



Life-cycle costing tool update

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The water component of STEP is a collaborative of:



About STEP

STEP is a multi-agency initiative developed to support broader implementation of sustainable technologies and practices within a Canadian context.

The water component of STEP is a conservation authority collaborative. Current partners are:



Our key areas of focus are:

- Low Impact Development
- Erosion and Sediment Control
- Road Salt Management
- Natural Features Restoration

Agenda

- What is the STEP life-cycle costing tool
- What's new
- How the STEP partners are using it
- How it works
- Sensitivity analyses

The original life-cycle costing tool



Low Impact Development Costing Tool

Please select an LID practice to open costing sheets



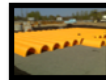
Bioretention (BR)



Enhanced Grass Swale (EGS)



Green Roof (GR)



Infiltration Chamber (IC)



Infiltration Trench (IT)



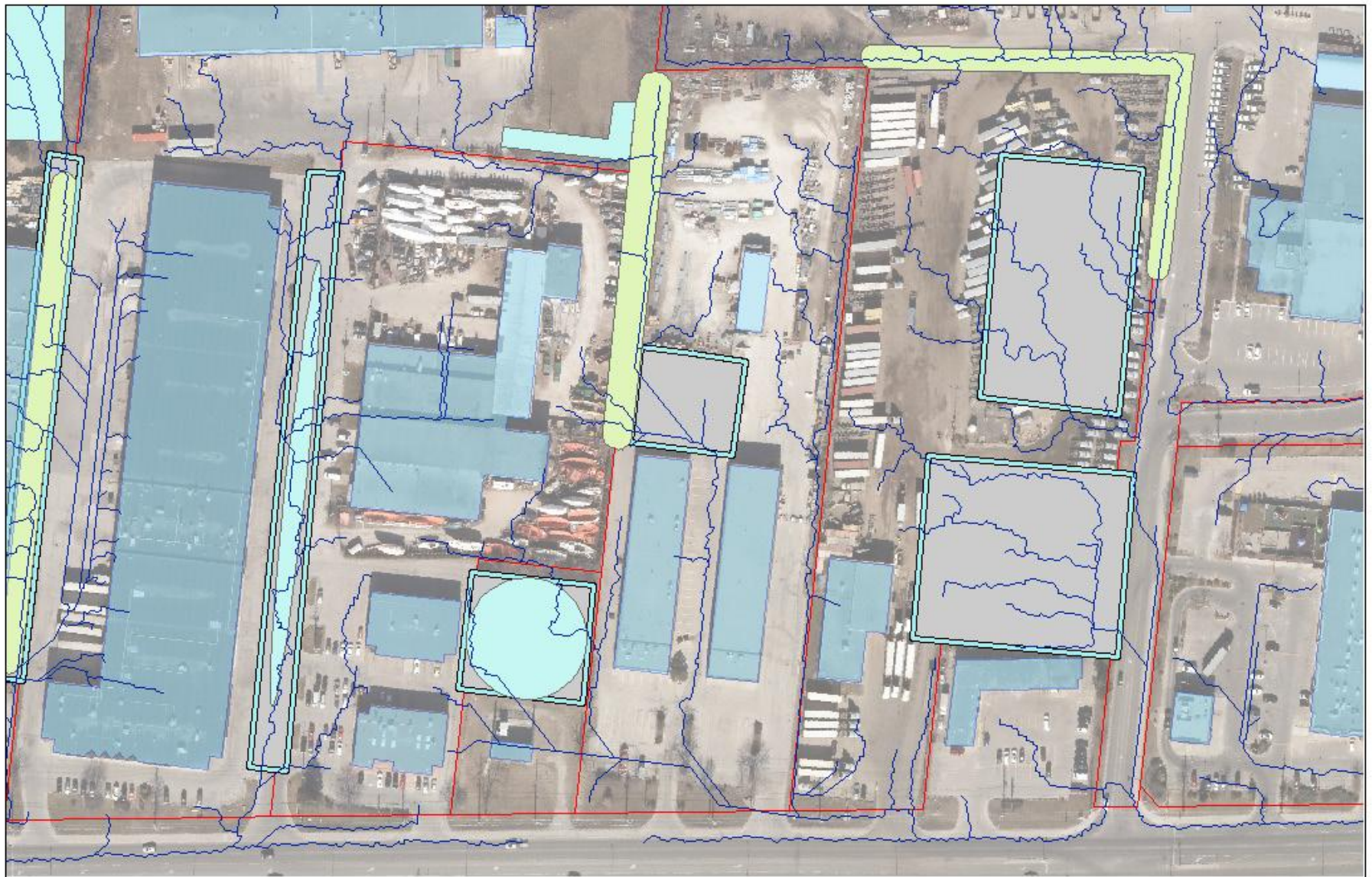
Permeable Interlocking Concrete Pavers (PICP)



Rainwater Harvesting (RWH)

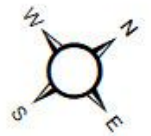
What's new

- Tool's back end will be open and modifiable
- Added wet ponds and dry ponds
- Updated unit costing data to 2018
- Added a land cost/opportunity cost option
- Developing costing curves (LSRCA project, integration with the Treatment Train Tool)

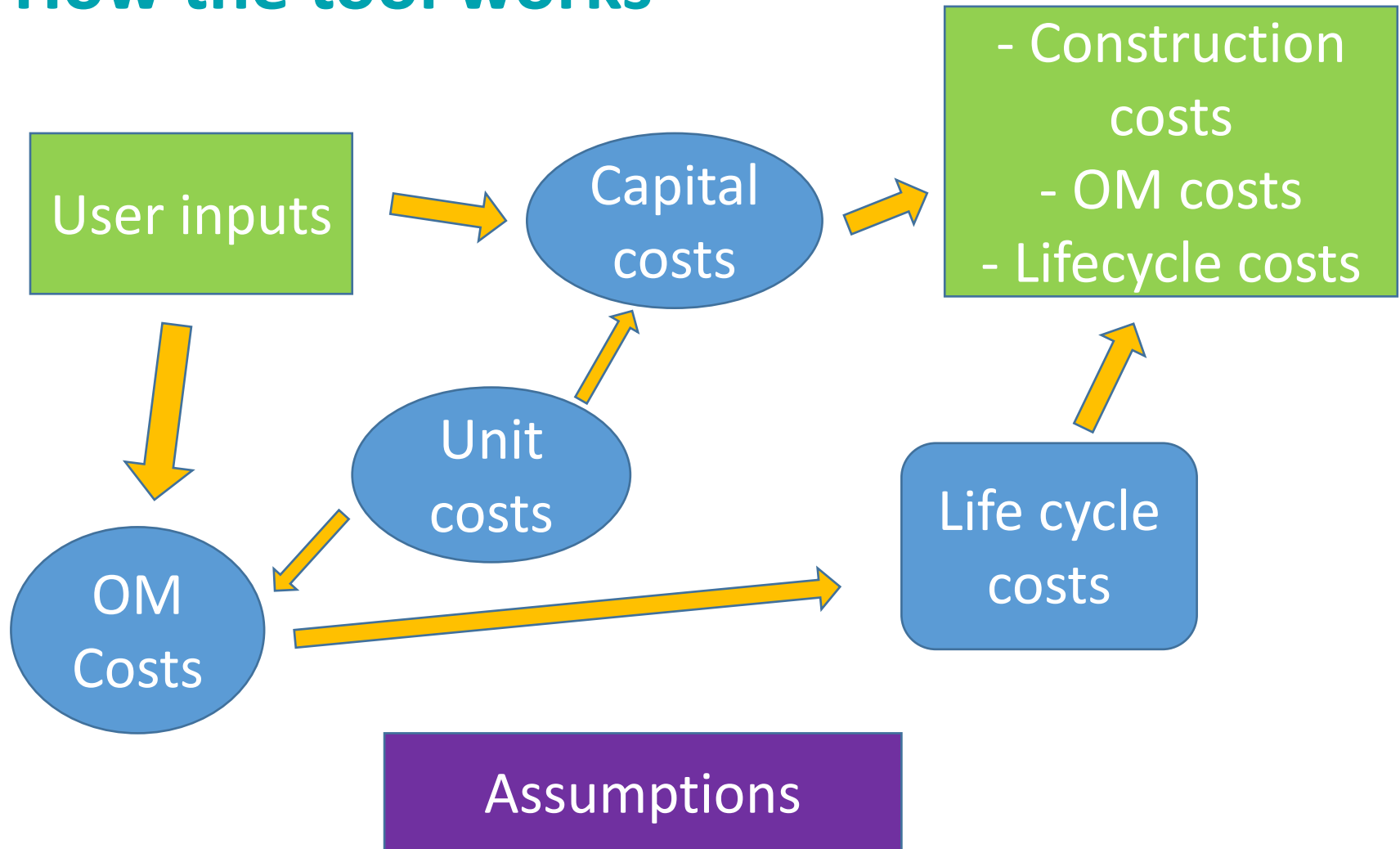


- Building
- Property Line
- Drainage Network

- Bioretention
- Enhanced Grass Swale
- Infiltration Chamber



How the tool works



Basic User Inputs: bioretention

Site and Design Information

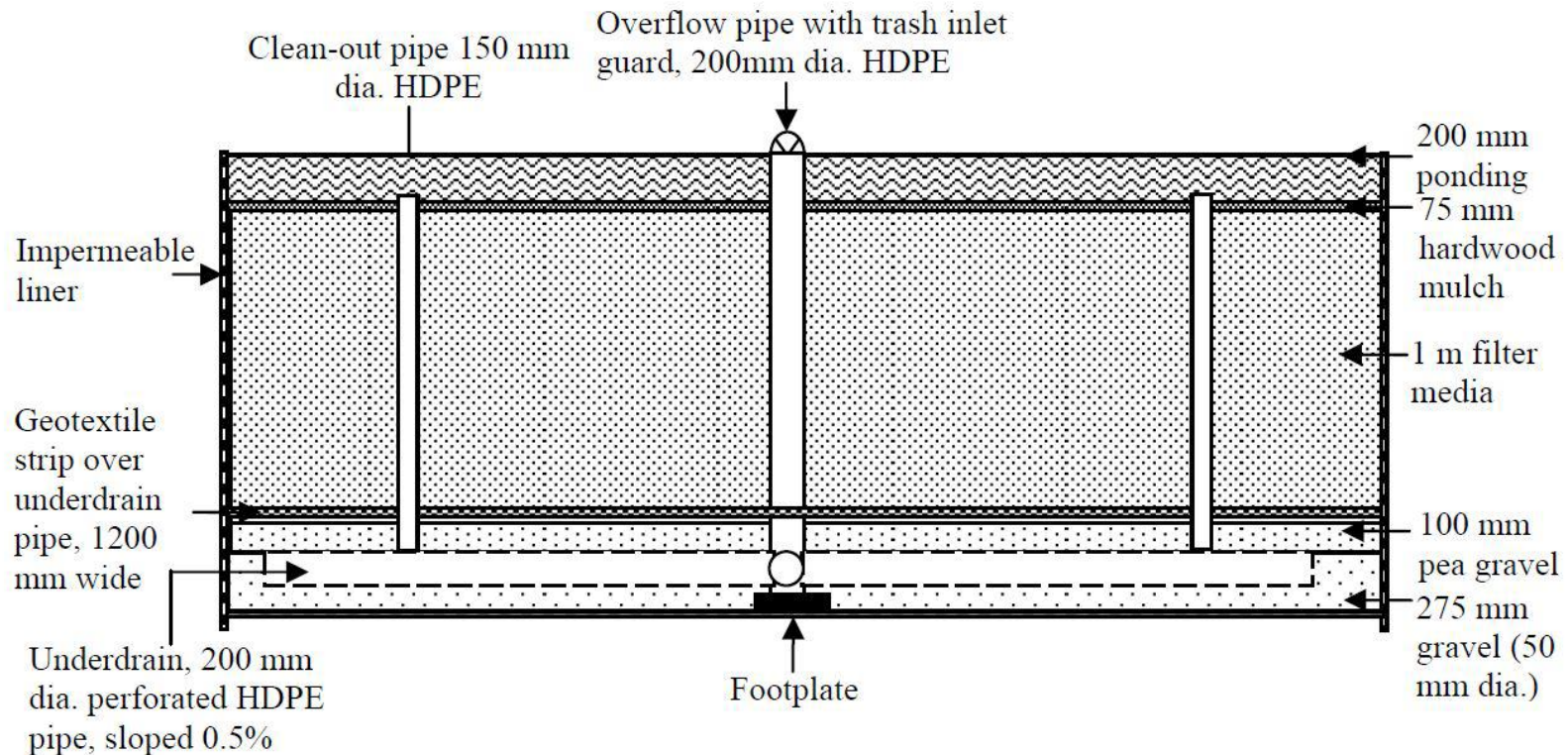
USER INPUTS			
Drainage area (DA)		2000	m ²
Native soil infiltration rate		10	mm/hr
Design type ¹		Partial Infiltration	Unitless
Drainage period		36	hours
BR surface area length to width ratio		1	Unitless
Project land value classification		None	Unitless
DESIGN DEFAULTS		defaults (values in col G can be changed)	
Maximum drainage area to surface area ratio	20	20	Unitless
Water Quality Volume Requirement	45	45	m ³ /ha
Filter Media Depth	0.75	0.75	m
Ponding depth	0.2	0.2	m
Safety factor	2.5	2.5	Unitless
Void ratio	40	40	%
Mulch depth	0.075	0.075	m

Design inputs

Site and Design Information

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Model Designs: Bioretention



Capital costs

BIORETENTION				
Manhole adaptor	2	units	\$148.31	\$296.61
Delivery	2	each	\$205.68	\$411.36
Stone inlets	0.3	m ³	\$44.38	\$13.32
Stone	58	Cm ³	\$44.38	\$2,574.26
Pea gravel, including labour	0	m ³	\$52.83	\$0.00
Geotextile	10.0	m ²	\$1.84	\$18.38
Backfill	0.5	Lm ³	\$1.80	\$0.82
Curbs & gutter with curb inlets	40	m	\$95.89	\$3,835.74
Vegetation	67	m ²	\$84.08	\$5,605.34
Wood mulch	97	m ²	\$11.72	\$1,136.55
Filter media TOTAL				\$4,166.72
Filter media (plus delivery)	73	Lm ³	\$43.26	\$4,036.35
Filter media installation	73	Lm ³	\$1.80	\$130.37

Unit costs

31 25 14.16 1000	Silt fence, install and maintain, remove
31 23 16.16 6060	Excavating, common earth, minor structures, backhoe 2 c.y. bucket
31 23 16.16 6060	Fill assumed same as excavating, common earth, minor structures, backhoe 2 c.y. bucket
31 23 16.16 6060	Remove pavers assumed 10% higher than Excavating, common earth, minor structures, backhoe
31 23 16.16 6060 X 0.85	Remove No. 8, and top 2" of No.57 stone assumed 15% lower than Excavating, common earth, r
31 23 16.16 6100	Excavating, common earth, small bldg foundations, backhoe 2 c.y. bucket
31 23 16.42 0260	Excavating, common earth piled, bulk bank, backhoe 2 c.y. bucket
31 23 16.13 1372	Excavating, trench, 6'-10' deep, w/trench box, backhoe 2.5 c.y. bucket
31 23 16.42 0260	Assumed to be 85% of Excavating, common earth piled, bulk bank, backhoe 2 c.y. bucket
G1030 115 1950	Site earthwork, Cut and fill, common earth, 105 hp dozer and roller compactor, 150' haul, 8" lifts

Operation and maintenance inputs

Maintenance and Life Cycle Costs

USERS: Choose your maintenance level. Defaults will populate the table below. Light green coloured cells can be modified.

Select maintenance level	Low
Sales tax/HST (%)	13%

MAINTENANCE OPTIONS	Life Cycle Occurrence (every X years)			Unit cost
	Occurrence	Default	Assumed	
Routine Operation Inspections	Periodic	1	1	\$157
Maintenance Inspections	Periodic	5	5	\$138
Performance Verification Inspections	Periodic	15	15	\$430
PV Option #1: Surface infiltration testing	Periodic	15	15	\$1,488
PV Option #2: Natural event testing	Ignore	15	15	\$0
PV Option #3: Simulated event testing	Ignore	15	15	\$0
PV Option #4: 6 months water level monitoring	Ignore	15	15	\$0
Watering - Year 1 only	Once	1	1	\$311
Watering - Year 2 only	Once	2	2	\$176
Annual watering - Starts in Year 3	Periodic	1	1	\$52
Drought watering	Periodic	5	5	\$4
Remove litter and debris	Periodic	1	1	\$48
Prune	Periodic	1	1	\$69
Weed	Periodic	1	1	\$49
Sediment removal - Starts Year 2	Periodic	1	1	\$302
Add mulch to maintain 75 mm - Starts Year 2	Periodic	2	2	\$726
Replace lost vegetation - Starts Year 2	Periodic	1	1	\$716
Unclog underdrain - Starts Year 2	Periodic	1	1	\$177
User added additional options	Periodic	n/a	n/a	\$0
User added additional options	Periodic	n/a	n/a	\$0
User added additional options	Periodic	n/a	n/a	\$0
User added additional options	Periodic	n/a	n/a	\$0
Rehabilitation	Periodic	25	25	\$9,958

Operations and Maintenance

Maintenance tasks DEFAULTS			
	LOW	HIGH	
Water - see water schedule			
Remove litter	2	4	Visits per year
Prune	1	1	Visits per year
Weed	2	4	Visits per year
Sediment Removal - Starts year 2	1	2	Visits per year
Add Mulch -Starts year 2	50%	50%	Amount
Restore lost vegetation - Starts year 2	10%	20%	Amount
Unclog Underdrain - Starts year 2	1	1	Visits per year

Life-cycle costs and Assumptions

- Sheet projects OM and rehabilitation costs over the life-cycle of the facility
- Given in present values
- Dependent on assumptions, especially the selected inflation and discount rates
 - Default inflation: 3%
 - Default discount rate: 5%
- Adjusting RS Means: default is to the Ontario average

Output: capital costs

Construction Costs

Sales tax / HST (%)

13%

PRE-CONSTRUCTION		Unit	Cost	Cost adjustment
Test pits (2)	5	m ³	\$1,064	0%
Infiltration tests (2 per test pit)	4	tests	\$601	0%
Stakeout of utilities	1	visit	\$582	0%
Erosion and sediment controls:				
2" Submersible gas pump	3	days	\$104	0%
Silt sack in catchbasin	1	each	\$78	0%
Silt fence 2 m around excavation	50.6608	m	\$382	0%
Value of project land	100	m ²	\$0	0%
Add additional costs if necessary			\$0	
EXCAVATION				
Excavation	155.50	m ³	\$438	0%
Loading	15%	% of excavation cost	\$66	0%
Hauling	5.00	hours	\$1,021	0%
Safety fencing 6 m around excavation	88.00	m (1 week rental)	\$1,925	0%
Trenching for pipe to sewer	11.00	m	\$489	0%
Add additional costs if necessary			\$0	
MATERIALS & INSTALLATION				
Impermeable membrane	0.00	m ²	\$0	0%
Underdrain	10.00	m	\$734	0%
Clean out pipes (2 pipes)	2.25	m	\$77	0%
Overflow pipes	1.69	m	\$81	0%
Pipe to sewer	11.00	m	\$532	0%
Monitoring pipes	2.00	each	\$206	0%
Fittings (materials & labour)	Yes	\$	\$5,088	0%
Manhole adaptor	Yes	units	\$335	0%
Delivery	2.00	each	\$465	0%
Stone inlets	0.30	m ³	\$15	0%
Stone	56.00	m ³	\$2,809	0%
Pea gravel, including labour	10.00	m ³	\$597	0%
Geotextile	10.00	m ²	\$21	0%
Backfill	3.11	m ³	\$6	0%
Curbs & gutter with curb inlets	40.00	m	\$4,334	0%
Vegetation	66.67	m ²	\$6,334	0%
Wood mulch	97.00	m ³	\$1,284	0%
Filter media TOTAL	93.75	Lm ³	\$5,790	0%
Add additional costs if necessary			\$0	

Output: Capital, OM and Life-Cycle Costs

Cost Summary

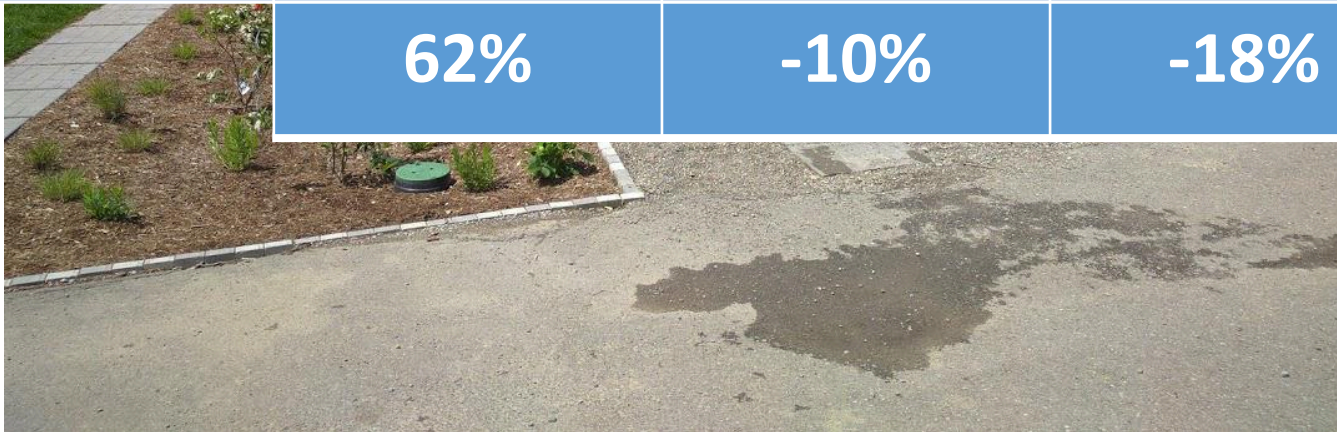
Total construction costs	\$41,052.60
Construction cost break down	
Pre-construction	\$2,812
Excavation	\$3,939
Materials & Installation	\$28,710
Inspections	\$1,859
Project mngt, overhead & other	\$3,732
Life Cycle Totals	
50 YEAR EVALUATION PERIOD	
PV of maintenance & rehabilitation	\$66,984
PV of all costs	\$108,036
30 YEAR EVALUATION PERIOD	
PV of maintenance & rehabilitation	\$44,853
PV of all costs	\$85,906

Profit, overhead, design and contingency costs

- RS means markup for contractor overhead and profit: 10% added to material, to labour, and to equipment costs
- The LCCT adds an additional 10% to the subtotal of all construction costs to account for additional overhead and construction management

Sensitivity analysis: Kenollie PS

Construction cost (adjusted for inflation)	LCCT output: user inputs only	LCCT output: user inputs and defaults	LCCT output without overhead and MGMT:
\$35,949	\$58,185	\$32,308	\$29,346
	62%	-10%	-18%



Sensitivity analysis: Kenollie PS

USER INPUTS

Drainage area (DA)	3294	m ²
Native soil infiltration rate	10.5	mm/hr
Design type ¹	Partial Infiltration	Unitless
Drainage period	48	hours
BR surface area length to width ratio	1	Unitless
Project land value classification	None	Unitless

DESIGN DEFAULTS

defaults (values in col G can be changed)

Maximum drainage area to surface area ratio	20	44	Unitless
Water Quality Volume Requirement	45	45	m ³ /ha
Filter Media Depth	0.75	0.38	m
Ponding depth	0.2	0.15	m
Safety factor	2.5	2.5	Unitless
Void ratio	40	40	%
Mulch depth	0.075	0.075	m

Sensitivity analysis: Glendale PS

Average of all bids (3)	LCCT output: user inputs only	LCCT output: user inputs and defaults	LCCT output without overhead and MGMT:
\$164,707	\$237,017	\$185,846	\$168,951
	44%	13%	3%



Sensitivity analysis: County Court

DESIGN DEFAULTS	defaults (values in col G can be changed)		
Maximum drainage area to surface area ratio	20	6.7	Unitless
Water Quality Volume Requirement	45	45	m ³ /ha
Filter Media Depth	0.75	0.5	m
Ponding depth	0.2	0.3	m
Safety factor	2.5	2.5	Unitless
Void ratio	40	40	%
Mulch depth	0.075	0.075	m

\$141,777

\$80,725

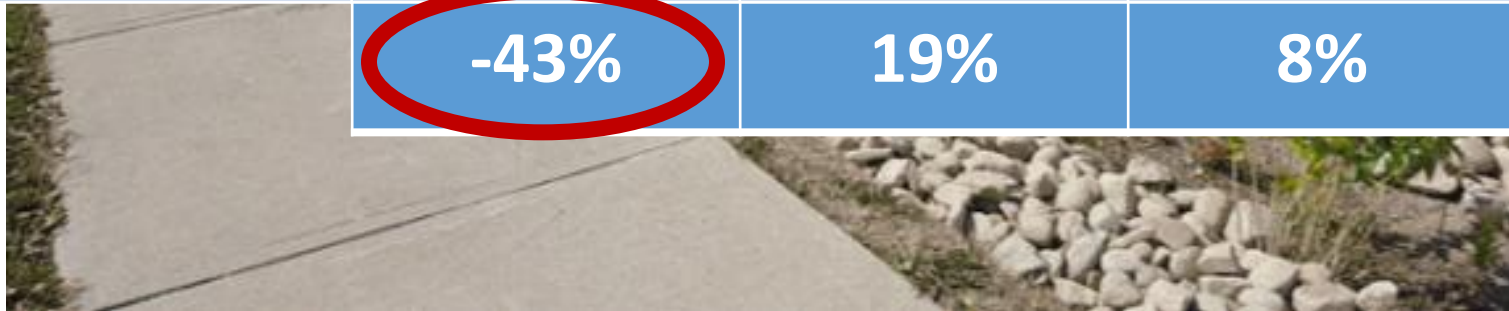
\$168,081

152,801

-43%

19%

8%



Sensitivity analysis: CVC parking lot

Construction cost (adjusted for inflation)	LCCT output: user inputs only	LCCT output: user inputs and defaults	LCCT output without overhead and MGMT:
\$321,570	\$327,058	\$336,272	\$303,702
	2%	5%	-5%



Sensitivity analysis: TRCA parking lot

Construction cost (adjusted for inflation)	LCCT output: user inputs only	LCCT output: user inputs and defaults	LCCT output without overhead and MGMT:
\$140,750	\$140,658	\$148,233	\$134,757
	0%	5%	-4%



Comments

- Comparing LID practices to one another and LID to ponds: it uses the same unit costs/assumptions across the board
- The tool (so far!) exceeds our goals for construction cost accuracy
- Design, contingency, and project management required for full capital costs (adjust the extra 10%)
- The tool is very useful for knowing whether your bids are in the right ballpark
- “Full” release coming soon ...

What we hope to get from you: data

- We're hoping to do further sensitivity analyses for the other stormwater management practices
- We especially need:
 - Infiltration/exfiltration trenches
 - Infiltration chambers
 - Rainwater harvesting
 - Enhanced grass swales
 - Green roofs
 - Wet and dry ponds

Visit the STEP Booth!

Exhibitor's Gallery (10b)

Thank you

For more information:

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