6. Benefits Analysis

6.1 Introduction

This chapter considers the overall change in risk of contamination to PWS drinking water supplies, as indicated by the presence of Total Coliforms (TC) and *E. coli* (EC), associated with compliance with the current TCR and with each of the two alternatives considered: the AIP and the Alternative Analysis. Based on limitations in available data as described further in section 6.3 of this chapter, EPA determined that benefits could not be calculated in terms of avoided costs or other quantified benefits related to avoided morbidity or mortality. EPA assumes that a decrease in (risk of) contamination of PWS water supplies by TC and EC equates to some degree of reduction in adverse health and economic effects related to exposure to contaminated water supplies for the population served. Therefore, the reduction in risk discussed in this chapter is an indicator of the benefits of the proposed RTCR.

This analysis considers the net changes in occurrence of contaminant indicators under both regulatory alternatives considered as compared to the current TCR. EPA assumes that a decrease in indicator occurrence is likely to be associated with a decrease in fecal contaminant occurrence, which in turn reduces potential risk to human health for PWS customers. Customers of PWSs serving ≤4,100 people are expected to benefit more than customers of larger systems based on the larger number of changes that smaller systems would make in response to the proposed RTCR. In particular, model results suggest that customers of small ground water TNCWSs would benefit the most under the proposed RTCR alternatives (i.e., occurrence of contaminant indicators is predicted to decrease most for these systems).

The qualitative analysis considers the direction of anticipated changes in risk related to changes in sampling and corrective action regimens under each regulatory scenario (section 6.2). EPA considered the results of the quantified and qualitative assessments to determine how the current TCR and each of the two alternatives considered compare in terms of overall change in risk to the population served by PWSs across the United States.

The remainder of this chapter is organized as follows:

6.2 Qualitative Benefits Analyses
6.3 Assessment of Predictive Analysis Results
6.4 Uncertainty Sensitivity Analyses
6.5 Other Potential Benefits

6.2 Qualitative Benefits Analyses

The qualitative analysis uses the judgment of EPA as informed by TCR Distribution System Advisory Committee (TCRDSAC) deliberations (described in Chapter 3 of this EA) as well as the quantitative data discussed above to establish the direction of change in risk for each regulatory component proposed as part of the proposed RTCR. Exhibit 6.1 (below) presents a summary of this evaluation for each regulatory alternative considered in this EA as compared to the current TCR. The qualitative analysis discusses the influence of each regulatory component of the proposed RTCR and Alternative on the occurrence of TC+ and EC+ samples. Since a threshold of exposure has not been established for relating health effects resulting from exposure to the occurrence of EC+ samples, as discussed in section 6.2, the resulting risk to human health are discussed only in terms of the change in the direction of risk.

The terms "increase," "decrease," and "no change" in Exhibit 6.1 indicate the direction of change in risk under the two regulatory alternatives relative to the baseline, which is the regulatory environment under the current TCR, as described in Chapter 4 of this EA. A discussion of each regulatory component in the exhibit is provided following the exhibit. The component discussions in sections 6.2.1 through 6.2.8 address the individual effects within a category of component on the various system types and sizes; within a component category, risk may change for some systems of various sizes or types and not for others. In this case, Exhibit 6.6 reflects the overall change in risk; the statement of increase, decrease, or no change may not apply to all types and sizes of systems.

As described in the Introduction to this chapter, risk is defined, for the purpose of this EA, as exposure to water with contaminant indicators present. The discussion in section 6.2.9 considers how expected decreases in this risk by some components are offset by expected increases resulting from other components, and provides an overall assessment of the direction in change of risk for the regulatory alternatives considered.

Exhibit 6.1 Directional Change in Risk Under Alternative Regulatory Scenarios Relative to Current TCR

Current TCR Regulatory Components	Assessment of Potential Changes in Risk[1]	
	AIP	Alternative Analysis
Implementation Activities[2]	No change	No change
Routine Monitoring (including standard and reduced regimens) [2]	Decrease	Decrease
Repeat Monitoring	Increase	Decrease
Additional Routine Monitoring	Increase	Increase
Annual Inspections	No change	Increase
Assessments	Decrease	Decrease
Corrective Actions	Decrease	Decrease
Public Notification	No change	No change
Overall	Decrease	Decrease

[1] Detailed discussion of the rationale for determinations of potential risk for each rule component is presented in the sections immediately following this exhibit.
[2] Assessment of potential changes in risk for monitoring components is an *overall* assessment. Potential changes (or static state) of risk for particular system sizes and types differ according to individual regulatory requirements and are discussed in additional detail in the sections following this exhibit.
Note: Chapter 3 provides a detailed description of the regulatory components for all three regulatory scenarios. Additional discussion of the TCRDSAC process and the rationale underlying the structure of the regulatory alternatives considered can be found in the Preamble to the proposed RTCR.

6.2.1 Implementation Activities

Rule implementation activities are expected to be similar under all regulatory scenarios considered. These activities are primarily administrative in nature and include items such as reading and understanding the rule, training, and development of reporting and recordkeeping protocols. Because of the similarities in expected implementation activities under all regulatory scenarios, they are not expected to have an observably different affect on overall risk relative to current regulations. Both PWSs and states would incur additional burden and costs for transitioning to operations under the proposed RTCR requirements. However, because the activities undertaken to make the transition are primarily administrative, the additional activities are not expected to have any direct impact on risk.

6.2.2 Routine Monitoring

The Agency expects that more frequent monitoring would decrease the risk of contamination in PWSs based on an enhanced ability to diagnose and mitigate system issues in a

more timely fashion. Equivalently, the Agency assumes that a less frequent monitoring schedule would increase that risk.

The current TCR requires most water systems (including all surface water systems) to perform monthly monitoring for total coliforms. Some systems are eligible for reduced monitoring, as follows.

- Ground water NCWSs serving ≤1,000 people are required to monitor quarterly. States may allow annual monitoring if a sanitary survey conducted in the past five years shows the system is supplied solely by protected GW sources and is free of sanitary defects.
- Ground water CWSs serving ≤1,000 people may monitor quarterly if they have no history of total coliform contamination in their current configurations and a sanitary survey conducted in the past five years shows that the system is supplied solely by a protected GW source and has no sanitary defects.

Agreement in Principle

Routine monitoring requirements for non-seasonal PWSs do not change under the AIP. However, the eligibility requirements for ground water systems to qualify for reduced monitoring under the AIP are more stringent. In order to be eligible for reduced monitoring, ground water PWSs under the AIP must meet criteria:

- Sanitary survey conducted in the past five years showing the system is free of sanitary defects, has a protected water source and meets approved construction standards; and
- A clean TCR compliance history for the past 12 months (i.e., no TCR violations for the past 12 months); and
- The system must meet at least one of the following criteria:
    - An annual site visit by the primacy agency or a Level 2 assessment by a party approved by the state and correction of all identified sanitary defects (or an approved plan and schedule to correct them);
    - A cross connection control program;
    - Continuous disinfection for water entering the distribution system and maintenance of a residual in the distribution system;
    - Demonstration of maintenance of at least a 4-log removal or inactivation of viruses;
    - Other equivalent enhancements to water systems as approved by the state.

Additional Requirment for NCWS with Annual Monitoring

- In addition, ground water NCWSs must have an annual site visit by the primacy agency or a Level 2 assessment in order to qualify for annual monitoring.

Based on the additional protection provided by the more stringent criteria to qualify for reduced monitoring (i.e., Level 2 assessment, cross connection control program, etc.), the AIP is expected to reduce risk for GWSs that qualify for reduced monitoring compared to the eligibility requirements under the current TCR. In addition, those systems that no longer qualify for reduced monitoring are expected to have a reduced risk as a function of the increased numbers of samples taken.

Seasonal systems (those operating less than four calendar quarters per year) that sample on a reduced schedule under the current TCR may retain their current schedules unless and until a primacy agency determines that more frequent sampling is appropriate. For seasonal systems required to move to an increased monitoring schedule, risk would decrease as a function of the increase in monitoring. In addition, more explicit procedural requirements related to monitoring under the AIP (i.e., samples must be taken during the period of highest vulnerability or peak usage) would also be expected to reduce risk for seasonal systems.

Alternative Analysis

Under the alternative analysis, all systems must initially collect total coliform samples monthly regardless of size or type (i.e., water source), which is more frequent for those systems on reduced monitoring schedules under the current TCR (or AIP). Over time, in the second year of rule implementation and beyond, this rule option would allow some ground water PWSs to reduce to quarterly monitoring if the systems meet the same qualifications required for quarterly monitoring under the AIP. Reduced monitoring on an annual scheduled is not allowed under the Alternative Analysis, creating a further increase in samples taken over the TCR and AIP. Overall, the more frequent monitoring requirements (i.e., all PWSs are monitor monthly in the first few years after promulgation and no annual reduced monitoringis allowed) would reduce risk.

6.2.3 Repeat Monitoring

Under the current TCR, PWS serving ≤1,000 people take 4 repeat samples at and within five service connections upstream and downstream of the initial total coliform positive (TC+) occurrence event over the course of the 24 hours following the event. Three repeat samples are required for PWSs serving >1,000 people, including one sample at the site of the initial TC+ and two addition samples within five service connections up or downstream of that site.

Under the AIP and Alternative Analysis, PWSs serving ≤1,000 people are only required to take three repeat samples. The reduction in the number of repeat samples required would increase risk. However, the total number of repeat samples taken is also a function of the number of regular and additional routine samples taken, which in turn affects the number of TC+

samples found (i.e., the more samples taken, the greater chance of finding a TC+). Thus, the overall increase in routine sampling under the AIP and Alternative Analysis would result in more repeat samples while the decreases in additional routine samples under both of these options would lead to fewer repeat samples. The overall effect is a reduction in the number of required repeat samples under the AIP and a corresponding increase in risk compared to the current. For the Alternative Analysis, the overall effect would be an increase in total repeat samples and a corresponding decrease in risk compared to the current TCR. Repeat monitoring for PWSs serving >1,000 would remain the same under both alternatives compared to the current TCR, and risk would not change for this subset of systems.

6.2.4 Additional Routine Monitoring

Under the current TCR regulations, PWSs serving ≤4,100 people must conduct additional routine monitoring following a TC+ sample. All systems must conduct a minimum of five samples following the TC+ sample, unless the state finds that additional sampling is unnecessary or the state determines the cause of the TC+ sample and establishes that the system has corrected or would correct the problem.

Under both the AIP and Alternative Analysis, all systems that sample monthly under routine monitoring requirements are no longer required to conduct additional routine monitoring. This includes:

- All surface water PWSs sampling monthly;
- All ground water PWSs serving >1,000 people sampling monthly; and
- Ground water PWSs serving ≤1,000 people that monitor monthly.

Risk for these systems would increase under both alternatives from the current TCR based on reduced sampling frequency. However, the Agency believes this risk is small because these systems are sampling on a monthly basis and have a significant chance of identifying contamination issues through monthly routine monitoring.

Ground water PWSs serving ≤1,000 people on reduced monitoring (quarterly or annually) would be required to collect three samples in the month following a violation under the AIP and the Alternative Analysis, also increasing risk from the current regulation which requires five samples per month.

6.2.5 Annual Site Inspections

Currently, the TCR does not include any requirements for annual site inspections. However, based on discussions with stakeholders, some states do perform annual site visits for any systems on an annual sampling schedule.

Under the AIP, ground water NCWSs serving ≤1,000 people must, within one year of the compliance effective date, have an initial (and annually thereafter) visit by the primacy agency or an annual voluntary Level 2 assessment by a party approved by the primacy agency in order to

remain on an annual monitoring schedule. Because of the cost differential between conducting annual site inspections and the alternative (quarterly monitoring), EPA has estimated that only those states that already voluntarily conduct annual site inspections under the current TCR would also do so under the proposed RTCR. Therefore, no risk reduction is expected for these systems (and thus overall) from this regulatory component under the AIP.

The Alternative Analysis does not allow systems to reduce to a frequency of annual monitoring and therefore does not include an annual site inspection requirement. However, based on discussions with stakeholders, those states that currently conduct annual site assessments under the current TCR may no longer have the resources to both continue the inspections and conduct quarterly monitoring under the Alternative Analysis. Based on the discussions of the TCRDSAC, annual site visits provide diagnostic capability beyond that of three additional samples (i.e., quarterly versus annual monitoring). This trade-off between annual monitoring with site inspections and quarterly monitoring only would result in an increased risk for those systems that switch under the Alternative Analysis.

6.2.6 Assessments

Under the current TCR, although there is no explicit "assessment" required, some level of investigation is necessary to evaluate the cause of a problem. In particular, a system must investigate a problem and is required to notify the public and state under different scenarios. Specifically, a PWS must:

- Report any acute violation to the state no later than the end of the business after the system learns of a violation;
- Notify the public within 24 hours of an acute violation.
- Notify the public within 30 days of a monthly/non-acute MCL violation;

Under the AIP and Alternative Analysis, PWSs are required to perform and submit a Level 1 assessment if:

- Systems taking 40 or more samples per month have more than 5.0% total coliform positive samples;
- Systems taking less than 40 samples per month have two or more total coliform positive samples in one month; or
- A system fails to take all required repeat samples after a single total coliform positive sample.

A more detailed examination of the system, including its monitoring and operational practices (a Level 2 assessment), is required if a system has:

- An *E. coli* MCL violation;

- An *E. coli* monitoring violation; or
- A second Level 1 trigger within a rolling 12 month period.

Mandatory assessments are a new requirement under the AIP and Alternative Analysis, and also represent an increased focus on problem solving from the less defined investigations conducted under the current TCR. Because of the more explicit requirements for conduct of assessments, it is expected that more problems would be identified and resolved. As a result, the risk relative to the current TCR is assumed to decrease.

6.2.7 Corrective Actions

Corrective actions are not explicitly required under the current TCR. However, systems do perform corrective actions based on investigations performed (see section 6.3.6 above) in response to positive samples.

Under the AIP and Alternative Analysis, PWSs are responsible for correcting any sanitary defects found during either a Level 1 or Level 2 assessment. For corrections not completed by the time of submission of the assessment form, the system and primacy agency would be required to agree on a schedule to complete the remaining corrective action. Systems would be required to notify the primacy agency when they have completed each corrective action. Failure to implement a corrective action is considered a treatment technique violation, subject to public notification.

EPA does not have data on the existing rates at which corrective actions are taken under the existing TCR, so an assumption of the incremental percentage of assessments resulting in corrective action (10 percent)[1] is made as part of this EA and subsequent evaluation of changes in risk. Overall, increased protection provided by this net increase in corrective action as a result of requiring systems to implement a correction action through an enforceable mechanism would reduce risk under both the AIP and Alternative Analysis.

6.2.8 Public Notification

The existing regulation requires public notification within 30 days of a monthly MCL violation or 24 hours of an acute MCL violation.

Both the AIP and Alternative Analysis would require:

- Tier 1 public notification within 24 hours of an *E. coli* MCL violation;
- Tier 2 public notification within 30 days of a treatment technique violation; and

[1] The 10 percent assumption is based on EPA discussions with stakeholders regarding experiences with implementing the current TCR and the expected impact of proposed RTCR revisions. A sensitivity analysis evaluating alternative assumptions was conducted. Results of these analyses are discussed in Chapter 5 (section 5.3.3.1).

- Tier 3 public notification following either a routine monitoring violation or a reporting violation.

However, under either option, the reporting requirements for monthly non-acute violations would no longer be required. Since this accounts for a large number violations under the current TCR, there is expected to be a large decrease in the number of notices presented to the public. If it is assumed that such notices provide information that aid in risk avoidance by water customers, risk may increase as a result of removing this public notification requirement. Because PWSs are no longer required to send out notices for monthly non-acute violations, there is also the potential that some PWSs may be more become more lax in addressing TC hits or preventing them from occurring in the first place. However, this potential increase in risk is expected to be avoided through the implementation of other requirements under the proposed RTCR (e.g., mandatory assessments and corrective actions).

The TCRDSAC evaluation of TCR public notification also concluded that the sheer numbers of monthly non-acute notices that go out to the public are confusing. Unlike acute violations, monthly non-acute violations may have no connection to a direct health risk. To the extent that a high number of notices issued for monthly non-acute violations numb the consumers to prevent appreciation of the risk posed when a notice of an acute violation is issued, risk may decrease through the elimination of this PN requirement under the AIP and Alternative Analysis. Although they are not quantitatively evaluated as part of the EA, the TCRDSAC also concluded that significant reductions in monitoring violations may be realized through the revised regulatory framework of the proposed RTCR. Resources used to issue high numbers of monthly non-acute and monitoring violation notices (as well as the time spent responding to customer inquiries about the notices) may be better employed on other system issues which could further reduce risk.

As discussed above, the influences on risk of eliminating the PN requirements for monthly non-acute violations may run in both directions. A decrease in the overall information received by consumers may result in reduced ability to undertake averting behaviors necessary to avoid potentially contaminated drinking water when appropriate, increasing potential risk. Conversely, overly abundant notices may cause confusion or indifference that may result in consumers not taking averting actions when appropriate (i.e., ignoring an acute violation notice). Thus focusing on fewer, yet more "serious" notices may result in a decrease in potential risk. Risk may also decrease as a result of PWSs being able to better employ resources currently used on notice issuance and follow-up. Overall, given the contradictions in potential risk reductions, EPA assumes that there would not be an overall change in risk by changing PN requirements under the proposed RTCR.

6.2.9 Summary of Qualitative Benefits Analyses

The discussions above describe relative risks in terms of individual components of the regulatory alternatives. Based on the discussions presented above, EPA has used best professional judgment to qualitatively estimate the relative risk of each regulatory alternative. This assessment was made with contributions from a wide range of drinking water experts, including public health scientists, engineers, administrators, and regulatory experts. The overall

change in risk relative to the current TCR baseline is a result of the complex interactions of all regulatory components.

The consensus opinion resulting from the TCRDSAC deliberations was that the proposed RTCR, as described in the Agreement in Principle, would achieve a net risk reduction compared to the current TCR. The committee applied best professional judgment in determining that the increased protection provided by the new requirement for implementing focused assessments and implementing appropriate corrective actions would more than offset any potential increase in risk introduced by the reduction in samples and or other changes resulting from the proposed RTCR. The committee considered that the Alternative Analysis presents potential for further reduction in risk due to the increased numbers of samples taken, especially in the first several years of implementation. However, as presented in the discussion of costs in Chapter 7, the additional burden of this requirement would fall disproportionately on small systems, and especially TNCWSs serving ≤500 people due to the extremely high number of PWSs in this category. This would be expected to result in the long run increased steady state reduction in occurrence that is very close to that achieved under the AIP.

6.3 Assessment of Predictive Analysis Results

Based on discussions in and information developed for the TCRDSAC meetings (described in Chapter 3 of this EA), EPA anticipated prior to beginning this EA that the proposed RTCR would not be a significant rule in terms of costs (i.e., less than $100 million annually). However, EPA did evaluate the feasibility of performing a traditional risk assessment that would produce quantified estimates of costs, benefits, and net costs and benefits. For this type of analysis, the minimum information requirements comprise data on contaminant occurrence; exposure rates in the population defined for the various pathways (i.e., water consumption, inhalation, and dermal contact); potential health effects associated with exposure to contaminated water; and a dose-response relationship. A quantified benefits analysis would use this information to estimate the number of avoided cases of morbidity or mortality associated with the rule, which would then be valued in terms of saved lives and preserved quality of life and work capacity.

For the proposed RTCR EA, the available information includes data on the incidence of positive Total Coliform (TC+) samples collected under the current TCR over the 6 year period from 1998 – 2005, from which EPA selected one complete year (2005) to use for analyses in this EA, as explained in Section 4.2 of this EA. For the year 2005, EPA also has data on TC+ samples that subsequently test positive for *E. coli* (using EPA-approved standard methods available at that time). No other national occurrence data are available.

As discussed in Chapter 2 of this EA, *E. coli* occurrence is an indication that the water contains fecal contamination. Some *E. coli* strains (or serotypes) such as *E. coli* O157:H7, for example, are pathogens, but the EPA-approved standard methods available for *E. coli* do not detect the most prevalent pathogenic *E. coli* strains. Thus, *E. coli* occurrence, as used in this EA, serves only as an indication of fecal contamination. *E. coli* occurrence does not confer any significant quantitative information about the likelihood of health effects (e.g. acute

gastrointestinal illness) from consuming drinking water contaminated with fecal indicator organisms.

There are few data reporting the co-occurrence in a single sample of fecal indicator *E. coli* (assayed using EPA-approved standard methods) and pathogenic E. coli strains. One notable exception are the data reported by Cooley et al. (2007), which showed high concentrations of pathogenic *E. coli* strains in samples containing high concentrations of fecal indictor *E. coli*. These data are from streams and other poor quality surface waters surrounding California spinach fields associated with the recent *E. coli* O157:H7 outbreak related to raw spinach consumption. Data equivalent to these are not available from drinking water samples collected under the TCR**.**

In the absence of co-occurrence data for indicator and pathogenic *E. coli,* EPA did not estimate the cases of morbidity or mortality avoided, but instead estimated changes in occurrence (for systems serving ≤4,100 people) and changes in number of violations (for systems serving 4,101 – 33,000 people) as measures of reduced risk[2].

For systems serving ≤4,100 people and those serving 4,101-33,000 people, EPA also estimated the behavioral response of the regulated community based on projected occurrence rates or violations, respectively, under the proposed RTCR alternatives, including the frequency of Level 1 or Level 2 assessments and the type and number of corrective actions implemented by PWSs to address the problems identified. EPA expects that the effects of these changes on risk will be varied, as described in sections 6.2.1 – 6.2.3.

6.3.1 Assessment of Predictive Analysis Results for Smaller (≤4,100) and Larger (4,101 – 33,000) Systems

For reasons described in Chapter 4 (section 4.3.4.2) and Chapter 5 (sections 5.3 and 5.4) of this EA, smaller systems (serving ≤4,100 people) were analyzed separately from larger systems (serving 4,101 to 33,000 people) in regard to the impact of regulatory changes.

Although the largest systems (serving >33,000 people) are significant in the proportion of the population that they serve, EPA estimated regulatory responses (i.e., performance of corrective actions) for these systems that would affect underlying occurrence rates. Based on knowledge of the industry developed over the course of the SDWA rule makings and a review of the relatively low number of violations found in this group (Exhibit 4.10), EPA believes that systems of this size are already engaging in thorough assessments and targeted corrective actions. Therefore, behavior (and risk of contamination) under the proposed RTCR is not expected to change appreciably for the largest systems.

[2] The rationale for using different metrics (predictions of occurrence vs. predictions of violations) as proxies for risk reduction for systems serving ≤4,100 people and those serving 4,101 – 33,000 is explained in Chapters 4 and 5 of this EA.

6.3.1.1 Smaller Systems (Serving ≤4,100 People)

For smaller systems, EPA developed a model to simulate regulatory responses for a 30 year period of analysis, including 25 years of proposed RTCR analysis and 5 preceding years to account for implementation of the GWR.[3] A complete description of the model is provided in Chapter 5 of this EA, and data sources used are described in Chapter 4. Output from the smaller system simulation model includes the following estimates for each year of analysis:

- Samples taken (routine, additional routine, and repeat);
- Level 1 and Level 2 assessments conducted based on non-acute violations;
- Level 2 assessments conducted based on acute violations; and
- Corrective actions based on Level 1 assessments and Level 2 assessments.

Exhibits 6.2 – 6.4 (below) present a summary of the 25-year period of analysis[4] following rule promulgation.

As discussed earlier in this section, because a dose-response relationship between EC+ occurrence (i.e., acute violations) and illness is not available, EPA is focusing on changes in EC+ occurrence. EPA assumes that reduced occurrence in PWSs should generally correlate with a reduction in risk of contamination to PWS drinking water. Therefore, the lower occurrence rates predicted under the AIP and Alternative Analysis (Exhibits 6.3 – 6.4) represent a level of risk of contamination that is reduced from that predicted under the current TCR (Exhibit 6.2). As described in section 6.1, this reduction in contamination events indicates a reduction in risk of illness.

The changes in the annual numbers of acute violations from the current TCR to each alternative considered are shown in Exhibit 6.5 below. The estimates shown in Exhibit 6.4 for the systems serving ≤4,100 people are from the predictive model and reflect the average annual estimates for the last 20 years of the model period. The first 5 years were excluded because of the strong influence of the "All Monthly" sampling during that period for some of the groups of systems that is not representative of the steady state results. The reductions in the number of acute violations found under the AIP and Alternative Analysis primarily reflect the benefits of corrective actions under these two alternatives in preventing many of the acute violations that would otherwise occur over this period. As described in Chapter 2 of this EA, *E. coli* is an indicator of fecal contamination, and the reduction in its occurrence reduces the likelihood of people served by PWSs ingesting fecally contaminated drinking water. The benefit of the

[3] Reductions in EC+ occurrence or violations are only attributable to the proposed RTCR if they result from requirements of the proposed RTCR alternatives; reductions resulting from the GWR are not attributable to the proposed RTCR and are not considered further in this chapter. As described in sections 4.2, 4.3, and 5.2 of this EA, GWR effects are incorporated to adjust source data to the appropriate baseline for this EA.

[4] The first 3 years of the period of RTCR analysis account for implementation by states and other administrative activities detailed in Chapter 7 of this EA; thus the last 22 years of this period reflect the implementation of new requirements under each of the alternatives considered under the proposed RTCR. Because these estimates include only the applicable 22 years of the analysis, they differ slightly from estimates presented in Chapter 5 (Exhibits 5.15 – 5.20). Model output presented in Chapter 5 does not incorporate the 3 initial years of pre-implementation activities for the purpose of modeling simplicity, and therefore include 25 years of occurrence output based on full implementation as compared to the 22 years included in Exhibits 6.2 – 6.4.

proposed RTCR is this reduction in potential contamination indicated by the reduced occurrence of *E. coli*. There is also a smaller effect in the opposite direction (increasing the potential for contamination) as a result of the reduced sampling requirements under those options. These factors are addressed more fully in section 6.4 (Uncertainty and Sensitivity Analysis) below.

EPA further considered the change in predicted numbers of acute violations (from the current TCR to the AIP or the Alternative Analysis) in percent terms on the basis of system type and size (Exhibit 6.6). These results reveal that while most categories of systems/sizes would experience a decrease in predicted numbers of violations under the AIP or Alternative Analysis, some categories would actually experience an increase (a negative percent reduction in this exhibit). Under the AIP, one group is predicted to experience such an increase: surface water CWSs serving 1,001 – 4,100 people. Under the Alternative Analysis, five subcategories showed an increase in the number of acute violations: surface water CWSs serving 1,001-4,100; and NTNC and TNC ground water systems serving ≤500 and 501-1,000 people. It is important to note that in all cases except one, the increase in violations predicted under either alternative is very small — less than one violation — as shown in Exhibit 6.5. The one category with an increase of greater than one violation is the TNC GW systems serving ≤500 people, for which an increase of approximately 76 acute violations is predicted.

An increase in violations could be induced by an increase in the average level of contamination in a water system, or by a system improving its ability to diagnose more issues (e.g., through more sampling). Conversely, a decrease in violations may be caused by an improvement in water quality, which in this model would result from an increased proportion of effective corrective actions implemented ("prevented" occurrence events). Alternatively, a decrease in acute violations could be caused by a decreased ability in PWSs to diagnose the occurrence of TC/EC because of a reduced sampling schedule, resulting in undetected or "missed" occurrence events. Section 6.4 of this chapter presents a stepwise analysis to discern the relative significance of the effects of reduced additional routine samples and increased corrective action efficacy as shown by predictions of "prevented", "found", and "missed" acute violations under the proposed RTCR.

In each case of an increase in acute violations predicted under the alternatives to the current TCR, the reduction in additional routine samples has a larger effect on the number of acute violations predicted than does the increased proportion of effective corrective actions implemented. However, the estimates of occurrence events predicted to be prevented, found, or missed (Ex. 6.7) show that the proposed RTCR prevents many more occurrence events than it misses. This would equate to an overall decrease in risk of contamination for PWSs.

6.3.1.2 Larger Systems (Serving 4,101 – 33,000 People)

Based on system type, water source, and size category of population served, a group of systems experienced a given number of acute and non-acute violations in the 2007 SDWIS/FED data. EPA assumes for this analysis that these groups would have the same number of annual violations throughout the 25 years of the analysis. This number of violations is used to calculate the number of Level 1 and Level 2 assessments and corrective actions by PWS category that systems will implement under the proposed RTCR alternatives. As does the occurrence model

for smaller systems, this analysis assumes that systems responding to an acute violation would identify and correctly address the contamination issue 10 percent more often under the AIP and Alternative Analysis will than under the current TCR[5].

Exhibit 6.5 presents the number of acute violations for this group of systems. Exhibits 6.2 – 6.4 present the number of activities – assessments and corrective actions – EPA expects systems to implement under each of the regulatory alternatives considered.

[5] See footnote 1.

Exhibit 6.2 Predicted Outcomes for 25-Year Period of Analysis under Current TCR

System Size (Population Served)	Systems Subject to RTCR	Number of Routine Monitoring Samples	Number of Additional Routine Samples	Number of Repeat Monitoring Samples	Total Number of Monitoring Samples	Number of Non-Acute Violation Assessments (Single Violations)	Number of Corrective Actions (based on Single Non-Acute Violation Assessment)	Number of Acute Violation Assessments	Number of Non-Acute Violation Assessments (Multiple Violations)	Number of Corrective Actions (based on Acute and Multiple Non-Acute Violation Assessments)	Tier 2 PNs
Community Water Systems (CWSs) - SW											
≤500	3,320	866,312	50,325	40,498	957,135	1,162	-	336	279	-	1,441
501-1,000	1,173	306,733	14,501	11,641	332,875	339	-	99	61	-	400
1,001-4,100	2,938	1,920,789	55,202	33,730	2,009,722	931	-	149	123	-	1,055
4,101-33,000	3,164	10,636,296	-	186,781	10,823,077	2,089	-	115	-	-	2,089
33,001-96,000	720	11,058,960	-	194,204	11,253,164	475	-	44	-	-	475
96,001-500,000	308	10,190,400	-	178,951	10,369,351	203	-	19	-	-	203
500,001-1 Million	31	2,019,600	-	35,466	2,055,066	-	-	-	-	-	-
> 1 Million	17	1,686,960	-	29,624	1,716,584	-	-	-	-	-	-
Totals	**11,671**	**38,686,051**	**120,028**	**710,896**	**39,516,974**	**5,199**	**-**	**761**	**463**	**-**	**5,662**
Community Water Systems (CWSs) - GW											
≤500	25,830	6,190,070	534,861	369,071	7,094,002	17,231	-	2,314	8,817	-	26,048
501-1,000	4,467	1,072,053	70,367	51,248	1,193,668	2,120	-	296	909	-	3,029
1,001-4,100	6,443	3,998,892	153,962	95,908	4,248,762	3,295	-	450	1,758	-	5,053
4,101-33,000	3,156	9,145,224	-	219,336	9,364,560	3,846	-	101	-	-	3,846
33,001-96,000	335	4,884,000	-	117,136	5,001,136	421	-	10	-	-	421
96,001-500,000	63	1,945,680	-	46,665	1,992,345	79	-	2	-	-	79
500,001-1 Million	4	253,440	-	6,078	259,518	-	-	22	-	-	-
> 1 Million	3	269,280	-	6,458	275,738	22	-	-	-	-	22
Totals	**40,301**	**27,758,639**	**759,191**	**911,900**	**29,429,730**	**27,014**	**-**	**3,195**	**11,484**	**-**	**38,498**
Nontransient Noncommunity Water Systems (NTNCWSs) - SW											
≤500	503	131,048	8,652	7,013	146,713	173	-	66	106	-	279
501-1,000	88	22,970	1,299	1,046	25,315	28	-	10	14	-	42
1,001-4,100	72	41,740	2,147	1,351	45,238	43	-	16	33	-	75
4,101-33,000	22	50,424	-	1,632	52,056	51	-	-	-	-	51
33,001-96,000	2	34,320	-	1,111	35,431	-	-	-	-	-	-
96,001-500,000	1	31,680	-	1,025	32,705	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**688**	**312,182**	**12,097**	**13,179**	**337,458**	**294**	**-**	**92**	**153**	**-**	**447**
Nontransient Noncommunity Water Systems (NTNCWSs) - GW											
≤500	15,439	1,697,166	191,021	126,412	2,014,599	8,146	-	1,203	5,142	-	13,288
501-1,000	1,718	190,539	15,842	10,668	217,049	632	-	88	316	-	948
1,001-4,100	812	460,656	27,464	17,531	505,651	635	-	131	651	-	1,285
4,101-33,000	70	153,648	-	5,847	159,495	103	-	6	-	-	103
33,001-96,000	2	23,760	-	904	24,664	4	-	-	-	-	4
96,001-500,000	-	-	-	-	-	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**18,041**	**2,525,769**	**234,327**	**161,363**	**2,921,459**	**9,519**	**-**	**1,429**	**6,108**	**-**	**15,628**
Transient Noncommunity Water Systems (TNCWSs) - SW											
≤500	1,836	473,552	55,019	44,890	573,461	1,763	-	710	1,316	-	3,079
501-1,000	88	22,683	2,720	2,220	27,624	86	-	36	66	-	152
1,001-4,100	67	39,816	3,990	2,590	46,396	102	-	52	122	-	225
4,101-33,000	18	40,656	-	-	40,656	4	-	-	-	-	4
33,001-96,000	-	-	-	-	-	-	-	-	-	-	-
96,001-500,000	-	-	-	-	-	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	1	102,960	-	-	102,960	-	-	-	-	-	-
Totals	**2,010**	**679,667**	**61,730**	**49,700**	**791,097**	**1,956**	**-**	**797**	**1,504**	**-**	**3,460**
Transient Noncommunity Water Systems (TNCWSs) - GW											
≤500	79,475	6,106,110	1,228,268	817,225	8,151,603	58,114	-	8,777	33,187	-	91,300
501-1,000	1,963	177,043	32,788	22,142	231,973	1,444	-	222	859	-	2,304
1,001-4,100	617	335,123	29,699	18,945	383,767	971	-	204	929	-	1,900
4,101-33,000	67	156,288	-	8,835	165,123	88	-	5	-	-	88
33,001-96,000	2	34,320	-	1,940	36,260	-	-	-	-	-	-
96,001-500,000	1	26,400	-	1,492	27,892	-	-	-	-	-	-
500,001-1 Million	1	63,360	-	3,582	66,942	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**82,126**	**6,898,643**	**1,290,756**	**874,162**	**9,063,561**	**60,617**	**-**	**9,209**	**34,975**	**-**	**95,592**
Grand Total	**154,837**	**76,860,951**	**2,478,128**	**2,721,199**	**82,060,279**	**104,599**	**-**	**15,484**	**54,688**	**-**	**159,287**

Notes: Predicted outcomes for systems serving ≤4,100 are output from the occurrence model detailed in Ch. 5 of this EA; those for systems serving 4,101-33,000 people are from the larger systems model based on 2007 SDWIS violations data. Data for the systems serving >33,000 people are shown because they are adjusted to account for reduced repeat modeling, as referenced in section 6.3.1.

The number of corrective actions listed under the categories N. and Q. are zero because these columns represent incremental changes from the level of corrective actions that EPA estimates would be implemented under the current TCR.

Results differ slightly from those presented in Ex. 5.15 – 5.20 because Ex. 6.2 – 6.4 account for 3 years of pre-implementation activity and include only 22 years of implementation results; Chapter 5 exhibits include 25 years of implementation results.

Exhibit 6.3 Predicted Outcomes for 25-Year Period of Analysis under the AIP

System Size (Population Served)	Systems Subject to RTCR	Number of Routine Monitoring Samples	Number of Additional Routine Samples	Number of Repeat Monitoring Samples	Total Number of Monitoring Samples	Number of Level 1 Assessments	Number of Corrective Actions (based on Level 1 Assessments)	Number of Level 2 Assessments (based on Acute Violations)	Number of Level 2 Assessments (based on Non-Acute Violations)	Number of Corrective Actions (based on Level 2 Assessments)	Tier 2 PNs
Community Water Systems (CWSs) - SW											
≤500	3,320	876,336	-	28,208	904,544	828	82	247	128	38	956
501-1,000	1,173	309,610	-	8,366	317,976	254	23	74	30	11	284
1,001-4,100	2,938	1,950,717	-	32,222	1,982,939	846	83	161	96	23	942
4,101-33,000	3,164	10,636,296	-	175,689	10,811,985	2,089	209	115	-	12	2,089
33,001-96,000	720	11,058,960	-	182,671	11,241,631	475	47	44	-	4	475
96,001-500,000	308	10,190,400	-	168,324	10,358,724	203	20	19	-	2	203
500,001-1 Million	31	2,019,600	-	33,360	2,052,960	-	-	-	-	-	-
> 1 Million	17	1,686,960	-	27,865	1,714,825	-	-	-	-	-	-
Totals	**11,671**	**38,728,879**	**-**	**656,704**	**39,385,583**	**4,695**	**464**	**659**	**253**	**90**	**4,949**
Community Water Systems (CWSs) - GW											
≤500	25,830	6,291,124	14,885	278,988	6,584,997	14,662	1,479	1,686	4,735	648	19,397
501-1,000	4,467	1,085,105	1,840	37,894	1,124,839	1,811	186	217	482	70	2,293
1,001-4,100	6,443	4,078,046	-	86,033	4,164,080	2,953	299	358	1,079	145	4,032
4,101-33,000	3,156	9,145,224	-	192,934	9,338,158	3,846	385	101	-	10	3,846
33,001-96,000	335	4,884,000	-	103,036	4,987,036	421	42	10	-	1	421
96,001-500,000	63	1,945,680	-	41,047	1,986,727	79	8	2	-	0	79
500,001-1 Million	4	253,440	-	5,347	258,787	-	-	22	-	2	-
> 1 Million	3	269,280	-	5,681	274,961	22	2	-	-	-	22
Totals	**40,301**	**27,951,899**	**16,725**	**750,961**	**28,719,585**	**23,795**	**2,402**	**2,395**	**6,296**	**877**	**30,091**
Nontransient Noncommunity Water Systems (NTNCWSs) - SW											
≤500	503	132,752	-	4,913	137,665	135	13	51	54	11	189
501-1,000	88	23,223	-	721	23,944	23	2	8	7	2	30
1,001-4,100	72	42,751	-	1,183	43,934	38	4	12	18	3	56
4,101-33,000	22	50,424	-	1,395	51,819	51	5	-	-	-	51
33,001-96,000	2	34,320	-	950	35,270	-	-	-	-	-	-
96,001-500,000	1	31,680	-	877	32,557	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**688**	**315,151**	**-**	**10,038**	**325,188**	**247**	**25**	**72**	**79**	**15**	**326**
Nontransient Noncommunity Water Systems (NTNCWSs) - GW											
≤500	15,439	1,603,442	73,141	101,506	1,778,089	7,452	737	932	2,791	365	10,243
501-1,000	1,718	176,916	6,619	8,710	192,244	586	59	74	182	25	767
1,001-4,100	812	473,131	-	14,816	487,947	563	59	87	339	42	902
4,101-33,000	70	153,648	-	4,811	158,459	103	10	6	-	1	103
33,001-96,000	2	23,760	-	744	24,504	4	0	-	-	-	4
96,001-500,000	-	-	-	-	-	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**18,041**	**2,430,897**	**79,759**	**130,587**	**2,641,243**	**8,708**	**865**	**1,099**	**3,312**	**433**	**12,020**
Transient Noncommunity Water Systems (TNCWSs) - SW											
≤500	1,836	484,610	-	28,603	513,213	1,376	133	461	591	108	1,967
501-1,000	88	23,222	-	1,384	24,606	66	6	22	29	5	95
1,001-4,100	67	42,209	-	2,118	44,327	90	9	32	62	9	152
4,101-33,000	18	40,656	-	2,040	42,696	4	0	-	-	-	4
33,001-96,000	-	-	-	-	-	-	-	-	-	-	-
96,001-500,000	-	-	-	-	-	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	1	102,960	-	5,167	108,127	-	-	-	-	-	-
Totals	**2,010**	**693,657**	**-**	**39,312**	**732,969**	**1,537**	**149**	**515**	**682**	**122**	**2,218**
Transient Noncommunity Water Systems (TNCWSs) - GW											
≤500	79,475	7,822,654	599,134	810,984	9,232,772	59,291	5,780	7,674	25,355	3,226	84,646
501-1,000	1,963	204,416	14,305	19,933	238,654	1,388	139	178	553	75	1,940
1,001-4,100	617	348,291	-	15,633	363,924	851	87	152	493	67	1,344
4,101-33,000	67	156,288	-	7,015	163,303	88	9	5	-	1	88
33,001-96,000	2	34,320	-	1,540	35,860	-	-	-	-	-	-
96,001-500,000	1	26,400	-	1,185	27,585	-	-	-	-	-	-
500,001-1 Million	1	63,360	-	2,844	66,204	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**82,126**	**8,655,729**	**613,440**	**859,133**	**10,128,302**	**61,617**	**6,013**	**8,009**	**26,400**	**3,368**	**88,018**
Grand Total	**154,837**	**78,776,211**	**709,924**	**2,446,734**	**81,932,870**	**100,599**	**9,917**	**12,748**	**37,022**	**4,905**	**137,621**

Notes: Predicted outcomes for systems serving ≤4,100 are output from the occurrence model detailed in Ch. 5 of this EA; those for systems serving 4,101-33,000 people are from the larger systems model based on 2007 SDWIS violations data. Data for the systems serving >33,000 people are shown because they are adjusted to account for reduced repeat modeling, as referenced in section 6.3.1.

Columns N. and Q. represent the incremental changes in the level of corrective actions that EPA estimates would be implemented under the regulatory alternative in comparison to the current TCR.

Results differ slightly from those presented in Ex. 5.15 – 5.20 because Ex. 6.2 – 6.4 account for 3 years of pre-implementation activity and include only 22 years of implementation results; Chapter 5 exhibits include 25 years of implementation results.

Exhibit 6.4 Predicted Outcomes under the Alternative Analysis

System Size (Population Served)	Systems Subject to RTCR	Number of Routine Monitoring Samples	Number of Additional Routine Samples	Number of Repeat Monitoring Samples	Total Number of Monitoring Samples	Number of Level 1 Assessments	Number of Corrective Actions (based on Level 1 Assessments)	Number of Level 2 Assessments (based on Acute Violations)	Number of Level 2 Assessments (based on Non-Acute Violations)	Number of Corrective Actions (based on Level 2 Assessments)	Tier 2 PNs
Community Water Systems (CWSs) - SW											
≤500	3,320	876,336	-	28,208	904,544	828	82	247	128	38	956
501-1,000	1,173	309,610	-	8,366	317,976	254	23	74	30	11	284
1,001-4,100	2,938	1,950,717	-	32,222	1,982,939	846	83	161	96	23	942
4,101-33,000	3,164	10,636,296	-	175,689	10,811,985	2,089	209	115	-	12	2,089
33,001-96,000	720	11,058,960	-	182,671	11,241,631	475	47	44	-	4	475
96,001-500,000	308	10,190,400	-	168,324	10,358,724	203	20	19	-	2	203
500,001-1 Million	31	2,019,600	-	33,360	2,052,960	-	-	-	-	-	-
> 1 Million	17	1,686,960	-	27,865	1,714,825	-	-	-	-	-	-
Totals	**11,671**	**38,728,879**	**-**	**656,704**	**39,385,583**	**4,695**	**464**	**659**	**253**	**90**	**4,949**
Community Water Systems (CWSs) - GW											
≤500	25,830	6,362,722	12,850	282,064	6,657,636	14,806	1,492	1,707	4,827	659	19,633
501-1,000	4,467	1,097,866	1,585	38,313	1,137,764	1,830	188	219	491	72	2,320
1,001-4,100	6,443	4,078,046	-	86,033	4,164,080	2,953	299	358	1,079	145	4,032
4,101-33,000	3,156	9,145,224	-	192,934	9,338,158	3,846	385	101	-	10	3,846
33,001-96,000	335	4,884,000	-	103,036	4,987,036	421	42	10	-	1	421
96,001-500,000	63	1,945,680	-	41,047	1,986,727	79	8	2	-	0	79
500,001-1 Million	4	253,440	-	5,347	258,787	-	-	22	-	2	-
> 1 Million	3	269,280	-	5,681	274,961	22	2	-	-	-	22
Totals	**40,301**	**28,036,258**	**14,436**	**754,456**	**28,805,150**	**23,958**	**2,417**	**2,418**	**6,397**	**889**	**30,354**
Nontransient Noncommunity Water Systems (NTNCWSs) - SW											
≤500	503	132,752	-	4,913	137,665	135	13	51	54	11	189
501-1,000	88	23,223	-	721	23,944	23	2	8	7	2	30
1,001-4,100	72	42,751	-	1,183	43,934	38	4	12	18	3	56
4,101-33,000	22	50,424	-	1,395	51,819	51	5	-	-	-	51
33,001-96,000	2	34,320	-	950	35,270	-	-	-	-	-	-
96,001-500,000	1	31,680	-	877	32,557	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**688**	**315,151**	**-**	**10,038**	**325,188**	**247**	**25**	**72**	**79**	**15**	**326**
Nontransient Noncommunity Water Systems (NTNCWSs) - GW											
≤500	15,439	2,286,102	56,900	134,953	2,477,956	8,942	885	1,210	4,339	561	13,281
501-1,000	1,718	245,125	5,088	11,390	261,603	698	69	89	283	37	982
1,001-4,100	812	473,131	-	14,816	487,947	563	59	87	339	42	902
4,101-33,000	70	153,648	-	4,811	158,459	103	10	6	-	1	103
33,001-96,000	2	23,760	-	744	24,504	4	0	-	-	-	4
96,001-500,000	-	-	-	-	-	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**18,041**	**3,181,767**	**61,988**	**166,714**	**3,410,469**	**10,310**	**1,023**	**1,392**	**4,962**	**641**	**15,271**
Transient Noncommunity Water Systems (TNCWSs) - SW											
≤500	1,836	484,610	-	28,603	513,213	1,376	133	461	591	108	1,967
501-1,000	88	23,222	-	1,384	24,606	66	6	22	29	5	95
1,001-4,100	67	42,209	-	2,118	44,327	90	9	32	62	9	152
4,101-33,000	18	40,656	-	2,040	42,696	4	0	-	-	-	4
33,001-96,000	-	-	-	-	-	-	-	-	-	-	-
96,001-500,000	-	-	-	-	-	-	-	-	-	-	-
500,001-1 Million	-	-	-	-	-	-	-	-	-	-	-
> 1 Million	1	102,960	-	5,167	108,127	-	-	-	-	-	-
Totals	**2,010**	**693,657**	**-**	**39,312**	**732,969**	**1,537**	**149**	**515**	**682**	**122**	**2,218**
Transient Noncommunity Water Systems (TNCWSs) - GW											
≤500	79,475	12,608,106	444,794	1,179,108	14,232,008	75,856	7,311	10,443	44,636	5,456	120,492
501-1,000	1,963	299,924	10,030	26,863	336,817	1,674	162	234	914	115	2,587
1,001-4,100	617	348,291	-	15,633	363,924	851	87	152	493	67	1,344
4,101-33,000	67	156,288	-	7,015	163,303	88	9	5	-	1	88
33,001-96,000	2	34,320	-	1,540	35,860	-	-	-	-	-	-
96,001-500,000	1	26,400	-	1,185	27,585	-	-	-	-	-	-
500,001-1 Million	1	63,360	-	2,844	66,204	-	-	-	-	-	-
> 1 Million	-	-	-	-	-	-	-	-	-	-	-
Totals	**82,126**	**13,536,689**	**454,825**	**1,234,188**	**15,225,701**	**78,469**	**7,568**	**10,834**	**46,043**	**5,639**	**124,511**
Grand Total	**154,837**	**84,492,400**	**531,249**	**2,861,412**	**87,885,060**	**119,214**	**11,646**	**15,890**	**58,415**	**7,396**	**177,629**

Notes: Predicted outcomes for systems serving ≤4,100 are output from the occurrence model detailed in Ch. 5 of this EA; those for systems serving 4,101-33,000 people are from the larger systems model based on 2007 SDWIS violations data. Data for the systems serving >33,000 people are shown because they are adjusted to account for reduced repeat modeling, as referenced in section 6.3.1.

Columns N. and Q. represent the incremental changes in the level of corrective actions that EPA estimates would be implemented under the regulatory alternative in comparison to the current TCR.

Results differ slightly from those presented in Ex. 5.15 – 5.20 because Ex. 6.2 – 6.4 account for 3 years of pre-implementation activity and include only 22 years of implementation results; Chapter 5 exhibits include 25 years of implementation results.

Exhibit 6.5 Average Annual Acute Violations by Regulatory Alternative and System Type[1]

PWS Type	System Size (Population Served)	Number of Systems	TCR	AIP	Alternative Analysis
CWS SW	≤500	3,320	15	11	11
	501-1,000	1,173	4	3	3
	1,001-4,100	2,938	7	7	7
	4,101-33,000	3,164	12	12	12
	33,001-96,000	720	4	4	4
	96,001-500,000	308	2	2	2
	500,001-1 Million	31	0	0	0
	> 1 Million	17	1	1	1
	Totals	**11,671**	**45**	**40**	**40**
CWS GW	≤500	25,830	105	77	78
	501-1,000	4,467	13	10	10
	1,001-4,100	6,443	20	16	16
	4,101-33,000	3,156	6	6	6
	33,001-96,000	335	1	1	1
	96,001-500,000	63	0	0	0
	500,001-1 Million	4	1	1	1
	> 1 Million	3	0	0	0
	Totals	**40,301**	**147**	**111**	**112**
NTNC SW	≤500	503	3	2	2
	501-1,000	88	0	0	0
	1,001-4,100	72	1	1	1
	4,101-33,000	22	0	0	0
	33,001-96,000	2	0	0	0
	96,001-500,000	1	0	0	0
	500,001-1 Million	0	0	0	0
	> 1 Million	0	0	0	0
	Totals	**688**	**4**	**3**	**3**
NTNC GW	≤500	15,439	55	42	55
	501-1,000	1,718	4	3	4
	1,001-4,100	812	6	4	4
	4,101-33,000	70	0	0	0
	33,001-96,000	2	0	0	0
	96,001-500,000	0	0	0	0
	500,001-1 Million	0	0	0	0
	> 1 Million	0	0	0	0
	Totals	**18,041**	**65**	**50**	**63**
TNC SW	≤500	1,836	32	21	21
	501-1,000	88	2	1	1
	1,001-4,100	67	2	1	1
	4,101-33,000	18	0	0	0
	33,001-96,000	0	0	0	0
	96,001-500,000	0	0	0	0
	500,001-1 Million	0	0	0	0
	> 1 Million	1	0	0	0
	Totals	**2,010**	**36**	**23**	**23**
TNC GW	≤500	79,475	399	349	475
	501-1,000	1,963	10	8	11
	1,001-4,100	617	9	7	7
	4,101-33,000	67	0	0	0
	33,001-96,000	2	0	0	0
	96,001-500,000	1	0	0	0
	500,001-1 Million	1	0	0	0
	> 1 Million	0	0	0	0
	Totals	**82,126**	**419**	**364**	**493**
All Systems	**Grand Total**	**154,837**	**716**	**592**	**735**

Source: Output from Proposed RTCR models as described in sections 5.3 and 5.4 of this EA for smaller systems and larger systems, respectively.

Notes: [1] Average violation estimates are for the modeled period after systems reach their new predicted distribution between monthly, quarterly, and annual monitoring.

Exhibit 6.6 Change in Average Annual Acute Violations[1] by Regulatory Alternative and System Type

PWS Type	System Size (Population Served)	AIP	Alternative Analysis
CWS SW	≤500	27%	27%
	501-1,000	25%	25%
	1,001-4,100	-8%	-8%
	Totals	**10%**	**10%**
CWS GW	≤500	27%	26%
	501-1,000	27%	26%
	1,001-4,100	21%	21%
	Totals	**25%**	**24%**
NTNC SW	≤500	22%	22%
	501-1,000	17%	17%
	1,001-4,100	24%	24%
	Totals	**22%**	**22%**
NTNC GW	≤500	23%	-1%
	501-1,000	16%	-1%
	1,001-4,100	34%	34%
	Totals	**23%**	**3%**
TNC SW	≤500	35%	35%
	501-1,000	38%	38%
	1,001-4,100	38%	38%
	Totals	**35%**	**35%**
TNC GW	≤500	13%	-19%
	501-1,000	20%	-5%
	1,001-4,100	26%	26%
	Totals	**13%**	**-18%**
All Systems	**Grand Total**	**17%**	**-3%**

Source: Exhibit 6.5.
[1] Average violation estimates are for the modeled period after systems reach their new predicted distribution between monthly, quarterly, and annual monitoring.
Note: Positive changes indicate reductions in the number of acute violations under either alternative in comparison to the current TCR; negative changes indicate increases in acute violations. Large systems were omitted from this table because there were no changes predicted in the number of violations.

6.3.1.3 Overall Assessment of Predictive Analysis Results

EPA does not expect risk to change significantly for the systems serving >4,100 people under the proposed RTCR, primarily because it expects little change in both the number of samples taken and the resulting number of corrective actions to be implemented. However, for smaller systems, EPA expects risk to decrease under the AIP and Alternative Analysis as compared to the current TCR. As shown by the year by year detail of the output provided in Appendix A of this EA and summarized in Exhibits 5.21 – 5.26, risk is further reduced for GWSs under the Alternative Analysis for the first 5 years after the effective date of the proposed RTCR as compared to the AIP. This additional reduction in risk under the Alternative Analysis is driven by the increase in additional sampling that would occur while all systems were still on

monthly sampling. Over time, some of these systems could qualify to move from monthly to quarterly under either alternative, or from quarterly to annual sampling under the AIP. Unlike the AIP, no systems under the Alternative Analysis would be able to sample annually. However, the additional costs of the Alternative Analysis make this alternative less desirable, especially for the systems most impacted by the proposed RTCR (TNCWSs serving ≤500 people). Chapter 7 presents the full discussion of costs associated with implementation of the regulatory options considered.

When considering the period beginning in Years 6 – 30 after implementation under the rule alternatives[6] (Exhibits 5.21 – 5.26), the AIP and Alternative Analysis generally have similar estimates of occurrence. However, for some categories and sizes of PWSs where the annual inspection can be performed more regularly (i.e., the state has more resources available for inspections because fewer resources are needed for monitoring), the AIP actually has a lower rate than the Alternative Analysis. Appendix B includes graphs of predicted occurrence for each of the size and PWS categories considered in this analysis.

6.4 Uncertainty and Sensitivity Analyses

Key sources of uncertainty in this EA include the data used and the model input variables, as described in Chapters 4 and 5 of this EA, respectively. The quality and representativeness of the data used in this EA are discussed in Section 4.2; the uncertainty in model input variables is discussed in Section 5.3.3.1 of this EA. This discussion focuses on the provisions of the AIP and Alternative Analysis for conducting Level 1 and Level 2 assessments, and the reductions in additional routine and repeat samples following a TC+. The analyses performed and presented here are intended to provide insight into the overall impact of (the interplay of) these two changes in the proposed RTCR compared with the current TCR, each of which moves risk (as defined in this EA) in opposite directions. Unlike the sensitivity analysis presented in Chapter 5 (Occurrence Analysis), this analysis does not consider variations on the assumptions related to corrective actions, but instead tests the relative impact of changes in the sampling regimen given the assumptions for corrective actions applied in the primary analysis of this EA (and summarized in section 5.3).

The primary benefit of the proposed RTCR is a potential reduction in exposure to drinking water supplies affected by microbial contamination. Two features of the proposed RTCR are expected to influence the exposure reduction.

The first feature is the requirement to perform assessments and corrective actions in response to the Level 1 and Level 2 triggers. This will reduce exposure to microbial contamination both by addressing the immediate problem identified by the Level 1 or Level 2 trigger and by preventing some additional future exposures.

The second feature, which primarily affects the smaller systems, is the reduction in the numbers of additional routine and repeat samples that systems are required to take whenever routine samples are found to be TC-positive. This change may contribute to increased exposure

[6] The regulatory scenarios are described in detail in Chapter 3 of this EA.

and risk because fewer samples provide fewer opportunities to identify and address TC and EC exposures.

The analyses that were performed used the predictive model with the occurrence input parameters for the nondisinfecting ground water TNCWS serving <101 people. This set of systems was chosen because 1) it contains the largest number of systems of the 27 occurrence sets (46,642 systems in this set); 2) it is subject to all of the changes in sampling requirements; and 3) it has the highest routine TC hit rate so that effects on this set of systems are likely to be more pronounced (and therefore more clearly observable) than other sets. The analysis was carried out by running simulations of 10,000 systems each for monthly, quarterly, or annual monitoring schedules. There were 5 sampling and corrective action "regimens" considered in the model:

As shown in Exhibit 6.7, Regimens 1 through 3 assume a routine sampling regimen equivalent to the current TCR (i.e., 1 regular routine sample and a minimum of 5 routine samples in any month following a TC+). Regimen 1 is the only one of the 5 regimens that assumes there are no corrective actions (incremental beyond those already conducted under the current TCR); regimens 2 through 5 all assume corrective actions are conducted in accordance with requirements under the proposed RTCR. Regimens 3 through 5 decrease the repeat samples from 4 to 3. Regimen 4 also decreases the additional routine samples in the month following a TC+ from 5 to 3; Regimen 5 decreases these further to 1 but only for Monthly systems (quarterly and annual systems remain at 3 additional routine samples in the month following a TC+).

In this analysis, Regimen 1 describes the current TCR and Regimen 5 describes the AIP version of the proposed RTCR. Going from Regimen 1 to Regimen 2, where corrective actions are brought in without any change in sampling, provides key insights to the benefits derived from the corrective action aspect of the proposed RTCR. Going from Regimen 2 through Regimen 5 provides some insight into how much of those corrective action benefits might be foregone because of small reductions in the number of TC samples required.

The metric used for comparing the relative impacts of these 5 regimens was the number of acute violations based on EC+ assays ("acutes" throughout this section), because this was considered to be the most relevant measure of the potential microbial health risk-based benefits of the proposed RTCR. The numbers presented are the average annual numbers of acute violations based on a 40 year model run.

It is important to note that in order to isolate the effects of the proposed RTCR corrective actions and sampling changes, this analysis excluded any effect of the ground water rule. To further understand the effects of sampling regimen, this analysis also presents the results separately for monthly, quarterly, and annual sampling since one of the changes in the AIP applies only to those on monthly sampling. Exhibit 6.7 provides a summary of the results of this analysis.

Exhibit 6.7 Relative Impacts Analysis for TNCWS Serving <101 Corrective Actions and Sampling Regimens

Regimen	Samples in Month Following a TC+			Repeat Samples	L1 & L2 CAs?	Average Total TC Samples per Year			Acutes Per Year Found			Acutes Per Year Prevented			Acutes Per Year Missed		
	M	Q	A			M	Q	A	M	Q	A	M	Q	A	M	Q	A
1	5	5	5	4	No	166,449	61,100	15,438	271	112	27						
2	5	5	5	4	Yes	157,519	58,480	15,120	148	77	23	123	35	4	0	0	0
3	5	5	5	3	Yes	152,948	56,639	14,641	136	64	22	113	29	3	22	18	1
4	3	3	3	3	Yes	142,354	51,693	13,198	121	63	20	100	28	3	51	20	4
5	1	3	3	3	Yes	132,373			109			91			72		
											Ratios of Prevented to Found:	0.83	0.45	0.15			

Key: (CA) = correction action; L1 and L2 = Level 1 and Level 2; M = monthly; Q = quarterly; and A = annual.

Definitions: Acutes "found" are acute violations the model predicts will be identified; acutes "prevented" are those avoided by implementation of CAs; acutes "missed" are those found under the sampling regimen of the current TCR (Regimen 1) that were not found under the reduced sampling of Regimens 3, 4, and 5 (calculated by subtracting acutes found under Regimens 3, 4, and 5 from those found under Regimen 1).

Notes:

- Results shown are based on simulations of 10,000 systems each for monthly, quarterly, and annual monitoring using occurrence inputs for nondisinfecting GW TNCWS serving <101 people.
- Assumptions for L1 and L2 corrective action efficacy and resulting duration of reduced occurrence are those used in the primary analysis.
- For the purpose of isolating the relative impacts of changes in monitoring regimens and implementation of L1 and L2 corrective actions, no GWR effects (including GWR corrective actions) are modeled in these runs.
- Ratios of non-acutes and acutes "prevented" to those "found" are based on Regimen 2 results, which was the current TCR sampling regimen with implementation of L1 and L2 correction actions.

Regimen 1, representing the current TCR, provides a "baseline" against which the other regimens can be compared. Although arguably more acute violations could be found if more routine and repeat samples were taken, the numbers of acute violations shown here as " found" (monthly = 271, quarterly = 112, and annual = 27) represent the maximum number that can be found. This finding is based on analysis using 10,000 simulated systems each for monthly, quarterly, and annual; the sampling scheme under the current TCR; and no additional corrective actions being performed.

Regimen 2 uses the exact same sampling scheme as Regimen 1, but includes the performance of Level 1 and Level 2 corrective actions consistent with the proposed RTCR. Here we observe a reduction in the number of acutes found for monthly, quarterly, and annual. Since there is no change in the sampling requirements, this reduction is attributable to those acutes being prevented as a result of the corrective actions. For example, in the monthly sampling group, only 148 of the baseline 271 acutes are found. The difference, 123 acute violations, represents those prevented as a result of the corrective actions.

Regimen 3 reflects the small reduction in repeat sampling requirements of 4 to 3 following a TC+. This, as would be expected, also results in a small reduction in the number of acutes found. For example, in the monthly sampling group this falls from 148 to 136. If it is assumed that the ratio of acutes prevented to acutes found observed in Regimen 2 apply to the other regimens as well, then for the monthly sampling group (where 123/148 = 0.83) it is estimated that 113 acutes are still prevented. The sum of those found (136) and those prevented (113) for the monthly group totals 249. This implies, then, that as a result of this change in repeat sampling there are also 22 acutes that are missed (271 "found" under the current TCR sampling regimen - 136 - 113 = 22). That is, they are neither found nor prevented, but are assumed to occur unobserved. Approximately the same number of acutes are "missed" for the quarterly sampling group (18), but only 1 acute is estimated to be missed for the annual sampling group.

Regimen 4 steps down the number of routines in a month following a TC+ from 5 to 3, but retains the 3 repeats and the corrective action requirements. The number of acutes now "missed" increases to 51, 20, and 4 respectively for those on monthly, quarterly, and annual sampling.

Regimen 5 excludes, for those on monthly sampling, any additional routine samples in the month following a TC+. Regimen 5, as noted above, represents the AIP version of the proposed RTCR. Here the number of "missed" acutes for those on monthly increases from 51 to 72. There are no changes for those on quarterly or annual sampling relative to Regimen 4.

Note that in addition to displaying the changes in the number of annual average acutes for these 5 regimens, Exhibit 6.6 also shows the average annual number of TC samples (regular routine, additional routines and repeat samples) taken. These sample numbers decline considerably across the regimes due both to the reduction in actual sampling requirements and to reduced number of additional routines and repeats that need to be taken because of the prevention of TC occurrence by the corrective actions taken.

This analysis points first and foremost to the highly positive public health benefits of including the corrective actions as part of the proposed RTCR (based on the modest assumptions regarding their effectiveness used in the occurrence analysis detail in Chapter 5 of this EA). This is seen not only in the number of acutes that are found for which corrective actions may be performed, but also – and perhaps more importantly – in the large number of acutes that are prevented from occurring again in those systems as a result of those corrective actions.

While some of these potential benefits are "missed" as a result of the reductions in additional routine and repeat sampling requirements, these numbers (shown in Exhibit 6.7) seem small when compared to the numbers found and prevented. This is particularly important when considering the potential cost savings from reducing the number of TC samples that are taken, as discussed in Chapter 9 (Net Benefits) of this EA.

It is important to note that this analysis addressed monthly, quarterly, and annual sampling separately. The number of "missed" EC+ samples noted is somewhat larger (per 10,000 systems) in those doing monthly sampling versus those doing quarterly or annual sampling. However, the group of 46,642 TNCWSs serving <101 currently has, and will continue to have, a vast majority of systems on either quarterly or annual sampling in the steady state of the analysis period, approximately 5 years after promulgation.[7]

It should also be noted that while the analysis described in this section was based on model runs for the nondisinfecting ground water TNCWS serving <101 people (selected for the reasons stated at the outset of this section), the trends seen in these results are applicable to all of the other types and sizes of systems serving fewer than 4,100 people where the key changes in additional next month samples and repeats samples occur under the AIP. That is, relative to the current TCR, the inclusion of the Level 1 and Level 2 corrective actions will always result in more benefit accruing from corrective actions being performed and acute violations being avoided than the relatively small reductions in sample numbers will result in "missing" acute violations.

Because all of the other system types have lower overall TC and EC hit rates than the nondisinfecting ground water TNCWS serving <101 people, on a "per system basis" their missed acute violations would be fewer than those estimated in this analysis. Furthermore, for the systems serving 1,001 to 4,100 people where the AIP change in the minimum number of samples to be taken following a month with a TC+ is smaller, the number of "missed" acute violations would be further reduced. For example, for systems serving 3,301 to 4,100 (which are all on monthly sampling), the minimum number of next month samples is reduced from 5 to 4 compared with a reduction from 5 to 1 for the systems serving fewer than 1,001 people that perform monthly sampling. Thus this analysis presents an estimate that is near the higher end of the range for various system types in expected "missed" acute violations due to reduced sampling requirements under the proposed RTCR. In spite of this conservative estimate, the effect of the proposed RTCR requirements for corrective actions more than balances this effect with a larger change in risk in the opposite (reducing) direction, as shown by the relatively large number of "prevented" to "missed" acute violations.

6.5 Other Potential Benefits

A number of benefits may accrue to PWS and their populations served that are not included in the qualitative relative risk comparison or reductions in occurrence discussed in Sections 6.1 – 6.4 (above), they are described in the following sections.

6.5.1 Increased System Knowledge

By requiring additional assessments focused on isolating and identifying system problems in response to TC+ or EC+ samples, the proposed RTCR will increase the likelihood

[7] Under the proposed RTCR (AIP alternative), approximately 5 years after the rule is implemented, qualifying systems may reduce from monthly to quarterly or annual monitoring. These qualifications are discussed in Chapter 3 of this EA.

that PWS operators, in particular those of systems receiving violations, will develop further general understanding of system operations and potential issues. This heightened familiarity with the system may increase preventive maintenance, or may increase the efficiency with which future problems are identified, decreasing risk to the PWS population served in both cases. Delaying system component replacement costs or avoiding an increase in treatment costs may also result in cost savings for some communities.

6.5.2 Accelerated Infrastructure Repair/Replacement

As described in 6.5.1 (above), the increased familiarity of operators with their systems may encourage an increase in preventive maintenance, preempting some potential contamination issues and decreasing risk for the PWS population served. In addition to benefits from additional preventative maintenance, some systems may accelerate their capital replacement fund investments in response to early identification of impending problems with large capital components. Although such capital investment would have occurred anyway, earlier investment may ensure that problems are addressed in a preventive manner and may preclude some decrease in protection that may have occurred otherwise. At the very least, the increased operator awareness should reduce the occurrence of unplanned capital expenditures in any given year.

6.5.3 Reduction in Averting Behavior

As the risk of contamination is reduced in PWSs over time following RTCR promulgation, EPA expects that the public will eventually become aware of increased quality, and consistency of quality, of their water. This may lead to PWS customers becoming increasingly comfortable with drinking tap water and cause them to exercise less averting behavior (e.g., drinking bottled water or using (POU) filtration devices). Such averting behaviors are costly relative to consuming tap water.

References

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