Screening method for emissions to air from landfill sites (typical gas engines, flare stacks and area sources)

1.0 Horizontal Guidance Note IPPC H1 "Environmental Assessment and Appraisal of BAT" issued by the Environment Agency gives criteria for screening out insignificant emissions to air, which do not warrant further assessment. Air emissions are considered to be insignificant if

Maximum Process Contribution (long-term) ≤ 1% of the long-term Environmental Assessment Level (or Environmental Quality Standard)

and

Maximum Process Contribution (short-term) ≤ 10% of the short-term Environmental Assessment Level (or Environmental Quality Standard).

Note: These inequalities may also be applied to critical levels and critical loads when conducting Habitats assessments for nearby European sites.

2.0 Tables 1 and 2 can be used with estimated emission rates such as those calculated by GasSim (taking the predicted maximum 95th percentile emission rate over the life of the landfill site) to determine the maximum long-term and short-term process contributions of emissions from typical gas engines and flare stacks. Worked examples are given in Appendix 1.

Table 1a Maximum hourly ground level concentration beyond a given distance from a typical landfill gas engine (mg/m^3 per g/s emitted)

Shortest distance from engine to site boundary or nearest sensitive receptor	Height of gas engine stack (m)											
	3.5	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**	**20**	**25**	**30**
< 50 m	460	380	255	185	135	100	85	75	35	20	15	10
50 m	330	300	240	185	135	100	85	75	35	20	15	10
100 m	160	155	140	125	115	100	85	75	35	20	15	10
150 m	100	100	95	85	80	75	70	60	35	20	15	10
200 m	75	70	70	65	60	55	55	50	35	20	15	10
250 m	55	55	55	50	50	45	45	40	30	20	15	10
300 m	45	45	45	40	40	40	35	35	25	20	15	10
350 m	40	40	35	35	35	35	30	30	25	15	15	10
400 m	35	35	30	30	30	30	25	25	20	15	10	10
450 m	30	30	30	25	25	25	25	25	20	15	10	10
500 m	25	25	25	25	25	25	20	20	15	15	10	10

Table 1b Maximum hourly ground level concentration beyond a given distance from a typical landfill flare stack (mg/m^3 per g/s emitted)

Shortest distance from flare to site boundary or nearest sensitive receptor	Height of flare stack(m)									
	2.5	3	4	5	6	7	8	9	10	12
< 50 m	1795	1065	715	400	285	195	140	105	75	55
50 m	325	315	290	255	215	180	140	105	75	55
100 m	130	130	125	120	110	100	90	80	75	55
150 m	80	80	75	75	70	65	60	60	55	45
200 m	55	55	55	50	50	50	45	45	40	35
250 m	40	40	40	40	40	35	35	35	35	30
300 m	35	35	35	30	30	30	30	30	25	25
350 m	30	30	30	25	25	25	25	25	25	20
400 m	25	25	25	25	20	20	20	20	20	20
450 m	20	20	20	20	20	20	20	20	15	15
500 m	20	20	20	20	15	15	15	15	15	15

Table 2a Maximum annual mean ground level concentration beyond a given distance from a typical landfill gas engine (mg/m^3 per g/s emitted)

Shortest distance from engine to site boundary or nearest sensitive receptor	Height of gas engine stack (m)											
	3.5	4	5	6	7	8	9	10	15	20	25	30
< 50 m	19	17	13	11	9.5	8	7	6	3.5	2	1.5	1
50 m	19	17	13	11	9.5	8	7	6	3.5	2	1.5	1
100 m	15	14.5	13	11	9.5	8	7	6	3.5	2	1.5	1
150 m	10	10	9.5	9	8	7.5	7	6	3.5	2	1.5	1
200 m	7	7	7	6.5	6.5	6	5.5	5.5	3.5	2	1.5	1
250 m	5.5	5.5	5.5	5	5	5	4.5	4.5	3	2	1.5	1
300 m	4	4	4	4	4	4	3.5	3.5	3	2	1.5	1
350 m	3.5	3.5	3.5	3.5	3.5	3	3	3	2.5	2	1.5	1
400 m	3	3	3	3	3	2.5	2.5	2.5	2	1.5	1.5	1
450 m	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	1.5	1	1
500 m	2	2	2	2	2	2	2	2	1.5	1.5	1	1

Table 2b Maximum annual mean ground level concentration beyond a given distance from a typical landfill flare stack (μg/m³ per g/s emitted)

Shortest distance from flare to site boundary or nearest sensitive receptor	Height of flare stack(m)									
	2.5	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12**
< 50 m	13.5	12	10.5	7.5	7	6	5.5	4.5	4	3
50 m	12.5	12	10.5	7.5	7	6	5.5	4.5	4	3
100 m	8.5	8.5	8.5	7.5	7	6	5.5	4.5	4	3
150 m	6	6	6	6	5.5	5	5	4.5	4	3
200 m	4.5	4.5	4.5	4.5	4.5	4	4	4	3.5	3
250 m	3.5	3.5	3.5	3.5	3.5	3.5	3	3	3	2.5
300 m	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5
350 m	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2
400 m	2	2	2	2	2	2	2	2	2	1.5
450 m	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
500 m	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

3.0 Table 3 can be used with estimated emission rates such as those calculated by GasSim (taking the predicted maximum 95th percentile emission rate for the year in question) to determine the maximum long-term and short-term process contributions of emissions from a typical landfill area source such as an active cell. A worked example is given in Appendix 2.

Table 3 Maximum hourly and annual mean ground level concentrations beyond a given distance from a typical landfill area source (μg/m³ per g/s emitted)

Shortest distance from sensitive receptor to nearest edge of ground level area source	Maximum hourly ground level concentration (μg/m³ per g/s emitted)	Maximum annual mean ground level concentration (μg/m³ per g/s emitted)
50 m	8000	165
100 m	6000	80
150 m	5000	45
200 m	4000	35
250 m	3500	25
300 m	3000	20
350 m	2500	15
400 m	2000	15
450 m	2000	10
500 m	1500	10

4.0 Horizontal Guidance Note IPPC H1 also gives criteria for determining whether detailed modelling is required for air emissions that have not been screened out by the criteria specified in 1.0 above. Detailed modelling is required if

[Process Contribution (long-term) + background concentration] > 70% of the long-term Environmental Assessment Level (or Environmental Quality Standard)

or

[Process Contribution (short-term) + 0.2 × background concentration] > 20% of the short-term Environmental Assessment Level (or Environmental Quality Standard).

Note that the background concentration to be used in short-term assessments is typically **twice** the annual mean background concentration. Worked examples are given in Appendices 1 and 2.

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Appendix 1 Worked examples for gas engines and flare stacks

Example 1 There are a gas engine stack (7 m high) and flare stack (10 m high), emitting 0.5 g/s and 0.1 g/s respectively of nitrogen oxides (expressed as NO_2). The shortest distances from the gas engine stack and flare stack to the landfill site boundary are 400 m and 500 m respectively. The background annual mean concentration of nitrogen dioxide is 20 $\mu g/m^3$. Is detailed modelling required?

Solution:

Environmental Assessment Level (long–term) for nitrogen dioxide = 40 $\mu g/m^3$
Environmental Assessment Level (short–term) for nitrogen dioxide = 200 $\mu g/m^3$

Emissions from the gas engine and flare stack are considered separately because they are not expected to operate simultaneously.

For the gas engine:

Maximum Process Contribution (long-term) = emission rate $\times$ 3 $\mu g/m^3$ (from Table 2) = 0.5 $\times$ 3 $\mu g/m^3$ = 1.5 $\mu g/m^3$

Maximum Process Contribution (short-term) = emission rate $\times$ 30 $\mu g/m^3$ (from Table 1) = **0.5** $\times$ 0.5 $\times$ 30 $\mu g/m^3$ = 7.5 $\mu g/m^3$

Note: For assessment against the short-term standard we assume that only 50% of the nitrogen oxides are oxidised to NO_2.

Although the maximum process contribution (short-term) < 10% of the short-term Environmental Assessment Level (or Environmental Quality Standard), the maximum process contribution (long-term) > 1% of the long-term Environmental Assessment Level (or Environmental Quality Standard), so the air emission from the gas engine may be significant.

Process Contribution (long-term) + background concentration = 1.5 $\mu g/m^3$ + 20 $\mu g/m^3$ = 21.5 $\mu g/m^3$

Process Contribution (short-term) + 0.2 $\times$ background concentration = 7.5 $\mu g/m^3$ + 0.2 $\times$ **2** $\times$ 20 $\mu g/m^3$ = 15.5 $\mu g/m^3$

Note: Background concentration doesn't necessarily mean background annual mean concentration. For assessment against short-term standards, twice the background annual mean is taken.

Since the [Process Contribution (long-term) + background concentration] < 70% of the long-term Environmental Assessment Level (or Environmental Quality Standard) and the [Process Contribution (short-term) + 0.2 $\times$ background concentration] < 20% of the short-term Environmental

Assessment Level (or Environmental Quality Standard), no detailed modelling is required.

For the flare stack:

Maximum Process Contribution (long-term) = emission rate × 1.5 $\mu g/m^3$ (from Table 2) = 0.1 × 1.5 $\mu g/m^3$ = 0.15 $\mu g/m^3$

Maximum Process Contribution (short-term) = emission rate × 15 $\mu g/m^3$ (from Table 1) = 0.5 × 0.1 × 15 $\mu g/m^3$ = 0.75 $\mu g/m^3$

Since the maximum process contribution (short-term) < 10% of the short-term Environmental Assessment Level (or Environmental Quality Standard) and the maximum process contribution (long-term) < 1% of the long-term Environmental Assessment Level (or Environmental Quality Standard), the air emission from the flare stack is considered to be insignificant.

Example 2 There are two gas engine stacks, both of which are 7 m tall and emit to air 0.5 g/s of nitrogen oxides (expressed as NO_2). The shortest distance from the gas engine stacks to the landfill site boundary is 400 m. The background annual mean concentration of nitrogen dioxide is 20 $\mu g/m^3$. Is detailed modelling required?

Solution:

Environmental Assessment Level (long–term) for nitrogen dioxide = 40 $\mu g/m^3$
Environmental Assessment Level (short–term) for nitrogen dioxide = 200 $\mu g/m^3$

For the two gas engines:

Total emission rate = 2 × 0.5 = 1 g/s

Maximum Process Contribution (long-term) = emission rate × 3 $\mu g/m^3$ (from Table 2) = 1 × 3 $\mu g/m^3$ = 3 $\mu g/m^3$

Maximum Process Contribution (short-term) = emission rate × 30 $\mu g/m^3$ (from Table 1) = **0.5** × 1 × 30 $\mu g/m^3$ = 15 $\mu g/m^3$

Note: For assessment against the short-term standard we assume that only 50% of the nitrogen oxides are oxidised to NO_2.

Although the maximum process contribution (short-term) < 10% of the short-term Environmental Assessment Level (or Environmental Quality Standard), the maximum process contribution (long-term) > 1% of the long-term Environmental Assessment Level (or Environmental Quality Standard), so the air emission from the gas engines may be significant.

Process Contribution (long-term) + background concentration = 3 $\mu g/m^3$ + 20 $\mu g/m^3$ = 23 $\mu g/m^3$

Process Contribution (short-term) + 0.2 × background concentration = 15 $\mu g/m^3$ + 0.2 × **2** × 20 $\mu g/m^3$ = 23 $\mu g/m^3$

Note: Background concentration doesn't necessarily mean background annual mean concentration. For assessment against short-term standards, twice the background annual mean is taken.

Since the [Process Contribution (long-term) + background concentration] < 70% of the long-term Environmental Assessment Level (or Environmental Quality Standard) and the [Process Contribution (short-term) + 0.2 × background concentration] < 20% of the short-term Environmental Assessment Level (or Environmental Quality Standard), no detailed modelling is required.

Appendix 2 Worked example for a landfill area source

A 100 m × 100 m landfill cell emits benzene at a rate of 10^{-6} $g/m^2/s$. The nearest sensitive receptor is 350 m from the nearest edge of the cell. Is detailed modelling required?

Solution:

Environmental Assessment Level (long–term) for benzene = 16.25 $\mu g/m^3$
Environmental Assessment Level (short–term) for benzene = 208 $\mu g/m^3$

For the area source:

Total emission rate = 10,000 m^2 × 10^{-6} $g/m^2/s$ = 0.01 g/s

Maximum Process Contribution (long-term) = emission rate × 15 $\mu g/m^3$ (from Table 3) = 0.15 $\mu g/m^3$

Maximum Process Contribution (short-term) = emission rate × 2500 $\mu g/m^3$ (from Table 3) = 25 $\mu g/m^3$

The maximum process contribution (long-term) < 1% of the long-term Environmental Assessment Level (or Environmental Quality Standard), but the maximum process contribution (short-term) > 10% of the short-term Environmental Assessment Level (or Environmental Quality Standard).

However, assuming a zero background concentration, [Process Contribution (short-term) + 0.2 × background concentration] < 20% of the short-term Environmental Assessment Level (or Environmental Quality Standard), so no detailed modelling is required.