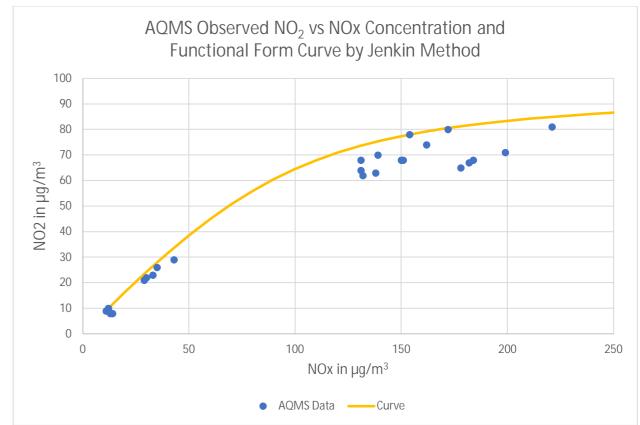
## Appendix 3.9 Derivation of Cumulative Annual Average NOX-to-NO2 Conversion Equation using Jenkin Method

## Jenkin Method for Long-term Cumulative NO<sub>2</sub> Assessment

With reference to the *Review of Methods for NO to NO<sub>2</sub> Conversion in plumes at short ranges*<sup>1</sup>, Jenkin method was adopted for the conversion of cumulative annual average NO<sub>x</sub> to NO<sub>2</sub> by using the functional form of annual mean of NO<sub>2</sub>-to-NO<sub>x</sub>. The mentioned functional form is referenced from Jenkin, 2004a<sup>2</sup> and is presented below:

$$[NO2] = \frac{\left( [\text{NOx}] + [\text{OX}] + \frac{J}{k} \right) - \sqrt{([NOx] + [OX] + \frac{J}{k})^2 - 4[NOx][OX]}}{2}$$
 where 
$$[\text{NO}_2] \qquad \text{is the NO}_2 \text{ concentration}$$
 
$$[\text{NO}_x] \qquad \text{is the NOx concentration}$$
 
$$[\text{OX}] \qquad \text{is the sum of NO}_2 \text{ concentration and O}_3 \text{ concentration (i.e. [OX] = [NO}_2] + [O_3])}$$
 
$$J \qquad \text{is the photolysis rate of NO}_2$$
 
$$k \qquad \text{is the rate coefficient for reaction between NO and O}_3$$

The above functional form was used to analyze the annual mean data obtained from the nearest EPD's air quality monitoring stations (AQMS) including Tuen Mun general station, Tap Mun general station and Roadside AQMS (i.e. Mong Kok roadside station). The recent five years annual mean data are extracted and presented in below table. Scattered plot for recent 5 years annual means  $NO_2$  versus  $NO_x$  concentrations obtained from relevant AQMS was created. The functional form curve would fit the annual mean data when  $[OX] = 95.57 \ \mu g/m^3$  and  $J/k = 17.114 \ \mu g/m^3$ . The value of [OX] and J/k are considered reasonable as they are within typical value range for Hong Kong. The resulting functional form curve was adopted for the cumulative annual average  $NO_x$  to  $NO_2$  conversion. The curve is slightly higher than all the annual mean data obtained from AQMS, the calculated annual average  $NO_2$  concentration using the obtained functional form curve based on the observed annual average  $NO_x$  obtained from AQMS are presented in below table, the calculated annual average  $NO_2$  concentration are higher than the observed annual average  $NO_2$  concentration is expected.



For the long-term cumulative  $NO_2$  assessment (i.e. predictions of annual average  $NO_2$  concentration), cumulative annual average  $NO_x$  to  $NO_2$  conversion equation for this assessment was calculated as follows:

$$= \frac{([NO2]_c}{2} = \frac{([NOx]_c + 95.57 + 17.11) - \sqrt{([NOx]_c + 95.57 + 17.11)^2 - 4[NOx]_c \times 95.57}}{2}$$
 where

 $[NO_2]_c$  is the predicted cumulative  $NO_2$  concentration

 $[NO_x]_c$  is the predicted cumulative  $NO_x$  concentration

Environment Agency. 2007. *Review of methods for NO to NO<sub>2</sub> conversion in plumes at short range.* Prepared by Environmental Agency.

Jenkin. 2004a. *Analysis of sources and partitioning of oxidant in the UK – Part 1: The NOx-dependence of annual mean concentrations of nitrogen dioxide and ozone.* Atmospheric Environment, 38, 5117-5129.

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## Appendix 3.9 Derivation of Cumulative Annual Average NOX-to-NO2 Conversion Equation using Jenkin Method

Annual Average NO<sub>X,</sub> NO<sub>2</sub> and OX concentration in Recent Five Years (Year 2019-2023) at Selected EPD AQMS

AQMS Data of the Past 5 Years				
Year	Station	NO2 (ug/m3)	NOx (ug/m3)	Conversion
2019	TSEUNG KWAN O	29	43	33.7
2020	TSEUNG KWAN O	23	33	26.5
2021	TSEUNG KWAN O	26	35	27.9
2022	TSEUNG KWAN O	21	29	23.4
2023	TSEUNG KWAN O	22	30	24.2
2019	TAP MUN	10	12	10.0
2020	TAP MUN	9	11	9.2
2021	TAP MUN	10	12	10.0
2022	TAP MUN	8	13	10.8
2023	TAP MUN	8	14	11.6
2019	MONG KOK	78	154	78.0
2020	MONG KOK	74	162	79.2
2021	MONG KOK	70	139	75.3
2022	MONG KOK	64	131	73.6
2023	MONG KOK	68	131	73.6
2019	CENTRAL	80	172	80.5
2020	CENTRAL	68	151	77.5
2021	CENTRAL	68	150	77.3
2022	CENTRAL	62	132	73.8
2023	CENTRAL	63	138	75.1
2019	CAUSEWAY BAY	81	221	84.9
2020	CAUSEWAY BAY	68	184	81.9
2021	CAUSEWAY BAY	71	199	83.3
2022	CAUSEWAY BAY	65	178	81.2
2023	CAUSEWAY BAY	67	182	81.6