

after facilities comply with today's rule. Increases in the percentage of exposed populations that would be exposed to no risk of non-cancer adverse human health effects due to the MP&M discharges occur in both the fish and drinking water analyses. The shift to lower hazard indices should be considered in conjunction with the finding that the hazard indices for incremental exposures to pollutants discharged by MP&M facilities (for which reference doses are available) are less than one in the baseline analysis for the entire population associated with sample facilities. Whether the incremental shifts in hazard indices are significant in reducing absolute risks of non-cancer adverse human health effects is uncertain and will depend on the magnitude of contaminant exposures for a given population from risk sources not accounted for in this analysis.

3. Benefits From Reduced Exposure to Lead

EPA performed a separate analysis of benefits from reduced exposure to lead. This analysis differs from the analysis of non-cancer adverse human health effects from exposure to other MP&M pollutants because it is based on dose-response functions tied to specific health endpoints to which monetary values can be applied.

Many lead-related adverse health effects are relatively common and are chronic in nature. These effects include, but are not limited to, hypertension, coronary heart disease, and impaired cognitive function. Lead is harmful to individuals of all ages, but the effects of lead on children are of particular concern. Children's rapid rate of development makes them more susceptible to neurobehavioral effects from lead exposure. The neurobehavioral effects on children from lead exposure include hyperactivity, behavioral and attention difficulties, delayed mental development, and motor and perceptual skill deficits.

This analysis assessed benefits of reduced lead exposure from consumption of contaminated fish tissue to three sensitive populations: (1) Preschool age children; (2) pregnant women; and (3) adult men and women. This analysis uses blood-lead levels as a biomarker of lead exposure. EPA estimated baseline and post-compliance blood lead levels in the exposed populations and then used changes in these levels to estimate benefits in the form of avoided health damages.

EPA assessed neurobehavioral effects on children based on a dose response

relationship for IQ decrements. Avoided neurological and cognitive damages are expressed as changes in overall IQ levels, including reduced incidence of extremely low IQ scores (<70, or two standard deviations below the mean) and reduced incidence of blood-lead levels above 20 µg/dL. The analysis uses the value of compensatory education that an individual would otherwise need and the impact of an additional IQ point on individuals' future earnings to value the avoided neurological and cognitive damages. The national-level analyses shows that implementation of the final option would not result in any changes in IQ loss across all exposed children. The final option does not reduce occurrences of extremely low IQ scores (<70) or incidences of blood-lead levels above 20 µg/dL.

Prenatal exposure to lead is an important route of exposure. Fetal exposure to lead in utero due to maternal blood-lead levels may result in several adverse health effects, including decreased gestational age, reduced birth weight, late fetal death, neurobehavioral deficits in infants, and increased infant mortality. To assess benefits to pregnant women, EPA estimated changes in the risk of infant mortality due to changes in maternal blood-lead levels during pregnancy. The national-level analysis shows that the final option does not result in changes in maternal blood lead levels during pregnancy and as a result does not reduce neonatal mortality.

The national-level analysis finds no benefits to children from reduced exposure to lead. However, as for the cancer risk analysis previously discussed, these findings differ from the more comprehensive analysis used in the Ohio case study. Using the case study approach, EPA estimates that the final regulation will yield annual lead-related benefits for children in Ohio of \$422,113 (2001\$). This benefit value includes three components. First, reduced lead exposure is estimated to reduce neonatal mortality by 0.024 cases annually with an annual value of \$162,094 (2001\$). Second, reduced lead exposure will avoid the loss of an estimated 26.96 IQ points among preschool children in Ohio, which translates into \$253,934 (2001\$) per year in benefits. Third, the annually avoided costs of compensatory education from incidence of IQ below 70 and blood-lead levels above 20 µg/dL among children amounts to approximately \$5,345 (2001\$).

Lead exposure has been shown to have adverse effects on the health of adults as well as children. The health effects in adults that EPA quantified all derive from lead's effects on blood

pressure. Quantified health effects include increased incidence of hypertension (estimated for males only), initial coronary heart disease (CHD), strokes (initial cerebrovascular accidents and atherothrombotic brain infarctions), and premature mortality. This analysis does not include other health effects associated with elevated blood pressure and other adult health effects of lead, including nervous system disorders in adults, anemia, and possible cancer effects. EPA used cost of illness estimates (*i.e.*, medical costs and lost work time) to estimate monetary value of reduced incidence of hypertension, initial CHD, and strokes. EPA then used the value of a statistical life saved to value changes in risk of premature mortality. The national level analysis finds that the final rule will achieve no lead-related health benefits among adults.

Again, the national analysis results differ from the Ohio case study results. Using the case study approach, EPA estimates that the final regulation will achieve total lead-related benefits among Ohio adults of \$117,393 (2001\$). This value includes benefits from reduced hypertension among adult males: a reduction of an estimated 9.4 cases annually, with benefits of approximately \$10,670 (2001\$). In addition, reducing the incidence of initial CHD, strokes, and premature mortality among adult males and females in Ohio would result in estimated benefits of \$963, \$2,115, and \$103,645, respectively.

Based on the national-level benefits analysis, EPA found that total benefits from reduced exposure to lead, for both children and adults, are negligible under the final rule. However, based on the Ohio case study findings, benefits for children and adults from reduced lead-related health effects to the final rule are estimated to total approximately \$0.5 million (2001\$) annually in the State of Ohio alone (*see* section H of today's final rule for detail). As in the cancer risk analysis, the difference in the national and Ohio-based results is primarily due to more comprehensive information on MP&M and non-MP&M facility discharges used in Ohio.

4. Reduced Exceedances of Health-Based AWQC

EPA also estimated the effect of MP&M facility discharges on the occurrence of pollutant concentrations in affected waterways that exceed human health-based AWQCs. In a conceptual sense, this analysis and its findings are not additive to the preceding analyses of change in cancer or lead-related health risks but are