

# UAW-GM Cohort Study

Tables and figures

December 17, 2019

Table 1: Summary of study population characteristics ( $N = 38\,549$ ; 1.51 million person-years). The cohort was restricted to individuals who were hired in or after 1938 and for whom at least half of their work history data was available. Individuals were considered lost to follow-up once they reach the maximum observed age at death.

|   | $n$    | %                      |                        |  |
|---|--------|------------------------|------------------------|--|
| Study population size ( $N$ )                                   | 38 549 | 100%                   |                        |  |
| Race  |        |                        |                        |  |
| White   | 22 816 | 59%                    |                        |  |
| African American  | 7 131  | 18%                    |                        |  |
| Unknown   | 8 602  | 22%                    |                        |  |
| Sex   |        |                        |                        |  |
| Male  | 33 792 | 88%                    |                        |  |
| Female  | 4 757  | 12%                    |                        |  |
| Plant <sup>‡</sup>  |        |                        |                        |  |
| Plant 1   | 9 090  | 24%                    |                        |  |
| Plant 2   | 17 087 | 44%                    |                        |  |
| Plant 3   | 12 372 | 32%                    |                        |  |
| Ever exposed to MWFs  |        |                        |                        |  |
| Straight  | 20 352 | 53%                    |                        |  |
| Soluble   | 31 795 | 82%                    |                        |  |
| Synthetic   | 12 523 | 32%                    |                        |  |
| Deceased by end of follow-up                                    | 20 565 | 53%                    |                        |  |
|   | Median | 25 <sup>th</sup> %tile | 75 <sup>th</sup> %tile |  |
| Years of follow-up  | 39     | 34                     | 47                     |  |
| Year of hire  | 1965   | 1952                   | 1973                   |  |
| Age at hire (years)   | 28     | 23                     | 36                     |  |
| Year of birth   | 1937   | 1922                   | 1948                   |  |
| Year of death among deceased                                    | 1996   | 1984                   | 2006                   |  |
| Age at death (years) among deceased                             | 70     | 60                     | 79                     |  |
| Cumulative exposure <sup>#</sup> to MWFs (mg/m <sup>3</sup> ·y) |        |                        |                        |  |
| Straight  | 0.66   | 0.21                   | 2.34                   |  |
| Soluble   | 4.41   | 1.74                   | 10.71                  |  |
| Synthetic   | 0.44   | 0.15                   | 1.56                   |  |

<sup>‡</sup> For individuals who worked at several plants, plant was taken to be the site where they accrued the most work record time.

<sup>#</sup> Summary statistics calculated for ever-exposed individuals at end of follow-up only. Exposures were lagged 21 years.

Table 2: Standardized mortality ratios calculated for the GM-UAW cohort followed from 1941 to 2015. NIOSH LTAS-extracted reference rates were used for the years 1940 through 2009. CDC Mortality data were used as reference rates for 2010 onwards.

| Cause of death                            | <i>N</i> | SMR  | (95% CI) <sup>b</sup> |
|---|----------|------|-----------------------|
| All causes                                | 20 565   | 0.91 | (0.89, 0.92)          |
| All natural causes                        | 18 857   | 0.89 | (0.88, 0.91)          |
| All cancers                               | 5 472    | 0.96 | (0.94, 0.99)          |
| Esophageal cancer                         | 184      | 1.06 | (0.92, 1.23)          |
| Stomach cancer                            | 192      | 1.10 | (0.95, 1.27)          |
| Intestinal cancer                         | 418      | 0.90 | (0.82, 0.99)          |
| Rectal cancer                             | 89       | 0.86 | (0.70, 1.06)          |
| Bladder and urinary organ cancers         | 146      | 0.95 | (0.81, 1.12)          |
| Bile duct, liver, and gallbladder cancers | 162      | 0.88 | (0.76, 1.03)          |
| Pancreatic cancer                         | 315      | 1.05 | (0.94, 1.17)          |
| Laryngeal cancer                          | 74       | 1.17 | (0.93, 1.47)          |
| Lung cancer                               | 1 891    | 1.07 | (1.02, 1.12)          |
| Skin cancer                               | 73       | 0.66 | (0.52, 0.83)          |
| Prostate cancer                           | 417      | 0.82 | (0.75, 0.91)          |
| Brain and nervous system cancers          | 128      | 0.99 | (0.84, 1.18)          |
| Leukemia                                  | 200      | 0.98 | (0.85, 1.12)          |
| Breast cancer                             | 76       | 0.79 | (0.63, 0.99)          |
| All nonmalignant respiratory diseases     | 1 682    | 0.84 | (0.81, 0.89)          |
| Chronic obstructive pulmonary disease     | 924      | 0.93 | (0.87, 0.99)          |
| Cirrhosis and other chronic liver disease | 379      | 0.90 | (0.81, 1.00)          |
| All heart diseases                        | 6 743    | 0.75 | (0.73, 0.77)          |
| Ischemic heart disease                    | 5 056    | 0.89 | (0.87, 0.92)          |
| Cerebrovascular disease                   | 1 080    | 0.83 | (0.78, 0.88)          |
| All external causes                       | 1 671    | 1.03 | (0.98, 1.08)          |

<sup>b</sup> Variance estimates assume Poisson-distributed rates in the observed population. Reference rates were assumed to be parameters.

Table 3: Standardized mortality ratios by race.

| Cause of death                            | White  |      |                       | African American |      |                       | African American* |      |                       |
|---|--------|------|-----------------------|------------------|------|-----------------------|-------------------|------|-----------------------|
|   | N      | SMR  | (95% CI) <sup>b</sup> | N                | SMR  | (95% CI) <sup>b</sup> | N                 | SMR  | (95% CI) <sup>b</sup> |
| All causes                                | 10 237 | 0.85 | (0.83, 0.86)          | 3 738            | 0.83 | (0.80, 0.85)          | 5 128             | 0.85 | (0.83, 0.88)          |
| All natural causes                        | 9 537  | 0.85 | (0.83, 0.87)          | 3 414            | 0.82 | (0.80, 0.85)          | 4 663             | 0.84 | (0.82, 0.87)          |
| All cancers                               | 2 863  | 0.92 | (0.88, 0.95)          | 1 045            | 0.95 | (0.89, 1.00)          | 1 357             | 0.93 | (0.88, 0.98)          |
| Esophageal cancer                         | 94     | 1.03 | (0.84, 1.26)          | 41               | 0.92 | (0.68, 1.25)          | 55                | 0.92 | (0.71, 1.20)          |
| Stomach cancer                            | 78     | 0.99 | (0.79, 1.24)          | 50               | 0.98 | (0.74, 1.29)          | 65                | 0.94 | (0.74, 1.20)          |
| Intestinal cancer                         | 221    | 0.88 | (0.77, 1.00)          | 90               | 1.05 | (0.85, 1.29)          | 106               | 0.94 | (0.77, 1.13)          |
| Rectal cancer                             | 47     | 0.83 | (0.62, 1.10)          | 13               | 0.73 | (0.43, 1.26)          | 18                | 0.77 | (0.48, 1.22)          |
| Bladder and urinary organ cancers         | 92     | 1.03 | (0.84, 1.26)          | 14               | 0.75 | (0.44, 1.26)          | 19                | 0.75 | (0.48, 1.17)          |
| Bile duct, liver, and gallbladder cancers | 92     | 0.93 | (0.76, 1.15)          | 31               | 0.67 | (0.47, 0.96)          | 43                | 0.73 | (0.54, 0.98)          |
| Pancreatic cancer                         | 154    | 0.92 | (0.79, 1.08)          | 75               | 1.31 | (1.04, 1.64)          | 90                | 1.20 | (0.97, 1.47)          |
| Laryngeal cancer                          | 31     | 0.98 | (0.69, 1.40)          | 21               | 1.27 | (0.82, 1.94)          | 24                | 1.08 | (0.73, 1.62)          |
| Lung cancer                               | 1 011  | 1.02 | (0.96, 1.09)          | 339              | 1.02 | (0.91, 1.13)          | 462               | 1.04 | (0.95, 1.14)          |
| Skin cancer                               | 49     | 0.65 | (0.49, 0.87)          | 6                | 1.07 | (0.48, 2.37)          | 8                 | 1.08 | (0.54, 2.16)          |
| Prostate cancer                           | 193    | 0.80 | (0.70, 0.93)          | 130              | 0.92 | (0.77, 1.09)          | 156               | 0.80 | (0.68, 0.93)          |
| Brain and nervous system cancers          | 79     | 0.95 | (0.76, 1.19)          | 13               | 1.08 | (0.62, 1.85)          | 24                | 1.53 | (1.03, 2.29)          |
| Leukemia                                  | 112    | 0.93 | (0.77, 1.12)          | 27               | 0.98 | (0.67, 1.42)          | 37                | 1.01 | (0.73, 1.40)          |
| Breast cancer                             | 39     | 0.76 | (0.55, 1.04)          | 17               | 0.84 | (0.52, 1.35)          | 17                | 0.83 | (0.52, 1.34)          |
| All nonmalignant respiratory diseases     | 921    | 0.84 | (0.79, 0.90)          | 226              | 0.67 | (0.59, 0.77)          | 350               | 0.77 | (0.70, 0.86)          |
| Chronic obstructive pulmonary disease     | 547    | 0.93 | (0.85, 1.01)          | 101              | 0.85 | (0.70, 1.03)          | 165               | 1.04 | (0.89, 1.21)          |
| Cirrhosis and other chronic liver disease | 183    | 0.78 | (0.67, 0.90)          | 67               | 0.77 | (0.61, 0.98)          | 109               | 0.96 | (0.79, 1.16)          |
| All heart diseases                        | 3 327  | 0.72 | (0.70, 0.74)          | 1 130            | 0.67 | (0.63, 0.71)          | 1 623             | 0.71 | (0.68, 0.75)          |
| Ischemic heart disease                    | 2 521  | 0.83 | (0.80, 0.87)          | 718              | 0.80 | (0.74, 0.86)          | 1 093             | 0.90 | (0.84, 0.95)          |
| Cerebrovascular disease                   | 494    | 0.81 | (0.74, 0.88)          | 242              | 0.78 | (0.69, 0.88)          | 310               | 0.74 | (0.66, 0.82)          |
| All external causes                       | 680    | 0.76 | (0.71, 0.82)          | 316              | 0.84 | (0.75, 0.94)          | 454               | 0.92 | (0.84, 1.01)          |

<sup>b</sup> Variance estimates assume Poisson-distributed rates in the observed population. Reference rates were assumed to be parameters.

\* With race unknown from plant 1.

Table 4: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **straight** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|                               |                          | Number of cases | HR   | 95% CI       |   |
|-------------------------------|--------------------------|-----------------|------|--------------|---|
| Laryngeal cancer (73 cases)   |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 40              |      |              |   |
| > 0 to 0.5                    | mg/m <sup>3</sup> .years | 17              | 1.18 | (0.59, 2.37) |   |
| > 0.5                         | mg/m <sup>3</sup> .years | 16              | 0.81 | (0.41, 1.58) |   |
| Lung cancer (1 891 cases)     |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 964             |      |              |   |
| > 0 to 0.3                    | mg/m <sup>3</sup> .years | 309             | 1.07 | (0.92, 1.25) |   |
| > 0.3 to 1.6                  | mg/m <sup>3</sup> .years | 309             | 0.96 | (0.82, 1.12) |   |
| > 1.6                         | mg/m <sup>3</sup> .years | 309             | 0.91 | (0.79, 1.05) |   |
| Esophageal cancer (176 cases) |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 83              |      |              |   |
| > 0 to 0.4                    | mg/m <sup>3</sup> .years | 31              | 1.16 | (0.71, 1.91) |   |
| > 0.4 to 2.1                  | mg/m <sup>3</sup> .years | 32              | 1.19 | (0.74, 1.92) |   |
| > 2.1                         | mg/m <sup>3</sup> .years | 30              | 1.16 | (0.73, 1.84) |   |
| Stomach cancer (192 cases)    |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 103             |      |              |   |
| > 0 to 0.3                    | mg/m <sup>3</sup> .years | 30              | 1.16 | (0.70, 1.91) |   |
| > 0.3 to 2.9                  | mg/m <sup>3</sup> .years | 29              | 0.80 | (0.49, 1.32) |   |
| > 2.9                         | mg/m <sup>3</sup> .years | 30              | 1.86 | (1.17, 2.97) | * |
| Colon cancer (407 cases)      |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 211             |      |              |   |
| > 0 to 0.5                    | mg/m <sup>3</sup> .years | 66              | 0.89 | (0.64, 1.23) |   |
| > 0.5 to 2.1                  | mg/m <sup>3</sup> .years | 65              | 0.93 | (0.67, 1.29) |   |
| > 2.1                         | mg/m <sup>3</sup> .years | 65              | 0.92 | (0.68, 1.25) |   |
| Rectal cancer (83 cases)      |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 44              |      |              |   |
| > 0 to 1                      | mg/m <sup>3</sup> .years | 20              | 0.78 | (0.40, 1.51) |   |
| > 1                           | mg/m <sup>3</sup> .years | 19              | 0.89 | (0.47, 1.68) |   |
| Bladder cancer (138 cases)    |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 73              |      |              |   |
| > 0 to 0.3                    | mg/m <sup>3</sup> .years | 20              | 0.90 | (0.51, 1.60) |   |
| > 0.3 to 1.8                  | mg/m <sup>3</sup> .years | 22              | 0.65 | (0.37, 1.13) |   |
| > 1.8                         | mg/m <sup>3</sup> .years | 23              | 0.69 | (0.41, 1.16) |   |
| Liver cancer (123 cases)      |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 55              |      |              |   |
| > 0 to 0.5                    | mg/m <sup>3</sup> .years | 22              | 1.05 | (0.58, 1.88) |   |
| > 0.5 to 1.6                  | mg/m <sup>3</sup> .years | 23              | 1.89 | (1.08, 3.30) | * |
| > 1.6                         | mg/m <sup>3</sup> .years | 23              | 1.24 | (0.72, 2.13) |   |
| Pancreatic cancer (315 cases) |                          |                 |      |              |   |
| 0                             | mg/m <sup>3</sup> .years | 154             |      |              |   |
| > 0 to 0.3                    | mg/m <sup>3</sup> .years | 54              | 1.25 | (0.86, 1.81) |   |
| > 0.3 to 1.1                  | mg/m <sup>3</sup> .years | 53              | 1.17 | (0.80, 1.70) |   |
| > 1.1                         | mg/m <sup>3</sup> .years | 54              | 0.85 | (0.60, 1.20) |   |
| Skin cancer (69 cases)        |                          |                 |      |              |   |

Table 4: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **straight** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|  |                          | Number of cases | HR   | 95% CI         |
|--|--------------------------|-----------------|------|----------------|
| 0  | mg/m <sup>3</sup> .years | 32              |      |                |
| > 0 to 0.9                                   | mg/m <sup>3</sup> .years | 18              | 1.16 | (0.58, 2.34)   |
| > 0.9  | mg/m <sup>3</sup> .years | 19              | 1.31 | (0.67, 2.57)   |
| Prostate cancer (417 cases)                  |                          |                 |      |                |
| 0  | mg/m <sup>3</sup> .years | 192             |      |                |
| > 0 to 0.5                                   | mg/m <sup>3</sup> .years | 75              | 1.15 | (0.84, 1.57)   |
| > 0.5 to 2                                   | mg/m <sup>3</sup> .years | 75              | 1.11 | (0.81, 1.52)   |
| > 2  | mg/m <sup>3</sup> .years | 75              | 1.05 | (0.78, 1.40)   |
| Brain and nervous system cancers (128 cases) |                          |                 |      |                |
| 0  | mg/m <sup>3</sup> .years | 74              |      |                |
| > 0 to 1                                     | mg/m <sup>3</sup> .years | 27              | 0.61 | (0.35, 1.05)   |
| > 1  | mg/m <sup>3</sup> .years | 27              | 0.73 | (0.44, 1.22)   |
| Leukemia (200 cases)                         |                          |                 |      |                |
| 0  | mg/m <sup>3</sup> .years | 100             |      |                |
| > 0 to 0.3                                   | mg/m <sup>3</sup> .years | 34              | 1.09 | (0.68, 1.74)   |
| > 0.3 to 2.3                                 | mg/m <sup>3</sup> .years | 33              | 0.77 | (0.48, 1.23)   |
| > 2.3  | mg/m <sup>3</sup> .years | 33              | 0.94 | (0.60, 1.47)   |
| Breast cancer (76 cases)                     |                          |                 |      |                |
| 0  | mg/m <sup>3</sup> .years | 43              |      |                |
| > 0 to 0.7                                   | mg/m <sup>3</sup> .years | 16              | 1.32 | (0.63, 2.77)   |
| > 0.7  | mg/m <sup>3</sup> .years | 17              | 2.11 | (1.03, 4.34) * |

Table 5: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **soluble** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|                               |                          | Number of cases | HR   | 95% CI       |
|-------------------------------|--------------------------|-----------------|------|--------------|
| Laryngeal cancer (73 cases)   |                          |                 |      |              |
| 0 to 0.055                    | mg/m <sup>3</sup> .years | 18              |      |              |
| > 0.055 to 7.3                | mg/m <sup>3</sup> .years | 28              | 0.79 | (0.39, 1.59) |
| > 7.3                         | mg/m <sup>3</sup> .years | 27              | 0.88 | (0.42, 1.84) |
| Lung cancer (1 891 cases)     |                          |                 |      |              |
| 0 to 0.055                    | mg/m <sup>3</sup> .years | 435             |      |              |
| > 0.055 to 3.3                | mg/m <sup>3</sup> .years | 486             | 0.96 | (0.83, 1.12) |
| > 3.3 to 11.2                 | mg/m <sup>3</sup> .years | 485             | 0.89 | (0.76, 1.04) |
| > 11.2                        | mg/m <sup>3</sup> .years | 485             | 0.99 | (0.84, 1.17) |
| Esophageal cancer (176 cases) |                          |                 |      |              |
| 0 to 0.055                    | mg/m <sup>3</sup> .years | 34              |      |              |
| > 0.055 to 3.3                | mg/m <sup>3</sup> .years | 46              | 1.06 | (0.64, 1.75) |
| > 3.3 to 10.8                 | mg/m <sup>3</sup> .years | 47              | 1.04 | (0.62, 1.75) |
| > 10.8                        | mg/m <sup>3</sup> .years | 49              | 1.18 | (0.69, 2.05) |
| Stomach cancer (192 cases)    |                          |                 |      |              |
| 0 to 0.055                    | mg/m <sup>3</sup> .years | 58              |      |              |

Table 5: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **soluble** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|  |                          | Number of cases | HR   | 95% CI       |   |
|--|--------------------------|-----------------|------|--------------|---|
| > 0.055 to 4.2                               | mg/m <sup>3</sup> .years | 45              | 0.68 | (0.42, 1.08) |   |
| > 4.2 to 10                                  | mg/m <sup>3</sup> .years | 44              | 1.08 | (0.67, 1.75) |   |
| > 10   | mg/m <sup>3</sup> .years | 45              | 0.71 | (0.42, 1.18) |   |
| Colon cancer (407 cases)                     |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 80              |      |              |   |
| > 0.055 to 3.5                               | mg/m <sup>3</sup> .years | 109             | 1.15 | (0.83, 1.58) |   |
| > 3.5 to 12                                  | mg/m <sup>3</sup> .years | 109             | 0.97 | (0.70, 1.35) |   |
| > 12   | mg/m <sup>3</sup> .years | 109             | 0.94 | (0.66, 1.34) |   |
| Rectal cancer (83 cases)                     |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 20              |      |              |   |
| > 0.055 to 4.6                               | mg/m <sup>3</sup> .years | 19              | 0.86 | (0.41, 1.77) |   |
| > 4.6 to 8.6                                 | mg/m <sup>3</sup> .years | 23              | 2.19 | (1.07, 4.49) | * |
| > 8.6  | mg/m <sup>3</sup> .years | 21              | 0.86 | (0.40, 1.85) |   |
| Bladder cancer (138 cases)                   |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 26              |      |              |   |
| > 0.055 to 3.7                               | mg/m <sup>3</sup> .years | 37              | 1.11 | (0.64, 1.93) |   |
| > 3.7 to 11.1                                | mg/m <sup>3</sup> .years | 36              | 1.18 | (0.67, 2.08) |   |
| > 11.1                                       | mg/m <sup>3</sup> .years | 39              | 1.14 | (0.64, 2.02) |   |
| Liver cancer (123 cases)                     |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 22              |      |              |   |
| > 0.055 to 2.3                               | mg/m <sup>3</sup> .years | 34              | 1.31 | (0.72, 2.36) |   |
| > 2.3 to 9.2                                 | mg/m <sup>3</sup> .years | 32              | 0.76 | (0.41, 1.41) |   |
| > 9.2  | mg/m <sup>3</sup> .years | 35              | 0.94 | (0.50, 1.75) |   |
| Pancreatic cancer (315 cases)                |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 70              |      |              |   |
| > 0.055 to 3.4                               | mg/m <sup>3</sup> .years | 82              | 0.81 | (0.57, 1.17) |   |
| > 3.4 to 9.3                                 | mg/m <sup>3</sup> .years | 81              | 0.93 | (0.64, 1.35) |   |
| > 9.3  | mg/m <sup>3</sup> .years | 82              | 0.81 | (0.55, 1.20) |   |
| Skin cancer (69 cases)                       |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 15              |      |              |   |
| > 0.055 to 4.7                               | mg/m <sup>3</sup> .years | 26              | 1.70 | (0.78, 3.72) |   |
| > 4.7  | mg/m <sup>3</sup> .years | 28              | 1.65 | (0.71, 3.82) |   |
| Prostate cancer (417 cases)                  |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 68              |      |              |   |
| > 0.055 to 5.1                               | mg/m <sup>3</sup> .years | 117             | 0.76 | (0.55, 1.05) | . |
| > 5.1 to 15.6                                | mg/m <sup>3</sup> .years | 116             | 0.80 | (0.57, 1.11) |   |
| > 15.6                                       | mg/m <sup>3</sup> .years | 116             | 0.81 | (0.57, 1.14) |   |
| Brain and nervous system cancers (128 cases) |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 32              |      |              |   |
| > 0.055 to 2.7                               | mg/m <sup>3</sup> .years | 32              | 1.53 | (0.87, 2.67) |   |
| > 2.7 to 9.2                                 | mg/m <sup>3</sup> .years | 32              | 1.49 | (0.83, 2.69) |   |
| > 9.2  | mg/m <sup>3</sup> .years | 32              | 1.55 | (0.82, 2.92) |   |
| Leukemia (200 cases)                         |                          |                 |      |              |   |
| 0 to 0.055                                   | mg/m <sup>3</sup> .years | 48              |      |              |   |
| > 0.055 to 3.3                               | mg/m <sup>3</sup> .years | 51              | 1.04 | (0.66, 1.65) |   |

Table 5: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **soluble** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|                          |                          | Number of cases | HR   | 95% CI       |
|--------------------------|--------------------------|-----------------|------|--------------|
| > 3.3 to 9.7             | mg/m <sup>3</sup> .years | 50              | 1.10 | (0.68, 1.77) |
| > 9.7                    | mg/m <sup>3</sup> .years | 51              | 0.88 | (0.53, 1.46) |
| Breast cancer (76 cases) |                          |                 |      |              |
| 0 to 0.055               | mg/m <sup>3</sup> .years | 36              |      |              |
| > 0.055 to 2.9           | mg/m <sup>3</sup> .years | 22              | 0.60 | (0.31, 1.17) |
| > 2.9                    | mg/m <sup>3</sup> .years | 18              | 0.57 | (0.26, 1.23) |

Table 6: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **synthetic** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|                               |                          | Number of cases | HR   | 95% CI       |
|-------------------------------|--------------------------|-----------------|------|--------------|
| Laryngeal cancer (73 cases)   |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 54              |      |              |
| > 0                           | mg/m <sup>3</sup> .years | 19              | 1.37 | (0.67, 2.77) |
| Lung cancer (1891 cases)      |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 1374            |      |              |
| > 0 to 0.3                    | mg/m <sup>3</sup> .years | 173             | 0.93 | (0.77, 1.12) |
| > 0.3 to 1.4                  | mg/m <sup>3</sup> .years | 172             | 1.07 | (0.89, 1.29) |
| > 1.4                         | mg/m <sup>3</sup> .years | 172             | 1.00 | (0.84, 1.20) |
| Esophageal cancer (176 cases) |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 126             |      |              |
| > 0 to 0.7                    | mg/m <sup>3</sup> .years | 25              | 1.13 | (0.66, 1.96) |
| > 0.7                         | mg/m <sup>3</sup> .years | 25              | 1.39 | (0.84, 2.30) |
| Stomach cancer (192 cases)    |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 149             |      |              |
| > 0 to 0.5                    | mg/m <sup>3</sup> .years | 22              | 1.05 | (0.61, 1.84) |
| > 0.5                         | mg/m <sup>3</sup> .years | 21              | 0.90 | (0.53, 1.56) |
| Colon cancer (407 cases)      |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 310             |      |              |
| > 0 to 0.4                    | mg/m <sup>3</sup> .years | 33              | 0.79 | (0.52, 1.21) |
| > 0.4 to 1.7                  | mg/m <sup>3</sup> .years | 32              | 0.98 | (0.64, 1.50) |
| > 1.7                         | mg/m <sup>3</sup> .years | 32              | 0.92 | (0.62, 1.38) |
| Rectal cancer (83 cases)      |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 59              |      |              |
| > 0 to 0.8                    | mg/m <sup>3</sup> .years | 12              | 1.48 | (0.67, 3.27) |
| > 0.8                         | mg/m <sup>3</sup> .years | 12              | 1.64 | (0.79, 3.41) |
| Bladder cancer (138 cases)    |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 104             |      |              |
| > 0 to 0.5                    | mg/m <sup>3</sup> .years | 17              | 0.91 | (0.49, 1.69) |
| > 0.5                         | mg/m <sup>3</sup> .years | 17              | 0.67 | (0.37, 1.21) |
| Liver cancer (123 cases)      |                          |                 |      |              |
| 0                             | mg/m <sup>3</sup> .years | 89              |      |              |

Table 6: Cox model estimates of the hazard ratio for selected cancer outcomes associated with exposure to **synthetic** metalworking fluids, controlling for other fluid types, calendar year, calendar year of hire, age, race, sex, and plant, when possible.

|  |                          | Number of cases | HR   | 95% CI       |
|--|--------------------------|-----------------|------|--------------|
| > 0 to 0.4                                   | mg/m <sup>3</sup> .years | 17              | 1.17 | (0.60, 2.26) |
| > 0.4  | mg/m <sup>3</sup> .years | 17              | 0.88 | (0.48, 1.63) |
| Pancreatic cancer (315 cases)                |                          |                 |      |              |
| 0  | mg/m <sup>3</sup> .years | 227             |      |              |
| > 0 to 0.3                                   | mg/m <sup>3</sup> .years | 30              | 0.98 | (0.62, 1.55) |
| > 0.3 to 0.9                                 | mg/m <sup>3</sup> .years | 29              | 1.26 | (0.79, 2.00) |
| > 0.9  | mg/m <sup>3</sup> .years | 29              | 0.87 | (0.56, 1.34) |
| Skin cancer (69 cases)                       |                          |                 |      |              |
| 0  | mg/m <sup>3</sup> .years | 52              |      |              |
| > 0  | mg/m <sup>3</sup> .years | 17              | 0.67 | (0.34, 1.31) |
| Prostate cancer (417 cases)                  |                          |                 |      |              |
| 0  | mg/m <sup>3</sup> .years | 300             |      |              |
| > 0 to 0.5                                   | mg/m <sup>3</sup> .years | 39              | 1.01 | (0.67, 1.50) |
| > 0.5 to 2                                   | mg/m <sup>3</sup> .years | 39              | 1.13 | (0.76, 1.68) |
| > 2  | mg/m <sup>3</sup> .years | 39              | 1.30 | (0.89, 1.89) |
| Brain and nervous system cancers (128 cases) |                          |                 |      |              |
| 0  | mg/m <sup>3</sup> .years | 94              |      |              |
| > 0 to 0.6                                   | mg/m <sup>3</sup> .years | 17              | 1.52 | (0.80, 2.90) |
| > 0.6  | mg/m <sup>3</sup> .years | 17              | 1.36 | (0.75, 2.46) |
| Leukemia (200 cases)                         |                          |                 |      |              |
| 0  | mg/m <sup>3</sup> .years | 142             |      |              |
| > 0 to 0.9                                   | mg/m <sup>3</sup> .years | 29              | 1.11 | (0.67, 1.82) |
| > 0.9  | mg/m <sup>3</sup> .years | 29              | 1.37 | (0.86, 2.19) |
| Breast cancer (76 cases)                     |                          |                 |      |              |
| 0  | mg/m <sup>3</sup> .years | 60              |      |              |
| > 0  | mg/m <sup>3</sup> .years | 16              | 0.76 | (0.38, 1.53) |



