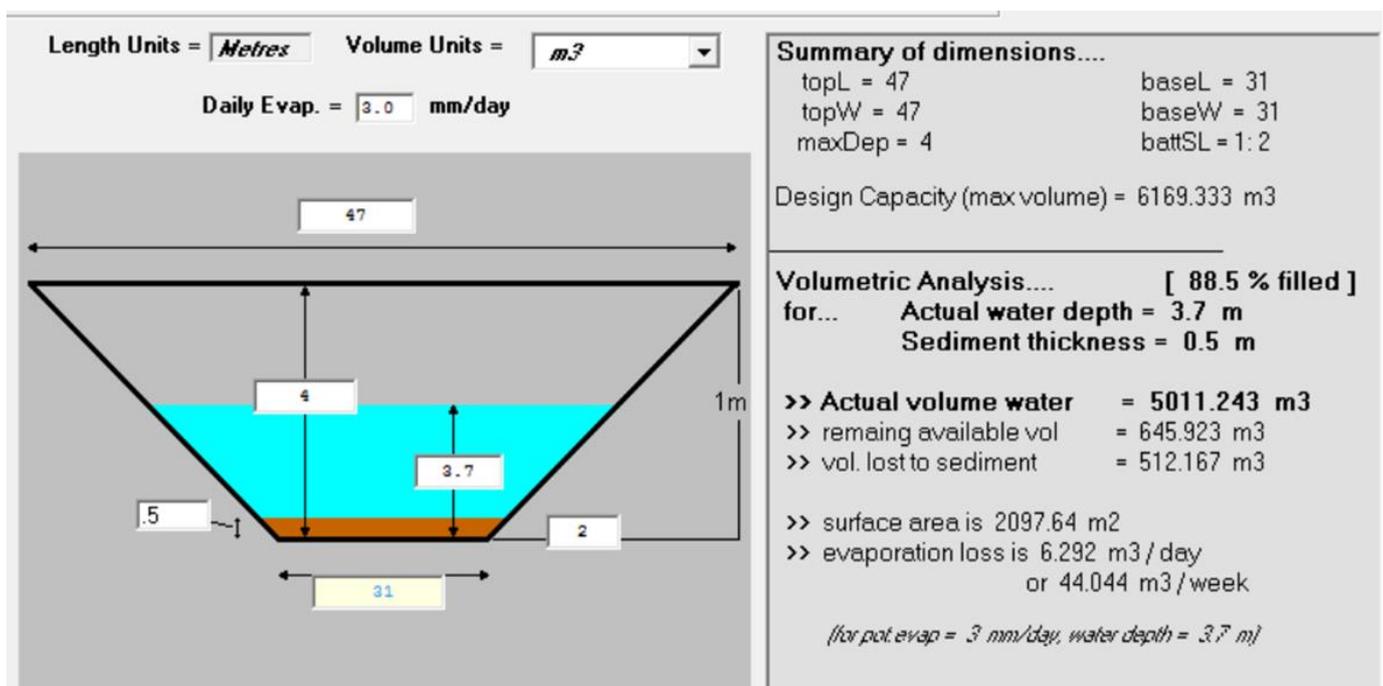


POND SIZE DIMENSIONS FOR WEEPING WALL AND MECHANICAL SOLIDS SEPARATION SYSTEMS:



Pond size required for separation options with 50m³ of recycled water on feed pad every day, lower "sludge" volume as solids separated out before getting to pond.

POND SIZE DIMENSIONS FOR POND ONLY SYSTEM:



Larger pond due to fact there is no green water recycling, so the 50m³ used in other options for recycled water is clean water to the pond