system, perchlorate concentrations were non-detect. Additionally, all subsequent sampling also indicated an absence of perchlorate in the water. Therefore, Manatee County was not included in the cost assessment.

The City of Midland, TX had perchlorate contamination in a 5 MGD well field that was used to provide water during peak summer demands. The well field was abandoned five years ago after the perchlorate contamination was discovered. The well field is mostly dry; prior to five years ago, they would inject water from a more distant groundwater source into the 5 MGD well field during the winter. The stored water in the 5 MGD well field would then be withdrawn to meet peak summer demands for the City of Midland. This system was not included in the cost assessment.

4.3.1 Comparison to Other Cost Studies

The total annualized national compliance costs shown in Figure 4-1 were compared to costs developed in two previous studies – Kennedy/Jenks (2004) and CDPH (2007). The two previous studies estimated total perchlorate treatment costs for utilities in California to respond to a state regulation. Based on the trends shown in Figure 3-1, the estimated national compliance costs should be approximately three times the calculated California costs, assuming that all three studies produced fairly accurate cost information.

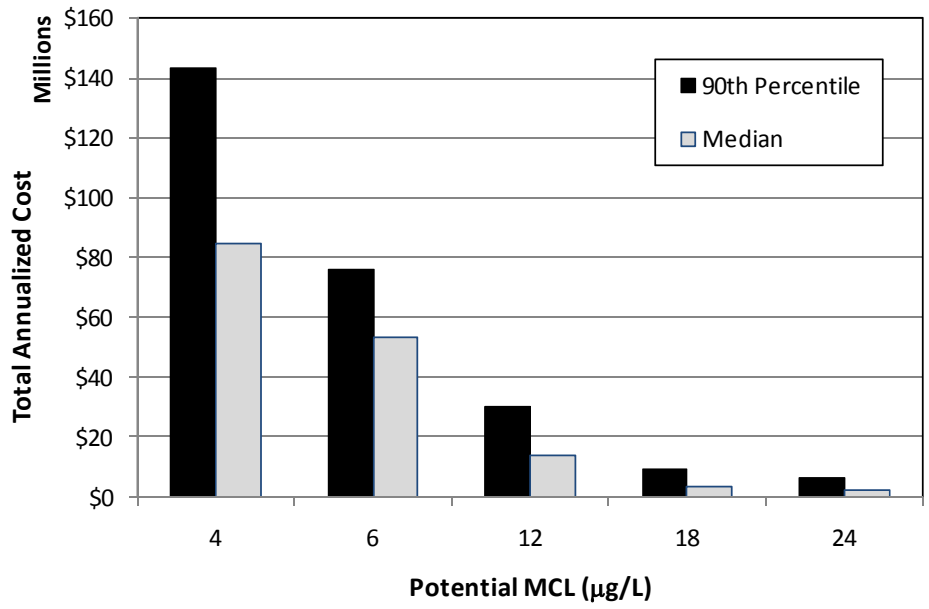

Figure 4-1. Total Estimated Annualized Costs Associated with Five Potential Perchlorate MCLs – based on installation of single pass ion exchange treatment systems (i.e., source abatement was not considered), 20 year life-of-service and 3% discount rate

Kennedy/Jenks (2004) estimated a total annual cost of $75 million (in 2004 dollars) to meet a 4 μg/L California MCL. The costs developed in this study indicate approximately twice that value for total national treatment costs, which is within an order of magnitude of expected results. For a 6 μg/L California MCL, Kennedy/Jenks (2004) and CDPH (2007) estimated $50 million and $24 million, respectively, in total annualized costs to treat perchlorate. The estimated national treatment costs (Figure 4-1) are approximately three times the CDPH calculated cost for California treatment, as expected. The resin replacement costs included in the Kennedy/Jenks (2004) study are higher than current market values, potentially accounting for the slightly higher estimates in the Kennedy/Jenks study as compared to the CDPH (2007) report and expected California costs based on the study presented herein.

5. Conclusions

In this study, the extent of perchlorate occurrence in large and small PWSs throughout the United States was assessed via a review of the UCMR database and previously published reports (Brandhuber and Clark, 2005; Kimbrough and Parekh, 2007; Gullick et al., 2000). The perchlorate occurrence data was then used to estimate national costs to treat contaminated water sources to meet five potential regulatory levels. The following conclusions can be made from the evaluation:

- Only 4.1% of all PWSs sampled under the UCMR had detectable levels of perchlorate in one or more of their source waters/entry points. Further, measured perchlorate concentrations at most locations were relatively low (12 μg/L or less).
- Only 3.4% of PWSs would be affected by a perchlorate MCL of 4 μg/L; less than 1% of PWSs would be required to treat their water at an MCL of 24 μg/L.
- While perchlorate contamination has been detected in source waters in 26 different states, one third of the PWSs affected are located in California. Most of the affected PWSs in California are already required to treat to remove perchlorate to meet the 6 μg/L MCL for the State of California.
- Most PWSs required to treat for perchlorate are expected to install single pass ion exchange systems given the simplicity and relatively low costs and based on current trends in Southern California. The advent of perchlorate-selective resins has made single pass ion exchange an economically competitive treatment option for perchlorate removal.
- Compared to other regulatory determinations, cost implications of a perchlorate MCL are relatively low due to the limited occurrence in source waters throughout the U.S. At an MCL of 4 μg/L, total compliance costs are estimated to be $2.1 billion.[7] The estimated nationwide compliance cost drops to approximately $0.1 billion at an MCL of 24 μg/L due to the small number of PWSs contaminated with perchlorate at that level. However, a small number of systems are carrying this cost burden and the cost impacts to an individual system installing perchlorate treatment would likely be significant.
- Costs to treat large PWSs account for the majority of the estimated nationwide compliance costs due to the higher percentage of large PWSs with perchlorate contamination (Table 3-2) and the higher capital and O&M costs to treat the greater quantity of water requiring treatment for a large system.
- Capital costs for single pass ion exchange are relatively low due to the simplicity of the treatment system. Capital costs to install single pass ion exchange systems

[7] Capital plus total operating costs (NPV) based on 20 years life of service at a 3% discount rate.

for all PWSs with perchlorate concentrations exceeding 4 μg/L are estimated to be $0.8 billion. Costs to operate the treatment systems for 20 years account for a larger percent of the total costs at $1.2 billion (NPV). A significant portion of the O&M costs for single pass ion exchange systems is the cost to periodically replace the spent resin.

- The presence of nitrate is known to substantially affect resin capacity and thus O&M costs. The effect of nitrate co-occurrence on costs was implicitly included in the cost evaluation by basing the O&M cost equation on known full-scale operating costs for systems with a range of water quality characteristics (i.e., nitrate concentrations ranging from 5 to 13 mg/L as nitrogen. Nevertheless, it may be beneficial in subsequent studies to consider the distribution of nitrate co-occurrence in the United States and then make reasonable assumptions of treatment process selection for the impacted utilities and the associated treatment costs.

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