# Appendix 3B

Helicopter Information	Unit Remarks
Helicopter Model	Airbus H175
Engine Type	Twin Engine Turboshaft
No. of Engine	2
Max. SHP of Engine	1776 SHP
Fuel Sulphur Content by Weight	0.3 %

SO <sub>2</sub> Emission Rate for Idling Mode	Unit	Remarks
Time in Mode (Idling)	300 s	
Estimated SHP	106.56 SHP	1
Fuel Flow per Engine	0.02351591 kg/s	2
SO <sub>2</sub> Emission Rate	0.282190917 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.023516 g/s	4
Total Emission of Idling Mode	84.65727506 g	

SO <sub>2</sub> Emission Rate for Hovering (Approach) and Touchdown Mode	Unit	Remarks
Time in Mode (Hovering (Approach) + Touchdown)	8 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.002820 g/s	4
Total Emission of Hovering (Approach) + Touchdown	10.15258092 g	

SO <sub>2</sub> Emission Rate for Hovering (Take Off) and Lift-Off Mode	Unit	Remarks
Time in Mode (Hovering (Take Off) + Lift-Off)	8 s	
Estimated SHP	1776 SHP	1
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.002820 g/s	4
Total Emission of Hovering (Take Off) + Lift-Off	10.15258092 g	

SO <sub>2</sub> Emission Rate for Take-off or Aprroach Mode along the Flight Path (SW1)	Unit	Remarks
Time in Mode (Take-off/ Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.021151 g/s	4
Effective area of the line source	2320.71 m <sup>2</sup>	6
Averaged SO <sub>2</sub> Emission Rate in an Hour	9.11411E-06 g/s/m <sup>2</sup>	
Total Emission of Take-off/ Approach	76.14435688 g	

SO <sub>2</sub> Emission Rate for Take-off or Aprroach Mode along the Flight Path (SW2)	Unit	Remarks
Time in Mode (Take-off/ Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.021151 g/s	4
Effective area of the line source	2204.86 m <sup>2</sup>	6
Averaged SO <sub>2</sub> Emission Rate in an Hour	9.59299E-06 g/s/m <sup>2</sup>	!
Total Emission of Take-off/ Approach	76.14435688 g	

## Appendix 3B

SO <sub>2</sub> Emission Rate for Take-off or Aprroach Mode along the Flight Path (N1)	Unit	Remarks
Time in Mode (Take-off/ Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.021151 g/s	4
Effective area of the line source	1780.43 m <sup>2</sup>	6
Averaged SO <sub>2</sub> Emission Rate in an Hour	1.18798E-05 g/s/m <sup>2</sup>	2

SO <sub>2</sub> Emission Rate for Take-off or Aprroach Mode along the Flight Path (N2)	Unit	Remarks
Time in Mode (Take-off/ Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.021151 g/s	4
Effective area of the line source	1875.77 m <sup>2</sup>	6
Averaged SO <sub>2</sub> Emission Rate in an Hour	1.1276E-05 g/s/m <sup>2</sup>	2

SO <sub>2</sub> Emission Rate for Take-off or Aprroach Mode along the Flight Path (N3)	Unit	Remarks
Time in Mode (Take-off/ Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.021151 g/s	4
Effective area of the line source	1557.92 m <sup>2</sup>	6
Averaged SO <sub>2</sub> Emission Rate in an Hour	1.35766E-05 g/s/m <sup>2</sup>	2

SO <sub>2</sub> Emission Rate for Take-off or Aprroach Mode along the Flight Path (N4)	Unit	Remarks
Time in Mode (Take-off/ Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
SO <sub>2</sub> Emission Rate	1.269072615 g/s	3
Averaged SO <sub>2</sub> Emission Rate in an Hour	0.021151 g/s	4
Effective area of the line source	1472.51 m <sup>2</sup>	6
Averaged SO <sub>2</sub> Emission Rate in an Hour	1.43641E-05 g/s/m <sup>2</sup>	!

Total Emission per Helicopter Flight 257 g
Assume 1 flight per day, i.e. 365 flights in 1 year 93897 g
0.094 tonnes

## Remarks:

- 1) The power for take-off per engine would be 100% of the maximum power. For Idling, 6% of maximum power per engine was employed as per Table 4 of Guidance on the Determination of Helciopter Emission (GDHE) (Swiss Confederation 2015)
- 2) The estimated fuel flow for the proposed helciopter is based on the empirical formula as listed in Section 3.2, Fuel Flow for Engines above 1000 SHP, GDHE
- 3) Emission rate for each engine = Fuel flow x Sulphur Content x 2
- 4) There will be <1 helicopter operation in a day. For conservative approach, the emission rate for 1 helciopter was applied to each hour of a year in the mdoel in order to obtain the worst concentration.
- 5) It is assumed 100% engine power for conservation approach.
- 6) The width of the line source is assemed to be the same as the width of H175, 2.85m. Length is shown in Appendix 301.

## Appendix 3B

Helicopter Information	Unit	Remarks
Helicopter Model	Airbus H175	
Engine Type	Twin Engine Turboshaft	
No. of Engine	2	
Max. SHP of Engine	1776 SHP	

NO <sub>v</sub> Emission Rate for Idling Mode	Unit	Remarks
Time in Mode (Idling)	300 s	
Estimated SHP	106.56 SHP	1
Fuel Flow per Engine	0.02351591 kg/s	2
NO <sub>x</sub> Emission Factor	2.992021646 g/kg	3
NO <sub>x</sub> Emission Rate	0.140720222 g/s	4
Total Emission of Idling Mode	42.216067 g	

NO <sub>v</sub> Emission Rate for Hovering (Approach) and Touchdown Mode	Unit	Remarks
Time in Mode (Hovering (Approach) + Touchdown)	8 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
NO <sub>x</sub> Emission Factor	14.77774834 g/kg	3
NO <sub>x</sub> Emission Rate	3.12567262 g/s	4
Total Emission of Hovering (Approach) + Touchdown	25.005381 g	

NOx Emission Rate for Hovering (Take Off) and Lift-Off Mode	Unit	Remarks
Time in Mode (Hovering (Take Off) + Lift-Off)	8 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
NO <sub>x</sub> Emission Factor	14.77774834 g/kg	3
NO <sub>x</sub> Emission Rate	3.12567262 g/s	4
Total Emission of Hovering (Take Off) + Lift-Off	25.005381 g	

NOx Emission Rate for Take-off Mode along the Flight Paths	Unit	Remarks
Time in Mode (Take-off)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
NO <sub>x</sub> Emission Factor	14.77774834 g/kg	3
NO <sub>x</sub> Emission Rate	3.12567262 g/s	4
Total Emission of Take-off/ Approach	187.540357 g	

NOx Emission Rate for Aprroach Mode along the Flight Paths	Unit	Remarks
Time in Mode (Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
NO <sub>x</sub> Emission Factor	14.77774834 g/kg	3
NO <sub>x</sub> Emission Rate	3.12567262 g/s	4
Total Emission of Take-off/ Approach	187.540357 g	

Total Emission per Helicopter Flight 467 g
Assume 1 flight per day, i.e. 365 flights in 1 year 170567 g
0.171 tonnes

#### Remarks:

- 1) The power for take-off per engine would be 100% of the maximum power. For Idling, 6% of maximum power per engine was employed as per Table 4 of Guidance on the Determination of Helciopter Emission (GDHE) (Swiss Confederation 2015)
- 2) The estimated fuel flow for the proposed helciopter is based on the empirical formula as listed in Section 3.2, Fuel Flow for Engines above 1000 SHP, GDHE
- 3) The emission factor for the proposed helicopter is based on the empirical formula as listed in Section 3.2, Emission Factors for NOx for Engines above 1000 SHP, GDHE
- 4) Emission rate for each mode = Fuel flow x Emission Factor x 2
- 5) It is assumed 100% engine power for conservation approach.

Helicopter Information	Unit Remar
Helicopter Model	Airbus H175
Engine Type	Twin Engine Turboshaft
No. of Engine	2
Max. SHP of Engine	1776 SHP

PM Emission Rate for Idling Mode		
Time in Mode (Idling)	300 s	
Estimated SHP	106.56 SHP	1
Fuel Flow per Engine	0.02351591 kg/s	2
PM Emission Factor	0.130271317 g/kg	3
PM Emission Rate	0.006126897 g/s	4
Total Emission of Idling Mode	1.838069 g	

PM Emission Rate for Hovering (Approach) and Touchdown Mode		
Time in Mode (Hovering (Approach) + Touchdown)	8 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
PM Emission Factor	0.374472192 g/kg	3
PM Emission Rate	0.079205401 g/s	4
Total Emission of Hovering (Approach) + Touchdown	0.633643 g	

PM Emission Rate for Hovering (Take Off) and Lift-Off Mode		
Time in Mode (Hovering (Take Off) + Lift-Off)	8 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
PM Emission Factor	0.374472192 g/kg	3
PM Emission Rate	0.079205401 g/s	4
Total Emission of Hovering (Take Off) + Lift-Off	0.633643 g	

PM Emission Rate for Take-off Mode along the Flight Paths		
Time in Mode (Take-off)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
PM Emission Factor	0.374472192 g/kg	3
PM Emission Rate	0.079205401 g/s	4
Total Emission of Take-off/ Approach	4.752324 g	

PM Emission Rate for Aprroach Mode along the Flight Paths		
Time in Mode (Approach)	60 s	
Estimated SHP	1776 SHP	1,5
Fuel Flow per Engine	0.105756051 kg/s	2
PM Emission Factor	0.374472192 g/kg	3
PM Emission Rate	0.079205401 g/s	4
Total Emission of Take-off/ Approach	4.752324 g	

Total Emission per Helicopter Flight 13 g
Assume 1 flight per day, i.e. 365 flights in 1 year 4603 g
0.0046 tonnes

#### Remarks

- 1) The power for take-off per engine would be 100% of the maximum power. For Idling, 6% of maximum power per engine was employed as per Table 4 of Guidance on the Determination of Helciopter Emission (GDHE) (Swiss Confederation 2015)
- 2) The estimated fuel flow for the proposed helciopter is based on the empirical formula as listed in Section 3.2, Fuel Flow for Engines above 1000 SHP, GDHE
- 3) The emission factor for the proposed helicopter is based on the empirical formula as listed in Section 3.2, Emission Factors for PM for Engines above 1000 SHP, GDHE
- 4) Emission rate for each mode = Fuel flow x Emission Factor x 2
- 5) It is assumed 100% engine power for conservation approach.