**Supplementary Materials**

# **Reconstructing Historical Exposures to Elongate Mineral Particles (EMPs) in the Taconite Mining Industry for 1955–2010**

## Appendix A: NIOSH-EMP JEM – Approach 1

**Table A-1** The job-exposure matrix for EMP in Mine F (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine F** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | / | / | / | / | / | / | / | / | / |
| 1968 | / | / | / | / | / | / | / | / | / |
| 1969 | / | / | / | / | / | / | / | / | / |
| 1970 | / | / | / | / | / | / | / | / | / |
| 1971 | / | / | / | / | / | / | / | / | / |
| 1972 | / | / | / | / | / | / | / | / | / |
| 1973 | / | / | / | / | / | / | / | / | / |
| 1974 | / | / | / | / | / | / | / | / | / |
| 1975 | / | / | / | / | / | / | / | / | / |
| 1976 | / | / | / | / | / | / | / | / | / |
| 1977 | 0.10 | 0.15 | 0.20 | 0.08 | 0.12 | 0.09 | 0.12 | 0.09 | 0.09 |
| 1978 | 0.10 | 0.14 | 0.19 | 0.08 | 0.11 | 0.09 | 0.11 | 0.08 | 0.08 |
| 1979 | 0.09 | 0.13 | 0.18 | 0.08 | 0.11 | 0.08 | 0.10 | 0.08 | 0.08 |
| 1980 | 0.09 | 0.13 | 0.17 | 0.07 | 0.10 | 0.08 | 0.10 | 0.08 | 0.08 |
| 1981 | 0.08 | 0.12 | 0.16 | 0.07 | 0.10 | 0.08 | 0.09 | 0.07 | 0.07 |
| 1982 | 0.08 | 0.12 | 0.15 | 0.07 | 0.09 | 0.07 | 0.09 | 0.07 | 0.07 |
| 1983 | 0.07 | 0.11 | 0.14 | 0.06 | 0.09 | 0.07 | 0.09 | 0.07 | 0.07 |
| 1984 | 0.07 | 0.11 | 0.14 | 0.06 | 0.08 | 0.07 | 0.08 | 0.07 | 0.07 |
| 1985 | 0.07 | 0.10 | 0.13 | 0.06 | 0.08 | 0.06 | 0.08 | 0.06 | 0.06 |
| 1986 | 0.06 | 0.10 | 0.13 | 0.05 | 0.07 | 0.06 | 0.07 | 0.06 | 0.06 |
| 1987 | 0.06 | 0.09 | 0.12 | 0.05 | 0.07 | 0.06 | 0.07 | 0.06 | 0.06 |
| 1988 | 0.06 | 0.09 | 0.11 | 0.05 | 0.07 | 0.06 | 0.07 | 0.06 | 0.06 |
| 1989 | 0.06 | 0.09 | 0.11 | 0.05 | 0.07 | 0.05 | 0.07 | 0.05 | 0.05 |
| 1990 | 0.05 | 0.08 | 0.10 | 0.05 | 0.06 | 0.05 | 0.06 | 0.05 | 0.05 |
| 1991 | 0.05 | 0.08 | 0.10 | 0.04 | 0.06 | 0.05 | 0.06 | 0.05 | 0.05 |
| 1992 | 0.05 | 0.08 | 0.10 | 0.04 | 0.06 | 0.05 | 0.06 | 0.05 | 0.05 |
| 1993 | 0.05 | 0.07 | 0.09 | 0.04 | 0.05 | 0.04 | 0.06 | 0.05 | 0.05 |
| 1994 | 0.05 | 0.07 | 0.09 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.04 |
| 1995 | 0.04 | 0.07 | 0.08 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.04 |
| 1996 | 0.04 | 0.07 | 0.08 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.04 |
| 1997 | 0.04 | 0.06 | 0.08 | 0.03 | 0.05 | 0.04 | 0.05 | 0.04 | 0.04 |
| 1998 | 0.04 | 0.06 | 0.07 | 0.03 | 0.04 | 0.04 | 0.05 | 0.04 | 0.04 |
| 1999 | 0.04 | 0.06 | 0.07 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| 2000 | 0.04 | 0.06 | 0.07 | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 |
| 2001 | 0.04 | 0.06 | 0.07 | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 |
| 2002 | 0.03 | 0.05 | 0.06 | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 |
| 2003 | 0.03 | 0.05 | 0.06 | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 |
| 2004 | 0.03 | 0.05 | 0.06 | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 |
| 2005 | 0.03 | 0.05 | 0.06 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 |
| 2006 | 0.03 | 0.05 | 0.06 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 2007 | 0.03 | 0.05 | 0.05 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 2008 | 0.03 | 0.05 | 0.05 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 2009 | 0.03 | 0.04 | 0.05 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 2010 | 0.03 | 0.04 | 0.05 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |

**Table A-2** The job-exposure matrix for EMP in Mine B (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine B** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | / | / | / | / | / | / | / | / | / |
| 1968 | / | / | / | / | / | / | / | / | / |
| 1969 | / | / | / | / | / | / | / | / | / |
| 1970 | / | / | / | / | / | / | / | / | / |
| 1971 | / | / | / | / | / | / | / | / | / |
| 1972 | / | / | / | / | / | / | / | / | / |
| 1973 | / | / | / | / | / | / | / | / | / |
| 1974 | 0.07 | 0.07 | 0.05 | 0.07 | 0.08 | 0.06 | 0.06 | 0.02 | 0.02 |
| 1975 | 0.06 | 0.06 | 0.05 | 0.07 | 0.07 | 0.06 | 0.06 | 0.02 | 0.02 |
| 1976 | 0.06 | 0.06 | 0.05 | 0.06 | 0.07 | 0.06 | 0.05 | 0.02 | 0.02 |
| 1977 | 0.05 | 0.05 | 0.04 | 0.06 | 0.06 | 0.05 | 0.05 | 0.02 | 0.02 |
| 1978 | 0.05 | 0.05 | 0.04 | 0.06 | 0.06 | 0.05 | 0.05 | 0.02 | 0.02 |
| 1979 | 0.05 | 0.05 | 0.04 | 0.05 | 0.06 | 0.05 | 0.04 | 0.02 | 0.02 |
| 1980 | 0.04 | 0.05 | 0.04 | 0.05 | 0.05 | 0.04 | 0.04 | 0.02 | 0.02 |
| 1981 | 0.04 | 0.04 | 0.03 | 0.05 | 0.05 | 0.04 | 0.04 | 0.02 | 0.02 |
| 1982 | 0.04 | 0.04 | 0.03 | 0.05 | 0.05 | 0.04 | 0.04 | 0.02 | 0.02 |
| 1983 | 0.04 | 0.04 | 0.03 | 0.04 | 0.05 | 0.04 | 0.04 | 0.02 | 0.02 |
| 1984 | 0.04 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 |
| 1985 | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1986 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1987 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1988 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1989 | 0.03 | 0.03 | 0.02 | 0.03 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1990 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1991 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1992 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 |
| 1993 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| 1994 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| 1995 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 1996 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 1997 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 1998 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 1999 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2000 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2001 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2002 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2003 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2004 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2005 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2006 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2007 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2008 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2009 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| 2010 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 |

**Table A-3** The job-exposure matrix for EMP in Mine D (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine D** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | 10.89 | 6.56 | 15.22 | 30.89 | 14.01 | 9.14 | 7.42 | 3.32 | 3.32 |
| 1968 | 8.41 | 5.10 | 11.82 | 23.96 | 10.86 | 7.09 | 5.75 | 2.80 | 2.80 |
| 1969 | 6.54 | 3.98 | 9.24 | 18.69 | 8.47 | 5.52 | 4.49 | 2.38 | 2.38 |
| 1970 | 5.11 | 3.13 | 7.26 | 14.67 | 6.65 | 4.33 | 3.52 | 2.02 | 2.02 |
| 1971 | 4.02 | 2.47 | 5.74 | 11.58 | 5.24 | 3.42 | 2.77 | 1.73 | 1.73 |
| 1972 | 3.18 | 1.97 | 4.56 | 9.19 | 4.16 | 2.71 | 2.20 | 1.48 | 1.48 |
| 1973 | 2.53 | 1.57 | 3.65 | 7.34 | 3.32 | 2.16 | 1.76 | 1.27 | 1.27 |
| 1974 | 2.02 | 1.26 | 2.93 | 5.89 | 2.67 | 1.74 | 1.41 | 1.10 | 1.10 |
| 1975 | 1.63 | 1.02 | 2.37 | 4.76 | 2.15 | 1.40 | 1.14 | 0.95 | 0.95 |
| 1976 | 1.32 | 0.83 | 1.93 | 3.87 | 1.75 | 1.14 | 0.92 | 0.82 | 0.82 |
| 1977 | 1.07 | 0.68 | 1.58 | 3.16 | 1.43 | 0.93 | 0.75 | 0.72 | 0.72 |
| 1978 | 0.88 | 0.56 | 1.30 | 2.60 | 1.17 | 0.76 | 0.62 | 0.63 | 0.63 |
| 1979 | 0.72 | 0.46 | 1.08 | 2.15 | 0.97 | 0.63 | 0.51 | 0.55 | 0.55 |
| 1980 | 0.60 | 0.39 | 0.90 | 1.79 | 0.81 | 0.52 | 0.43 | 0.48 | 0.48 |
| 1981 | 0.50 | 0.32 | 0.75 | 1.49 | 0.67 | 0.44 | 0.36 | 0.42 | 0.42 |
| 1982 | 0.42 | 0.27 | 0.63 | 1.26 | 0.57 | 0.37 | 0.30 | 0.38 | 0.38 |
| 1983 | 0.35 | 0.23 | 0.54 | 1.06 | 0.48 | 0.31 | 0.25 | 0.33 | 0.33 |
| 1984 | 0.30 | 0.20 | 0.46 | 0.91 | 0.41 | 0.26 | 0.22 | 0.30 | 0.30 |
| 1985 | 0.25 | 0.17 | 0.39 | 0.78 | 0.35 | 0.23 | 0.18 | 0.27 | 0.27 |
| 1986 | 0.22 | 0.15 | 0.34 | 0.67 | 0.30 | 0.20 | 0.16 | 0.24 | 0.24 |
| 1987 | 0.19 | 0.13 | 0.29 | 0.58 | 0.26 | 0.17 | 0.14 | 0.21 | 0.21 |
| 1988 | 0.16 | 0.11 | 0.26 | 0.50 | 0.23 | 0.15 | 0.12 | 0.19 | 0.19 |
| 1989 | 0.14 | 0.10 | 0.22 | 0.44 | 0.20 | 0.13 | 0.10 | 0.17 | 0.17 |
| 1990 | 0.13 | 0.09 | 0.20 | 0.39 | 0.18 | 0.11 | 0.09 | 0.16 | 0.16 |
| 1991 | 0.11 | 0.08 | 0.18 | 0.35 | 0.16 | 0.10 | 0.08 | 0.14 | 0.14 |
| 1992 | 0.10 | 0.07 | 0.16 | 0.31 | 0.14 | 0.09 | 0.07 | 0.13 | 0.13 |
| 1993 | 0.09 | 0.06 | 0.14 | 0.28 | 0.12 | 0.08 | 0.07 | 0.12 | 0.12 |
| 1994 | 0.08 | 0.05 | 0.13 | 0.25 | 0.11 | 0.07 | 0.06 | 0.11 | 0.11 |
| 1995 | 0.07 | 0.05 | 0.12 | 0.23 | 0.10 | 0.07 | 0.05 | 0.10 | 0.10 |
| 1996 | 0.06 | 0.05 | 0.11 | 0.21 | 0.09 | 0.06 | 0.05 | 0.09 | 0.09 |
| 1997 | 0.06 | 0.04 | 0.10 | 0.19 | 0.08 | 0.05 | 0.04 | 0.09 | 0.09 |
| 1998 | 0.05 | 0.04 | 0.09 | 0.17 | 0.08 | 0.05 | 0.04 | 0.08 | 0.08 |
| 1999 | 0.05 | 0.04 | 0.08 | 0.16 | 0.07 | 0.05 | 0.04 | 0.08 | 0.08 |
| 2000 | 0.05 | 0.03 | 0.08 | 0.15 | 0.07 | 0.04 | 0.04 | 0.07 | 0.07 |
| 2001 | 0.04 | 0.03 | 0.07 | 0.14 | 0.06 | 0.04 | 0.03 | 0.07 | 0.07 |
| 2002 | 0.04 | 0.03 | 0.07 | 0.13 | 0.06 | 0.04 | 0.03 | 0.06 | 0.06 |
| 2003 | 0.04 | 0.03 | 0.07 | 0.13 | 0.06 | 0.04 | 0.03 | 0.06 | 0.06 |
| 2004 | 0.04 | 0.03 | 0.06 | 0.12 | 0.05 | 0.04 | 0.03 | 0.06 | 0.06 |
| 2005 | 0.04 | 0.03 | 0.06 | 0.12 | 0.05 | 0.03 | 0.03 | 0.05 | 0.05 |
| 2006 | 0.03 | 0.03 | 0.06 | 0.11 | 0.05 | 0.03 | 0.03 | 0.05 | 0.05 |
| 2007 | 0.03 | 0.02 | 0.06 | 0.11 | 0.05 | 0.03 | 0.03 | 0.05 | 0.05 |
| 2008 | 0.03 | 0.02 | 0.06 | 0.11 | 0.05 | 0.03 | 0.03 | 0.05 | 0.05 |
| 2009 | 0.03 | 0.02 | 0.06 | 0.11 | 0.05 | 0.03 | 0.02 | 0.05 | 0.05 |
| 2010 | 0.03 | 0.02 | 0.06 | 0.11 | 0.05 | 0.03 | 0.02 | 0.05 | 0.05 |

**Table A-4** The job-exposure matrix for EMP in Mine G (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine B** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | 1.82 | 2.51 | 3.64 | 1.58 | 1.67 | 1.58 | 0.44 | 1.61 | 1.61 |
| 1958 | 1.70 | 2.35 | 3.40 | 1.47 | 1.56 | 1.48 | 0.41 | 1.51 | 1.51 |
| 1959 | 1.58 | 2.20 | 3.18 | 1.38 | 1.46 | 1.38 | 0.38 | 1.43 | 1.43 |
| 1960 | 1.48 | 2.05 | 2.97 | 1.29 | 1.37 | 1.30 | 0.36 | 1.34 | 1.34 |
| 1961 | 1.38 | 1.92 | 2.78 | 1.20 | 1.28 | 1.21 | 0.33 | 1.26 | 1.26 |
| 1962 | 1.29 | 1.80 | 2.60 | 1.13 | 1.20 | 1.13 | 0.31 | 1.19 | 1.19 |
| 1963 | 1.20 | 1.69 | 2.44 | 1.06 | 1.12 | 1.06 | 0.29 | 1.12 | 1.12 |
| 1964 | 1.13 | 1.58 | 2.28 | 0.99 | 1.05 | 1.00 | 0.27 | 1.06 | 1.06 |
| 1965 | 1.05 | 1.49 | 2.14 | 0.93 | 0.99 | 0.93 | 0.26 | 1.00 | 1.00 |
| 1966 | 0.99 | 1.39 | 2.01 | 0.87 | 0.92 | 0.88 | 0.24 | 0.94 | 0.94 |
| 1967 | 0.92 | 1.31 | 1.88 | 0.81 | 0.87 | 0.82 | 0.23 | 0.89 | 0.89 |
| 1968 | 0.86 | 1.23 | 1.77 | 0.76 | 0.81 | 0.77 | 0.21 | 0.83 | 0.83 |
| 1969 | 0.81 | 1.15 | 1.66 | 0.72 | 0.77 | 0.72 | 0.20 | 0.79 | 0.79 |
| 1970 | 0.76 | 1.09 | 1.56 | 0.67 | 0.72 | 0.68 | 0.19 | 0.74 | 0.74 |
| 1971 | 0.71 | 1.02 | 1.47 | 0.63 | 0.68 | 0.64 | 0.18 | 0.70 | 0.70 |
| 1972 | 0.67 | 0.96 | 1.38 | 0.59 | 0.64 | 0.60 | 0.16 | 0.66 | 0.66 |
| 1973 | 0.63 | 0.90 | 1.30 | 0.56 | 0.60 | 0.57 | 0.16 | 0.62 | 0.62 |
| 1974 | 0.59 | 0.85 | 1.22 | 0.53 | 0.56 | 0.53 | 0.15 | 0.59 | 0.59 |
| 1975 | 0.55 | 0.80 | 1.15 | 0.49 | 0.53 | 0.50 | 0.14 | 0.56 | 0.56 |
| 1976 | 0.52 | 0.76 | 1.08 | 0.47 | 0.50 | 0.47 | 0.13 | 0.52 | 0.52 |
| 1977 | 0.49 | 0.71 | 1.02 | 0.44 | 0.47 | 0.44 | 0.12 | 0.50 | 0.50 |
| 1978 | 0.46 | 0.67 | 0.96 | 0.41 | 0.44 | 0.42 | 0.11 | 0.47 | 0.47 |
| 1979 | 0.43 | 0.63 | 0.91 | 0.39 | 0.42 | 0.40 | 0.11 | 0.44 | 0.44 |
| 1980 | 0.41 | 0.60 | 0.85 | 0.37 | 0.39 | 0.37 | 0.10 | 0.42 | 0.42 |
| 1981 | 0.38 | 0.57 | 0.81 | 0.35 | 0.37 | 0.35 | 0.10 | 0.39 | 0.39 |
| 1982 | 0.36 | 0.53 | 0.76 | 0.33 | 0.35 | 0.33 | 0.09 | 0.37 | 0.37 |
| 1983 | 0.34 | 0.51 | 0.72 | 0.31 | 0.33 | 0.31 | 0.09 | 0.35 | 0.35 |
| 1984 | 0.32 | 0.48 | 0.68 | 0.29 | 0.31 | 0.30 | 0.08 | 0.33 | 0.33 |
| 1985 | 0.30 | 0.45 | 0.64 | 0.28 | 0.30 | 0.28 | 0.08 | 0.31 | 0.31 |
| 1986 | 0.29 | 0.43 | 0.61 | 0.26 | 0.28 | 0.27 | 0.07 | 0.30 | 0.30 |
| 1987 | 0.27 | 0.41 | 0.58 | 0.25 | 0.27 | 0.25 | 0.07 | 0.28 | 0.28 |
| 1988 | 0.25 | 0.38 | 0.54 | 0.23 | 0.25 | 0.24 | 0.07 | 0.27 | 0.27 |
| 1989 | 0.24 | 0.36 | 0.52 | 0.22 | 0.24 | 0.23 | 0.06 | 0.25 | 0.25 |
| 1990 | 0.23 | 0.34 | 0.49 | 0.21 | 0.23 | 0.21 | 0.06 | 0.24 | 0.24 |
| 1991 | 0.22 | 0.33 | 0.46 | 0.20 | 0.21 | 0.20 | 0.06 | 0.23 | 0.23 |
| 1992 | 0.20 | 0.31 | 0.44 | 0.19 | 0.20 | 0.19 | 0.05 | 0.21 | 0.21 |
| 1993 | 0.19 | 0.29 | 0.42 | 0.18 | 0.19 | 0.18 | 0.05 | 0.20 | 0.20 |
| 1994 | 0.18 | 0.28 | 0.40 | 0.17 | 0.18 | 0.17 | 0.05 | 0.19 | 0.19 |
| 1995 | 0.17 | 0.27 | 0.38 | 0.16 | 0.17 | 0.16 | 0.04 | 0.18 | 0.18 |
| 1996 | 0.16 | 0.25 | 0.36 | 0.15 | 0.17 | 0.16 | 0.04 | 0.17 | 0.17 |
| 1997 | 0.16 | 0.24 | 0.34 | 0.15 | 0.16 | 0.15 | 0.04 | 0.16 | 0.16 |
| 1998 | 0.15 | 0.23 | 0.32 | 0.14 | 0.15 | 0.14 | 0.04 | 0.15 | 0.15 |
| 1999 | 0.14 | 0.22 | 0.31 | 0.13 | 0.14 | 0.13 | 0.04 | 0.15 | 0.15 |
| 2000 | 0.13 | 0.21 | 0.29 | 0.12 | 0.14 | 0.13 | 0.03 | 0.14 | 0.14 |
| 2001 | 0.13 | 0.20 | 0.28 | 0.12 | 0.13 | 0.12 | 0.03 | 0.13 | 0.13 |
| 2002 | / | / | / | / | / | / | / | / | / |
| 2003 | / | / | / | / | / | / | / | / | / |
| 2004 | / | / | / | / | / | / | / | / | / |
| 2005 | / | / | / | / | / | / | / | / | / |
| 2006 | / | / | / | / | / | / | / | / | / |
| 2007 | / | / | / | / | / | / | / | / | / |
| 2008 | / | / | / | / | / | / | / | / | / |
| 2009 | / | / | / | / | / | / | / | / | / |
| 2010 | / | / | / | / | / | / | / | / | / |

**Table A-5** The job-exposure matrix for EMP in Mine E (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine E** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1968 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1969 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1970 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1971 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1972 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1973 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1974 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1975 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1976 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1977 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1978 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1979 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1980 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1981 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1982 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1983 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1984 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1985 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1986 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1987 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1988 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1989 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1990 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1991 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| 1992 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1993 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1994 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1995 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1996 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1997 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1998 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 |
| 1999 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 |
| 2000 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 |
| 2001 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 |
| 2002 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.01 | 0.02 | 0.02 |
| 2003 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.01 | 0.03 | 0.03 |
| 2004 | 0.02 | 0.03 | 0.04 | 0.04 | 0.03 | 0.02 | 0.01 | 0.03 | 0.03 |
| 2005 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2006 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2007 | 0.03 | 0.04 | 0.05 | 0.05 | 0.04 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2008 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2009 | 0.04 | 0.05 | 0.06 | 0.06 | 0.05 | 0.04 | 0.02 | 0.04 | 0.04 |
| 2010 | 0.04 | 0.06 | 0.07 | 0.06 | 0.06 | 0.04 | 0.03 | 0.05 | 0.05 |

**Table A-6** The job-exposure matrix for EMP in Mine A (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine A** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | 2.10 | 2.87 | 4.17 | 1.81 | 1.92 | 1.82 | 0.50 | 1.82 | 1.82 |
| 1956 | 1.95 | 2.69 | 3.90 | 1.69 | 1.79 | 1.70 | 0.47 | 1.71 | 1.71 |
| 1957 | 1.82 | 2.51 | 3.64 | 1.58 | 1.67 | 1.58 | 0.44 | 1.61 | 1.61 |
| 1958 | 1.70 | 2.35 | 3.40 | 1.47 | 1.56 | 1.48 | 0.41 | 1.51 | 1.51 |
| 1959 | 1.58 | 2.20 | 3.18 | 1.38 | 1.46 | 1.38 | 0.38 | 1.43 | 1.43 |
| 1960 | 1.48 | 2.05 | 2.97 | 1.29 | 1.37 | 1.30 | 0.36 | 1.34 | 1.34 |
| 1961 | 1.38 | 1.92 | 2.78 | 1.20 | 1.28 | 1.21 | 0.33 | 1.26 | 1.26 |
| 1962 | 1.29 | 1.80 | 2.60 | 1.13 | 1.20 | 1.13 | 0.31 | 1.19 | 1.19 |
| 1963 | 1.20 | 1.69 | 2.44 | 1.06 | 1.12 | 1.06 | 0.29 | 1.12 | 1.12 |
| 1964 | 1.13 | 1.58 | 2.28 | 0.99 | 1.05 | 1.00 | 0.27 | 1.06 | 1.06 |
| 1965 | 1.05 | 1.49 | 2.14 | 0.93 | 0.99 | 0.93 | 0.26 | 1.00 | 1.00 |
| 1966 | 0.99 | 1.39 | 2.01 | 0.87 | 0.92 | 0.88 | 0.24 | 0.94 | 0.94 |
| 1967 | 0.92 | 1.31 | 1.88 | 0.81 | 0.87 | 0.82 | 0.23 | 0.89 | 0.89 |
| 1968 | 0.86 | 1.23 | 1.77 | 0.76 | 0.81 | 0.77 | 0.21 | 0.83 | 0.83 |
| 1969 | 0.81 | 1.15 | 1.66 | 0.72 | 0.77 | 0.72 | 0.20 | 0.79 | 0.79 |
| 1970 | 0.76 | 1.09 | 1.56 | 0.67 | 0.72 | 0.68 | 0.19 | 0.74 | 0.74 |
| 1971 | 0.71 | 1.02 | 1.47 | 0.63 | 0.68 | 0.64 | 0.18 | 0.70 | 0.70 |
| 1972 | 0.67 | 0.96 | 1.38 | 0.59 | 0.64 | 0.60 | 0.16 | 0.66 | 0.66 |
| 1973 | 0.63 | 0.90 | 1.30 | 0.56 | 0.60 | 0.57 | 0.16 | 0.62 | 0.62 |
| 1974 | 0.59 | 0.85 | 1.22 | 0.53 | 0.56 | 0.53 | 0.15 | 0.59 | 0.59 |
| 1975 | 0.55 | 0.80 | 1.15 | 0.49 | 0.53 | 0.50 | 0.14 | 0.56 | 0.56 |
| 1976 | 0.52 | 0.76 | 1.08 | 0.47 | 0.50 | 0.47 | 0.13 | 0.52 | 0.52 |
| 1977 | 0.49 | 0.71 | 1.02 | 0.44 | 0.47 | 0.44 | 0.12 | 0.50 | 0.50 |
| 1978 | 0.46 | 0.67 | 0.96 | 0.41 | 0.44 | 0.42 | 0.11 | 0.47 | 0.47 |
| 1979 | 0.43 | 0.63 | 0.91 | 0.39 | 0.42 | 0.40 | 0.11 | 0.44 | 0.44 |
| 1980 | 0.41 | 0.60 | 0.85 | 0.37 | 0.39 | 0.37 | 0.10 | 0.42 | 0.42 |
| 1981 | 0.38 | 0.57 | 0.81 | 0.35 | 0.37 | 0.35 | 0.10 | 0.39 | 0.39 |
| 1982 | 0.36 | 0.53 | 0.76 | 0.33 | 0.35 | 0.33 | 0.09 | 0.37 | 0.37 |
| 1983 | 0.34 | 0.51 | 0.72 | 0.31 | 0.33 | 0.31 | 0.09 | 0.35 | 0.35 |
| 1984 | 0.32 | 0.48 | 0.68 | 0.29 | 0.31 | 0.30 | 0.08 | 0.33 | 0.33 |
| 1985 | 0.30 | 0.45 | 0.64 | 0.28 | 0.30 | 0.28 | 0.08 | 0.31 | 0.31 |
| 1986 | 0.29 | 0.43 | 0.61 | 0.26 | 0.28 | 0.27 | 0.07 | 0.30 | 0.30 |
| 1987 | 0.27 | 0.41 | 0.58 | 0.25 | 0.27 | 0.25 | 0.07 | 0.28 | 0.28 |
| 1988 | 0.25 | 0.38 | 0.54 | 0.23 | 0.25 | 0.24 | 0.07 | 0.27 | 0.27 |
| 1989 | 0.24 | 0.36 | 0.52 | 0.22 | 0.24 | 0.23 | 0.06 | 0.25 | 0.25 |
| 1990 | 0.23 | 0.34 | 0.49 | 0.21 | 0.23 | 0.21 | 0.06 | 0.24 | 0.24 |
| 1991 | 0.22 | 0.33 | 0.46 | 0.20 | 0.21 | 0.20 | 0.06 | 0.23 | 0.23 |
| 1992 | 0.20 | 0.31 | 0.44 | 0.19 | 0.20 | 0.19 | 0.05 | 0.21 | 0.21 |
| 1993 | 0.19 | 0.29 | 0.42 | 0.18 | 0.19 | 0.18 | 0.05 | 0.20 | 0.20 |
| 1994 | 0.18 | 0.28 | 0.40 | 0.17 | 0.18 | 0.17 | 0.05 | 0.19 | 0.19 |
| 1995 | 0.17 | 0.27 | 0.38 | 0.16 | 0.17 | 0.16 | 0.04 | 0.18 | 0.18 |
| 1996 | 0.16 | 0.25 | 0.36 | 0.15 | 0.17 | 0.16 | 0.04 | 0.17 | 0.17 |
| 1997 | 0.16 | 0.24 | 0.34 | 0.15 | 0.16 | 0.15 | 0.04 | 0.16 | 0.16 |
| 1998 | 0.15 | 0.23 | 0.32 | 0.14 | 0.15 | 0.14 | 0.04 | 0.15 | 0.15 |
| 1999 | 0.14 | 0.22 | 0.31 | 0.13 | 0.14 | 0.13 | 0.04 | 0.15 | 0.15 |
| 2000 | 0.13 | 0.21 | 0.29 | 0.12 | 0.14 | 0.13 | 0.03 | 0.14 | 0.14 |
| 2001 | 0.13 | 0.20 | 0.28 | 0.12 | 0.13 | 0.12 | 0.03 | 0.13 | 0.13 |
| 2002 | 0.12 | 0.19 | 0.26 | 0.11 | 0.12 | 0.12 | 0.03 | 0.12 | 0.12 |
| 2003 | 0.11 | 0.18 | 0.25 | 0.11 | 0.12 | 0.11 | 0.03 | 0.12 | 0.12 |
| 2004 | 0.11 | 0.17 | 0.24 | 0.10 | 0.11 | 0.11 | 0.03 | 0.11 | 0.11 |
| 2005 | 0.10 | 0.16 | 0.23 | 0.10 | 0.11 | 0.10 | 0.03 | 0.11 | 0.11 |
| 2006 | 0.10 | 0.16 | 0.22 | 0.09 | 0.10 | 0.10 | 0.03 | 0.10 | 0.10 |
| 2007 | 0.09 | 0.15 | 0.21 | 0.09 | 0.10 | 0.09 | 0.02 | 0.10 | 0.10 |
| 2008 | 0.09 | 0.14 | 0.20 | 0.09 | 0.09 | 0.09 | 0.02 | 0.09 | 0.09 |
| 2009 | 0.09 | 0.14 | 0.19 | 0.08 | 0.09 | 0.08 | 0.02 | 0.09 | 0.09 |
| 2010 | 0.08 | 0.13 | 0.18 | 0.08 | 0.08 | 0.08 | 0.02 | 0.08 | 0.08 |

**Table A-7** The job-exposure matrix for EMP in Mine C (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine C** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | 7.00 | 3.09 | 6.21 | 3.61 | 4.20 | 3.69 | 3.17 | 1.93 | 1.93 |
| 1965 | 6.16 | 2.73 | 5.49 | 3.19 | 3.72 | 3.27 | 2.80 | 1.75 | 1.75 |
| 1966 | 5.43 | 2.41 | 4.85 | 2.82 | 3.29 | 2.90 | 2.47 | 1.59 | 1.59 |
| 1967 | 4.79 | 2.13 | 4.30 | 2.49 | 2.91 | 2.58 | 2.19 | 1.44 | 1.44 |
| 1968 | 4.23 | 1.88 | 3.81 | 2.20 | 2.58 | 2.29 | 1.94 | 1.31 | 1.31 |
| 1969 | 3.74 | 1.67 | 3.37 | 1.95 | 2.29 | 2.04 | 1.72 | 1.19 | 1.19 |
| 1970 | 3.31 | 1.48 | 2.99 | 1.73 | 2.03 | 1.82 | 1.52 | 1.08 | 1.08 |
| 1971 | 2.93 | 1.31 | 2.66 | 1.54 | 1.81 | 1.62 | 1.35 | 0.99 | 0.99 |
| 1972 | 2.59 | 1.16 | 2.37 | 1.37 | 1.61 | 1.45 | 1.20 | 0.90 | 0.90 |
| 1973 | 2.30 | 1.03 | 2.11 | 1.22 | 1.43 | 1.30 | 1.07 | 0.82 | 0.82 |
| 1974 | 2.04 | 0.92 | 1.88 | 1.08 | 1.28 | 1.16 | 0.95 | 0.74 | 0.74 |
| 1975 | 1.82 | 0.82 | 1.67 | 0.96 | 1.14 | 1.04 | 0.85 | 0.68 | 0.68 |
| 1976 | 1.62 | 0.73 | 1.49 | 0.86 | 1.02 | 0.93 | 0.76 | 0.62 | 0.62 |
| 1977 | 1.44 | 0.65 | 1.33 | 0.77 | 0.91 | 0.83 | 0.68 | 0.56 | 0.56 |
| 1978 | 1.28 | 0.58 | 1.19 | 0.69 | 0.81 | 0.75 | 0.61 | 0.51 | 0.51 |
| 1979 | 1.14 | 0.52 | 1.07 | 0.61 | 0.73 | 0.67 | 0.54 | 0.47 | 0.47 |
| 1980 | 1.02 | 0.46 | 0.96 | 0.55 | 0.65 | 0.60 | 0.49 | 0.43 | 0.43 |
| 1981 | 0.91 | 0.42 | 0.86 | 0.49 | 0.59 | 0.54 | 0.43 | 0.39 | 0.39 |
| 1982 | 0.82 | 0.37 | 0.77 | 0.44 | 0.53 | 0.49 | 0.39 | 0.36 | 0.36 |
| 1983 | 0.73 | 0.33 | 0.69 | 0.40 | 0.47 | 0.44 | 0.35 | 0.33 | 0.33 |
| 1984 | 0.65 | 0.30 | 0.62 | 0.36 | 0.43 | 0.40 | 0.31 | 0.30 | 0.30 |
| 1985 | 0.59 | 0.27 | 0.56 | 0.32 | 0.38 | 0.36 | 0.28 | 0.27 | 0.27 |
| 1986 | 0.53 | 0.24 | 0.50 | 0.29 | 0.35 | 0.33 | 0.26 | 0.25 | 0.25 |
| 1987 | 0.47 | 0.22 | 0.45 | 0.26 | 0.31 | 0.30 | 0.23 | 0.23 | 0.23 |
| 1988 | 0.43 | 0.20 | 0.41 | 0.23 | 0.28 | 0.27 | 0.21 | 0.21 | 0.21 |
| 1989 | 0.38 | 0.18 | 0.37 | 0.21 | 0.25 | 0.24 | 0.19 | 0.19 | 0.19 |
| 1990 | 0.35 | 0.16 | 0.33 | 0.19 | 0.23 | 0.22 | 0.17 | 0.17 | 0.17 |
| 1991 | 0.31 | 0.14 | 0.30 | 0.17 | 0.21 | 0.20 | 0.15 | 0.16 | 0.16 |
| 1992 | 0.28 | 0.13 | 0.27 | 0.16 | 0.19 | 0.18 | 0.14 | 0.15 | 0.15 |
| 1993 | 0.25 | 0.12 | 0.25 | 0.14 | 0.17 | 0.17 | 0.13 | 0.13 | 0.13 |
| 1994 | 0.23 | 0.11 | 0.23 | 0.13 | 0.16 | 0.15 | 0.11 | 0.12 | 0.12 |
| 1995 | 0.21 | 0.10 | 0.20 | 0.12 | 0.14 | 0.14 | 0.10 | 0.11 | 0.11 |
| 1996 | 0.19 | 0.09 | 0.19 | 0.11 | 0.13 | 0.13 | 0.09 | 0.10 | 0.10 |
| 1997 | 0.17 | 0.08 | 0.17 | 0.10 | 0.12 | 0.11 | 0.09 | 0.09 | 0.09 |
| 1998 | 0.16 | 0.07 | 0.15 | 0.09 | 0.11 | 0.11 | 0.08 | 0.09 | 0.09 |
| 1999 | 0.14 | 0.07 | 0.14 | 0.08 | 0.10 | 0.10 | 0.07 | 0.08 | 0.08 |
| 2000 | 0.13 | 0.06 | 0.13 | 0.07 | 0.09 | 0.09 | 0.06 | 0.07 | 0.07 |
| 2001 | 0.12 | 0.06 | 0.12 | 0.07 | 0.08 | 0.08 | 0.06 | 0.07 | 0.07 |
| 2002 | 0.11 | 0.05 | 0.11 | 0.06 | 0.07 | 0.07 | 0.05 | 0.06 | 0.06 |
| 2003 | 0.10 | 0.05 | 0.10 | 0.06 | 0.07 | 0.07 | 0.05 | 0.06 | 0.06 |
| 2004 | 0.09 | 0.04 | 0.09 | 0.05 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |
| 2005 | 0.08 | 0.04 | 0.08 | 0.05 | 0.06 | 0.06 | 0.04 | 0.05 | 0.05 |
| 2006 | 0.07 | 0.04 | 0.08 | 0.04 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 |
| 2007 | 0.07 | 0.03 | 0.07 | 0.04 | 0.05 | 0.05 | 0.03 | 0.04 | 0.04 |
| 2008 | 0.06 | 0.03 | 0.06 | 0.04 | 0.04 | 0.05 | 0.03 | 0.04 | 0.04 |
| 2009 | 0.06 | 0.03 | 0.06 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 |
| 2010 | 0.05 | 0.03 | 0.05 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 |

**Table A-8** The job-exposure matrix for EMP in All 7 mines (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **All 7 mines** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | 0.41 | 0.60 | 0.47 | 0.45 | 0.49 | 0.41 | 0.23 | 0.45 | 0.45 |
| 1956 | 0.39 | 0.57 | 0.45 | 0.43 | 0.47 | 0.40 | 0.22 | 0.43 | 0.43 |
| 1957 | 0.37 | 0.54 | 0.43 | 0.41 | 0.45 | 0.38 | 0.21 | 0.41 | 0.41 |
| 1958 | 0.36 | 0.52 | 0.41 | 0.39 | 0.43 | 0.36 | 0.20 | 0.39 | 0.39 |
| 1959 | 0.34 | 0.50 | 0.39 | 0.38 | 0.41 | 0.34 | 0.19 | 0.38 | 0.38 |
| 1960 | 0.32 | 0.47 | 0.37 | 0.36 | 0.39 | 0.33 | 0.18 | 0.36 | 0.36 |
| 1961 | 0.31 | 0.45 | 0.36 | 0.34 | 0.37 | 0.32 | 0.17 | 0.35 | 0.35 |
| 1962 | 0.30 | 0.43 | 0.34 | 0.33 | 0.36 | 0.30 | 0.17 | 0.33 | 0.33 |
| 1963 | 0.28 | 0.41 | 0.33 | 0.31 | 0.34 | 0.29 | 0.16 | 0.32 | 0.32 |
| 1964 | 0.27 | 0.40 | 0.31 | 0.30 | 0.33 | 0.28 | 0.15 | 0.30 | 0.30 |
| 1965 | 0.26 | 0.38 | 0.30 | 0.29 | 0.31 | 0.26 | 0.15 | 0.29 | 0.29 |
| 1966 | 0.25 | 0.36 | 0.29 | 0.27 | 0.30 | 0.25 | 0.14 | 0.28 | 0.28 |
| 1967 | 0.24 | 0.35 | 0.27 | 0.26 | 0.29 | 0.24 | 0.13 | 0.27 | 0.27 |
| 1968 | 0.23 | 0.33 | 0.26 | 0.25 | 0.27 | 0.23 | 0.13 | 0.25 | 0.25 |
| 1969 | 0.22 | 0.32 | 0.25 | 0.24 | 0.26 | 0.22 | 0.12 | 0.24 | 0.24 |
| 1970 | 0.21 | 0.30 | 0.24 | 0.23 | 0.25 | 0.21 | 0.12 | 0.23 | 0.23 |
| 1971 | 0.20 | 0.29 | 0.23 | 0.22 | 0.24 | 0.20 | 0.11 | 0.22 | 0.22 |
| 1972 | 0.19 | 0.28 | 0.22 | 0.21 | 0.23 | 0.19 | 0.11 | 0.21 | 0.21 |
| 1973 | 0.18 | 0.27 | 0.21 | 0.20 | 0.22 | 0.19 | 0.10 | 0.20 | 0.20 |
| 1974 | 0.17 | 0.25 | 0.20 | 0.19 | 0.21 | 0.18 | 0.10 | 0.20 | 0.20 |
| 1975 | 0.17 | 0.24 | 0.19 | 0.18 | 0.20 | 0.17 | 0.09 | 0.19 | 0.19 |
| 1976 | 0.16 | 0.23 | 0.18 | 0.18 | 0.19 | 0.16 | 0.09 | 0.18 | 0.18 |
| 1977 | 0.15 | 0.22 | 0.18 | 0.17 | 0.18 | 0.16 | 0.09 | 0.17 | 0.17 |
| 1978 | 0.15 | 0.21 | 0.17 | 0.16 | 0.18 | 0.15 | 0.08 | 0.16 | 0.16 |
| 1979 | 0.14 | 0.21 | 0.16 | 0.15 | 0.17 | 0.14 | 0.08 | 0.16 | 0.16 |
| 1980 | 0.13 | 0.20 | 0.15 | 0.15 | 0.16 | 0.14 | 0.08 | 0.15 | 0.15 |
| 1981 | 0.13 | 0.19 | 0.15 | 0.14 | 0.15 | 0.13 | 0.07 | 0.14 | 0.14 |
| 1982 | 0.12 | 0.18 | 0.14 | 0.14 | 0.15 | 0.13 | 0.07 | 0.14 | 0.14 |
| 1983 | 0.12 | 0.17 | 0.14 | 0.13 | 0.14 | 0.12 | 0.07 | 0.13 | 0.13 |
| 1984 | 0.11 | 0.17 | 0.13 | 0.12 | 0.14 | 0.12 | 0.06 | 0.13 | 0.13 |
| 1985 | 0.11 | 0.16 | 0.12 | 0.12 | 0.13 | 0.11 | 0.06 | 0.12 | 0.12 |
| 1986 | 0.10 | 0.15 | 0.12 | 0.11 | 0.13 | 0.11 | 0.06 | 0.12 | 0.12 |
| 1987 | 0.10 | 0.15 | 0.11 | 0.11 | 0.12 | 0.10 | 0.06 | 0.11 | 0.11 |
| 1988 | 0.09 | 0.14 | 0.11 | 0.11 | 0.12 | 0.10 | 0.05 | 0.11 | 0.11 |
| 1989 | 0.09 | 0.13 | 0.11 | 0.10 | 0.11 | 0.09 | 0.05 | 0.10 | 0.10 |
| 1990 | 0.09 | 0.13 | 0.10 | 0.10 | 0.11 | 0.09 | 0.05 | 0.10 | 0.10 |
| 1991 | 0.08 | 0.12 | 0.10 | 0.09 | 0.10 | 0.09 | 0.05 | 0.09 | 0.09 |
| 1992 | 0.08 | 0.12 | 0.09 | 0.09 | 0.10 | 0.08 | 0.05 | 0.09 | 0.09 |
| 1993 | 0.08 | 0.11 | 0.09 | 0.09 | 0.09 | 0.08 | 0.04 | 0.09 | 0.09 |
| 1994 | 0.07 | 0.11 | 0.09 | 0.08 | 0.09 | 0.08 | 0.04 | 0.08 | 0.08 |
| 1995 | 0.07 | 0.11 | 0.08 | 0.08 | 0.09 | 0.07 | 0.04 | 0.08 | 0.08 |
| 1996 | 0.07 | 0.10 | 0.08 | 0.08 | 0.08 | 0.07 | 0.04 | 0.08 | 0.08 |
| 1997 | 0.07 | 0.10 | 0.08 | 0.07 | 0.08 | 0.07 | 0.04 | 0.07 | 0.07 |
| 1998 | 0.06 | 0.09 | 0.07 | 0.07 | 0.08 | 0.06 | 0.04 | 0.07 | 0.07 |
| 1999 | 0.06 | 0.09 | 0.07 | 0.07 | 0.07 | 0.06 | 0.03 | 0.07 | 0.07 |
| 2000 | 0.06 | 0.09 | 0.07 | 0.06 | 0.07 | 0.06 | 0.03 | 0.06 | 0.06 |
| 2001 | 0.06 | 0.08 | 0.06 | 0.06 | 0.07 | 0.06 | 0.03 | 0.06 | 0.06 |
| 2002 | 0.05 | 0.08 | 0.06 | 0.06 | 0.06 | 0.06 | 0.03 | 0.06 | 0.06 |
| 2003 | 0.05 | 0.08 | 0.06 | 0.06 | 0.06 | 0.05 | 0.03 | 0.06 | 0.06 |
| 2004 | 0.05 | 0.07 | 0.06 | 0.05 | 0.06 | 0.05 | 0.03 | 0.05 | 0.05 |
| 2005 | 0.05 | 0.07 | 0.06 | 0.05 | 0.06 | 0.05 | 0.03 | 0.05 | 0.05 |
| 2006 | 0.05 | 0.07 | 0.05 | 0.05 | 0.06 | 0.05 | 0.03 | 0.05 | 0.05 |
| 2007 | 0.04 | 0.07 | 0.05 | 0.05 | 0.05 | 0.05 | 0.02 | 0.05 | 0.05 |
| 2008 | 0.04 | 0.06 | 0.05 | 0.05 | 0.05 | 0.04 | 0.02 | 0.05 | 0.05 |
| 2009 | 0.04 | 0.06 | 0.05 | 0.04 | 0.05 | 0.04 | 0.02 | 0.04 | 0.04 |
| 2010 | 0.04 | 0.06 | 0.05 | 0.04 | 0.05 | 0.04 | 0.02 | 0.04 | 0.04 |

## Appendix B: NIOSH-EMP JEM – Approach 2

**Table B-1** The job-exposure matrix for EMP in Mine F (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine F** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | / | / | / | / | / | / | / | / | / |
| 1968 | / | / | / | / | / | / | / | / | / |
| 1969 | / | / | / | / | / | / | / | / | / |
| 1970 | / | / | / | / | / | / | / | / | / |
| 1971 | / | / | / | / | / | / | / | / | / |
| 1972 | / | / | / | / | / | / | / | / | / |
| 1973 | / | / | / | / | / | / | / | / | / |
| 1974 | / | / | / | / | / | / | / | / | / |
| 1975 | / | / | / | / | / | / | / | / | / |
| 1976 | / | / | / | / | / | / | / | / | / |
| 1977 | 0.03 | 0.05 | 0.10 | 0.05 | 0.08 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1978 | 0.03 | 0.05 | 0.10 | 0.05 | 0.08 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1979 | 0.03 | 0.05 | 0.10 | 0.04 | 0.08 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1980 | 0.03 | 0.05 | 0.09 | 0.04 | 0.07 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1981 | 0.03 | 0.04 | 0.09 | 0.04 | 0.07 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1982 | 0.03 | 0.04 | 0.09 | 0.04 | 0.07 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1983 | 0.03 | 0.04 | 0.09 | 0.04 | 0.07 | 0.02 | 0.05 | 0.05 | 0.05 |
| 1984 | 0.03 | 0.04 | 0.08 | 0.04 | 0.07 | 0.02 | 0.05 | 0.04 | 0.04 |
| 1985 | 0.03 | 0.04 | 0.08 | 0.04 | 0.06 | 0.02 | 0.05 | 0.04 | 0.04 |
| 1986 | 0.03 | 0.04 | 0.08 | 0.04 | 0.06 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1987 | 0.02 | 0.04 | 0.08 | 0.04 | 0.06 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1988 | 0.02 | 0.04 | 0.08 | 0.04 | 0.06 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1989 | 0.02 | 0.04 | 0.07 | 0.04 | 0.06 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1990 | 0.02 | 0.04 | 0.07 | 0.04 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1991 | 0.02 | 0.04 | 0.07 | 0.04 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1992 | 0.02 | 0.04 | 0.07 | 0.03 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1993 | 0.02 | 0.04 | 0.07 | 0.03 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1994 | 0.02 | 0.04 | 0.06 | 0.03 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1995 | 0.02 | 0.04 | 0.06 | 0.03 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1996 | 0.02 | 0.04 | 0.06 | 0.03 | 0.05 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1997 | 0.02 | 0.04 | 0.06 | 0.03 | 0.04 | 0.02 | 0.04 | 0.04 | 0.04 |
| 1998 | 0.02 | 0.04 | 0.06 | 0.03 | 0.04 | 0.02 | 0.04 | 0.03 | 0.03 |
| 1999 | 0.02 | 0.04 | 0.06 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2000 | 0.02 | 0.04 | 0.06 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2001 | 0.02 | 0.04 | 0.05 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2002 | 0.02 | 0.04 | 0.05 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2003 | 0.02 | 0.04 | 0.05 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2004 | 0.02 | 0.04 | 0.05 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2005 | 0.02 | 0.04 | 0.05 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2006 | 0.02 | 0.04 | 0.05 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2007 | 0.02 | 0.04 | 0.05 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2008 | 0.02 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2009 | 0.02 | 0.04 | 0.04 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 2010 | 0.02 | 0.04 | 0.04 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |

**Table B-2** The job-exposure matrix for EMP in Mine B (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine B** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | / | / | / | / | / | / | / | / | / |
| 1968 | / | / | / | / | / | / | / | / | / |
| 1969 | / | / | / | / | / | / | / | / | / |
| 1970 | / | / | / | / | / | / | / | / | / |
| 1971 | / | / | / | / | / | / | / | / | / |
| 1972 | / | / | / | / | / | / | / | / | / |
| 1973 | / | / | / | / | / | / | / | / | / |
| 1974 | 0.02 | 0.07 | 0.01 | 0.03 | 0.08 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1975 | 0.02 | 0.07 | 0.01 | 0.03 | 0.08 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1976 | 0.02 | 0.07 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1977 | 0.02 | 0.07 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1978 | 0.02 | 0.07 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1979 | 0.02 | 0.06 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1980 | 0.02 | 0.06 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1981 | 0.02 | 0.06 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1982 | 0.02 | 0.06 | 0.01 | 0.03 | 0.07 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1983 | 0.02 | 0.06 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1984 | 0.02 | 0.06 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1985 | 0.02 | 0.05 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1986 | 0.02 | 0.05 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1987 | 0.02 | 0.05 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1988 | 0.02 | 0.05 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1989 | 0.02 | 0.05 | 0.01 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1990 | 0.02 | 0.05 | 0.02 | 0.03 | 0.06 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1991 | 0.02 | 0.05 | 0.02 | 0.03 | 0.05 | 0.02 | 0.03 | 0.04 | 0.04 |
| 1992 | 0.02 | 0.05 | 0.02 | 0.03 | 0.05 | 0.02 | 0.02 | 0.04 | 0.04 |
| 1993 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.02 | 0.02 | 0.03 | 0.03 |
| 1994 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.02 | 0.02 | 0.03 | 0.03 |
| 1995 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.02 | 0.02 | 0.03 | 0.03 |
| 1996 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.03 | 0.02 | 0.03 | 0.03 |
| 1997 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.03 | 0.02 | 0.03 | 0.03 |
| 1998 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.03 | 0.02 | 0.03 | 0.03 |
| 1999 | 0.02 | 0.04 | 0.02 | 0.03 | 0.05 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2000 | 0.02 | 0.04 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2001 | 0.02 | 0.04 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2002 | 0.02 | 0.04 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2003 | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2004 | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2005 | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2006 | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2007 | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2008 | 0.02 | 0.03 | 0.02 | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2009 | 0.02 | 0.03 | 0.02 | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| 2010 | 0.02 | 0.03 | 0.02 | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |

**Table B-3** The job-exposure matrix for EMP in Mine D (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine D** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | 0.08 | 0.13 | 0.23 | 0.23 | 0.07 | 0.02 | 0.05 | 0.15 | 0.15 |
| 1968 | 0.07 | 0.12 | 0.22 | 0.23 | 0.07 | 0.02 | 0.05 | 0.15 | 0.15 |
| 1969 | 0.07 | 0.12 | 0.21 | 0.23 | 0.07 | 0.02 | 0.05 | 0.14 | 0.14 |
| 1970 | 0.07 | 0.11 | 0.21 | 0.22 | 0.06 | 0.02 | 0.05 | 0.14 | 0.14 |
| 1971 | 0.07 | 0.11 | 0.20 | 0.22 | 0.06 | 0.02 | 0.05 | 0.14 | 0.14 |
| 1972 | 0.07 | 0.11 | 0.20 | 0.22 | 0.06 | 0.02 | 0.05 | 0.14 | 0.14 |
| 1973 | 0.07 | 0.10 | 0.19 | 0.21 | 0.06 | 0.02 | 0.05 | 0.13 | 0.13 |
| 1974 | 0.07 | 0.10 | 0.18 | 0.21 | 0.06 | 0.02 | 0.05 | 0.13 | 0.13 |
| 1975 | 0.07 | 0.10 | 0.18 | 0.21 | 0.06 | 0.02 | 0.05 | 0.13 | 0.13 |
| 1976 | 0.06 | 0.09 | 0.17 | 0.20 | 0.06 | 0.02 | 0.04 | 0.13 | 0.13 |
| 1977 | 0.06 | 0.09 | 0.17 | 0.20 | 0.06 | 0.02 | 0.04 | 0.12 | 0.12 |
| 1978 | 0.06 | 0.09 | 0.16 | 0.20 | 0.06 | 0.02 | 0.04 | 0.12 | 0.12 |
| 1979 | 0.06 | 0.08 | 0.16 | 0.20 | 0.06 | 0.02 | 0.04 | 0.12 | 0.12 |
| 1980 | 0.06 | 0.08 | 0.16 | 0.19 | 0.06 | 0.02 | 0.04 | 0.12 | 0.12 |
| 1981 | 0.06 | 0.08 | 0.15 | 0.19 | 0.06 | 0.02 | 0.04 | 0.11 | 0.11 |
| 1982 | 0.06 | 0.08 | 0.15 | 0.19 | 0.06 | 0.02 | 0.04 | 0.11 | 0.11 |
| 1983 | 0.06 | 0.07 | 0.14 | 0.18 | 0.06 | 0.02 | 0.04 | 0.11 | 0.11 |
| 1984 | 0.06 | 0.07 | 0.14 | 0.18 | 0.06 | 0.02 | 0.04 | 0.11 | 0.11 |
| 1985 | 0.05 | 0.07 | 0.13 | 0.18 | 0.06 | 0.02 | 0.04 | 0.10 | 0.10 |
| 1986 | 0.05 | 0.07 | 0.13 | 0.18 | 0.06 | 0.02 | 0.04 | 0.10 | 0.10 |
| 1987 | 0.05 | 0.07 | 0.13 | 0.17 | 0.06 | 0.03 | 0.04 | 0.10 | 0.10 |
| 1988 | 0.05 | 0.06 | 0.12 | 0.17 | 0.06 | 0.03 | 0.03 | 0.10 | 0.10 |
| 1989 | 0.05 | 0.06 | 0.12 | 0.17 | 0.06 | 0.03 | 0.03 | 0.10 | 0.10 |
| 1990 | 0.05 | 0.06 | 0.12 | 0.17 | 0.06 | 0.03 | 0.03 | 0.09 | 0.09 |
| 1991 | 0.05 | 0.06 | 0.11 | 0.16 | 0.06 | 0.03 | 0.03 | 0.09 | 0.09 |
| 1992 | 0.05 | 0.06 | 0.11 | 0.16 | 0.06 | 0.03 | 0.03 | 0.09 | 0.09 |
| 1993 | 0.05 | 0.05 | 0.11 | 0.16 | 0.06 | 0.03 | 0.03 | 0.09 | 0.09 |
| 1994 | 0.05 | 0.05 | 0.10 | 0.16 | 0.06 | 0.03 | 0.03 | 0.09 | 0.09 |
| 1995 | 0.05 | 0.05 | 0.10 | 0.15 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 1996 | 0.05 | 0.05 | 0.10 | 0.15 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 1997 | 0.04 | 0.05 | 0.10 | 0.15 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 1998 | 0.04 | 0.05 | 0.09 | 0.15 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 1999 | 0.04 | 0.04 | 0.09 | 0.15 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 2000 | 0.04 | 0.04 | 0.09 | 0.14 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 2001 | 0.04 | 0.04 | 0.09 | 0.14 | 0.06 | 0.03 | 0.03 | 0.08 | 0.08 |
| 2002 | 0.04 | 0.04 | 0.08 | 0.14 | 0.06 | 0.03 | 0.03 | 0.07 | 0.07 |
| 2003 | 0.04 | 0.04 | 0.08 | 0.14 | 0.06 | 0.03 | 0.03 | 0.07 | 0.07 |
| 2004 | 0.04 | 0.04 | 0.08 | 0.14 | 0.06 | 0.03 | 0.03 | 0.07 | 0.07 |
| 2005 | 0.04 | 0.04 | 0.08 | 0.13 | 0.06 | 0.03 | 0.02 | 0.07 | 0.07 |
| 2006 | 0.04 | 0.04 | 0.07 | 0.13 | 0.06 | 0.03 | 0.02 | 0.07 | 0.07 |
| 2007 | 0.04 | 0.03 | 0.07 | 0.13 | 0.06 | 0.03 | 0.02 | 0.07 | 0.07 |
| 2008 | 0.04 | 0.03 | 0.07 | 0.13 | 0.06 | 0.03 | 0.02 | 0.07 | 0.07 |
| 2009 | 0.04 | 0.03 | 0.07 | 0.13 | 0.06 | 0.03 | 0.02 | 0.06 | 0.06 |
| 2010 | 0.04 | 0.03 | 0.07 | 0.12 | 0.06 | 0.03 | 0.02 | 0.06 | 0.06 |

**Table B-4** The job-exposure matrix for EMP in Mine G (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine G** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.09 | 0.09 |
| 1958 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.09 | 0.09 |
| 1959 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1960 | 0.07 | 0.22 | 0.04 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1961 | 0.07 | 0.22 | 0.04 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1962 | 0.07 | 0.22 | 0.04 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1963 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1964 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1965 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1966 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1967 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1968 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1969 | 0.07 | 0.22 | 0.05 | 0.04 | 0.19 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1970 | 0.07 | 0.22 | 0.06 | 0.04 | 0.19 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1971 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1972 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1973 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1974 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1975 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1976 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1977 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1978 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1979 | 0.07 | 0.22 | 0.08 | 0.04 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1980 | 0.07 | 0.22 | 0.08 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1981 | 0.07 | 0.22 | 0.08 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1982 | 0.08 | 0.22 | 0.08 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1983 | 0.08 | 0.22 | 0.09 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1984 | 0.08 | 0.22 | 0.09 | 0.05 | 0.17 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1985 | 0.08 | 0.22 | 0.09 | 0.05 | 0.17 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1986 | 0.08 | 0.22 | 0.09 | 0.05 | 0.17 | 0.07 | 0.01 | 0.12 | 0.12 |
| 1987 | 0.08 | 0.22 | 0.10 | 0.05 | 0.17 | 0.07 | 0.01 | 0.12 | 0.12 |
| 1988 | 0.08 | 0.22 | 0.10 | 0.05 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1989 | 0.08 | 0.22 | 0.10 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1990 | 0.08 | 0.22 | 0.11 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1991 | 0.08 | 0.22 | 0.11 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1992 | 0.08 | 0.22 | 0.11 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1993 | 0.08 | 0.22 | 0.12 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1994 | 0.08 | 0.22 | 0.12 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1995 | 0.08 | 0.22 | 0.13 | 0.06 | 0.17 | 0.08 | 0.02 | 0.12 | 0.12 |
| 1996 | 0.08 | 0.22 | 0.13 | 0.07 | 0.17 | 0.08 | 0.02 | 0.12 | 0.12 |
| 1997 | 0.08 | 0.22 | 0.13 | 0.07 | 0.16 | 0.09 | 0.02 | 0.12 | 0.12 |
| 1998 | 0.08 | 0.22 | 0.14 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 1999 | 0.08 | 0.22 | 0.14 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2000 | 0.08 | 0.22 | 0.15 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2001 | 0.08 | 0.22 | 0.15 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2002 | / | / | / | / | / | / | / | / | / |
| 2003 | / | / | / | / | / | / | / | / | / |
| 2004 | / | / | / | / | / | / | / | / | / |
| 2005 | / | / | / | / | / | / | / | / | / |
| 2006 | / | / | / | / | / | / | / | / | / |
| 2007 | / | / | / | / | / | / | / | / | / |
| 2008 | / | / | / | / | / | / | / | / | / |
| 2009 | / | / | / | / | / | / | / | / | / |
| 2010 | / | / | / | / | / | / | / | / | / |

**Table B-5** The job-exposure matrix for EMP in Mine E (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine E** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | / | / | / | / | / | / | / | / | / |
| 1965 | / | / | / | / | / | / | / | / | / |
| 1966 | / | / | / | / | / | / | / | / | / |
| 1967 | 0.04 | 0.03 | 0.02 | 0.15 | 0.22 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1968 | 0.04 | 0.03 | 0.02 | 0.15 | 0.21 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1969 | 0.04 | 0.03 | 0.02 | 0.15 | 0.21 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1970 | 0.04 | 0.03 | 0.02 | 0.14 | 0.20 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1971 | 0.04 | 0.04 | 0.02 | 0.14 | 0.20 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1972 | 0.04 | 0.04 | 0.02 | 0.14 | 0.19 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1973 | 0.04 | 0.04 | 0.02 | 0.14 | 0.19 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1974 | 0.04 | 0.04 | 0.02 | 0.14 | 0.18 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1975 | 0.04 | 0.04 | 0.02 | 0.14 | 0.18 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1976 | 0.04 | 0.04 | 0.02 | 0.14 | 0.18 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1977 | 0.04 | 0.04 | 0.02 | 0.14 | 0.17 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1978 | 0.03 | 0.04 | 0.02 | 0.14 | 0.17 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1979 | 0.03 | 0.04 | 0.02 | 0.14 | 0.16 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1980 | 0.03 | 0.04 | 0.02 | 0.14 | 0.16 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1981 | 0.03 | 0.04 | 0.03 | 0.14 | 0.15 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1982 | 0.03 | 0.05 | 0.03 | 0.14 | 0.15 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1983 | 0.03 | 0.05 | 0.03 | 0.14 | 0.15 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1984 | 0.03 | 0.05 | 0.03 | 0.14 | 0.14 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1985 | 0.03 | 0.05 | 0.03 | 0.14 | 0.14 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1986 | 0.03 | 0.05 | 0.03 | 0.14 | 0.14 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1987 | 0.03 | 0.05 | 0.03 | 0.14 | 0.13 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1988 | 0.03 | 0.05 | 0.03 | 0.14 | 0.13 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1989 | 0.03 | 0.05 | 0.03 | 0.14 | 0.13 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1990 | 0.03 | 0.05 | 0.03 | 0.14 | 0.12 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1991 | 0.03 | 0.06 | 0.03 | 0.14 | 0.12 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1992 | 0.03 | 0.06 | 0.03 | 0.14 | 0.12 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1993 | 0.03 | 0.06 | 0.03 | 0.14 | 0.11 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1994 | 0.03 | 0.06 | 0.03 | 0.13 | 0.11 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1995 | 0.03 | 0.06 | 0.03 | 0.13 | 0.11 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1996 | 0.03 | 0.06 | 0.04 | 0.13 | 0.11 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1997 | 0.03 | 0.06 | 0.04 | 0.13 | 0.10 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1998 | 0.03 | 0.06 | 0.04 | 0.13 | 0.10 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1999 | 0.03 | 0.07 | 0.04 | 0.13 | 0.10 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2000 | 0.03 | 0.07 | 0.04 | 0.13 | 0.10 | 0.05 | 0.02 | 0.07 | 0.07 |
| 2001 | 0.03 | 0.07 | 0.04 | 0.13 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 2002 | 0.03 | 0.07 | 0.04 | 0.13 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 2003 | 0.03 | 0.07 | 0.04 | 0.13 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 2004 | 0.03 | 0.07 | 0.04 | 0.13 | 0.09 | 0.05 | 0.03 | 0.07 | 0.07 |
| 2005 | 0.03 | 0.08 | 0.04 | 0.13 | 0.08 | 0.05 | 0.03 | 0.07 | 0.07 |
| 2006 | 0.03 | 0.08 | 0.04 | 0.13 | 0.08 | 0.05 | 0.03 | 0.07 | 0.07 |
| 2007 | 0.03 | 0.08 | 0.04 | 0.13 | 0.08 | 0.05 | 0.03 | 0.07 | 0.07 |
| 2008 | 0.03 | 0.08 | 0.05 | 0.13 | 0.08 | 0.05 | 0.03 | 0.07 | 0.07 |
| 2009 | 0.03 | 0.08 | 0.05 | 0.13 | 0.08 | 0.05 | 0.03 | 0.07 | 0.07 |
| 2010 | 0.03 | 0.08 | 0.05 | 0.13 | 0.07 | 0.05 | 0.03 | 0.07 | 0.07 |

**Table B-6** The job-exposure matrix for EMP in Mine A (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine A** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.09 | 0.09 |
| 1956 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.09 | 0.09 |
| 1957 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.09 | 0.09 |
| 1958 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.09 | 0.09 |
| 1959 | 0.07 | 0.22 | 0.04 | 0.03 | 0.20 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1960 | 0.07 | 0.22 | 0.04 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1961 | 0.07 | 0.22 | 0.04 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1962 | 0.07 | 0.22 | 0.04 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1963 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1964 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1965 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1966 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1967 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.05 | 0.01 | 0.10 | 0.10 |
| 1968 | 0.07 | 0.22 | 0.05 | 0.03 | 0.19 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1969 | 0.07 | 0.22 | 0.05 | 0.04 | 0.19 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1970 | 0.07 | 0.22 | 0.06 | 0.04 | 0.19 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1971 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1972 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.10 | 0.10 |
| 1973 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1974 | 0.07 | 0.22 | 0.06 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1975 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1976 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1977 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1978 | 0.07 | 0.22 | 0.07 | 0.04 | 0.18 | 0.06 | 0.01 | 0.11 | 0.11 |
| 1979 | 0.07 | 0.22 | 0.08 | 0.04 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1980 | 0.07 | 0.22 | 0.08 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1981 | 0.07 | 0.22 | 0.08 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1982 | 0.08 | 0.22 | 0.08 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1983 | 0.08 | 0.22 | 0.09 | 0.05 | 0.18 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1984 | 0.08 | 0.22 | 0.09 | 0.05 | 0.17 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1985 | 0.08 | 0.22 | 0.09 | 0.05 | 0.17 | 0.07 | 0.01 | 0.11 | 0.11 |
| 1986 | 0.08 | 0.22 | 0.09 | 0.05 | 0.17 | 0.07 | 0.01 | 0.12 | 0.12 |
| 1987 | 0.08 | 0.22 | 0.10 | 0.05 | 0.17 | 0.07 | 0.01 | 0.12 | 0.12 |
| 1988 | 0.08 | 0.22 | 0.10 | 0.05 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1989 | 0.08 | 0.22 | 0.10 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1990 | 0.08 | 0.22 | 0.11 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1991 | 0.08 | 0.22 | 0.11 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1992 | 0.08 | 0.22 | 0.11 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1993 | 0.08 | 0.22 | 0.12 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1994 | 0.08 | 0.22 | 0.12 | 0.06 | 0.17 | 0.08 | 0.01 | 0.12 | 0.12 |
| 1995 | 0.08 | 0.22 | 0.13 | 0.06 | 0.17 | 0.08 | 0.02 | 0.12 | 0.12 |
| 1996 | 0.08 | 0.22 | 0.13 | 0.07 | 0.17 | 0.08 | 0.02 | 0.12 | 0.12 |
| 1997 | 0.08 | 0.22 | 0.13 | 0.07 | 0.16 | 0.09 | 0.02 | 0.12 | 0.12 |
| 1998 | 0.08 | 0.22 | 0.14 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 1999 | 0.08 | 0.22 | 0.14 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2000 | 0.08 | 0.22 | 0.15 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2001 | 0.08 | 0.22 | 0.15 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2002 | 0.08 | 0.21 | 0.16 | 0.07 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2003 | 0.08 | 0.21 | 0.16 | 0.08 | 0.16 | 0.09 | 0.02 | 0.13 | 0.13 |
| 2004 | 0.08 | 0.21 | 0.17 | 0.08 | 0.16 | 0.10 | 0.02 | 0.13 | 0.13 |
| 2005 | 0.08 | 0.21 | 0.17 | 0.08 | 0.16 | 0.10 | 0.02 | 0.13 | 0.13 |
| 2006 | 0.08 | 0.21 | 0.18 | 0.08 | 0.16 | 0.10 | 0.02 | 0.13 | 0.13 |
| 2007 | 0.08 | 0.21 | 0.18 | 0.08 | 0.16 | 0.10 | 0.02 | 0.13 | 0.13 |
| 2008 | 0.08 | 0.21 | 0.19 | 0.09 | 0.16 | 0.10 | 0.02 | 0.14 | 0.14 |
| 2009 | 0.08 | 0.21 | 0.20 | 0.09 | 0.16 | 0.10 | 0.02 | 0.14 | 0.14 |
| 2010 | 0.08 | 0.21 | 0.20 | 0.09 | 0.16 | 0.11 | 0.02 | 0.14 | 0.14 |

**Table B-7** The job-exposure matrix for EMP in Mine C (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **Mine C** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | / | / | / | / | / | / | / | / | / |
| 1956 | / | / | / | / | / | / | / | / | / |
| 1957 | / | / | / | / | / | / | / | / | / |
| 1958 | / | / | / | / | / | / | / | / | / |
| 1959 | / | / | / | / | / | / | / | / | / |
| 1960 | / | / | / | / | / | / | / | / | / |
| 1961 | / | / | / | / | / | / | / | / | / |
| 1962 | / | / | / | / | / | / | / | / | / |
| 1963 | / | / | / | / | / | / | / | / | / |
| 1964 | 0.05 | 0.01 | 0.05 | 0.04 | 0.10 | 0.09 | 0.01 | 0.03 | 0.03 |
| 1965 | 0.05 | 0.01 | 0.05 | 0.04 | 0.10 | 0.09 | 0.01 | 0.03 | 0.03 |
| 1966 | 0.05 | 0.01 | 0.05 | 0.04 | 0.10 | 0.08 | 0.01 | 0.03 | 0.03 |
| 1967 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.08 | 0.01 | 0.03 | 0.03 |
| 1968 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.08 | 0.01 | 0.03 | 0.03 |
| 1969 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.08 | 0.01 | 0.03 | 0.03 |
| 1970 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.07 | 0.01 | 0.03 | 0.03 |
| 1971 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.07 | 0.01 | 0.03 | 0.03 |
| 1972 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.07 | 0.01 | 0.03 | 0.03 |
| 1973 | 0.05 | 0.01 | 0.05 | 0.04 | 0.09 | 0.07 | 0.01 | 0.03 | 0.03 |
| 1974 | 0.05 | 0.02 | 0.05 | 0.04 | 0.09 | 0.07 | 0.01 | 0.03 | 0.03 |
| 1975 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.07 | 0.01 | 0.03 | 0.03 |
| 1976 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.06 | 0.01 | 0.03 | 0.03 |
| 1977 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.06 | 0.01 | 0.03 | 0.03 |
| 1978 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.06 | 0.02 | 0.03 | 0.03 |
| 1979 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.06 | 0.02 | 0.03 | 0.03 |
| 1980 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.06 | 0.02 | 0.03 | 0.03 |
| 1981 | 0.05 | 0.02 | 0.05 | 0.04 | 0.08 | 0.06 | 0.02 | 0.03 | 0.03 |
| 1982 | 0.06 | 0.02 | 0.05 | 0.04 | 0.08 | 0.05 | 0.02 | 0.03 | 0.03 |
| 1983 | 0.06 | 0.02 | 0.05 | 0.04 | 0.08 | 0.05 | 0.02 | 0.03 | 0.03 |
| 1984 | 0.06 | 0.02 | 0.05 | 0.04 | 0.08 | 0.05 | 0.02 | 0.03 | 0.03 |
| 1985 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.05 | 0.02 | 0.03 | 0.03 |
| 1986 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.05 | 0.02 | 0.04 | 0.04 |
| 1987 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.05 | 0.02 | 0.04 | 0.04 |
| 1988 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.05 | 0.02 | 0.04 | 0.04 |
| 1989 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.05 | 0.02 | 0.04 | 0.04 |
| 1990 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1991 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1992 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1993 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1994 | 0.06 | 0.02 | 0.05 | 0.04 | 0.07 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1995 | 0.06 | 0.02 | 0.05 | 0.04 | 0.06 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1996 | 0.06 | 0.02 | 0.05 | 0.04 | 0.06 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1997 | 0.06 | 0.03 | 0.05 | 0.04 | 0.06 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1998 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.04 | 0.02 | 0.04 | 0.04 |
| 1999 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.04 | 0.02 | 0.04 | 0.04 |
| 2000 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2001 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2002 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2003 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2004 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2005 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2006 | 0.07 | 0.03 | 0.05 | 0.04 | 0.06 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2007 | 0.07 | 0.03 | 0.05 | 0.04 | 0.05 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2008 | 0.07 | 0.03 | 0.05 | 0.04 | 0.05 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2009 | 0.07 | 0.03 | 0.05 | 0.04 | 0.05 | 0.03 | 0.02 | 0.04 | 0.04 |
| 2010 | 0.07 | 0.03 | 0.05 | 0.04 | 0.05 | 0.03 | 0.02 | 0.04 | 0.04 |

**Table B-8** The job-exposure matrix for EMP in All 7 mines (all values in the table are arithmetic means in f/cc)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **f/cc** | **All 7 mines** | | | | | | | | |
| **EMP** | **Mining** | **Crushing** | **Concentrating** | **Pelletizing** | **Shop (mobile)** | **Shop (stationary)** | **Office/control room** | **Janitor** | **All 8 departments** |
| 1955 | 0.05 | 0.13 | 0.03 | 0.07 | 0.11 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1956 | 0.05 | 0.13 | 0.03 | 0.07 | 0.11 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1957 | 0.05 | 0.13 | 0.03 | 0.07 | 0.11 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1958 | 0.05 | 0.13 | 0.03 | 0.07 | 0.11 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1959 | 0.05 | 0.13 | 0.03 | 0.07 | 0.11 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1960 | 0.05 | 0.13 | 0.03 | 0.07 | 0.11 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1961 | 0.05 | 0.13 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1962 | 0.05 | 0.13 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1963 | 0.05 | 0.13 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1964 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1965 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1966 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1967 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1968 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1969 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.03 | 0.07 | 0.07 |
| 1970 | 0.05 | 0.12 | 0.03 | 0.07 | 0.10 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1971 | 0.05 | 0.12 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1972 | 0.05 | 0.12 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1973 | 0.05 | 0.12 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1974 | 0.05 | 0.12 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1975 | 0.05 | 0.12 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1976 | 0.05 | 0.11 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1977 | 0.04 | 0.11 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1978 | 0.04 | 0.11 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1979 | 0.04 | 0.11 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1980 | 0.04 | 0.11 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1981 | 0.04 | 0.11 | 0.04 | 0.07 | 0.09 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1982 | 0.04 | 0.11 | 0.04 | 0.07 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1983 | 0.04 | 0.11 | 0.04 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1984 | 0.04 | 0.11 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1985 | 0.04 | 0.11 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1986 | 0.04 | 0.11 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1987 | 0.04 | 0.11 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1988 | 0.04 | 0.11 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1989 | 0.04 | 0.10 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1990 | 0.04 | 0.10 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1991 | 0.04 | 0.10 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1992 | 0.04 | 0.10 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1993 | 0.04 | 0.10 | 0.05 | 0.08 | 0.08 | 0.05 | 0.02 | 0.07 | 0.07 |
| 1994 | 0.04 | 0.10 | 0.05 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1995 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1996 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1997 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1998 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 1999 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2000 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2001 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2002 | 0.04 | 0.10 | 0.06 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2003 | 0.04 | 0.10 | 0.07 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2004 | 0.04 | 0.09 | 0.07 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2005 | 0.04 | 0.09 | 0.07 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2006 | 0.04 | 0.09 | 0.07 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2007 | 0.04 | 0.09 | 0.07 | 0.08 | 0.07 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2008 | 0.04 | 0.09 | 0.07 | 0.08 | 0.06 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2009 | 0.04 | 0.09 | 0.07 | 0.08 | 0.06 | 0.05 | 0.02 | 0.06 | 0.06 |
| 2010 | 0.04 | 0.09 | 0.08 | 0.08 | 0.06 | 0.05 | 0.02 | 0.06 | 0.06 |

## Appendix C: Numerical comparison of the predicted versus measured mean EMP exposure values

**Table C-1** Numerical comparison of the predicted versus measured mean EMP exposure values (only for the years and locations with at least 3 sampling results)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Mine** | **Department** | **Year** | **# of Samples** | **Sample Median** | **Approach 2** | **Approach 1** |
| A | Mining | 2003 | 4 | 0.126 | 0.054 | 0.100 |
| A | Mining | 2004 | 16 | 0.035 | 0.054 | 0.096 |
| A | Mining | 2006 | 5 | 0.080 | 0.054 | 0.087 |
| A | Mining | 2007 | 22 | 0.080 | 0.055 | 0.083 |
| A | Mining | 2008 | 3 | 0.001 | 0.055 | 0.080 |
| A | Mining | 2009 | 21 | 0.009 | 0.055 | 0.076 |
| A | Mining | 2010 | 26 | 0.060 | 0.055 | 0.073 |
| A | Crushing | 1978 | 12 | 0.370 | 0.148 | 0.515 |
| A | Crushing | 1979 | 8 | 0.200 | 0.148 | 0.492 |
| A | Crushing | 1984 | 6 | 0.235 | 0.147 | 0.393 |
| A | Crushing | 1985 | 4 | 0.190 | 0.147 | 0.375 |
| A | Crushing | 1986 | 3 | 0.110 | 0.147 | 0.359 |
| A | Crushing | 1992 | 6 | 0.003 | 0.147 | 0.274 |
| A | Crushing | 2001 | 3 | 0.110 | 0.146 | 0.183 |
| A | Crushing | 2003 | 4 | 0.472 | 0.145 | 0.167 |
| A | Crushing | 2004 | 8 | 0.150 | 0.145 | 0.160 |
| A | Crushing | 2005 | 8 | 0.055 | 0.145 | 0.153 |
| A | Crushing | 2006 | 6 | 0.275 | 0.145 | 0.146 |
| A | Crushing | 2007 | 13 | 0.110 | 0.145 | 0.139 |
| A | Crushing | 2008 | 5 | 0.290 | 0.145 | 0.133 |
| A | Crushing | 2009 | 12 | 0.014 | 0.145 | 0.127 |
| A | Crushing | 2010 | 59 | 0.136 | 0.145 | 0.122 |
| A | Concentrating | 2005 | 6 | 0.095 | 0.118 | 0.198 |
| A | Concentrating | 2010 | 32 | 0.147 | 0.139 | 0.158 |
| A | Pelletizing | 2003 | 3 | 0.020 | 0.059 | 0.097 |
| A | Pelletizing | 2010 | 62 | 0.068 | 0.070 | 0.071 |
| A | Shop (mobile) | 1979 | 11 | 0.130 | 0.093 | 0.315 |
| A | Shop (mobile) | 2003 | 5 | 0.110 | 0.084 | 0.107 |
| A | Shop (mobile) | 2004 | 11 | 0.160 | 0.083 | 0.102 |
| A | Shop (mobile) | 2007 | 8 | 0.075 | 0.082 | 0.089 |
| A | Shop (mobile) | 2008 | 4 | 0.020 | 0.082 | 0.085 |
| A | Shop (mobile) | 2009 | 4 | 0.008 | 0.082 | 0.082 |
| A | Shop (mobile) | 2010 | 44 | 0.070 | 0.081 | 0.078 |
| A | Shop (stationary) | 2010 | 42 | 0.089 | 0.069 | 0.069 |
| A | Office/control room | 2010 | 15 | 0.013 | 0.014 | 0.014 |
| A | Janitor | 1980 | 4 | 0.346 | 0.065 | 0.384 |
| B | Mining | 2001 | 4 | 0.010 | 0.022 | 0.018 |
| B | Mining | 2003 | 5 | 0.010 | 0.022 | 0.019 |
| B | Mining | 2007 | 3 | 0.001 | 0.021 | 0.021 |
| B | Mining | 2010 | 36 | 0.019 | 0.021 | 0.022 |
| B | Crushing | 2010 | 23 | 0.020 | 0.025 | 0.027 |
| B | Concentrating | 2010 | 24 | 0.019 | 0.020 | 0.020 |
| B | Pelletizing | 1995 | 3 | 0.001 | 0.025 | 0.021 |
| B | Pelletizing | 2003 | 4 | 0.319 | 0.026 | 0.025 |
| B | Pelletizing | 2010 | 35 | 0.020 | 0.028 | 0.029 |
| B | Shop (mobile) | 2010 | 52 | 0.028 | 0.031 | 0.029 |
| B | Shop (stationary) | 2010 | 24 | 0.019 | 0.023 | 0.023 |
| B | Office/control room | 2010 | 11 | 0.020 | 0.020 | 0.020 |
| C | Mining | 2000 | 4 | 0.001 | 0.043 | 0.106 |
| C | Mining | 2001 | 5 | 0.010 | 0.044 | 0.098 |
| C | Mining | 2003 | 3 | 0.040 | 0.045 | 0.083 |
| C | Mining | 2007 | 4 | 0.020 | 0.047 | 0.060 |
| C | Mining | 2010 | 24 | 0.040 | 0.048 | 0.047 |
| C | Crushing | 1981 | 3 | 0.090 | 0.014 | 0.252 |
| C | Crushing | 1982 | 3 | 0.040 | 0.015 | 0.232 |
| C | Crushing | 1987 | 3 | 0.001 | 0.016 | 0.154 |
| C | Crushing | 2001 | 6 | 0.003 | 0.022 | 0.049 |
| C | Crushing | 2003 | 3 | 0.040 | 0.023 | 0.041 |
| C | Crushing | 2010 | 41 | 0.020 | 0.027 | 0.023 |
| C | Concentrating | 2010 | 18 | 0.020 | 0.033 | 0.045 |
| C | Pelletizing | 2010 | 57 | 0.020 | 0.030 | 0.028 |
| C | Shop (mobile) | 1982 | 3 | 0.220 | 0.057 | 0.352 |
| C | Shop (mobile) | 1986 | 6 | 0.042 | 0.054 | 0.253 |
| C | Shop (mobile) | 2010 | 52 | 0.036 | 0.039 | 0.035 |
| C | Shop (stationary) | 1978 | 5 | 0.640 | 0.053 | 0.466 |
| C | Shop (stationary) | 1979 | 7 | 0.140 | 0.051 | 0.429 |
| C | Shop (stationary) | 2010 | 22 | 0.020 | 0.023 | 0.034 |
| C | Office/control room | 2010 | 12 | 0.019 | 0.019 | 0.019 |
| D | Mining | 2003 | 4 | 0.014 | 0.033 | 0.032 |
| D | Mining | 2007 | 8 | 0.010 | 0.030 | 0.031 |
| D | Mining | 2010 | 45 | 0.021 | 0.029 | 0.030 |
| D | Crushing | 2010 | 19 | 0.030 | 0.029 | 0.022 |
| D | Concentrating | 2010 | 24 | 0.062 | 0.048 | 0.052 |
| D | Pelletizing | 2010 | 54 | 0.101 | 0.100 | 0.103 |
| D | Shop (mobile) | 2004 | 5 | 0.010 | 0.048 | 0.047 |
| D | Shop (mobile) | 2010 | 30 | 0.041 | 0.047 | 0.045 |
| D | Shop (stationary) | 2010 | 23 | 0.026 | 0.028 | 0.028 |
| D | Office/control room | 2010 | 12 | 0.020 | 0.022 | 0.022 |
| E | Mining | 2000 | 4 | 0.002 | 0.029 | 0.016 |
| E | Mining | 2001 | 24 | 0.010 | 0.029 | 0.017 |
| E | Mining | 2003 | 9 | 0.010 | 0.028 | 0.021 |
| E | Mining | 2007 | 6 | 0.014 | 0.028 | 0.032 |
| E | Mining | 2010 | 36 | 0.024 | 0.027 | 0.043 |
| E | Crushing | 2000 | 3 | 0.001 | 0.057 | 0.019 |
| E | Crushing | 2001 | 9 | 0.006 | 0.058 | 0.021 |
| E | Crushing | 2007 | 4 | 0.014 | 0.067 | 0.039 |
| E | Crushing | 2010 | 33 | 0.052 | 0.072 | 0.053 |
| E | Concentrating | 1990 | 4 | 0.038 | 0.027 | 0.008 |
| E | Concentrating | 1991 | 13 | 0.002 | 0.027 | 0.009 |
| E | Concentrating | 2001 | 4 | 0.015 | 0.034 | 0.025 |
| E | Concentrating | 2003 | 6 | 0.020 | 0.035 | 0.031 |
| E | Concentrating | 2010 | 24 | 0.037 | 0.041 | 0.063 |
| E | Pelletizing | 1994 | 3 | 0.006 | 0.092 | 0.012 |
| E | Pelletizing | 1995 | 3 | 0.001 | 0.092 | 0.013 |
| E | Pelletizing | 2000 | 3 | 0.006 | 0.090 | 0.022 |
| E | Pelletizing | 2001 | 8 | 0.007 | 0.090 | 0.025 |
| E | Pelletizing | 2003 | 18 | 0.003 | 0.089 | 0.030 |
| E | Pelletizing | 2010 | 55 | 0.098 | 0.088 | 0.062 |
| E | Shop (mobile) | 2001 | 6 | 0.003 | 0.070 | 0.022 |
| E | Shop (mobile) | 2003 | 4 | 0.017 | 0.067 | 0.027 |
| E | Shop (mobile) | 2010 | 79 | 0.048 | 0.056 | 0.055 |
| E | Shop (stationary) | 2010 | 30 | 0.031 | 0.039 | 0.039 |
| E | Office/control room | 2010 | 24 | 0.021 | 0.024 | 0.024 |
| E | Janitor | 2003 | 10 | 0.020 | 0.048 | 0.025 |
| F | Mining | 1979 | 4 | 0.024 | 0.026 | 0.058 |
| F | Mining | 1981 | 4 | 0.024 | 0.026 | 0.055 |
| F | Mining | 1983 | 3 | 0.040 | 0.025 | 0.052 |
| F | Mining | 1986 | 3 | 0.001 | 0.024 | 0.047 |
| F | Mining | 2003 | 4 | 0.014 | 0.020 | 0.028 |
| F | Mining | 2007 | 5 | 0.010 | 0.020 | 0.025 |
| F | Mining | 2010 | 14 | 0.018 | 0.019 | 0.023 |
| F | Crushing | 1979 | 7 | 0.100 | 0.039 | 0.095 |
| F | Crushing | 1981 | 5 | 0.030 | 0.039 | 0.090 |
| F | Crushing | 1985 | 3 | 0.030 | 0.038 | 0.080 |
| F | Crushing | 1986 | 4 | 0.088 | 0.037 | 0.077 |
| F | Crushing | 1988 | 5 | 0.001 | 0.037 | 0.073 |
| F | Crushing | 2003 | 4 | 0.012 | 0.032 | 0.046 |
| F | Crushing | 2010 | 12 | 0.025 | 0.031 | 0.037 |
| F | Concentrating | 2010 | 14 | 0.034 | 0.039 | 0.041 |
| F | Pelletizing | 2010 | 30 | 0.021 | 0.023 | 0.020 |
| F | Shop (mobile) | 2010 | 30 | 0.022 | 0.027 | 0.027 |
| F | Shop (stationary) | 2010 | 18 | 0.020 | 0.021 | 0.021 |
| F | Office/control room | 2010 | 18 | 0.020 | 0.025 | 0.025 |
| G | Mining | 1979 | 9 | 0.060 | 0.049 | 1.000 |
| G | Mining | 1980 | 5 | 0.040 | 0.049 | 1.000 |
| G | Crushing | 1979 | 5 | 0.350 | 0.148 | 1.000 |
| G | Crushing | 1982 | 4 | 0.098 | 0.148 | 1.000 |
| G | Concentrating | 2003 | 3 | 0.020 | 1.000 | 1.000 |
| G | Shop (stationary) | 1979 | 7 | 0.080 | 0.043 | 1.000 |