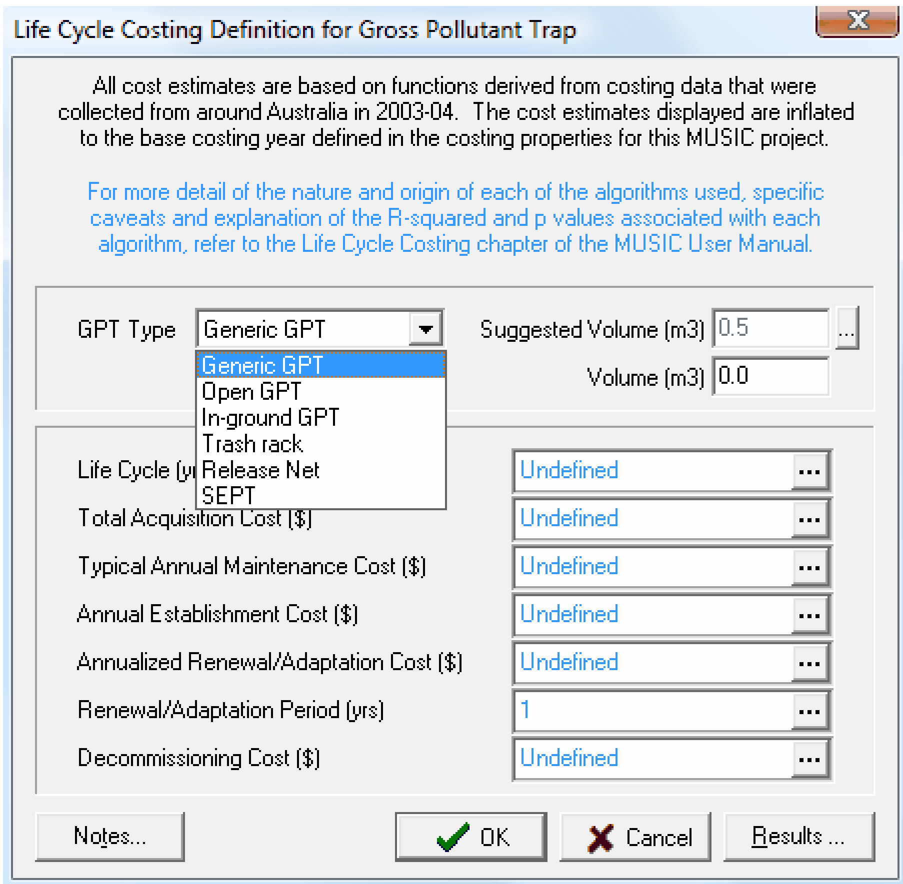
Gross Pollutant Traps (Costing)

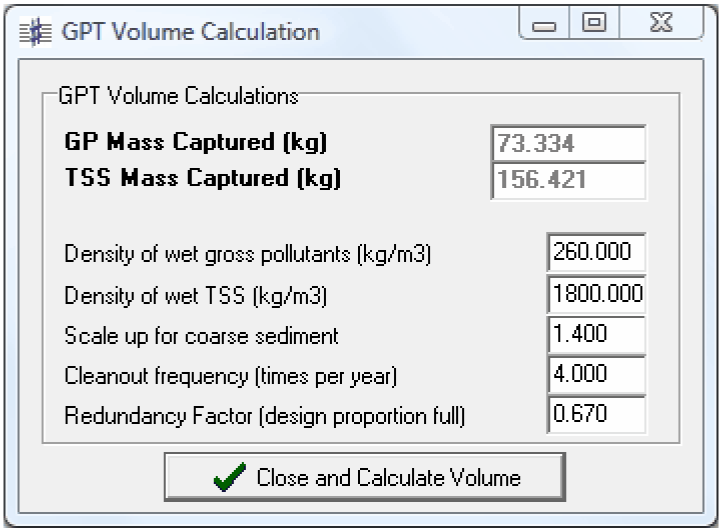
This section provides guidance on undertaking life cycle costing analyses for 'generic' GPTs (i.e. when the type has not yet been determined), in-ground GPTs (e.g. the common types of proprietary devices that are available in Australia), open GPTs (i.e. a sediment basin with a trash rack), trash rack GPTs, release net GPTs and side entry pit trap (SEPT) GPTs. For descriptions of these types of GPT, refer to the document titled 'Urban Stormwater: Best Practice Environmental Management Guidelines' (Victorian Stormwater Committee, 1999).

The process for undertaking a life cycle costing analysis for gross pollutant traps is the same as described in Life-Cycle Costing - Constructed Wetlands and Life-Cycle Costing - Bioretention Systems. The only significant differences are:

- The user must select a type of GPT in the primary costing screen using the drop down menu, as shown below.
- If the user chooses the cost / size relationship that involves estimating total acquisition cost from the volume of the GPT, this size attribute must be manually specified in the primary costing screen (see entry field below). The volume of the GPT (VU) is defined as the total volume (in m^3) of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow.



The desired volume of the GPT (VU) is calculated automatically and provided as the 'Suggested Volume (m[3])'. You can click the ... button to access the parameters of the calculation as shown below and make any changes. These will be then reflected back in the suggested volume.



Each of these parameters are outlined below in the process to undertake a manual calculation of VU, if required.

To manually estimate the desired volume of the GPT (VU), undertake the following steps:

- Firstly, assume the proposed GPT will be an in-ground proprietary device (music's cost / size relationship involving this size variable are based on a data set involving all of the types of units supplied by the four major suppliers of these types of GPTs in Australia).
- Use music to estimate the mass of gross pollutants (i.e. all material greater than 5 mm in size) trapped in the device in a typical year. To do this, right click on the GPT treatment node, then select 'statistics' > 'mean annual loads'. The mass of trapped gross pollutants is given by the inflow load of gross pollutants minus the outflow load (i.e. **mass trapped [kg/year] = inflow [kg/year] - outflow [kg/year]**).
- Convert this annual mass (kg) to a volume (m^3) using the following density for wet (drained) gross pollutants: 260 kg/m^3 (Allison et al., 1998).
- Scale up the volume of trapped gross pollutants per annum to an estimated volume of trapped gross pollutants and coarse sediment per annum using the following relationship: **Total volume of trapped gross pollutants and coarse sediment (m^3/year) = volume of trapped gross pollutants (m^3/year)•1.4**. This allows for the volume typically occupied by trapped coarse sediment (i.e. typically ~29% by volume) and was derived from a NSW data set involving 12 different sites, each hosting the same brand of proprietary in-ground GPT.
- In the unlikely event that the GPT has the ability to trap significant quantities of TSS, the volume of trapped TSS also needs to be added to the volume of gross pollutants and coarse sediment. The mass of trapped TSS can be obtained from music using the same method that was used for gross pollutants, except the mass of TSS should be converted to a volume using a density of approximately 1,800 kg/m^3. The sum of the trapped volumes of gross pollutants, coarse sediment and TSS gives the total volume of trapped pollutants per annum (m^3/year).
- Choose a preferred clean-out frequency for the GPT (e.g. monthly, every 2 months or every 3 months).
- Calculate the total volume of trapped pollutants per clean-out (assuming the load of trapped pollutants accumulates evenly over the year), by using the following relationship: **Total volume of trapped pollutants per clean-out (m^3/clean-out) = total volume of trapped pollutants per annum (m^3/year) / number of cleanout per year (clean-out/year)**.
- Calculate the desired capture volume of the GPT (m^3) by using the following relationship: The desired capture volume of the **GPT (m^3) = total volume of trapped pollutants per clean-out (m^3/clean-out)•1.5**. This is done so that clean-outs will typically occur when the GPT's capture structure is approximately 2/3rds full (i.e. we want to minimise the risk that the GPT will completely filled and gross pollutants will start to bypass the unit before it is maintained).
- Finally, calculate the desired volume of the GPT (VU) by using the following relationship: Volume of GPT [VU] (m^3) = 2.139•the desired capture volume of the GPT $(m^3)^{0.8985}$. This relationship has been derived from data supplied from the four largest suppliers of proprietary in-ground GPT's in Australia for 59 different GPT models (R^2 = 0.94; p < 0.01; and n = 59).

The origin of all of the 'expected' values and algorithms in MUSIC's costing module, as well as the statistical operations used to generate 'upper' and 'lower' estimates for GPTs are explained in Table 1 (generic designs), Table 2 (open GPTs), Table 3 (in-ground GPTs), Table 4 (trash racks and litter baskets), Table 5 (release nets) and Table 6 (side entry pit traps).

Table 1. Summary of cost-related relationships for 'generic' GPTs.

Element of Life Cycle Costing Model	Default Option for Estimation in music	Alternative(s)	Notes
Life cycle	63 years. n = 2	No alternative in music.	Upper and lower estimates derived using a 84th and 16th percentile, respectively.

Total acquisition cost (TAC)	TAC ($2004) = 22460 x (VU)$^{0.4702}$ R^2 = 0.59; $p < 0.01$; n = 72. Where: VU = total volume of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow (m^3).	TAC ($2004) = 31430 x ($C$)$^{0.3971}$ R^2 = 0.34; $p < 0.01$; n = 121. Where: C = area of the GPT's catchment in ha. For literature values, see Taylor (2005b) - Included in Appendix H: Costing information.*	**Warning:** The default algorithm has been derived from data involving in-ground, proprietary GPTs with no unusual cost elements. The alternative algorithm has been derived from a combined data set involving in-ground proprietary GPTs and open GPTs with no unusual cost elements. Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. If users want to manually enter their own TAC value in music but only have a total construction cost estimate, they can use the following approximate relationships that have been derived from the CRCCH's data set for all types of GPTs: Total construction cost 94% of TAC.
Typical annual maintenance (TAM) cost	TAM ($2004) = 698.3 x (V)$^{0.7766}$ R^2 = 0.72; $p < 0.01$; n = 57. Where: V = average annual volume of removed trapped material (i.e. gross pollutants, coarse sediment and TSS) in m^3.	See Table 1 for alternatives. For literature values, see Taylor (2005b).*	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. Currently music estimates V using the *combined* estimated volume of gross pollutants, coarse sediment and TSS that are trapped in the GPT per year. To adjust this *manually* (i.e. to include only one or two of these three elements), use the procedure provided in the tip box within Ponds and Sedimentation Basins (Costing).
Annualised renewal / adaptation cost (RC)	RC ($2004) = 0.70% of TAC p.a. n = 34	No alternative size / cost relationships in music. For literature values, see Taylor (2005b).	**Warning:** The default relationship has been derived from data involving in-ground GPTs, trash racks and litter baskets and release nets (as there was no data available for open GPTs). Upper and lower estimates derived using a 68% confidence interval around the mean.
Renewal period	1 year	No alternative in music.	Default position due to lack of high quality data supporting an alternative period.
Decommissioning cost (DC)	DC ($2004) = 23% of TAC n = 1	No alternative size / cost relationships in music.	**Warning:** This estimate is derived from only one high quality data set.
General caveats / notes for this type of device	* There are several estimates of capital and maintenance costs reported in the literature for open GPTs (see Taylor, 2005b or Appendix H: Costing information for a summary).		

Table 2. Summary of cost-relationed relationships for open GPTs (ie. sediment basins with trash racks)

Element of Life Cycle Costing Model	Default Option for estimation in MUSIC	Alternative(s)	Notes
Life cycle	63 years. n = 2	No alternative in MUSIC	Upper and lower estimates derived using a 84th and 16th percentile, respectively.

Total acquisition cost (TAC)	TAC ($2004) = 22460•$(VU)^{0.4702}$ R^2 = 0.59; $p < 0.01$; n = 72. Where: VU = total volume of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow (m^3).	TAC ($2004) = 22460•$(VU)^{0.4702}$ R^2 = 0.34; $p < 0.01$; n = 121. Where: C = area of the GPT's catchment in ha. For literature values, see Taylor (2005b) – Included in Appendix H: Costing information	**Warning**: The default algorithm has been derived from data involving in-ground, proprietary GPTs with no unusual cost elements. The alternative algorithm has been derived from a combined data set involving in-ground proprietary GPTs and open GPTs with no unusual cost elements. Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. If users want to manually enter their own TAC value in music but only have a total construction cost estimate, they can use the following approximate relationships that have been derived from the CRCCH's data set for all types of GPTs: Total construction cost 94% of TAC.
Typical annual maintenanc e (TAM) cost	TAM ($2004) = 698.3•$(VU)^{0.7766}$ R^2 = 0.72; $p < 0.01$; n = 57. Where: V = average annual volume of removed trapped material (i.e. gross pollutants, coarse sediment and TSS) in m^3.	See Table 1 for alternatives. For literature values, see Taylor (2005b).*	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. Currently music estimates V using the combined estimated volume of gross pollutants, coarse sediment and TSS that are trapped in the GPT per year. To adjust this manually (i.e. to include only one or two of these three elements), use the procedure provided in the tip box within Ponds and Sedimentation Basins (Costing).
Annualised renewal / adaptation cost (RC)	RC ($2004) = 0.70% of TAC p.a. n = 34	No alternative size / cost relationships in MUSIC. For literature values, see Taylor (2005b).	**Warning**: The default relationship has been derived from data involving in-ground GPTs, trash racks and litter baskets and release nets (as there was no data available for open GPTs). Upper and lower estimates derived using a 68% confidence interval around the mean.
Renewal period	1 year	No alternative in MUSIC	Default position due to lack of high quality data supporting an alternative period.
Decommissi oning cost (DC)	DC ($2004) = 23% of TAC n = 1	No alternative size / cost relationships in M USIC.	**Warning**: This estimate is derived from only one high quality data set.
General caveats / notes for this type of device	*There are several estimates of capital and maintenance costs reported in the literature for open GPTs (see Taylor, 2005b or Appendix H: Costing information for a summary).		

Table 3. Summary of cost-related relationships for in-ground GPTs.

Element of Life Cycle Costing Model	Default Option for Estimation in music	Alternative(s)	Notes
Life cycle	50 years. n = 66	No alternative in music.	Upper and lower estimates derived using a 84th and 16th percentile, respectively.
Total acquisition cost (TAC)	TAC ($2004) = 22460 x $(VU)^{0.4702}$ R^2 = 0.59; $p < 0.01$; n = 72. Where: VU = total volume of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow (m^3).	TAC ($2004) = 31430 x $(C)^{0.3971}$ R^2 = 0.34; p <0.01; n = 121. Where: C = area of the GPT's catchment in ha. For literature values, see Taylor (2005b) - Included in Appendix H: Costing information.*	The default algorithm has been derived from data involving in-ground, proprietary GPTs with no unusual cost elements. The alternative algorithm has been derived from a combined data set involving in-ground proprietary GPTs and open GPTs with no unusual cost elements. Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. If users want to manually enter their own TAC value but only have a total construction cost estimate, they can use the following approximate relationships that have been derived from the CRCCH's data set for all types of GPTs: Total construction cost 94% of TAC.
Typical annual maintenance (TAM) cost	TAM ($2004) = 1202 x $(C)^{0.3130}$ R^2 = 0.36; $p < 0.01$; n = 77. Where: C = area of the GPT's catchment in ha.	See Table 1 for alternatives. For literature values, see Taylor (2005b). *	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression.

Annualised renewal / adaptation cost (RC)	RC ($2004) = 0.54% of TAC p.a. *n* = 23	No alternative size / cost relationships in music. For literature values, see Taylor (2005b). *	Upper and lower estimates derived using a 68% confidence interval around the mean.
Renewal period	1 year	No alternative in music.	Default position due to lack of high quality data supporting an alternative period.
Decommissioning cost (DC)	DC ($2004) = 20% of TAC *n* = 18	No alternative size / cost relationships in music.	Upper and lower estimates derived using a 68% confidence interval around the mean.
General caveats / notes for this type of device	* There are several estimates of capital and maintenance costs reported in the literature for in-ground GPTs (see Taylor, 2005b or Appendix H: Costing information for a summary). Quotes on 'supply and install costs' (the main component of total acquisition costs) can also be readily obtained from suppliers of GPTs with propriety designs.		

Table 4. Summary of cost-related relationship for trash racks and litter baskets.

Element of Life Cycle Costing Model	Default Option for Estimation in music	Alternative(s)	Notes
Life cycle	25 years. *n* = 8	No alternative in music.	Upper and lower estimates derived using a 68% confidence interval around the mean.
Total acquisition cost (TAC)	TAC ($2004) = 22460 x $(VU)^{0.4702}$ $R^2 = 0.59$; $p < 0.01$; $n = 72$. Where: VU = total volume of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow (m^3).	TAC ($2004) = 31430 x $(C)^{0.3971}$ $R^2 = 0.34$; $p < 0.01$; $n = 121$. Where: *C* = area of the GPT's catchment in ha. For literature values, see Taylor (2005b) - Included in Appendix H.*	**Warning:** The default algorithm has been derived from data involving in-ground, proprietary GPTs with no unusual cost elements. The alternative algorithm has been derived from a combined data set involving in-ground proprietary GPTs and open GPTs with no unusual cost elements. Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. If users want to manually enter their own TAC values but only have a total construction cost estimate, they can use the following approximate relationships that have been derived from the CRCCH's data set for all types of GPTs: Total construction cost 94% of TAC.
Typical annual maintenance (TAM) cost	TAM ($2004) = 421.7 x $(V)^{0.6890}$ $R^2 = 0.66$; $p < 0.01$; $n = 75$. Where: V = average annual volume of removed trapped material (i.e. gross pollutants, coarse sediment and TSS) in m^3.	See Table 1 for alternatives. For literature values, see Taylor (2005b). *	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. Currently music estimates V using the *combined* estimated volume of gross pollutants, coarse sediment and TSS that are trapped in the GPT per year. To adjust this *manually* (i.e. to include only one or two of these three elements), use the procedure provided in the tip box within Life-Cycle Costing - Ponds and Sedimentation Basins.
Annualised renewal / adaptation cost (RC)	RC ($2004) = 0.85% of TAC p.a. *n* = 8	No alternative size / cost relationships in music. For literature values, see Taylor (2005b).	Upper and lower estimates derived using a 68% confidence interval around the mean.
Renewal period	1 year	No alternative in music.	Default position due to lack of high quality data supporting an alternative period.
Decommissioning cost (DC)	DC ($2004) = 7.3% of TAC *n* = 7	No alternative size / cost relationships in music.	Upper and lower estimates derived using a 68% confidence interval around the mean.
General caveats / notes for this type of device	* There are some estimates of capital and maintenance costs reported in the literature for trash racks and litter baskets (see Taylor, 2005b or Appendix H: Costing information for a summary).		

Table 5. Summary of cost-related relationships for release of net GPTs.

Element of Life Cycle Costing Model	Default Option for Estimation in music	Alternative(s)	Notes
Life cycle	10 years. *n* = 5	No alternative in music.	Upper and lower estimates derived using a 68% confidence interval around the mean.
Total acquisition cost (TAC)	TAC ($2004) = 22460 x $(VU)^{0.4702}$ $R^2 = 0.59$; $p < 0.01$; $n = 72$. Where: VU = total volume of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow (m^3).	TAC ($2004) = 31430 x $(C)^{0.3971}$ $R^2 = 0.34$; $p < 0.01$; $n = 121$. Where: *C* = area of the GPT's catchment in ha.	**Warning:** The default algorithm has been derived from data involving in-ground, proprietary GPTs with no unusual cost elements. The alternative algorithm has been derived from a combined data set involving in-ground proprietary GPTs and open GPTs with no unusual cost elements. Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression.
Typical annual maintenance (TAM) cost	TAM ($2004) = 652.6 x $(V)^{0.4920}$ $R^2 = 0.93$; $p < 0.01$; $n = 7$. Where: V = average annual volume of removed trapped material (i.e. gross pollutants, coarse sediment and TSS) in m^3.	See Table 1 for alternatives.	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. Currently music estimates V using the *combined* estimated volume of gross pollutants, coarse sediment and TSS that are trapped in the GPT per year. To adjust this *manually* (i.e. to include only one or two of these three elements), use the procedure provided in the tip box within Ponds and Sedimentation Basins (Costing).
Annualised renewal / adaptation cost (RC)	RC ($2004) = 31% of TAC p.a. *n* = 3	No alternative size / cost relationships in music.	Upper and lower estimates derived using an 84th and 16th percentile, respectively.
Renewal period	1 year	No alternative in music.	Default position due to lack of high quality data supporting an alternative period.
Decommissioning cost (DC)	DC ($2004) = 4.3% of TAC *n* = 1	No alternative size / cost relationships in music.	**Warning:** This estimate is derived from only one high quality data set.
General caveats / notes for this type of device	Quotes on 'supply and install costs' (the main component of total acquisition costs) can also be readily obtained from suppliers of GPTs with propriety designs.		

Table 6. Summary of cost-related relationships for side entry pit trap GPTs.

Element of Life Cycle Costing Model	Default Option for Estimation in music	Alternative(s)	Notes
Life cycle	5 years. *n* = 10	No alternative in music.	Upper and lower estimates derived using a 84th and 16th percentile, respectively.
Total acquisition cost (TAC)	TAC ($2004) = 22460 x $(VU)^{0.4702}$ $R^2 = 0.59$; $p < 0.01$; $n = 72$. Where: VU = total volume of all stormwater and trapped pollutants in the unit when it is operating at its peak design flow (m^3).	TAC ($2004) = 31430 x $(C)^{0.3971}$ $R^2 = 0.34$; $p < 0.01$; $n = 121$. Where: C = area of the GPT's catchment in ha. For literature values, see Taylor (2005b) - Included in Appendix H: Costing information.*	**Warning:** The default algorithm has been derived from data involving in-ground, proprietary GPTs with no unusual cost elements. The alternative algorithm has been derived from a combined data set involving in-ground proprietary GPTs and open GPTs with no unusual cost elements. Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression.

Typical annual maintenance (TAM) cost	TAM ($2004) = 292.2 x $(V)^{0.7353}$ R^2 = 0.87; $p < 0.01$; $n = 11$. Where: V = average annual volume of removed trapped material (i.e. gross pollutants, coarse sediment and TSS) in m^3.	See Table 1 for alternatives. For literature values, see Taylor (2005b).*	Upper and lower estimates derived using a 68% (or 1 standard deviation) prediction interval for the regression. Currently music estimates V using the *combined* estimated volume of gross pollutants, coarse sediment and TSS that are trapped in the GPT per year. To adjust this *manually* (i.e. to include only one or two of these three elements), use the procedure provided in the tip box within Ponds and Sedimentation Basins (Costing).
Annualised renewal / adaptation cost (RC)	RC ($2004) = 0.70% of TAC p.a. *n* = 34	No alternative size / cost relationships in music. For literature values, see Taylor (2005b).	**Warning:** The default relationship has been derived from data involving in-ground GPTs, trash racks and litter baskets and release nets (as there was no data available for side entry pit trap GPTs). Upper and lower estimates derived using a 68% confidence interval around the mean.
Renewal period	1 year	No alternative in music.	Default position due to lack of high quality data supporting an alternative.
Decommissioning cost (DC)	DC ($2004) = 16% of TAC *n* = 28	No alternative size / cost relationships in music.	**Warning:** The default relationship has been derived from data involving in-ground GPTs, trash racks and litter baskets, and release nets (as there was no data available for side entry pit trap GPTs). Upper and lower estimates derived using a 68% confidence interval around the mean.
General caveats / notes for this type of device	* There are some estimates of capital and maintenance costs reported in the literature for side entry pit traps (see Taylor, 2005b or Appendix H: Costing information for a summary). Quotes on 'supply and install costs' (the main component of total acquisition costs) can also be readily obtained from suppliers of GPTs with propriety designs.		