













Figure 2 - Indoor PM<sub>10</sub> concentrations (a) House B, 1-week pre/post lockdown; (b) House B typical diurnal profiles; (c) House F, 1-week pre/post lockdown; (d) House F typical diurnal profiles.

Average daily PM<sub>2.5</sub> and PM<sub>10</sub> concentrations for each house were compared with the corresponding WHO Air Quality Guidelines (AQG) (15 µg/m<sup>3</sup> and 45 µg/m<sup>3</sup> for PM<sub>2.5</sub> and PM<sub>10</sub>, respectively). In general, the PM<sub>2.5</sub> limit was exceeded more frequently than the PM<sub>10</sub> limit. Similar studies (Algarni et al., 2021; Cowell et al., 2023) have shown that WHO limits are typically exceeded with increased occupancy, but these mostly apply to homes which only have natural ventilation. Prior to lockdown, House C exceeded the PM<sub>2.5</sub> limit on 16 of the 21 days, while the only other exceedance was one day in House E. During lockdown, House C exceeded the PM<sub>2.5</sub> limit 11 days out of the 3-week period, House E exceeded on two days, while Houses B and D both exceeded one day. The PM<sub>10</sub> limit was only exceeded twice, two different houses, each on a different day, both during lockdown. House C was identified as comprising residents who regularly smoked cigarettes indoors. Cigarette smoking has been shown to increase indoor concentrations of PM<sub>2.5</sub> up to 28 times that for non-smoking households (Algarni et al., 2021).

The variability in indoor PM concentrations across the household was investigated by comparing PM concentrations between living areas and bedrooms. As expected, PM in bedrooms tended to be lower than in the living areas (60% lower prior to lockdown, 75% lower during lockdown), potentially due to people spending more of their time in the living areas.

### 3.3 Indoor Vs Outdoor PM

Outdoor PM measurements were obtained from three nearby council-owned urban air quality monitoring stations located across central Auckland. Average PM concentrations were calculated for the three-week periods immediately prior to and following COVID-19 lockdown. Average PM<sub>2.5</sub> concentrations decreased by 34% (from 7.7 µg/m<sup>3</sup> to 5.1 µg/m<sup>3</sup>), ranging between 30% and 37% for the three stations. PM<sub>10</sub> decreased by 31% (from 17.3 µg/m<sup>3</sup> to 11.9 µg/m<sup>3</sup>), ranging between 10% and 39%. Decreases in PM<sub>10</sub> and PM<sub>2.5</sub> were expected due to reduced traffic volumes and restrictions on non-essential commerce and industry during lockdown (Laltrello et al., 2022). Figure 3a and Figure 3b compare indoor and outdoor PM<sub>2.5</sub> and PM<sub>10</sub> levels for a typical house and AQ monitoring station, one week prior to and one week immediately after COVID-19 lockdown. Despite a gradual decrease in outdoor PM









