

**Supplementary Data: equations/functions/values used in the quantitative SD model**

**Table 1.** Equations and values used in the quantitative SD model

Variable Group	Variable	Type	Dimension	Equations/ Initial Value
<b>Amount of C&amp;D waste generated or disposed to landfills</b>	Accumulated amount of C&D waste landfilled	Stock/Level	tonne	Accumulated amount of C&D waste landfilled = INTEG(Waste landfilling, $1.51 \times 10^6$ )
	Amount of C&D waste generated yearly	Stock/Level	tonne	Amount of C&D waste generated yearly = INTEG(Waste generating – Waste reducing, $1.091 \times 10^6 \times 1.001$ )
	Decreasing rate of landfilling	Auxiliary	1/Year	Decreasing rate of landfilling = (“Decreasing rate of inert waste disposed to landfills” + Waste decreasing rate) ÷ 2
	Decreasing rate of inert waste disposed to landfills	Auxiliary	1/Year	"Decreasing rate of inert waste disposed to landfills" = WITH LOOKUP (((“Motivation of off-site sorting of waste” + “Motivation of on-site sorting of waste” + Motivation of waste recycling) ÷ 3)
	Motivation of off-site sorting of waste	Auxiliary	dimensionless	Motivation of off-site sorting of waste = (Motivation of waste management × 0.6+ “Motivation of off-site sorting of waste lookup”(“Unit charge of off-site sorting facilities”)) ÷ 2
	Motivation of on-site sorting of waste	Auxiliary	dimensionless	Motivation of on-site sorting of waste = (Motivation of waste management × 0.8 + “Motivation of on-site sorting of waste lookup”(Unit charge of public fill reception facilities)) ÷ 2
	Motivation of waste management	Auxiliary	dimensionless	Motivation of waste management = WITH LOOKUP (Unit landfill charge)
	Motivation of waste minimization	Auxiliary	dimensionless	Motivation of waste minimization = Motivation of waste management × 0.9

	Motivation of waste recycling	Auxiliary	dimensionless	Motivation of waste recycling = Motivation of waste management $\times$ 0.7
	Waste generating	Auxiliary	tonne/Year	Waste generating = Waste increasing rate $\times$ "Amount of C&D waste generated yearly"
	Waste increasing rate	Auxiliary	1/Year	Waste increasing rate = Waste increasing rate lookup(Time)
	Waste landfilling	Auxiliary	tonne/Year	Waste landfilling = "Amount of C&D waste generated yearly" $\times$ (1 – Decreasing rate of landfilling)
	Waste reducing	Auxiliary	tonne/Year	Waste reducing = "Amount of C&D waste generated yearly" $\times$ Waste reducing rate
	Waste reducing rate	Auxiliary	1/Year	Waste reducing rate = WITH LOOKUP (Motivation of waste minimization)
<b>Government's Cost to supply and operate landfill sites and cost recovery from revenues</b>	Estimated capital cost of NENT Extension	Auxiliary	Dollar	Estimated capital cost of NENT Extension = IF THEN ELSE(Extension of NENT extended landfill capacity > 0, $1.8395 \times 10^9$ , IF THEN ELSE(Remaining capacities of three existing landfills > 0, 0, IF THEN ELSE(Extension of SENT extended landfill capacity > 0, 0, $1.8395 \times 10^9$ )))
	Estimated capital cost of SENT Extension	Auxiliary	Dollar	Estimated capital cost of SENT Extension = IF THEN ELSE(Extension of SENT extended landfill capacity > 0, $1.993 \times 10^9$ , IF THEN ELSE(Remaining capacities of three existing landfills > 0, 0, $1.993 \times 10^9$ ))
	Estimated capital cost of WENT Extension	Auxiliary	Dollar	Estimated capital cost of WENT Extension = IF THEN ELSE(Extension of WENT extended landfill capacity > 0, $9.5 \times 10^6$ , IF THEN ELSE(Remaining capacities of three existing landfills > 0, 0, IF THEN ELSE(Extension of SENT extended landfill capacity > 0, 0, IF THEN ELSE(Extension of NENT extended landfill capacity > 0, 0, $9.5 \times 10^6$ ))))
	Landfill operating cost	Auxiliary	Dollar	Landfill operating cost = IF THEN ELSE(Time < 2016, ("Accumulated amount of C&D waste landfilled" $\times$ Unit operating cost) $\times$ 0.5, "Accumulated amount of C&D waste landfilled" $\times$ Unit operating cost)
	Government payback period (with percentage of costs recovered)	Auxiliary	dimensionless	Government payback period (with percentage of costs recovered) = (Total landfill charge $\div$ Total government cost for landfill disposal) $\times$ 100

	Total Capital costs	Auxiliary	Dollar	Total Capital costs = IF THEN ELSE(Time < 2016, (Capital costs of three existing landfills + Estimated capital costs of NENT extension + Estimated capital costs of SENT extension + Estimated capital costs of WENT extension) × 0.5, Capital costs of three existing landfills + Estimated capital costs of NENT extension + Estimated capital costs of SENT extension + Estimated capital costs of WENT extension)
	Total government cost for landfill disposal	Auxiliary	Dollar	Total government cost for landfill disposal = Landfill operating cost + Total Capital costs
	Total landfill charge	Auxiliary	Dollar	Total landfill charge = "Amount of C&D waste landfilled" × Unit landfill charge
	Unit landfill charge	Auxiliary	Dollar/tonne	IF THEN ELSE(Time < 2016, 125, 125)
<b>Landfill Capacities and extension schedules</b>	Total remaining landfill capacity	Auxiliary	tonne	Total remaining landfill capacity = Remaining capacities of three existing landfills + Extension of NENT extended landfill capacity + Extension of SENT extended landfill capacity + Extension of WENT extended landfill capacity
	Remaining capacity of three existing landfills	Auxiliary	tonne	Remaining capacity of three existing landfills = IF THEN ELSE( $1.82264 \times 10^7 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , 0, $1.82264 \times 10^7 - \text{"Accumulated amount of C\&D waste landfilled"}$ )
	Extension of NENT extended capacity	Auxiliary	tonne	Extension of NENT extended capacity = IF THEN ELSE( $9.035 \times 10^6 + 1.82264 \times 10^7 + 6.6025 \times 10^6 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , 0, IF THEN ELSE( $1.82264 \times 10^7 + 9.035 \times 10^6 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , $9.035 \times 10^6 + 1.82264 \times 10^7 + 6.6025 \times 10^6 - \text{"Accumulated amount of C\&D waste landfilled"}$ , 0))
	Extension of SENT extended capacity	Auxiliary	tonne	Extension of SENT extended capacity = IF THEN ELSE( $9.035 \times 10^6 + 1.82264 \times 10^7 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , 0, IF THEN ELSE( $1.82264 \times 10^7 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , $9.035 \times 10^6 + 1.82264 \times 10^7 - \text{"Accumulated amount of C\&D waste landfilled"}$ , 0))
	Extension of WENT extended capacity	Auxiliary	tonne	Extension of WENT extended capacity = IF THEN ELSE( $9.035 \times 10^6 + 1.82264 \times 10^7 + 2.81475 \times 10^7 + 6.6025 \times 10^6 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , 0, IF THEN ELSE( $1.82264 \times 10^7 + 9.035 \times 10^6 + 6.6025 \times 10^6 - \text{"Accumulated amount of C\&D waste landfilled"} < 0$ , $9.035 \times 10^6 + 1.82264 \times 10^7 + 2.81475 \times 10^7 + 6.6025 \times 10^6 - \text{"Accumulated amount of C\&D waste landfilled"}$ , 0))

				"Accumulated amount of C&D waste landfilled" < 0, $9.035 \times 10^6 + 1.82264 \times 10^7 + 2.81475 \times 10^7 + 6.6025 \times 10^6 -$ "Accumulated amount of C&D waste landfilled", 0))
<b>Illegal dumping</b>	Accumulated amount of C&D waste illegally dumped	Stock/Level	tonne	Accumulated amount of C&D waste illegally dumped = INTEG(Illegal dumping, $0.001 \times$ "Accumulated amount of C&D waste landfilled")
	Completeness of regulations	Auxiliary	dimensionless	Completeness of regulations =WITH LOOKUP (Time)
	Expected cost of violation of regulation	Auxiliary	Dollar	Expected cost of violation of regulation = Penalty $\times$ Probability of receiving penalty
	Decreasing rate of illegal dumping	Auxiliary	dimensionless	Decreasing percentage of illegal dumping = WITH LOOKUP (Expected cost of violation of regulation)
	Effectiveness of execution (prosecution)	Auxiliary	dimensionless	Effectiveness of execution (prosecution) = WITH LOOKUP ("Accumulated amount of C&D waste illegally dumped" $\div$ "Accumulated amount of C&D waste landfilled")
	Effectiveness of regulation	Auxiliary	dimensionless	Effectiveness of regulation = Effectiveness of execution (prosecution) $\times$ 0.4 + Completeness of regulations $\times$ 0.2 + Effectiveness of supervision $\times$ 0.4
	Effectiveness of supervision	Auxiliary	dimensionless	Effectiveness of supervision = WITH LOOKUP (Time)
	Illegal dumping	Auxiliary	tonne/Year	Illegal dumping = Waste landfilling $\times$ (Rate of illegal dumping – decreasing rate of illegal dumping)
	Rate of illegal dumping	Auxiliary	dimensionless	Rate of illegal dumping =WITH LOOKUP (Unit landfill charge)

**Table 2:** Lookup table used in the SD model 1 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of average motivation of off-site sorting of waste, on-site sorting of waste, and waste recycling	Values of decreasing rate of inert waste disposed to landfills
0.1	0.005
0.2	0.1
0.3	0.21
0.4	0.28
0.5	0.35
0.6	0.5
0.7	0.65
0.8	0.75
0.9	0.85

**Table 3:** Lookup table used in the SD model 2 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of unit charge of off-site sorting facilities	Values of motivation of off-site sorting of waste
75	0.7
100	0.5
125	0.4
150	0.38
175	0.3
200	0.2
225	0.1
250	0.05

**Table 4:** Lookup table used in the SD model 3 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of unit charge of public fill facilities	Values of motivation of on-site sorting of waste
27	0.7
50	0.6
75	0.5
100	0.45
125	0.3
150	0.2
175	0.1

**Table 5:** Lookup table used in the SD model 4 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of unit landfill charge	Values of motivation of waste management
75	0.05
100	0.1
125	0.15
175	0.18
225	0.23
275	0.27
325	0.3
375	0.35
425	0.4
475	0.45
525	0.5
575	0.6
625	0.7
675	0.8
725	0.9

**Table 6:** Lookup table used in the SD model 5 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of year	Values of waste increasing rate
2006	0.116
2007	-0.313
2008	0.055
2009	-0.172
2010	0.328
2011	-0.166
2012	0.52
2013	-0.413
2014	0.296
2015	0.173
2016	0.12
2017	0.6
2018	-0.02
2019	0.12
2020	-0.19
2021	-0.15
2022	0.11
2023	-0.13
2024	0.08
2025	0.08
2026	0.08
2027	0.08
2028	0.08
2029	0.08
2030	0.08

**Table 7:** Lookup table used in the SD model 6 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of motivation of waste minimization	Values of waste reducing rate
0.005	0.0075
0.1	0.015
0.2	0.02
0.3	0.025
0.4	0.028
0.5	0.03
0.6	0.035
0.7	0.04
0.8	0.045
0.9	0.05

**Table 8:** Lookup table used in the SD model 7 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of unit landfill charge	Values of rate of illegal dumping
75	0.008
125	0.01
175	0.014
225	0.017
275	0.021
325	0.025
375	0.028
425	0.031
475	0.035
525	0.041
575	0.048
625	0.058
675	0.07
725	0.085



**Table 9:** Lookup table used in the SD model 8 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of expected cost of violation of regulation	Values of decreasing percentage of illegal dumping
1000	0.0005
2000	0.001
3000	0.0015
4000	0.002
5000	0.0025
6000	0.003
7000	0.004
8000	0.005
9000	0.006
10000	0.008
11000	0.01
12000	0.011
13000	0.012
14000	0.013
15000	0.014
16000	0.015
17000	0.016

**Table 10:** Lookup table used in the SD model 9 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of ("amount of C&D waste illegal dumped" ÷ "accumulated amount of C&D waste landfilled")	Values of effectiveness of execution (prosecution)
0.0005	0.005
0.001	0.09
0.005	0.15
0.01	0.2
0.05	0.25
0.1	0.35
0.15	0.45
0.2	0.5
0.25	0.6
0.3	0.7
0.5	0.9
0.8	1
1	1

**Table 11:** Lookup table used in the SD model 10 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of effectiveness of regulation	Values of probability of receiving penalty
0.1	0.11
0.16	0.15
0.3	0.2
0.4	0.25
0.5	0.35
0.6	0.4
0.7	0.5
0.8	0.6
0.9	0.7

**Table 12:** Lookup table used in the SD model 11 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of year	Values of completeness of regulations
2006	0.2
2010	0.25
2015	0.3
2020	0.4
2025	0.5
2030	0.6

**Table 13:** Lookup table used in the SD model 12 (Source: Environmental Protection Department of Hong Kong and expert estimates)

Values of year	Values of effectiveness of supervision
2006	0.15
2010	0.25
2015	0.4
2020	0.5
2025	0.6
2030	0.7