A Review of Stormwater Quality Modelling Tools and How They Compare to MUSIC

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STORM Calculator





Background

MUSIC is NOT and Industry Standard.

MUSIC inputs and outputs/results

Are the Industry Standard.

How do we verify that tools responsible for billions of dollars worth of assets are appropriate?

Current Best Practice and Authority Guidelines

MUSIC-type inputs (catchment areas, treatments, etc.)

Some form/type of mathematical engine. This engine can be the MUSIC engine or an alternative

Outputs similar to MUSIC



Background

STORM can comply with "Industry Standard".

InSite Water can comply with "Industry Standard".

STORMupdated can comply with "Industry Standard".

STORM

Impervious Area Names	Impervious Area (m ²)	Treatment Type More information	Treatment Size (m ² or L)	Number of Bedrooms	Delete Row
test	500	Raingarden 300mr~	3	0 ~	
test2	333	Raingarden 100mr~	2	0 ~	
Add Treatment R	ow Delet	None Rainwater Tank Pond	Ca	lculate	Restart
Vhy Bedrooms? The number of	f bedrooms is nee	Wetland 200mm Wetland 400mm	anks. The STO	DRM Calculator a	assumes that the
ainwater tank is connected for eliable a demand as toilet flush he next time it rains, and less s	flushing toilets, an ning, especially in tormwater pollutio	Raingarden 100mm Raingarden 300mm	litres of dema e demand, the	nd per day. Garo e more space in f	ten irrigation is not as the tank to collect wate

Impervious Areas Rainwater demand?			Manufactured end-of-lin	e treatment device		
Tollet + Laundry Area Name 🕈	Area Type 🕈	Area (m²)	No end-of-line treatment Treatment Type	t v	Treatment size (L/s) Treatment Size (m ² /L/ items)	No. Bedrooms
Carpark LIVE STORM Result Roof to tank LIVE STORM Result	Road TN:108.6 TP:155.6 Roaf Roaf TN:0.0 TP:0.0	 3129 TSS: 110.6 2135 TSS: 0.0 	Bioretention 100mm + GP:142.9 Flow Re None + None	40 eduction: 5.1 Size (m ²) ction: 0.0	Water Supply L/Items) Water Supply	Reliability (%):N
This site has pervious sections Pervious Areas		Tra	Bioretention • Rainwater Tank - • Above Slab Buried	Area (5605.00 m² 5605.00m²	

InSite Water

Specify Stormwater Runoff Areas and Treatments

Enter only the impervious areas in your site connected to Council or Stormwater Authority drains. To simplify imput add total roof areas and total tank a areas like garden, gravel and lawn areas.

Impervious area	Impervious area name	Impervious Area (m2)	Stormwater Quality	Example drawing
->Please choose 👻			Improvement Device	✓ Show
Only add areas that are	Enter your own name for	Size of impervious area in	(3010)	
npervious and that are onnected to drainage	this impervious area	square metres	No treatment 🗸 🗸	
connected to drainage	(optional)		Select Stormwater Quality Improvement Device (SQID)	
Manufacturer project su	pport			
Tick this box to conse	nt to the			
Device Manufacturer or project builder once pr	ontacting the oject			

⊕ Add another impervious area ⊖

Some form/type of mathematical engine. This engine can be the MUSIC engine or an alternative

Outputs similar to MUSIC



STORM vs InSite vs STORMupdated vs MUSIC input interface

Problem

Are these tools:

STORM

InSite Water

STORMupdated

Complying with current Industry Standard?





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37	Croserial Street							
City	Council				Factoria			
Impenie	Areas.	_						
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(Inter+Louis	ay				No and of its	e trasterz.	·····	1
	an biome B		Acus Type?	Area (m ²)	Tranton	nt Type	Transferrant Give	No.
							(IV/5/ Remit)	Occupants
(capark)			Roat	w) x22	Bioretention 104	lws = 20	(IV'S,/ Remit)	Occupants
Carpark 1 L/AE S	TORN Result	10106.0	Road TP: 182.8	 #00 TBR 122.4 Fest 	Boreerson to	Fire Freitaber 18.0	(W.L/ News) Vote: Supply	Occupants Encución (%) 1514
LANG S	TORN Result	TRIMAN TRIMAN	Road TP 180.8 Real TP 180.8	 ✓ 822 TER 102.4 ✓ 813 TER 116 	Boreletton 10 GP 1923 Harveiter Tank GP 1923	The Feducities 11 0 About 1948 • 193 Fiber Feducition 24 0	(IV 6, News) Wer Supp New Supp	Decements Enclosely (5):514 Benoonly (5):513
Separk 1 U/6 S Not 1 U/6 S S The steres S The steres Area Name Indecapt	TORM Result TORM Result NOT ATCO generate sectors Was dres Type	101104	Road 17 190 5 Reaf 1P 190 9 es.pr) Teat	•	Boreardon 10 CP 1033 Marvedar Talas CP 1423 (P 1423 (P 1423)	Aver • 20 Fax Restance 10 Acoust two with Fax Restance 10 Fax Restance 10 Table Columnet 1 monitories Area Parviage Area	97% / Horse Wear Supply Wear S	Decensaries
Engank I Long si Intel 1 Unit S Engand S S Thus site has Pervices An Anabecape Long strong I Engandecape	CORM Result CORM Result CORM Result SUPPORT Area Type Descript Common States Type States Type States Type States Type	100-116.4 TRE-118.6 10 52 70- 222.2	Road TP 100 6 Road TP 100 9 ea pry Trade Barrier Toto 116 7 0	•) 802 T00:0204 •) 813 T00:716 T00:716 Res Res Res Res Res Res Res Res Res Res	Boxeentoon 100 on-1423 Reynoldti Tates on-1423 Hernoldti Tates on-1423 Hernoldti Tates on-1423	The Federation 12 0 Access 584 = 180 Access 584 = 180 R and 584 Access 12 0 The Federation State Servers State Calcherers State Servers State		Osceptante Terrately (%)500 Bringolay (%)500
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STORM and STORMupdated vs MUSIC input interface

Analysis

STORM

STORMupdated

Compared to

same models

built by MUSIC

and

STORM Assumptions:

- 1. Rainfall impact is negligible STORM rainfall data doesn't comply with the Guidelines,
 - 2. Difference between mixed and roof/road/landscape is not relevant,
- 3. Permeable areas are not relevant and
- 4. Total Nitrogen is the hardest to remove pollutant.

STORMupdated Assumptions:

None.

InSite Assumptions

- 1. Rainfall can be modified significantly Insite rainfall data doesn't comply with the Guidelines,
- 2. Difference between mixed and roof/road/landscape is not relevant,
- 3. Permeable areas are not relevant and
- 4. Total Nitrogen is the hardest to remove pollutant.



STORM and STORMupdated vs MUSIC input interface

Analysis

STORM

and

STORMupdated

Compared to same models built by MUSIC

Analysis:

- 1. Models built appropriately in MUSIC (following Guidelines) vs STORM vs STORMupdated
 - Comparison with and without permeable areas
- 2. Models built only with Mixed nodes
 - Comparison with and without permeable areas

Rainwater Tank Demand was set at 20L/person/day, as it is confirmed in STORM.



Comparison – models created as per Guidelines

-									Difference (no pervious)				Difference	(pervious)															
Proiect			Total Area		Size		Catchment	STORM	STORN	Aupdated (no perv)	M	IUSIC (no per	rv)	STOR	Mupdated (wperu)	Ν	MUSIC (wiper	.u)	Pervious	MUSIC & STORM	MUSIC	and STORM	updated	MUSIC & STORM	MUSIC	and STORM	updated
Identifier	Council	Address	(sqm)	Impervious Areas	(sqm)	Treatment	Туре	TN	TN	ТР	TSS	τN	TP	TSS	TN	ТР	TSS	TN	TP	TSS	Area	TN	TN	TP	TSS	TN	τN	TP	TSS
				Roof1	155.00	Rainwater Tank 3,000L 2Broom																							
				Roof 2	130.00	Rainwater Tank 3,000L 2Broom																							
		127 Stawell		Roof 3	130.00	Rainwater Tank 3,000L 2Broom	a - l'h																						
101	campaspe	VIC 3564	996	Unit Driveway	30.00	Bioretention 100mm 1.3sq m	Spirt	99.67	75.20	98.70	85.30	80.44	105.11	87.25	63.30	85.90	76.90	66.22	90.22	78.88	406.00	-19.23	5.24	6.41	1.95	-33.45	2.92	4.32	1.97
				Common Drive way	115.00	Bioretention 100mm 1.3sq m																							
				Common Drive way	30.00	N/A																							
				Bidg 1	500.00	Rainwater Tank 15,000L 5 Broom																							
	~	2 Despatch Street	3150	Bidg 2	500.00	Rainwater Tank 15,000L 5 Broom	c - l'h					~ ~ ~	403.54									40.77					0.77		0.00
103	campaspe	Echuca VIC 3564	345.6	Bidg. 3	500.00	Rainwater Tank 15,000L OBroom	- spint	100.11	66.60	105.30	92.40	65.11	103.56	91.50	56.00	93.40	85.20	56.22	92.22	86.00	1221.00	-19.23	-1.49	-1.74	-0.90	-43.89	0.22	-1.18	0.80
				Drive	735.00	Bioretention 100mm 5sq m																							
	SurfCoast	12Gairloch Avenue		Roof1	145.00	Rainwater Tank 2,000L 3Broom	- 15																						
148	Shire	Landu: VIC 3228	292.5	Paving	29.00	Bioretention 100mm 1sq m	- spirt	104.58	97.50	119.00	105.30	98.44	124.89	106.88	88.50	109.90	104.00	87.56	115.33	105.38	118.50	-6.14	0.94	5.89	1.58	-17.02	-0.94	5.43	1.38
				Unit 1 Roof	157.00	Rainwater Tank 4000L 4Broom																							
				Unit 1 Paved	5.00	N/A																							
	SurfCoast	3 Regal Road		Unit 1 Driveway	15.00	N/A	o a lite	400.55																					2.02
151	Shire	VIC 3228	580	Unit 2 Roof	157.00	Rainwater Tank 4000L 4Broom	Split 109.55	95.80	61.90	27.00	92.44	61.55	22.88	87.20	56.aU	26.60	85.11	56.89	22.63	232.00	-17.11	-5.50	-0.57	-4.15	- 26.44	-4.09	0.09	- 5.98	
				Unit 2 Paved	5.00	N/A																							
				Unit 2 Driveway	15.00	N/A																							
				Unit 1	95.00	Rainwater Tank 1000L 3Broom																							
		56Stanhope		Unit 2	74.80	Rainwater Tank 1000L 3Broom																							
184	Hume	Street Broad meadows	695	Unit 3	74.80	Rainwater Tank 1000L 3Broom	Split	101.70	92.20	56.10	17.00	94.67	61.11	17.63	83.10	51.70	16.80	82.67	57.00	17.38	295.50	-7.03	2.47	5.01	0.63	-19.03	-0.43	5.30	0.57
		VIC		Unit 4	75.70	Rainwater Tank 1000L 3Broom																							
				Impervious Surfaces	79.20	N/A																							
189	Hume	143 McKell Avenue	607	Unit 1	166.05	Rainwater Tank 3,000L 3Broom	Solit	100.78	78 10	65 30	57.49	80.22	77 33	64.75	66.20	57.70	57.60	68.44	63 33	57.99	789.51	-20.06	157	12.03	7 75	-31 84	7 74	6.63	4.40
		Sunbury VIC		Unit 2	151.44	Rainwater Tank 3,000L 2Broom			10.20																		2		
				Warehouse Roof	729.00	Raingarden 100mm 6sq m	-																						
207	Hume	10 Katz Wy, Somerton	1776	Carpark1	79.27	Raingarden 100mm 2sqm	Solit	106.47	98.40	105.80	99.90	102.00	107.11	101.50	95,90	104.00	99.70	98.89	105.33	101.75	181.43	-4.47	3.60	1.31	1.60	-7.53	2.99	1.33	1.55
		VIC 3062, Australia		Carpark 2	219.00	Raingarden 100mm 2sqm		100.41	50.40	100.00		101.00	10,111	100.00		104.00		56.65	100.00	101.2	101.45		5.00		1.00		2.55	1.00	1.55
				Untreated	17.30	N/A																							
621	Gallarat	45 Victoria Street	977	Roof	475.00	Raingarden 300mm 7.6sqm	Solit	99.60	104.00	22.40	19.30	107.33	21.33	20.00	86.60	19.60	19.00	86.00	18.67	19,63	357.00	7,73	3.33	-1.07	0.70	-13.60	-0.60	-0.93	-0.63
		Sebastopol VIC 3350		Driveway	145.00	N/A																							
		419a York		Roof Areas	1,645.00	Rainwater Tank 24000L 30Broom																							
623	Gallarat	Street Ballarat East	4763	Driveway	1,030.00	Raingarden 100mm 18sq m	Split	99.71	86.40	120.40	96.80	89.78	124.44	98.00	69.90	106.70	95.50	69.33	109.78	96.63	1938.00	-9.93	3,38	4.04	1.20	- 30, 38	-0.57	3.08	1.13
		3750 VIC		Pavement	150.00	N/A																							

Comparison – models created as per Guidelines

Analysis

STORM

and

STORMupdated

Compare the results to same models built in MUSIC – SPLIT nodes, as per Guidelines

Eleanstormwater

These models are created with "split" nodes approach, and include analysis with and without the permeable area.

Analysis:

- The red cells show where STORM or STORMupdated results are less than MUSIC
- 2. The green cells show areas where STORMupdated performance results are same or more conservative than MUSIC

Comments:

- 1. STORM fails all the projects on one or more pollutant
- 2. STORM fails most of the projects on TN
- 3. TSS appears to be the hardest pollutant to remove
- 4. Permeable areas appear to make a relevant impact.
- STORMupdated results are more appropriate than MUSIC results for very small areas.

			Difference (r	no pervious)		Difference (pervious)					
	Pervious	MUSIC & STORM	MUSIC	and STORM	updated	MUSIC & STORM	MUSIC	and STORM	updated		
	Area	TN	TN	ТР	TSS	TN	TN	ТР	TSS		
	406.00	-19.23	5.24	6.41	1.95	-33.45	2.92	4.32	1.97		
	1221.00	-19.23	-1.49	-1.74	-0.90	-43.89	0.22	-1.18	0.80		
8	118.50	-6.14	0.94	5.89	1.58	-17.02	-0.94	5.43	1.38		
	232.00	-17.11	-3.36	-0.57	-4.13	- 26.44	-4.09	0.09	-3.98		
	295.50	-7.03	2.47	5.01	0.63	-19.03	-0.43	5.30	0.57		
	289.51	- 20.06	1.52	12.03	7.35	- 31.84	2.24	6.63	4.40		
	181.43	-4.42	3.60	1.31	1.60	-7.53	2.99	1.33	1.55		
	357.00	7.73	3.33	-1.07	0.70	-13.60	-0.60	-0.93	-0.63		
	1938.00	-9.93	3.38	4.04	1.20	- 30, 38	-0.57	3.08	1.13		

Comparison – models created with MIXED nodes

																	Difference (no pervious)					Difference (pervious)						
Project	Coursil	Address	TotalArea	Impervious	Size	Treatment	Catchment	STORM	STOR	Mupdated (r	io perv)	ľv	IUSIC (no pe	rv)	STORN	Aupdated (w	vperv)	P	AUSIC (wiper	ru)	Pervious	MUSIC& STORM	MUSIC	and STORM	updated	MUSIC& STORM	MUSICa	and STORM	updated
Identifier	COUNCIL	Houress	(sqm)	Areas	(sqm)	The service of the se	Түре	TN	τN	TP	TSS	τN	ТР	TSS	TN	TP	TSS	TN	ТР	TSS	Area	TN	τN	тр	TSS	TN	TN	ТР	TSS
148	SurfCoast	12Gairloch	7075	Roof1	145.00	Painwater Tank 2,000L 3Broom	Mixed	104.58	107.00	130.30	00.40	107 67	137 77	01.13	97.00	176 30	89.70	97.56	178 44	90.50	118 50	-1.01	-0.73	2.02	0.73	-7.07	0.56	714	0.80
140	Shire	VIC 3228	252.5	Paving	29.00	Bioretention 100mm 1sq m	ionaed	104.58	102.90	130.20	50.40	102.07	152.22	91.15	57.00	120.30	49.70	97.50	125.44	90.50	118.50	-1.51	-0.25	2.02	0.75	-7.02	0.50	2.14	0.80
				Unit 1	95.00	Rainwater Tank 1000L 3Broom																							
		56 Stanbore		Unit 2	74.80	Rainwater Tank 1000L 3Broom	1																						
184	Hume	Street Broad meadows	695	Unit 3	74.80	Rainwater Tank 1000L 3Broom	Mixed	101.70	78.90	96.90	62.50	81.11	100.22	63.88	69.50	90.10	61.30	71.78	93.78	62.75	295.50	-20.59	2.21	3.32	1.38	-29.92	2.28	3.68	1.45
		VIC		Unit 4	75.70	Rainwater Tank 1000L 3Broom																							
				Impervious Surfaces	79.20	N/A																							
180	Li umo	143 McKell Avenue		Unit 1	166.05	Rainwater Tank 3,000L 3Broom	Rained	100.78	78.00	116.70	82.80	04 22	177.44	95 7 5	74.40	110.00	87.30	24.00	116.00	00.75	780 51	12.05	7.47	5.74	4.45	76.78	0.40	6.00	1.45
109	nume	Sunbury VIC		Unit 2	151.44	Rainwater Tank 3,000L 2Broom	ivitied	100.28	78.90	110.70	a 5.a0	81.55	122.44	ao.20	74.40	110.00	82.30	74.00	110.00	85.75	209.51	-18.95	2.45	5.74	1.45	-20.25	-0.40	0.00	1.45
				Warehouse Roof	729.00	Raingarden 100mm 6sqm																							
		10 Katz Wy, Somerton		Carpark1	79.27	Raingarden 100mm 2sqm	1																						
207	Hume	VIC 3062, Australia	1226	Carpark 2	219.00	Raingarden 100mm 2sqm	Moved	106.42	96.50	126.50	100.20	99.11	127.56	101.75	94.60	125.00	99.80	97.33	126.22	101.38	181.43	-7.31	2.61	1.06	1.55	-9.09	2.73	1.22	1.57
				Untreated	17.30	N/A																							
679	Palacet	45 Victoria Street	077	Roof	475.00	Paingarden 300mm 7.6sqm	Minud		116.70	117 70		447 77	115 11		104.40	110.50	80.10	105.77	108.80	80.12	77.00		17	3.00	0.70	6.67	107	1 01	0.07
621	banarat	Sebastopol VIC 3350	977	Driveway	145.00	N/A	ivibed	99.00	116.20	117.20	90.20	117.55	115.11	90.00	104.40	110.50	49.10	106.22	108.89	89.15	357.00		15	-2.09	-0.20	0.02	1.82	-1.61	0.03
		419a York		Roof Areas	1,645.00	Rainwater Tank 24000L 30Broom																							
623	Ballarat	Street Ballarat East	47 63	Driveway	1,030.00	Paingarden 100mm 18sq m	Mixed	99.71	97.60	120.60	90.00	99.56	123.78	90.75	86.00	112.50	88.70	88.44	116.00	89.63	1938.00	-0.15	1.96	3.18	0.75	-11.27	2.44	3.50	0.92
		VIC 3350		Pavement	150.00	N/A																							
1399	City of Melbourne	Unit 1 45 Albert Street East Melbourne VIC 3002	170	Roof	101.10	Rainwater Tank 2000L 2Broom	Mixed	102.00	77.40	116.90	84.50	81.11	123.56	86.88	68.90	109.30	82.90	72.67	116.00	85.38	68.90	- 20.89	3.71	6.66	2.38	-29.33	3.77	6.70	2.47
				Roof Area South	825.00	Rainwater Tank 30000L100Broom																							
1401	Glen Eira	10-16SELWYN ST	5600	Roof Area North	2, 270.00	Rainwater Tank 40000L 100Broom	Mixed	104.30	92.40	106.90	65.10	95.78	110.22	67.25	88.20	104.10	64.60	91.78	107.56	66.88	1165.00	-8.52	3.38	3.32	2.15	-12.52	3.58	3.46	2.28
		VIC 3185		Remaining Impervious Untreated	1,340.00	N/A]																						
		36-58 Macaulay Road North		Roof Catchment Area	1,400.00	Rainwater Tank 60000L SOBroom																							
1404	Melbourne	Melbourne VIC	2784	Remaining Impervious Untreated	979.00	N/A	Mixed	100.04	95.30	103.50	61.90	95.11	106.44	65.63	93.50	102.3	61.70	92.22	104.67	65.38	405.00	-4.93	-0.19	2.94	3.73	-7.82	-1.28	2.37	3.68
1423	Melbourne	64 Clarendon Street	412	Roof Catchment Incl Terrace	293.00	Painwater Tank 5000L 100Broom	Mixed	105.68	133.10	131.00	76.80	133.78	134.00	76.38	132.00	130.70	76.80	133.78	134.00	76.38	10.00	28.1	0.68	3.00	-0.42	1,78	1.78	3,30	-0.42
		VIC 3006		Remaining Impervious	109.00	N/A																							



Comparison – models created with Mixed nodes

Analysis

STORM

and

STORMupdated

Compare the results to same models built in MUSIC – MIXED nodes

Cleanstormwater

These models are created with "mixed" nodes approach, and include analysis with and without the permeable area.

Analysis:

- The red cells show where STORM or STORMupdated results are less than MUSIC
- 2. The green cells show areas where STORMupdated performance results are same or more conservative than MUSIC

Comments:

- 1. STORM fails all the projects on one or more pollutant, EVEN ON MIXED
- 2. STORM fails most of the projects on TN
- 3. TSS appears to be the hardest pollutant to remove
- 4. Permeable areas appear to make a relevant impact.
- 5. STORMupdated results are slightly conservative compared to MUSIC.

	D	merence (n	о региюца,		Difference (pervious)				
Pervious	MUSIC& STORM	MUSICa	and STORM	updated	MUSIC8: STORM	MUSICa	and STORM	updated	
Area	ΤN	ΤN	ТР	TSS	τN	ΤN	ТР	TSS	
118.50	-1.91	-0.23	2.02	0.73	-7.02	0.56	2.14	0.80	
295.50	-20.59	2.21	3.32	1.38	- 29.92	2.23	3.66	1.45	
289.51	-18.95	2.43	5.74	1.45	- 26, 28	-0.40	6.00	1.45	
181.43	-7.31	2.61	1.06	1.55	-9.09	2.73	1.22	1.57	
357.00		1.13	-2.09	-0.20	6.62	1.82	-1.61	0.03	
1938.00	-0.15	1.96	3.18	0.75	-11.27	2.44	3.50	0.92	
68 .90	- 20.89	3.71	6.66	2.38	-29.33	3.77	6.70	2.47	
1165.00	-8.52	3.38	3.32	2.15	-12.52	3.58	3.46	2.28	
405.00	-4.93	-0.19	2.94	3.73	-7.82	-1.28	2.37	3.68	
10.00	28.1	0.68	3.00	-0.42	1.78	1.78	3.30	-0.42	

Comparison – models created per Guidelines w 60Lpd RWT demand

Project			Total Area	Impervious	Size	_	Catchment	STOR	Mupdated (no	perv)		MUSIC (no per	v)	Pervious	InSite	Rainfall	STORMupdated	
Identifier	Council	Address	(sqm)	Areas	(sqm)	Treatment	Туре	TN	TP	TSS	TN	TP	TSS	Area	TN	Location	vs InSite	MUSIC vs InSite
	_	1 Studley Park Road		All Roof Areas	343.00	Rainwater Tank 7000L 50BRx3												
1605	Boroondara	Kew VIC3101	538.00	Other Impervious Area	174.00	N/A	'Split'	136.00	78.60	15.10	135.78	71.78	15.25	21.00	133.00	2.00	3.00	2.78
				Roof existing building	123.00	Rainwater Tank 3800L 3BR x3												
1607	Dest Divisio	13 Wilton Grove	748.00	Roof apartment building including roof terrace	228.00	RainwaterTank7000L10BRx3	(Colleg	116 70	00.00	27.00	110.00	91 56	20.00	120.00	126.00	2.00	0.90	67
1697	Port Philip	Elwood VIC3184	748.00	Driveway adjacentto existing building	66.00	Raingarden300mm11.9sqm	spire	116.70	80.80	37.20	119.35	01.56	39.00	130.00	126.00	2.00	-9.30	-6.67
				Remaining Impermeable area	201.00	n/a												
-	141 .	119 Beach Road		RoofAreas	527.00	Rainwater Tank 17500 15BR×3					101.00					14.00		
2166	Kingston	Parkdale VIC3195	1015.00	Remaining Impervious	156.00	N/A	зрис	129.00	80.40	20.20	131.33	80.89	20.50	332.00	83.00	16.00	46.00	48.33
		Lot 534, 80		RoofAreas	1,092.00	Rainwater Tank 20000L 30 BRx3												
2203	Wyndham	Woods Rd Truganina	2104.00	Remaining Impervious	295.00	N/A	'Split'	121.20	94.70	47.30	122.00	94.89	47.88	567.00	130.00	2.00	-8.80	-8.00
		VIC3029		Driveway to rain garden	150.00	Raingarden100mm3sqm												
		22 Arthur Street		Roof & Terrace Areas	612.00	RainwaterTank20000L30BRx3												
2231	Nillumbik	Eltham VIC3095	1207.00	Remaining Impervious	405.00	n/a	'Split'	116.80	51.70	11.60	118.67	57.78	11.75	190.00	122.00	2.00	-5.20	-3.33
		121 Lygon		Roof & Terraces	620.00	RainwaterTank1750030BRx3												
2264	Moreland	Street East Brunswick	1382.00	TH Roof & Terraces	239.00	Raingarden 300 mm 8 sqm	'Split'	111.40	45.70	13.00	112.00	48.67	13.13	56.00	116.00	2.00	-4.60	-4.00
		VIC3057		Remaining Impervious	467.00	n/a												
		1 Lombardy		Roof	2,351.60	RainwaterTank50000L60BRx3												
3497	Whittlesea	drive	3470.50	Carpark	233.20	Raingarden 300mm 4 sqm	'Split'	137.60	118.60	67.20	138.89	122.89	68.25	642.80	149.00	2.00	-11.40	-10.11
		VIC3754		Footpath	242.90	n/a												
		293-295		Roof	449.34	RainwaterTank12200L20BRx3												
3914	Maribyrnong	Ballarat Road Braybrook	1117.59	Balcony	17.85	N/A	'Split'	107.40	42.90	10.90	106.44	53.11	11.00	355.50	95.00	2.00	12.40	11.44
		VIC3019		Driveway/Paving	294.90	N/A												
				RW tank shed	154.00	RainwaterTank4000L7BRx3												
		78 Newcombe		RW tank E	445.00	RainwaterTank10000L20BRx3												
3472	Geelong	Portarlington	3451.00	RWtankW	541.00	RainwaterTank14000L30BRx3	'Split'	177.60	181.40	121.20	180.22	182.89	122.38	1356.00	170.00	17.00	7.60	10.22
		VIU3223		RG1	600.00	Raingarden 300mm 20 sqm												
				RG2	355.00	Raingarden 300 mm 10 sqm												

Comparison – models created with Split nodes

Analysis

InSite

and

STORMupdated

Compare the results to same models built in MUSIC – SPLIT nodes These models are created with "split" nodes approach, and include analysis with and without the permeable area.

Analysis:

- The red cells show where InSite has better TN results than MUSIC or STORMupdated
 - The green cells show areas where InSite performance results are same or more conservative than MUSIC or STORMupdated

Comments:

- 1. InSite fails 8 our of 9 projects on pollutants other than TN.
- InSite TN results vary wildly compared to MUSIC or STORMupdated (4 x conservative, 5 x overpredicting)
- 3. STORMupdated results consistently track MUSIC results
- 4. TN is clearly not the hardest pollutant to remove.

Pervious	InSite	Rainfall	STORMupdated	MURIC us la Cito
Area	TN	Location	vs InSite	MUSIC VS IIISILE
21.00	133.00	2.00	3.00	2.78
130.00	126.00	2.00	-9.30	-6.67
332.00	83.00	16.00	46.00	48.33
567.00	130.00	2.00	-8.80	-8.00
190.00	122.00	2.00	-5.20	-3.33
56.00	116.00	2.00	-4.60	-4.00
642.80	149.00	2.00	-11.40	-10.11
355.50	95.00	2.00	12.40	11.44
1356.00	1356.00 170.00		7.60	10.22



Analysis

InSite rainfalls.

Compare the Rainfalls allocated by InSite to ONE council to the rainfalls covered by that Council in the MW MUSIC Guidelines Map.

Comparison InSite Rainfall coverage vs MW MUSIC Guidelines Map

InSite only allocates one rainfall per Council.

Table to the right shows overlap of rainfalls (top) over Council areas, with "InSite rainfall location" showing the one rainfall InSite allocates to that Council.



Appendix D: Comparison of Insite Rainfall Locations

	In§ite	Melbourne Water Rainfall Regions											
Council	Rainfall Location	Little River	Melbourne Airport	Melbourne City	Koo Wee Rup	Narre Warren North	Mount St Leonard						
Boroondara	2	400mm-500mm	500mm-650mm	650mm-750mm	750mm-850mm	850mm-1100mm	110mm-2100mm						
Know	2 6												
Reiox	10												
Bass coase	10												
Banyule Bausida	2												
Bayside	2												
Brimbank	2												
Lardinia	ь												
Casey	16												
Darebin	2												
Frankston	16												
Frenchisland	16												
GlenEira	2												
Golden Plains Shire ¹	17												
Greater Dandenong	16												
Greater Geelong ²	17												
Hobsons Bay	2												
Hume	2												
Kingston	16												
Macedon Ranges	2												
Manningham	6												
Maribyrnong	2												
Maroondah	6												
Melbourne	2												
Melton Shire	2												
Mildura³	22												
Mitchell ⁴	2												
Monash	6												
Moonee Vallev	2												
Moorabool?	2												
Moreland	2												
Mornington Peninsula	16												
Murrindindi ^e	6												
Nillumbik	2												
Port Phillip	2												
South Giopsland [®]	- 16												
Stonnington	2												
\A/bitehorse	- 6												
\//hittlesea	2												
Windham	2												
Varra	2												
Yarra Dangas	۲ د												
raira kanges	D												

Comparison InSite Rainfall coverage vs MW MUSIC Guidelines Map

Analysis

Insite value is	Little Diver	Melhourne Airport	Melhourne City Koo Wee Pun	Narre Warren	Mount St	Others
used to		Meibourne Airport	Memburne City Roo wee Rup	Nth	Leonard	Others
replace:	400mm-500mm	500mm-650mm	650mm-750mm 750mm-850mm	850mm-1100mm	110mm-2100mm	mm specified below
2						+ 493mm +719mm (Moorabool) + 564mm + 618mm (Mitchell)
6						+ 618mm, 1,105mm, 753mm (Murrindindi)
16						+ 1,106mm South Gippsland mlb
17						2 x Greater Geelong, 1 x Golden Plains
22						1 mlb in Mildura



Conclusions

Our analysis shows definitively that:

STORM does NOT comply with "Industry Standard"

InSite Water does NOT comply with "Industry Standard"

STORMupdated DOES comply with "Industry Standard"

STORM

Impervious Area Names	Impervious Area (m ²)	Treatment Type More information	Treatment Size (m ² or L)	Number of Bedrooms	Delete Row
test	500	Raingarden 300mr~	3	0 ~	
test2	333	Raingarden 100mr~	2	0 ~	
Add Treatment R	Add Treatment Row Deleter Rainwater Tank Pond				Restart
Wetland 200mm Why Bedrooms? The number of bedrooms is nee. Trainwater tank is connected for flushing toilets, and Raingarden 100mm reliable a demaid as toilet flushing, especially in Y Raingarden 300mm			anks. The STORM Calculator assumes that the litres of demand per day. Garden irrigation is not as a demand, the more space in the tank to collect water		
the next time it rains, and less s	tormwater pollutio	Infiltration Sand			

Rainwater demand?					Manufactured end-of	l-line treatment device:		
Toilet + Laundry	۲				No end-of-line treatm	nent 🗸	Treatment size (L/s)	
Area Name 💡		Area Type 💡		Area (m²)	Treatment Type	•	Treatment Size (m ² /L/ items)	No. Bedrooms
Carpark		Road	~	3129	Bioretention 100mm •	40		
LIVE STORM Result	TN:108.6	TP:155.6	TS	B:110.6	GP:142.9 Flow	Reduction:6.1	Water Supply	y Reliability (%):N
Roof to tank		Roof	~	2135	None -	Size (m² /	L/items)	
LIVE STORM Result	TN:0.0	TP:0.0	ΤS	IS: <mark>0.0</mark>	None	ction:0.0	Water Supply	y Reliability (%):N
					Bioretention -			
This site has pervious sections					Rainwater Tank - 🝷			
Pervious Areas					Above Slab	Area	5605.00 m²	
					Buried	chment area	5605.00m²	
Area Name Area Type	A	rea (mº) Treatm	ent Typ	e ire Siz		us Area	5264.00m²	
Cround .	0.4.1	Disentent			Enviss Pit	Area	341.00m²	
Ground V	241	Bioretent	100	- P	SQIDEP .	Invious Areas	1	
LIVE STORM Result ? TN: 175.4	TP: 0.0	TSS: 98.1 GP:	142.9	Flow Redu	Ecocol Storm DR Close 27	101 01		

STORMupdated Calculator

eatment Noder

InSite Water

Specify Stormwater Runoff Areas and Treatments

Enter only the impervious areas in your site connected to Council or Stormwater Authority drains. To simplify imput add total roof areas and total tank a areas like garden, gravel and lawn areas.

Impervious area	Impervious area name	Impervious Area (m2)	Stormwater Quality	Example drawing	
->Please choose 👻			Improvement Device	✓ Show	
Only add areas that are	Enter your own name for	Size of impervious area in	(3010)		
impervious and that are	this impervious area	square metres	No treatment 🗸 🗸		
connected to drainage	(optional)		Select Stormwater Quality Improvement Device (SQID)		
Manufacturer project su Tick this box to conse Device Manufacturer co project builder once pr	pport int to the ontacting the roject				

⊕ Add another impervious area 🛛 ⊖ I

Some form/type of mathematical engine. This engine can be the MUSIC engine or an alternative

Outputs vastly different from MUSIC

Outputs VERY SIMILAR to MUSIC Outputs vastly different from MUSIC







