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Variance Technology Findings for Contaminants Regulated Before 1996

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1. INTRODUCTION

Section 1.1: Safe Drinking Water Act Implementation

The Safe Drinking Water Act (SDWA) Amendments were signed by the President on August 6, 1996. There are over 70 statutory deadlines in the 1996 SDWA for the Environmental Protection Agency (EPA). The Amendments contain a challenging set of activities for EPA, States, Indian tribes, public water systems, and other stakeholders.

Due to the 1996 SDWA's emphasis on public information and participation, as well as EPA's desire to seek a broad range of public input, the stakeholder process that was begun during the 1995 drinking water program redirection effort has been greatly expanded. Many of the 70 statutory deadlines have been grouped into twelve project areas. Each of these areas has a broad set of stakeholders that will provide information and comments.

One of the twelve project areas created by the 1996 SDWA is being addressed by EPA's Treatment Technology Team. The mission of the Treatment Technology Team is to identify and/or develop high quality, cost-effective treatment technologies to meet regulation development and program implementation objectives and deadlines. The short-term goals of this team are to prepare: (1) by August 6, 1997, the list of technologies that small systems can use to comply with the Surface Water Treatment Rule (SWTR); (2) by August 6, 1998, the list of technologies that small systems can use to comply with all of the other pre-1996 National Primary Drinking Water Regulations (NPDWRs); and (3) by August 6, 1998, the list of variance technologies for small systems for the appropriate pre-1996 NPDWRs. The long-term goals include the identification of: (1) small system compliance and variance technologies for all future regulations; (2) best available technologies (BATs) for larger systems in future regulations; and (3) emerging technologies that should be evaluated as potential compliance or variance technologies for both existing and future regulations.

EPA met the first of these short-term goals in August, 1997. A Federal Register notice dated August 11, 1997 published the compliance technology list for the SWTR (EPA, 1997a). The notice also announced the availability of a guidance manual entitled "Compliance Technology List for the Surface Water Treatment Rule" (EPA, 1997b). The guidance manual contained more detailed information on the list of technologies published in the Federal Register notice.

EPA updated the list of compliance technologies for the SWTR and published the list of compliance technologies for the total coliform rule in a Federal Register notice on August 6, 1998 (EPA, 1998a). EPA is also publishing an update to the guidance manual that supported the original SWTR list of compliance technologies. The updated guidance manual is entitled "Compliance Technology List for the Surface Water Treatment Rule and the Total Coliform Rule" (EPA, 1998b). This document covers both update of the SWTR list and the compliance technologies identified for the Total Coliform Rule (TCR). These have been grouped into one publication as they both address microbial contaminants and their indicators in drinking water.

The list of compliance technologies for the TCR is one of the lists required by Section 1412(b)(4)(E)(iii) of the SDWA.

EPA met both the second and third of the short-term goals in August 1998. A Federal Register notice dated August 6, 1998 published the list of compliance technologies that systems can use to comply with all of the other NPDWRs and the findings concerning variance technologies for the contaminants regulated before 1996. EPA did not, at that time, list any variance technologies for contaminants regulated before 1996. Guidance manuals were developed to provide more detail on each of these lists. A document entitled "Small System Compliance Technology List for the Non-Microbial Contaminants Regulated Before 1996" (EPA, 1998c) provides more detail on the list of compliance technologies for the non-microbial contaminants regulated before 1996. The current document has been prepared to describe the *procedures* that were used to make the determination, at this time, that there would be no variance technologies for contaminants regulated before 1996.

Section 1.2: Need for a Small System Technology Requirement

The 1986 SDWA identified a process for setting maximum contaminant levels (MCLs) as close to the maximum contaminant level goal (MCLG) as is "feasible." The Act states that the term "feasible" means feasible with the use of the best technology, treatment techniques and other means which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking cost into consideration) [Section 1412(b)(4)(D)]. The technologies that met this feasibility criterion are called "best available technologies" (BATs) and are listed in the final regulations. This process is retained in the 1996 SDWA. All of the existing NPDWRs covered in this document were developed using this process, with the exception of three rules described below.

One regulation covered in this document is the lead and copper rule. The Lead and Copper Rule requires compliance with a treatment technique rule rather than an MCL. Section 1412(b)(7)(A) of the 1986 SDWA listed the conditions under which a treatment technique could be promulgated in lieu of an MCL. When these conditions are met, the Act states that ". . . the Administrator must identify those treatment techniques which, in the Administrator's judgement, would prevent known or anticipated adverse effects on the health of persons to the extent feasible". The definition of feasible listed above would also apply in the technology determinations for the Lead and Copper rule.

The SWTR is another treatment technique rule. It is a treatment technique for microbial contaminants. The structure of this rule is described in detail in the guidance manual entitled "Small System Compliance Technology List for the Surface Water Treatment Rule and the Total Coliform Rule" (EPA, 1998b).

There is one other treatment technique rule in the group of contaminants regulated before 1996. Epichlorohydrin and acrylamide are regulated through treatment techniques rather than with a MCL. Unlike the SWTR or the Lead and Copper Rule, the treatment techniques for these two contaminants are not based on the use of technology to remove or reduce the contaminant concentration. The treatment technique for these two contaminants requires public water systems to certify annually, in writing, to the State that when acrylamide or epichlorohydrin are used in drinking water treatment, the combination of dose and monomer level does not exceed specified levels. Since technologies are not being utilized for these NPDWRs, neither compliance nor variance technologies will be listed for these contaminants.

Before the 1996 Amendments, cost assessments for the treatment technology feasibility determinations were based upon impacts to regional and large metropolitan water systems. This protocol was established when the SDWA was originally enacted in 1974 (Congressional Record, 1974) and was carried over when the Act was amended in 1986 (Congressional Record, 1986). The population size categories that EPA has used to make feasibility determinations for regional and large metropolitan water systems has varied among different regulation packages. The most common population size categories used were 50,000 - 75,000 people and 100,000 - 500,000 people. The technical demands and costs associated with technologies that are feasible based on regional and large metropolitan water systems often make these technologies inappropriate for small systems. The 1996 Amendments attempt to redress this problem by having EPA identify treatment technologies that are suited for small systems (compliance technologies). The two compliance technology guidance manuals will help small systems comply with existing NPDWRs.

Section 1.3: Small System Treatment Technology Requirements of the 1996 SDWA

Since large systems were used as the basis for the feasibility determinations, the existing BATs for MCLs and the existing treatment techniques may not be appropriate for small systems. The 1996 SDWA specifically requires EPA to make technology assessments relevant to the three categories of small systems respectively for both existing and future regulations, in addition to the pre-1996 Amendments BAT protocol. The three population-served size categories of small systems defined by the 1996 SDWA are: 10,000 - 3,301 persons, 3,300 - 501 persons, and 500 - 25 persons.

The 1996 SDWA identifies two classes of technologies for small systems: compliance technologies and variance technologies. A “compliance technology” may refer to both a technology or other means that is affordable and that achieves compliance with the MCL and to a technology or other means that satisfies a treatment technique requirement. Possible compliance technologies include packaged or modular systems and point-of-entry (POE) or point-of-use (POU) treatment units [see Section 1412(b)(4)(E)(ii)]. Variance technologies are only specified for those system size/source water quality combinations for which there are no listed compliance technologies [Section 1412(b)(15)(A)]. Thus, the listing of a compliance technology for a size category/source water combination prohibits the listing of variance technologies for that combination. While variance technologies may not achieve compliance with the MCL or treatment technique requirement, they must achieve the maximum reduction or inactivation efficiency that is affordable considering the size of the system and the quality of the source water.

Variance technologies must also achieve a level of contaminant reduction that is protective of public health [Section 1412(b)(15)(B)].

The variance procedure for small systems has been significantly revised under the 1996 SDWA. Under the 1986 SDWA, systems were required to install a technology before applying for a variance; if they were unable to meet the MCL, they could then apply for a variance. The 1996 Amendments have given the variance option additional flexibility in that variances can be applied for and granted *before* the variance technology is installed, thus ensuring that the system will have a variance before it invests in treatment. Under the 1996 SDWA, there is a new procedure available for small systems (systems serving less than 10,000): the "small system variance". The difference between a regular variance and a small system variance is the basis for the feasibility (technical and affordability) determination. For the former, large systems are the basis; for the latter, small systems are the basis. If there are no affordable compliance technologies listed by the EPA for a small system size category/source water quality combination, then the system may apply for a small system variance. One of the criteria for obtaining a small system variance is that the system must install a variance technology listed for that size category/source water quality combination [Section 1415(e)(2)(A)]. A small system variance may only be obtained if alternate source, treatment, and restructuring options are unaffordable at the system-level.

There are some additional requirements for small system variances that affect the listing of variance technologies. Small system variances are not available for any MCL or treatment technique for a contaminant with respect to which a national primary drinking water regulation was promulgated prior to January 1, 1986 [Section 1415(e)(6)(A)]. The final Variance and Exemption Rule provides EPA's interpretation of this requirement (EPA, 1998d). Small system variances would not be available for those contaminants with existing MCLs that were promulgated prior to January 1, 1986. Small system variances would not be available if the pre-1986 MCL was retained or raised. Small system variance would only be available if the pre-1986 MCL was lowered (could apply to updates of the existing arsenic and radionuclides MCLs if the pre-1986 MCLs are lowered). If the Agency revises a pre-1986 MCL and makes it more stringent, there would be an additional restriction of the availability of small system variances. If the variance option was available, the finished water quality could not exceed the pre-1986 MCL. Nor are small system variances available for a NPDWR for a microbial contaminant (including a bacterium, virus, or other organism) or an indicator or treatment technique for a microbial contaminant [Section 1415(e)(6)(B)]. The sole purpose of the listing of variance technologies is to enable small systems to obtain a small system variance. Therefore, when these small system variances are not available under the SDWA, variance technologies were not specified for those contaminants.

The process for identifying compliance and variance technologies for future regulations was summarized in the preceding paragraphs. The language in the 1996 SDWA Amendments is different for the existing regulations. There are two mandatory lists of compliance technologies that were developed for the existing rules. By August 6, 1997, the Administrator was required to list technologies that meet the SWTR for each of the three size categories [Section 1412(b)(4)(E)(v)]. By August 6, 1998, after consultation with the States, the Administrator was required to issue a list of technologies that achieve compliance with the MCLs or treatment technique requirements for other existing NPDWRs. By August 6, 1998, after consultation with the States, the Administrator was required to issue guidance or regulations for variance technologies for the existing NPDWRs for which a small system variance can be granted. Figure 1 summarizes the requirements for compliance and variance technologies and differentiates between existing and future regulations.

FIGURE 1
SMALL SYSTEM REQUIREMENTS
COMPLIANCE VS. VARIANCE TECHNOLOGIES

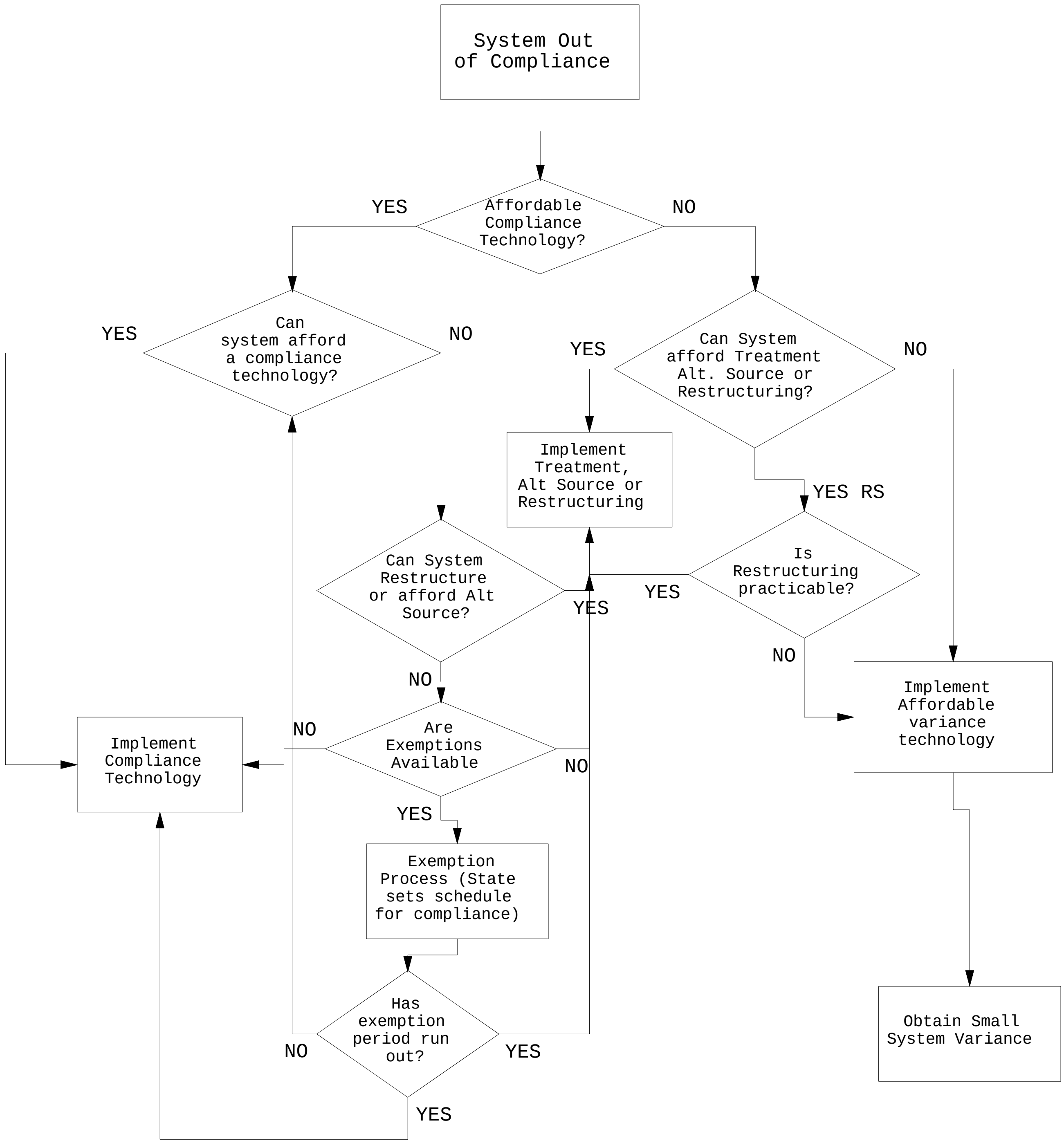
	COMPLIANCE TECHNOLOGY	**VARIANCE TECHNOLOGY**
EXISTING REGULATIONS:		
Meet affordable technology criteria	Not Explicitly Required	Inherently Required
Source Water Quality	GOOD	POOR
Endpoint	MCL	Maximum Reduction that is Affordable
Health Requirements Separate from MCL	NONE	Must be protective of public health
FUTURE REGULATIONS:		
Meet affordable technology criteria	Required	Required
Source Water Quality	GOOD	POOR
Endpoint	MCL	Maximum Reduction that is Affordable
Health Requirements Separate from MCL	NONE	Must be protective of public health

The two major concerns regarding technologies for small systems are affordability and technical complexity: per household costs tend to be higher for the smaller system customers for most central treatment technologies, leading to many cases where small systems simply cannot afford to install a prescribed technology, and small systems often do not have access to well-trained water system operators. Although the statute is silent concerning whether small system compliance technologies for existing regulations should be affordable, EPA believes that the better approach under the statute is that affordability should be evaluated for future regulations *and* existing regulations where the statute allows variance technologies. If the candidate technologies are not evaluated against an affordable technology criterion, then compliance technologies would automatically exist for all of the existing regulations regardless of the source water quality. The existing best available technologies (BATs) or treatment techniques would become the compliance technologies for small systems, which was the case prior to the 1996 Amendments. EPA does not believe that result to be what Congress intended. As a result, EPA evaluated small system technologies against an affordable technology criterion for those existing regulations where small system variances or variance technologies are not prohibited by the SDWA.

The flow chart in Figure 2 shows the role of the affordable technology criteria in the treatment technology arena. The primary function of the criteria is to determine whether a system of a given size/source water quality combination should proceed down the compliance or variance technology pathway. The secondary function is to define the universe of technologies within the compliance or variance technology pathway. These affordable technology criteria are different from the affordability criteria to be used by States in granting small system variances under Section 1415(e). The criteria used by States will be applicable to individual systems ("system-level affordability criteria"). Options that States can use for system-level affordability criteria were developed in the Small System National Drinking Water Advisory Council (NDWAC) Working Group process and are available in "Information for States on Developing Affordability Criteria for Drinking Water" (EPA, 1998e). This document was published on February 4, 1998 can be downloaded at http://www.epq.gov/OGWDW/smallsys/afford.html. In contrast, the affordable technology criteria developed under Section 1412(b)(4) can be viewed as "national-level affordability criteria". Technologies that meet the national-level criteria may not be affordable for a particular system within the size category. The role of the system-level affordability criteria is illustrated in Figure 2 as well.

For those existing regulations where the SDWA prohibits small system variances or variance technologies, the candidate compliance technologies will not be evaluated against an affordable technology criterion. There are two statutory prohibitions on small system variances and one prohibition on variance technologies. As previously mentioned, small system variances are not available for any NPDWR for a microbial contaminant (or indicator). Variance technologies were not identified for any of the six microbial contaminants that are currently regulated. Small system variances are also not available for any MCL or treatment technique with respect to which a NPDWR was promulgated prior to January 1, 1986. Variance technologies were not identified for any of the 12 contaminants where the pre-1986 MCL has

FIGURE 2
AFFORDABLE COMPLIANCE TECHNOLOGIES*



*NOTE: This approach covers the regulations that pass all of the screening criteria for variance technologies.

been retained or raised. The statutory prohibition on variance technologies is found in Section 1412(b)(15)(B) of the SDWA. The Administrator shall not identify any variance technology under this paragraph, unless the Administrator has determined, considering the quality of the source water to be treated and the expected useful life of the technology, that the variance technology is protective of public health. For 19 contaminants, it was determined that, in order to be protective of public health, the MCL had to be met. Since the MCL is the treatment standard, compliance technologies are the only alternative. These statutory screens for variance technologies are discussed in more detail in Chapter 2.

Section 1.4: Format of Variance Technology Lists

Section 1412(b)(15)(D) states that the variance technology list for the contaminants regulated before 1996 can be issued either through guidance or regulations. The three key requirements of Section 1412(b)(15)(D) on the list format are as follows: "Not later than 2 years after the date of enactment of this paragraph and after consultation with the States, the Administrator shall issue guidance or regulations under subparagraph (A) for each national primary drinking water regulation promulgated prior to the date of enactment of this paragraph for which a variance may be granted under section 1415(e). The Administrator may, at any time after a national primary drinking water regulation has been promulgated, issue guidance or regulations describing additional variance technologies. The Administrator shall, not less often than every 7 years, or upon receipt of a petition supported by substantial information, review variance technologies identified under this paragraph."

EPA has chosen the guidance format for a number of reasons. Because this is the first time that EPA has undertaken the variance technology analysis required under the amended SDWA (which includes new findings concerning "affordability" and "protectiveness") and given the relatively short time for development of this analysis, EPA considers the methodology described here and the resulting finding of no variance technologies to be an initial screening effort, rather than a final determination of any kind. In addition, by enabling EPA to list variance technologies through guidance rather than specifying them by regulation, the statute specifically contemplates that this analysis (and any resulting list) would be subject to revision, based on new information and petitions from interested parties.

In summary, EPA has chosen to list the variance technology findings through a Federal Register notice and a guidance document because regulation development is unnecessary and could considerably delay publication of the criteria used in this screening effort. Issuing the findings without rule-making allows EPA to meet the statutory deadline and to disseminate the criteria used to make the "affordability" and "protectiveness" findings. It is much easier and faster to update a guidance rather than a rule to address pertinent comments received in petitions from interested parties.

Section 1.5: Content of Variance Technology Lists

The SDWA does specify some content requirements for variance technologies. Section 1412(b)(15)(C) states that "The Administrator shall include in the guidance or regulations identifying variance technologies under this paragraph any assumptions supporting the public health determination referred to in subparagraph (B), where such assumptions concern the public water system to which the technology may be applied, or its source waters. The Administrator shall provide any assumptions used in determining affordability, taking into consideration the number of persons served by such systems. The Administrator shall provide as much reliable information as practicable on performance, effectiveness, limitations, costs, and other relevant factors including the applicability of variance technology to water from surface and underground sources." EPA interprets this provision as requiring the list of variance technologies to include information regarding "protectiveness", "affordability", and "performance and effectiveness" of the listed technologies.

The "protectiveness" criteria are discussed briefly in Chapter 2. The "affordability" criteria are discussed in detail in Chapter 3. The "performance and effectiveness" criteria are described in the final Variance and Exemption Rule (EPA, 1998d). When variance technologies are identified, EPA will provide accompanying guidance. The guidance will identify the typical removal efficiency achieved by each variance technology, considering the overall capabilities of the treatment process and the source water on which the technology would typically be applied. The guidance will also discuss source water characteristics that can adversely affect the removal of the contaminant by the process. The guidance will discuss the cost estimate for the technology that was used to determine if the technology was affordable. The guidance will discuss site-specific factors that can affect technology costs as well as the performance and effectiveness of the technology.

When variance technologies are identified, the list will not be product-specific. Variance technologies will be very similar to compliance technologies in that a general technology designation will be used. However, the guidance will contain more detail on treatment performance and costs than the compliance technology guidances. The variance technology lists will not be product-specific because EPA's Office of Ground Water and Drinking Water does not have the resources to review each product for each potential application; nor does EPA feel it would be appropriate to do so.

Information on specific products will be available through another mechanism. EPA's Office of Research and Development has a pilot project under the Environmental Technology Verification (ETV) Program to provide treatment system purchasers with performance data from independent third parties. The EPA and National Sanitation Foundation International (NSF) are cooperatively organizing and conducting this pilot project to allow for verification testing of packaged drinking water treatment systems for meeting community and commercial needs. This pilot project includes development of verification protocols and test plans, independent testing and validation of packaged equipment, conveying and supporting government/industry partnerships to obtain credible cost and performance data, and preparation of product verification reports for wide-spread distribution.

Section 1.6: Stakeholder Involvement

EPA held a stakeholder meeting on May 18 and 19, 1998. Approximately 50 people registered and participated in the meeting. Key stakeholders included States, water systems, and equipment manufacturers. Representatives from nine States were present at the meeting (either at the meeting or on conference lines) and several others received the material that was sent out prior to the meeting for review. A draft of the "National-Level Affordability Criteria Under the 1996 Amendments to the Safe Drinking Water Act" (EPA, 1998f) was sent out prior to the meeting.

There were two major topics related to variance technology findings that were discussed in the stakeholder meeting. The first was the two-stage screening process that is discussed in Chapter 2. The second is the national-level affordability criteria that are discussed in Chapter 3. Stakeholder comments will be discussed in each of these chapters rather than in Chapter 1.

Section 1.7: Organization of the Document

This document is organized into several chapters describing the variance technology findings for the contaminants regulated before 1996. Chapter 1 discusses the requirements of the 1996 SDWA and the overall approach EPA is following to meet those requirements. Chapter 2 discusses the two-stage screening process that was used to identify those contaminants that would have technology costs compared against the national-level affordability criteria. Chapter 3 summarizes the derivation of the national-level affordability criteria. Chapter 4 describes the affordable technology determinations and how treatment costs are compared against the national-level affordability criteria. Chapter 5 contains a summary of the variance technology findings for contaminants regulated before 1996.

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2. TWO-STAGE SCREENING PROCESS

Section 2.1: Overview

Chapter 1 discussed the SDWA requirements related to compliance and variance technologies. Compliance and variance technologies are mutually exclusive for a system size category/source water quality combination. Since compliance technologies were provided for *all* of the regulated contaminants and *all* classes of small systems, variance technologies will not, at this time, be listed for any existing NPDWR.

There are NPDWRs for 80 contaminants. The existing regulations can be divided into six categories: 6 microbial contaminants, 1 disinfection by-product, 21 volatile organic contaminants (VOCs), 32 synthetic organic contaminants (SOCs), 17 inorganic contaminants (IOCs), and 3 radionuclides. This chapter looks at the screening process that was used to identify the contaminants that would need to have technology costs compared against the national-level affordability criteria. Three of the 80 regulated contaminants were removed prior to the two-stage screening process: total trihalomethanes, acrylamide, and epichlorohydrin.

The current total trihalomethane regulation only applies to systems serving greater than 10,000 people. Therefore, small systems do not have to meet the existing standard, so neither compliance nor variance technologies will be listed. Compliance technologies and variance technologies (if appropriate) will be listed when the standard is revised and applied to small systems.

Acrylamide and epichlorohydrin are compounds associated with chemical additives used in drinking water treatment. These contaminants are regulated through a treatment technique that requires a certification that the product of the dose and monomer concentration will not exceed certain levels. Treatment technology is not installed to remove the contaminants under this treatment technique. As such, there are no compliance or variance technologies for either of these two contaminants.

As described above, one disinfection by-product and two of the SOCs were removed prior to the two-stage screening process. The first stage of the two-stage screening process is an evaluation of statutory screens. The second stage of the process involved the use of affordability and occurrence screens. The remaining 77 contaminants proceeded through this two-stage screening process.

Section 2.2: Stage One of the Screening Process: Statutory Screens

The first stage of the screening process was an evaluation of statutory screens that limit the availability of small system variances or variance technologies. There are three statutory screens. The first two prohibit small system variances. The sole purpose of the listing of variance technologies is to enable small systems to obtain a small system variance. Therefore, when these small system variances are not available under the SDWA, variance technologies will not be specified. The third statutory screen is a restriction on the listing of variance technologies.

Section 2.2.1: Statutory Screens: Microbial Contaminants

The first statutory screen is in Section 1415(e)(6)(B) of the SDWA. Small system variances are not available for any microbial contaminant (including a bacterium, virus, or other organism) or an indicator or treatment technique for a microbial contaminant. This screen removes 6 contaminants from consideration for variance technologies. These contaminants are: *Giardia lamblia*, *Legionella*, heterotrophic plate count bacteria, turbidity, viruses and total coliforms. *Giardia lamblia*, *Legionella*, and viruses are microbial contaminants. Heterotrophic plate count and total coliforms are indicators for microbial contaminants. Turbidity is used to measure the effectiveness of filtration in removing microbial contaminants. Filtration is one of the treatment techniques identified in the surface water treatment rule.

Section 2.2.2: Statutory Screens: Contaminants with NPDWRs Promulgated before 1986

The second statutory screen is in Section 1415(e)(6)(A) of the SDWA. Small system variances are not available for any MCL or treatment technique with respect to which a NPDWR was promulgated prior to January 1, 1986. The proposed and final Variance and Exemption Rule describes EPA's interpretation of this section of the SDWA [(EPA, 1998a) and (EPA, 1998b)]. EPA has interpreted this prohibition to apply to the level at which any contaminant was regulated before 1986. EPA surmised that the intent behind this provision was to prohibit a public water system from obtaining a variance for a contaminant for which compliance should have been achieved long ago. Therefore, small system variances are not be available for those contaminants where the pre-1986 MCL has been retained or raised. However, if EPA revises a pre-1986 level and makes it more stringent (i.e., makes the MCL lower), then a variance might be available for that contaminant, but only up to the pre-1986 MCL.

The second statutory screen removes 12 contaminants from consideration. These contaminants are: arsenic, beta particle and photon activity, gross alpha particle activity, radium 226 and 228 combined, 2,4,5-TP, endrin, fluoride, barium, chromium, mercury, nitrate, and selenium. The pre-1986 MCLs were not revised for arsenic and the three radionuclide contaminants. Revisions to these rules are expected in the future. If the pre-1986 MCL is lowered, small system variances (and variance technologies) for those contaminants would no longer be prohibited by this section of the SDWA. A small system variance would be available for those contaminants, but only up to the pre-1986 MCL. Six of the contaminants had their pre-1986 MCL raised when the MCL was revised between 1986 and 1996. These six contaminants are: 2,4,5-TP, endrin, fluoride, barium, chromium, and selenium. Two of the contaminants had their pre-1986 MCLs retained when the MCL was re-evaluated between 1986 and 1996: mercury and nitrate.

Section 2.2.3: Statutory Screens: Protective of Public Health Requirement

The final statutory screen is in Section 1412(b)(15)(B) of the SDWA. "The Administrator shall not identify any variance technology under this paragraph, unless the Administrator has determined, considering the quality of the source water to be treated and the expected useful life of the technology, that the variance technology is protective of public health." For the two-stage screening process, a surrogate was used for the "protective of public health" levels. The procedures for determining an unreasonable risk to health (URTH) were used as the surrogate for "protective of public health" levels. URTH is a concept that was retained in the 1996 SDWA from the 1986 SDWA and it applies to the granting of variances under Section 1415(a) or exemptions. In order to grant a variance under Section 1415(a) or an exemption, the State must find that the variance or exemption will not result in an unreasonable risk to health. The variances under Section 1415(a) are different from the small system variances under Section 1415(e).

The procedures for determining URTH values are described in "Toxicological Basis for Drinking Water: Unreasonable Risk to Health Values" (Orme-Zavaleta, 1992). The procedures in this paper have been used with the data in "Drinking Water Regulations and Health Advisories" (EPA, 1996) to derive URTH values for the regulated contaminants that passed through the first two statutory screens.

The toxicity or pathogenicity of a contaminant is considered in developing the maximum contaminant level goal (MCLG), a non-enforceable health goal. As previously discussed, the MCL is set as close to the MCLG as feasible, taking such factors as analytical capability, cost of treatment, and treatment availability into account. For most non-carcinogens, the MCL will equal the MCLG. For carcinogens and a very few non-carcinogens, the MCL is higher than the MCLG and is based on feasibility. The MCLGs for carcinogens were set at zero and the MCLs had to be set at a higher level since it is not feasible to achieve a level of zero.

For the regulated contaminants, EPA considered two mechanisms for producing a toxic or pathogenic response -- threshold or non-threshold. For a threshold response, exposure at or above the threshold level can result in a toxic outcome, whereas for non-threshold response, exposure at any level except zero can theoretically lead to a toxic outcome. In general, the health effects for non-carcinogens utilized a threshold approach and the carcinogens utilized a non-threshold approach.

For the threshold (non-carcinogenic) contaminants, the MCLG represents a level that is protective of health effects for up to a lifetime exposure. A lifetime is assumed to be 70 years for this analysis. One of the key components to determining an URTH value for drinking water contaminants is the determination of short-term acceptable risk levels. Under the procedures outlined in the article, a short-term acceptable risk level is defined as the concentration above the MCL that would not pose a health risk for a short period of time (e.g., up to 7 years, or 10% of an individual's lifetime). A 7-year period is recommended for both non-carcinogenic and carcinogenic contaminants. The URTH values were used as a surrogate for the protective of public health requirement of Section 1412(b)(15)(B) because the URTH values are based on a short-term exposure of up to 7 years. Section 1412(b)(15)(B) requires that the variance technology be protective of public health for the expected useful life of the technology. Most technologies will have expected useful lives greater than 7 years, so a concentration that is protective of public health would need to be less than or equal to the URTH value. The expected useful life for most treatment technologies for small systems was assumed to be 20 years. There is an ongoing project to better define the expected useful life for each type of technology. Once this work is completed, it will be utilized in the development of "protective of public health" ranges when variance technologies are identified.

Since the concentration that is protective of public health needs to be less than or equal to the URTH value, contaminants with little or no margin between the MCL and the URTH value could be removed from consideration for variance technologies. For 19 contaminants, the derived URTH value was equal to the MCL or very close to the MCL. For these 19 contaminants, it was determined that in order to be protective of public health, the MCL had to be met. Since the MCL is the treatment standard, compliance technologies are the only alternative. Variance technologies are not listed for these contaminants. The process used to derive the URTH values for all of the contaminants that passed through the first two statutory screens is described in the following paragraphs.

In developing a short-term acceptable risk level, the toxicity of each contaminant needs to be evaluated individually. This was done by considering any available risk assessment conducted for each contaminant (EPA, 1996). Both cancer and non-cancer hazards were considered in the evaluation of the risk assessments. The type of available risk assessment values used for developing the short-term acceptable risk levels include: a) the maximum contaminant level goal (MCLG) and the MCL; b) the drinking water equivalent level (DWEL), which represents a lifetime exposure concentration protective of adverse, non-cancer health effects, that assumes all of the exposure to a contaminant is from a drinking water source; c) the longer-term health advisory for a child; d) the EPA cancer classification and MCLG category I, II, or III; e) the 10^{-4} excess cancer risk level; and f) the MCLG multiplied by a factor of 1 to 10 for contaminants with limited evidence of carcinogenicity via ingestion. Rather than describe all of the procedures in the article on deriving URTH values, this guidance will cover those that were used for the 19 contaminants that were removed from consideration for variance technologies.

The MCLGs for three contaminants were based on acute endpoints of toxicity. For these contaminants, the MCL is used as the benchmark for the short-term acceptable risk level. These three contaminants are: copper, nitrite, and nitrate plus nitrite. Copper is also discussed later in the affordability screen section along with lead.

There are 16 contaminants whose MCLGs were based on chronic health effects. The MCLGs for 12 of these 16 contaminants were based on carcinogenic risks. The MCLGs for the remaining 4 contaminants were based on non-carcinogenic risks.

For the 12 contaminants whose MCLGs were based on carcinogenic risks, the 10^{-4} excess cancer risk level was used to derive the URTH value. When EPA set MCLs for carcinogenic contaminants, the excess risk of cancer associated with the MCL was within an acceptable range of 1 cancer in ten thousand people (10^{-4}) to 1 cancer in one million people (10^{-6}). These cancer risks were estimated for both known and probable human carcinogens via ingestion. For carcinogens where the MCL is set at a concentration less than the 10^{-4} risk level, the 10^{-4} excess cancer risk level may be used as the short-term acceptable risk level for URTH if this value does not exceed the DWEL or the longer-term health advisory for a child. The lower of these values is recommended as the short-term acceptable risk level for URTH. For the 12 contaminants, the lowest value was the 10^{-4} excess cancer risk level. For eight of the contaminants, the 10^{-4} excess cancer risk level was equivalent to the MCL. These contaminants are: vinyl chloride, styrene, ethylene dibromide, PCBs, toxaphene, benzo(a)pyrene, 2,3,7,8-TCDD (dioxin), and beryllium. For four of the contaminants, the 10^{-4} excess cancer risk level was less than or equal to 1 μg/L above the MCL. Since the URTH value was approximately equivalent to the MCL and since the protective of public health concentration would likely need to be closer to the MCL, the MCL was selected as being the protective of public health concentration for these contaminants. In addition, the cost difference between meeting the MCL and a concentration less than 1 μg/L above the MCL would be negligible for systems that had to install treatment. These contaminants are chlordane, heptachlor, heptachlor epoxide, and hexachlorobenzene.

The remaining four contaminants showed no evidence of carcinogenicity via ingestion. The MCLGs are based on non-carcinogenic risks. For these contaminants, the longer-term health advisory for a child is recommended for the short-term acceptable risk level. Longer-term health advisories are derived from subchronic studies that involve exposures for up to 10% of the animals lifetime. Since the MCL is based on a lifetime exposure of 70 years, the longer-term health advisory would be appropriate for an exposure period of up to 7 years. The longer-term health advisory is calculated for both a child and an adult. For a child, adjustments are made for the child’s body weight and average daily water consumption. Alternatively, the DWEL is recommended for the short-term acceptable risk level when data to calculate a longer-term health advisory are not available or if the DWEL provides a lower value than the longer-term health advisory.

The longer-term health advisory for the child is equivalent to the MCL for three of the four contaminants. There contaminants are: oxamyl, cadmium, and cyanide. For thallium, the DWEL is approximately equal to the MCL (DWEL = 2.3 μg/L and the MCL = 2 μg/L). Thallium is unique in that it is the only non-carcinogenic contaminant where the MCL does not equal the MCLG. The MCLG for thallium is 0.5 μg/L. That is why the DWEL is approximately equal to the MCL. Since the URTH value was approximately equivalent to the MCL and since the protective of public health concentration would likely need to be closer to the MCL, the MCL was selected as being the protective of public health concentration for thallium. In addition, the cost difference between meeting the MCL and a concentration less than 1 μg/L above the MCL would be negligible for systems that had to install treatment.

EPA is currently evaluating the procedures outlined in the "Toxicological Basis for Drinking Water: Unreasonable Risk to Health Values" paper (Orme-Zaveleta, 1992). EPA will issue a revised guidance manual for determining URTH as a result of this review process. The URTH values listed in Table 1 will be modified or recalculated based on revisions to the procedures for determining URTH values. The 19 contaminants removed by this screen will be examined using the new procedures to determine if there is a level above the MCL that may be protective of public health for the expected useful life of a technology.

Variance technologies were not listed for 37 contaminants based on the statutory screens described in this section. The remaining 40 contaminants proceeded into the second stage of the screening process.

Section 2.3: Stage Two of the Screening Process: Affordability Screens

The second stage of the screening process involved affordability screens and evaluations. There were three affordability screens used in this stage of the process. The first screen examined those contaminants that had a low-cost technology option available. The next screen used occurrence data to make projections about the likelihood of MCL violations. The third screen examined violation data for contaminants.

Section 2.3.1: Affordability Screens: Low-Cost Compliance Technology

Since Section 1412(b)(15)(A) of the SDWA authorizes a variance technology listing only where compliance technologies are unaffordable for any category of small systems, any contaminant that has a low-cost compliance technology will not have variance technologies. When a low-cost compliance technology that meets the national-level affordability criteria can be identified for a system size/source water quality combination, variance technologies are not available. For this screen, the best available technologies (BATs) listed in the regulations were examined and technologies that imposed an increase of less than $300/household/year for each size category were identified to screen for affordability. The “National-Level Affordability Criteria Under the 1996 Amendments to the Safe Drinking Water Act” report (EPA, 1998c) identified options for national-level affordability criteria that ranged from 1.5% to 3% of the median household income. The cost increase associated with the lowest option (1.5%) translated into an increase of $270/household/year, which was rounded up to $300/household/year for this screening analysis in the 25 - 500 size category. For the larger two size categories, $250/household/year was used for this screen. All of the technology costs were later verified against the national-level affordability criteria that were selected. The national-level affordability criteria are discussed in detail in Chapter 3.

The BATs were examined for each of the remaining 40 contaminants. Four technologies were identified as being low-cost technologies for each of the three size categories. These technologies that met this screening criterion were aeration, aeration plus chlorination, corrosion control, and oxidation. Diffused aeration and chlorine oxidation technologies can be characterized as requiring basic operator skill with low monitoring requirements, low capital cost and low relative operating cost [see "Safe Water from Every Tap" (NRC, 1997)]. Corrosion control using chemical feeders can be characterized as requiring basic operator skill with low monitoring requirements, low capital costs and medium relative operating cost (NRC, 1997). Thus, these technologies represent the most basic options available to systems to reduce contaminant concentrations.

The cost for diffused aeration was estimated to be below $150/household/year for the 25 - 500 category. The cost for diffused aeration plus chlorination were estimated to be below $250/household/year for the 25 - 500 category. For this analysis, costs were done for a centralized system (one well) and a decentralized system (two wells). The higher costs for the decentralized scenario were towards the higher end of the ranges listed above. In the higher size categories, the costs estimated for diffused aeration and diffused aeration plus chlorination were below $100/household/year. These cost estimates were verified against the national-level affordability criteria described in Chapter 3 to ensure that there was an affordable compliance technology. In addition, these cost estimates were compared against the national-level affordability criteria to identify affordable compliance technologies. The affordable compliance technologies for VOCs are discussed in "Small System Compliance Technology List for the Non-Microbial Contaminants Regulated Before 1996" (EPA, 1998d). Variance technologies were not available for all of the VOCs based on the affordability of aeration technologies. There are 21 regulated VOCs. Variance technologies were already not available for styrene and vinyl chloride because of the statutory screen that requires the variance technology to be protective of public health. The other 19 VOCs removed by this screen are: benzene, carbon tetrachloride, chlorobenzene, cis-1,2-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethylene, dichloromethane, 1,2-dichloropropane, ethylbenzene, o-dichlorobenzene, p-dichlorobenzene, tetrachloroethylene, toluene, trans-1,2-dichloroethylene, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, and xylenes (total). In addition, there are three SOCs that can be effectively removed by aeration. These SOCs are: dibromochloropropane, di(2-ethylhexyl) adipate, and hexachlorocyclopentadiene. The affordability of aeration technologies removed 22 contaminants from consideration.

The listed BAT for glyphosate is oxidation. The oxidation can be accomplished through the use of either chlorination or ozonation. The costs for chlorination were estimated to be below $100/household/year for all three size categories. The costs for ozonation were higher than chlorination, especially in the smallest size category. Since there is an affordable compliance technology for glyphosate, variance technologies will not be available. The affordability of the chlorine oxidation removes glyphosate from consideration of variance technologies.

The final contaminant removed from consideration for variance technologies by this screen is lead. Corrosion control is listed as one of the treatment techniques for both lead and copper under the lead and copper rule. The lead and copper rule lists three general classes of corrosion control treatments: alkalinity and pH adjustment, calcium hardness adjustment, and corrosion inhibitors. The following chemical feed systems can be used for the alkalinity and pH adjustment and the calcium hardness adjustment options: sodium hydroxide, lime, sodium bicarbonate, and soda ash. The costs for each of these corrosion control feed systems is less than $100/household/year in all three size categories. The lead and copper rule identifies two types of corrosion control inhibitors: orthophosphate-based and silicate-based. Annual costs were estimated for a zinc orthophosphate inhibitor feed system. These costs were also below $100/household/year in all three size categories. The lead and copper rule envisions that some systems might need two chemical feed systems for their optimal corrosion control process. The costs for these combinations will be well under $200/household/year. Since the corrosion control treatments meet the affordability screen, variance technologies would not be available for lead. Variance technologies were already not available for copper because of the statutory screen that requires the variance technology to be protective of public health. Otherwise, copper would be removed by this screen.

The technologies evaluated for this screen represent simple, low-cost options for compliance with the rules for 24 contaminants. In addition, aeration and oxidation are very efficient processes for VOCs and glyphosate, respectively. A variance technology may not achieve compliance with the MCL or treatment requirement of a regulation, but shall achieve the maximum reduction or inactivation frequency that is affordable considering the size of the system and the quality of the source water. Since removal efficiency is not a driving factor in the costs of these technologies, a contaminant endpoint above the MCL would not significantly reduce household water bills. Thus, the goal for these systems should be compliance with the standard using one of the identified compliance technologies.

Section 2.3.2: Affordability Screens: Contaminant Occurrence - No Projected Violations

After the first affordability screen, 16 contaminants remained eligible for consideration for variance technologies. The next affordability screen involved an evaluation of compliance monitoring data and National Pesticide Survey data for the remaining 16 contaminants (14 pesticides). The other two contaminants, antimony and asbestos, are inorganic contaminants (IOCs). EPA assumed that if there were no violations, existing technologies for compliance have been affordable and variance technologies were not available for these contaminants.

One of the sources of occurrence data used for this screen was the National Pesticide Survey. The National Pesticide Survey was conducted from April 1988 through February 1990. Drinking water wells throughout the country were analyzed for 126 pesticides and pesticide degradates, plus nitrate. During the survey, 783 rural domestic wells and 566 community water system wells were sampled. Thirteen of the 14 pesticides were included in the National Pesticide Survey. Only endothall was not included. For each pesticide in the survey, a minimum reporting level (MRL) was established. The MRL was the minimum concentration at which a pesticide was reported as detected. Appendix E of the “National Survey of Pesticides in Drinking Water Wells Phase I Report” (EPA, 1990) was examined to determine which of the 13 pesticides were detected above the MRL in the survey.

The second data source used for the occurrence screen is compliance monitoring data. EPA received data from 11 States to assist in the chemical monitoring reform effort in early 1996. Monitoring data for both pesticides and IOCs were submitted as part of this effort. The States that supplied occurrence data are: Alabama, Alaska, Arkansas, California, Georgia, Kansas, Mississippi, Nebraska, New Jersey, Oregon, and Wisconsin. For the 14 pesticides, data was submitted based on the analysis of 5,125 to 13,753 samples depending upon the contaminant. For asbestos, data was submitted on the analysis of 1,225 samples. For antimony, data was submitted on the analysis of 14,747 samples.

The screening criteria for contaminant occurrence and projected violations was as follows: no detections in the National Pesticide Survey, MCLs at least one order of magnitude higher than the reporting limit for the compliance monitoring data, and a low positive rate in the compliance data with no MCL exceedances. Five pesticides were removed from consideration based on those criteria: carbofuran, 2,4-D, methoxychlor, dalapon, and picloram. Endothall was also removed from consideration based solely on the relationship of the reporting limits for the State data and the MCL and the very low positive rate (e.g., < 0.03%) in the compliance data. Carbofuran was selected to illustrate this process for the five contaminants included in the National Pesticide Survey because it had the lowest MCL/detection limit ratio. Detection limits for the regulated SOCs are found in 40 CFR §141.24(h)(18). The listed detection limit for carbofuran is 0.9 μg/L. The MCL for carbofuran is 40 μg/L. The MCL is just over 44 times larger than the detection limit. Carbofuran was detected in 23 out of 10,955 samples (0.23%) in the State compliance data. None of these samples exceeded the MCL. In addition, carbofuran was not detected in the National Pesticide Survey, which had a MRL of 1.2 μg/L for carbofuran. Based on the very small percentage of detections and the large difference between the detection limit and the MCL, no violations were projected for carbofuran. For endothall, only the compliance monitoring data was used. The listed detection limit for endothall in 40 CFR §141.24(h)(18) is 9 μg/L. The MCL for endothall is 100 μg/L. Endothall was only detected in 2 out of 6,218 samples, which converts to 0.03% of the samples. Neither of these samples exceeded the MCL. Based on this data, no MCL violations were projected for endothall. The listed detection limits for the other four pesticides removed by this screen can be found in 40 CFR §141.24(h)(18). A summary of the percentage of positive samples in the compliance monitoring data and the National Pesticide Survey results can be found in Table 1 at the end of this chapter. This table summarizes the screening process for all of the 80 contaminants.

Section 2.3.3: Affordability Screens: No Violations

Only 10 contaminants remained after the projected violation screen was applied. EPA's Safe Drinking Water Information System (SDWIS) contains data on the compliance status of drinking water systems. A query on violations for the 10 remaining contaminants was run on December 16, 1997 (EPA, 1997). This query looked for either of the following types of violation types: a single sample violation of the MCL or an MCL violation based on the average of the most recent four quarters of data. The other two violation types in SDWIS are monitoring and reporting violations. Data on those violation types were not used for this screen, since MCL exceedances cannot be predicted from that data. Since only systems with violations of the MCL will require treatment, 5 contaminants were removed because there were no MCL violations. The violation data on the 5 contaminants with MCL exceedances will be used in the affordable technology determination described in Chapter 4. The contaminants that did not have any MCL exceedances in SDWIS are all pesticides: alachlor, pentachlorophenol, dinoseb, diquat, and simazine.

For these 5 contaminants, the lack of violations was not the sole reason for removing them from consideration for variance technologies. The compliance monitoring data from the 11 States was also examined along with the SDWIS data. Alachlor and dinoseb had positive rates below 0.25% and no detections above the MCL. There were data submitted from 5,125 samples for diquat. There were 60 positive samples (1.17%) between the detection limit of 0.4 μg/L and the MCL of 20 μg/L. There was one positive sample (0.02%) reported that exceeded the MCL. Both pentachlorophenol and simazine had lower percentages of positive samples, but each had very limited MCL exceedances. Table 1 at the end of this chapter provides more details on the screens that were applied to each contaminant. Since the occurrence data was from 1996 and the violation data in SDWIS was late 1997, it was assumed that the positives in the compliance data were not MCL exceedances that would require treatment. However, violation data on all 5 of these contaminants will be reviewed over the next year to see if new violations have been recorded in SDWIS. If violations are found for these contaminants, that data would be used to perform an affordable technology analysis, which is described in Chapter 4.

Section 2.4: Summary of Screening Process

Three contaminants were removed from consideration for variance technologies prior to the screening process. The two-stage screening process evaluated the eligibility of the remaining 77 regulated contaminants for variance technologies. The results of the two-stage screening process were that only five contaminants remained eligible for variance technologies. These five contaminants were: antimony, asbestos, atrazine, di-(2-ethylhexyl) phthalate and lindane. These contaminants proceeded through a more extensive affordability analysis where technology cost estimates were compared with the national-level affordability criteria to determine if there is an affordable compliance technology. This process is described in Chapter 4.

The entire screening process was presented at the May 18 and 19, 1998 stakeholder meeting. The two affordability screens that utilized occurrence data (lack of projected violations and lack of violations) generated comments from stakeholders and States. Both were concerned that systems with problems could be overlooked in the data sources used by EPA. EPA stated that the lists are not static documents and that they can be updated if new data are received. For variance technologies, this new data is not limited to technology performance. EPA noted that if data are received showing violations for contaminants removed by the occurrence screens, then EPA would use this data to determine if the system needed a variance technology. As was previously noted, EPA believes that the results of this analysis would be subject to revision based on new information and petitions from interested parties.

TABLE 1

REGULATED CONTAMINANTS AND THEIR ELIGIBILITY FOR VARIANCE TECHNOLOGIES AFTER TWO-STAGE SCREENING PROCESS

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Arsenic (pre-1986)	NO	Section 1415(e)(6)(A) of SDWA (pre-1986 MCL not revised)[2]	50	
Beta particle & photon radioactivity (pre-1986)	NO	Section 1415(e)(6)(A) of SDWA (pre-1986 MCL not revised)[2]	4 mrem	4 mrem
Gross alpha particle activity (pre-1986)	NO	Section 1415(e)(6)(A) of SDWA (pre-1986 MCL not revised)[2]	15 pCi/L	15 pCi/L
Radium 226 & 228 (combined) (pre-1986)	NO	Section 1415(e)(6)(A) of SDWA (pre-1986 MCL not revised)[2]	5 pCi/L	20 pCi/L
Total Trihalomethanes	NO	MCL does not apply (applies only to systems > 10,000 people)	100	
Benzene	NO	Aeration is affordable	5	200
Carbon Tetrachloride	NO	Aeration is affordable	5	30
p-Dichlorobenzene	NO	Aeration is affordable	75	750
1,2-Dichloroethane	NO	Aeration is affordable	5	40
1,1-Dichloroethylene	NO	Aeration is affordable	7	70
1,1,1-Trichloroethane	NO	Aeration is affordable	200	1,000
Trichloroethylene	NO	Aeration is affordable	5	300

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Vinyl Chloride	NO	URTH = MCL and Aeration is affordable	2	2
Chlorobenzene	NO	Aeration is affordable	100	700
o-Dichlorobenzene	NO	Aeration is affordable	600	3,000
cis-1,2-Dichloroethylene	NO	Aeration is affordable	70	400
trans-1,2-Dichloroethylene	NO	Aeration is affordable	100	600
1,2-Dichloropropane	NO	Aeration is affordable	5	60
Ethylbenzene	NO	Aeration is affordable	700	1,000
Styrene	NO	URTH = MCL and Aeration is affordable	100	100
Tetrachloroethylene	NO	Aeration is affordable	5	70
Toluene	NO	Aeration is affordable	1,000	2,000
Xylenes (total)	NO	Aeration is affordable	10,000	40,000
Dichloromethane	NO	Aeration is affordable	5	500
1,2,4-Trichlorobenzene	NO	Aeration is affordable	70	100
1,1,2-Trichloroethane	NO	Aeration is affordable	5	30
Giardia lamblia	NO	Section 1415(e)(6)(B) of SDWA	NA	
Legionella	NO	Section 1415(e)(6)(B) of SDWA	NA	

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Standard Plate Count	NO	Section 1415(e)(6)(B) of SDWA	NA	
Turbidity	NO	Section 1415(e)(6)(B) of SDWA	NA	
Viruses	NO	Section 1415(e)(6)(B) of SDWA	NA	
Total Coliform	NO	Section 1415(e)(6)(B) of SDWA	< 5% positives	
Alachlor	NO	Detected in NPS above MRL of 0.5 μg/L[5], 0.13% positives: all below MCL (State data)[6]**,** No MCL exceedances in 12/97 SDWIS run[10]	2	40
Atrazine	YES	Detected in NPS above MRL of 0.12 μg/L[5], 1.34% positives: all below MCL (State data)[6], MCL exceedances in 12/97 SDWIS run[10]	3	30
Carbofuran	NO	Not detected in NPS with MRL of 1.2 μg/L[5], 0.21% positives: all below MCL (State data)[6]	40	50
Chlordane	NO	URTH ≈ MCL (≤ 1 μg/L difference)	2	3
Dibromochloropropane	NO	Aeration is affordable	0.2	3

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
2,4-D	NO	Not detected in NPS with MRL of 0.25 μg/L[5], 0.36% positives: all below MCL (State data)[6]	70	100
Ethylene Dibromide	NO	URTH = MCL and aeration is affordable	0.05	0.05
Heptachlor	NO	URTH ≈ MCL (≤ 1 μg/L difference)	0.4	0.8
Heptachlor Epoxide	NO	URTH ≈ MCL (≤ 1 μg/L difference)	0.2	0.4
Lindane	YES	Detected in NPS above MRL of 0.043 μg/L[5], 0.15% positives: all below MCL (State data)[6], MCL exceedances in 12/97 SDWIS run[10]	0.2	2
Methoxychlor	NO	Not detected in NPS with MRL of 0.30 μg/L[5], 0.07% positives: all below MCL (State data)[6]	40	50
Polychlorinated Biphenyls	NO	URTH = MCL	0.5	0.5
Pentachlorophenol	NO	Not detected in NPS with MRL of 0.10 μg/L[5], 0.34% positives: 0.02% > MCL, 0.32% < MCL (State data)[6], No MCL exceedances in 12/97 SDWIS run[10]	1	30

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Toxaphene	NO	URTH = MCL	3	3
2,4,5-TP	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL raised[2]	50	70
Benzo(a)pyrene	NO	URTH = MCL	0.2	0.2
Dalapon	NO	Not detected in NPS[5], 0.42% positives: all below MCL (State data)[6]	200	300
Di(2-ethylhexyl) adipate	NO	Aeration is affordable	400	3,000
Di(2-ethylhexyl) phthalate	YES	3.72% positives: 0.98% > MCL, 2.74% < MCL (State data)[6], MCL exceedances in 12/97 SDWIS run[10]	6	300
Dinoseb	NO	Detected in NPS above MRL of 1.3 μg/L[5], 0.26% positives: all below MCL (State data)[6], No MCL exceedances in 12/97 SDWIS run[10]	7	10
Diquat	NO	1.19% positives: 0.01% > MCL, 1.18% < MCL (State data)[6], No MCL exceedances in 12/97 SDWIS run[10]	20	80
Endothall	NO	0.03% positives: all below MCL (State data)[6]	100	200

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Endrin	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL raised[2], URTH ≈ MCL (≤ 1 μg/L)	2	3
Glyphosate	NO	Treatment option is affordable	700	1,000
Hexachlorobenzene	NO	URTH ≈ MCL (≤ 1 μg/L difference)	1	2
Hexachlorocyclopentadiene	NO	Aeration is affordable	50	200
Oxamyl	NO	URTH = MCL	200	200
Picloram	NO	Not detected in NPS with MRL of 0.5 μg/L[5], 0.13% positives: all below MCL (State data)[6]	500	700
Simazine	NO	Detected in NPS with MRL of 0.38 μg/L[5], 0.64% positives: 0.01% > MCL, 0.65% < MCL (State data)[6], No MCL exceedances in 12/97 SDWIS run[10]	4	40
2,3,7,8-TCDD (Dioxin)	NO	URTH = MCL	3×10^{-5}	3×10^{-5}
Acrylamide	NO	Not a technology-based NPDWR[9]	TT	1
Epichlorohydrin	NO	Not a technology-based NPDWR[9]	TT	70
Fluoride	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL raised[2]	4,000	5,000

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Asbestos	YES	5.71% positives: 0.41% > MCL, 5.30 % < MCL (State data)[7], MCL exceedances in 12/97 SDWIS run[10]	7 MFL	70 MFL
Barium	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL raised[2]	2,000	5,000
Cadmium	NO	URTH = MCL	5	5
Chromium	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL raised[2]	100	200
Mercury	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL retained[2], URTH = MCL	2	2
Nitrate (as N)	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL retained[2], URTH = MCL, acute effect	10,000	10,000
Nitrite (as N)	NO	URTH = MCL, acute effect	1,000	1,000
Total Nitrate & Nitrite (as N)	NO	URTH = MCL, acute effect	10,000	10,000
Selenium	NO	Section 1415(e)(6)(A) applies because pre-1986 MCL raised[2]	50	200

Contaminant[1]	Are Variance Technologies an Option?	Rationale	MCL (μg/L)	URTH Value[3] (μg/L)
Antimony	YES	2.08% positives: 0.24% > MCL, 1.84% < MCL (State data)[8], MCL exceedances in 12/97 SDWIS run[10]	6	10
Beryllium	NO	URTH = MCL	4	4[4]
Cyanide (as free cyanide)	NO	URTH = MCL and treatment option is affordable	200	200
Thallium	NO	URTH ≈ MCL (≤ 1 μg/L difference)	2	2.3
Lead	NO	Corrosion Treatment is affordable	15 (TT)	30
Copper	NO	URTH = Action level, acute effect, Treatment is affordable	1,300 (TT)	1,300

NOTES:

1) Aldicarb, aldicarb sulfoxide, aldicarb sulfone, and nickel are not included since the MCLs for these contaminants are not in effect.

2) Section 1415(e)(6)(A) states that a small system variance shall not be available for any maximum contaminant level or treatment technique for a contaminant with respect to which a national primary drinking water regulation was promulgated prior to January 1, 1986. See text for details on the interpretation of this requirement.

3) These URTH values have been estimated using the procedures in "Toxicological Basis for Drinking Water: Unreasonable Risk

to Health Values" (Orme-Zavaleta, 1992) and the health advisory data in "Drinking Water Regulations and Health Advisories" (EPA, 1996). The calculation of URTH values is currently under review at EPA. EPA will issue a revised guidance manual for determining URTH as a result of that process. The URTH values listed in this table will be modified or recalculated based on revisions to the procedures for determining URTH values. The values in this table should be considered an interim estimate for URTH and will be replaced by the values in the forthcoming URTH guidance. This guidance manual will be updated to incorporate the revised URTH values.

4) The URTH for beryllium was estimated at the MCL because the 10^{-4} cancer risk level is lower than the MCL, even though the MCLG was set based on Category II process. The derivation of the MCLG included a safety factor of 10 to account for possible carcinogenic effects of beryllium via ingestion since the data did not support classifying beryllium as a carcinogen through ingestion. However, the URTH guidance states that the safety factor can be removed as long as the 10^{-4} risk level is not exceeded.

5) These analytes were included in the National Pesticide Survey [National Survey of Pesticides in Drinking Water Wells] that was conducted by EPA and examined both Community Water System wells and rural domestic wells. The MRL is the minimum reporting limit used for the analytes in the NPS. All positive samples would have concentrations at or above the MRL.

6) Compliance monitoring data from 11 States were submitted to assist EPA in the development of Chemical Monitoring Reform. For these pesticides, the total number of sites monitored ranged from 5,125 to 13,753 depending upon the contaminant. The States that submitted data are: Alabama, Alaska, Arkansas, California, Georgia, Kansas, Mississippi, Nebraska, New Jersey, Oregon, and Wisconsin.

7) Compliance monitoring data from the same 11 States were also submitted on asbestos. The percentages are based on data from 1,225 sites.

8) Compliance monitoring data from the same 11 States were also submitted on antimony. The percentages are based on data from 14,747 sites.

9) The NPDWRs for acrylamide and epichlorohydrin are treatment techniques that require a certification that when they are used in drinking water, the product of dose and monomer does not exceed certain levels. Since this is not a technology-based

standard, there are no compliance or variance technologies.

10) A 12/16/97 run of SDWIS (EPA, 1997) was done for ten contaminants to determine if there were MCL exceedances.

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3.0 NATIONAL-LEVEL AFFORDABILITY

Section 3.1: Introduction

Section 1412(b)(15)(C) of the SDWA requires EPA to list any assumptions used in determining affordability, taking into consideration the number of persons served by such systems when variance technologies are listed. Even though EPA did not list variance technologies in the August 6, 1998 Federal Register notice (EPA, 1998a), the affordability criteria used by EPA for these findings were included in the notice. These affordability criteria were used to identify affordable compliance technologies for some of the regulated contaminants. EPA compared technology cost estimates for each small size category against an affordable technology criterion for those regulations where a small system variance could be granted. The affordable compliance technologies are discussed in "Small System Compliance Technology List for the Non-Microbial Contaminants" (EPA, 1998b).

The size category-dependent affordable technology criteria are collectively referred to as "national-level affordability criteria." This nomenclature has been used to distinguish the national-level affordability criteria from the "system-level affordability criteria" that States will use for determinations affecting individual systems. EPA published information regarding these system-level affordability criteria in February, 1998 (EPA, 1998c). This information was required by Section 1415(e)(7)(B) of the SDWA. There are three provisions of the SDWA that refer to these system-level affordability criteria. Section 1415(e) provides for affordability-based variances, under certain circumstances, for small drinking water systems. Section 1416 allows for exemptions that provide systems facing compelling economic factors additional time to comply with SDWA requirements. Small systems could receive as long as nine additional years to comply. Finally, Section 1452(b) provides that affordability on a per household basis shall be one of the three factors used to prioritize systems for assistance from the new Drinking Water State Revolving Fund (DWSRF). The system-level affordability criteria can be different for different purposes. For example, States can use different affordability criteria to make decisions about whether a system should receive a small system variance and when a system should receive additional subsidization from the DWSRF. In fact, the threshold used for additional assistance for systems meeting a NPDWR would likely be lower than the threshold used to determine when a system would operate at a level that does not provide an equivalent level of protection as meeting the MCL.

The national-level affordability criteria for the affordable variance technology determinations will also be different from the system-level criteria used by the State to determine if a system should receive a small system variance. Technologies determined to be "unaffordable" under the national-level affordability criteria may still be affordable for a specific system within the size category, in which case the system may install that technology if it so chooses. Conversely, if a financially disadvantaged small water system out of compliance with a NPDWR cannot afford any of the compliance technologies that are determined to be "affordable," one option for that system would be to apply to the State for an exemption. This process is available for regulations promulgated after 1996. Such a system cannot apply for a new exemption for the regulations issued prior to August 6, 1998. Those small systems with existing exemptions for rules in effect on August 6, 1998 may continue to get renewals of their exemptions until the exemption period has run out. That means that a small system can have no more than 9 years after the Section 1412 compliance date to meet the applicable MCL/treatment technique even if the exemption was issued prior to the 1996 SDWA Amendments.

Section 3.2: Role of National-Level Affordability Criteria

The role of the national-level affordability criteria was discussed briefly in Section 1.3 of this document. Figure 2 in that section showed the role that national-level affordability criteria play in the treatment technology arena. The primary function of the criteria is to determine whether a system of a given size/source water quality combination should proceed down the compliance or variance technology pathway. The secondary function is to define the universe of technologies within the compliance or variance technology pathway. Since affordable compliance technologies were identified for all of the regulated contaminants, the variance technology pathway will not be utilized at this time. The secondary function of the national-level affordability criteria is demonstrated in the compliance technology tables (EPA, 1998b). For the smallest size category, technologies that met the national-level affordability criteria and those that did not meet the national-level affordability criteria were identified.

The primary function of the national-level affordability criteria is to determine whether the treatment goal of the water system should be compliance with the NPDWR or whether the system should proceed down the variance pathway towards obtaining a small system variance. A variance technology must be installed to obtain a small system variance. The variance technology may not achieve compliance with the NPDWR, but will achieve the maximum reduction or inactivation that is affordable considering the size of the system and the quality of the source water. Thus, the treatment objective for a variance technology might be a concentration that is higher than the MCL. This higher concentration must be protective of public health, considering the quality of the source water and the expected useful life of the technology. Variance technologies cannot be identified if they are not protective of public health [see Section 1412(b)(15)(B) of the SDWA]. The treatment goal under a small system variance is to be within the range identified as being protective of public health. This range would start at the MCL and would go up to the maximum concentration that is still protective of public health based on the expected useful life of the technology. The actual treatment goal is to be as close to the MCL as is affordable within the protective of public health range.

The national-level affordability criteria help define the range of options available to a small system that is out of compliance with a NPDWR. The overall range of options are: 1) install a technology to comply with the NPDWR; 2) receive an exemption and then install a technology to comply with the NPDWR; or 3) obtain a small system variance (if option is available). For the two compliance options, the system is not required to install a compliance technology identified by EPA. The compliance technology list is intended as guidance to provide small systems with information concerning the types of technologies that can be used to comply with the NPDWR. Systems can install other technologies that are not on the list to comply with the NPDWR. Alternate source and regionalization options are also available for a system to comply with a NPDWR. The compliance option can be characterized as a "pay now" approach. The exemption followed by compliance option can be characterized as a "pay later" approach. The small system variance option can be characterized as "pay less for less" approach. These systems will not have the same level of protection as systems complying with the NPDWR during the duration of the small system variance. Households in these systems will likely have lower water bills than they would if the system were in full compliance with the NPDWR. There are NO no-cost options available for violations of NPDWRs. All three options have treatment costs associated with them. When a variance technology is installed, there are additional administrative costs associated with the small system variance procedures. These procedures are detailed in the final Variance and Exemption Rule (EPA, 1998d). The national-level affordability criteria will determine when the "pay less for less" option will be available.

Section 3.3: Unit of Measure for the National-Level Affordability Criteria

Public water systems fall into one of three categories. A community water system (CWS) is a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. A non-transient non-community water system (NTNCWS) is a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year. A transient non-community water system (TNCWS) is a non-community water system that does not regularly serve at least 25 of the same persons over six months per year.

Community water systems can absorb water service cost increases by directly charging their customers in the form of increased water bills. Community water systems serve both residential and non-residential customers. The majority of the customers in small systems are residential or household connections. System size and the percentage of non-residential customers are directly related. Thus, the typical system in the smallest size category relies almost exclusively on residential customers. Since there are so few non-residential customers, the ability of these systems to spread the cost of SDWA compliance beyond the household level is restricted. The other two size categories have a larger percentage of non-residential customers, but residential customers still account for the majority of the revenues received by the water system. The national-level affordability criteria for CWSs are based on the ability of household customers to shoulder the additional costs of installing a technology to meet a NPDWR. For more information on the selection of the household as the most sensitive user for cost increases, see "National-Level Affordability Criteria Under the 1996 Amendments to the Safe Drinking water Act" (EPA, 1998e).

For non-community water systems, the operation of the system is generally peripheral to some other type of business or activity. These systems are generally engaged in an enterprise other than water supply and do not rely directly on households to recover water production costs.

A second document evaluated non-community water systems (NCWS) and compared their vulnerability to cost increases with households in community water systems [see background document entitled "An Assessment of the Vulnerability of Non-community Water Systems to SDWA Cost Increases" (EPA, 1998f)]. The conclusion was that the categories of NCWSs were either not vulnerable to SDWA-related treatment cost increases or were less vulnerable to SDWA-related treatment cost increases than a typical household.

One other element in the 1996 Amendments to the SDWA provides a very cost-effective solution for NTNCWSs. Since variance technologies are only an option for chronic contaminants, point-of-use devices are an available compliance technology option. Most NTNCWSs only provide a very small portion of the water for drinking purposes. Point-of-use devices could be installed on all taps where water is used for human consumption or food preparation. Treatment costs would be much higher if all the water provided by the system was treated to meet drinking water standards.

TNCWSs are only required to treat for acute contaminants. These include microbial contaminants and nitrate. As discussed in Chapter 2, there are statutory prohibitions against variance technologies for these contaminants. Therefore, variance technologies are not an option and national-level affordability criteria are not needed for this category of public water systems.

Since the household was determined to be more vulnerable to treatment cost increases than the various categories of non-community water systems, national-level affordability based on households would serve as an adequate surrogate for NTNCWSs as well as CWSs. Therefore, whether treatment is affordable depends upon how treatment costs compare with existing household water costs. The selected approach was to equate user burden to the increase in annual household water bills that would result from installation of treatment. To determine if there are any affordable compliance technologies for a given NPDWR, the national-level affordability criteria are compared against the cost projections for the applicable treatment technologies. If there are no affordable compliance technologies, then variance technologies would become an option.

Section 3.4: Derivation of the National-Level Affordability Criteria

A summary of the methodology used to determine the national-level affordability criteria is described below. The household is the focus of the national-level affordability analysis. Treatment technology costs are presumed affordable to the typical household if they can be shown to be within an affordability index range (defined as a range of percentages of median household income) that appears reasonable when compared to other household expenditures. This approach is based on the assumption that affordability to the median household served by the CWS can serve as an adequate proxy for the affordability of technologies to the system itself. EPA has chosen to express the water system financial and operational characteristics using their median values, which is a measure of their respective central tendencies. EPA believes that the national-level affordability criteria should describe the characteristics of typical systems and should not address extreme situations where costs might be extremely low or excessively burdensome.

The national-level affordability criteria have two major components: current annual water bills (baseline) and the affordability threshold (upper limit for water bills). The current annual household water bills were subtracted from the affordability threshold to determine the maximum increase that can be imposed by treatment and still be considered affordable. This difference was compared with the converted treatment costs to make the affordable technology determinations. This difference is called the available expenditure margin.

The affordability threshold was determined by comparing the cost of public water supply for households with other household expenditures and risk-averting behavior (such as use of bottled water or point-of-use devices). National expenditure estimates were derived to illustrate the current allocation of household income across a range of general household expenditures. This consumer expenditure data provided a basis for determining the affordability threshold by comparing baseline household water costs to median household income (MHI) to determine the financial impact of increased water costs on households.

Section 3.4.1: Derivation of Baselines

Baselines were determined for the three parameters needed to perform the affordable technology analysis. These parameters are: annual household consumption, current annual water bills, and median household income. Separate baselines for the three parameters were established for each of the three system size categories. Annual household consumption was used to convert treatment cost increases into household impacts as discussed in Section 4.4 of this document. Current annual water bills were subtracted from the affordability threshold to determine the available expenditure margin. The median household income was used to translate the threshold percentage into an actual dollar figure.

The baselines for annual household water consumption and the current annual water bills were derived from data in the 1995 Community Water System (CWS) Survey. EPA began the 1995 CWS Survey in the fall of 1994. In June 1995, the surveys were distributed to a stratified random sample of 3,700 water systems nationwide. Community water system respondents had until February 1996 to return the completed questionnaires. Slightly more than 54 percent of the systems that received questionnaires responded to the survey. For more information on the 1995 CWS Survey and an overview of the results, see "Community Water System Survey Volume I: Overview" (EPA, 1997a). For detailed survey result tables and copies of the survey questionnaires, see "Community Water System Survey Volume II: Detailed Survey Result Tables and Methodology Report" (EPA, 1997b).

EPA's goal was to define a typical system within each small system category for affordability purposes. This is very similar to the model systems approach that is used to evaluate the cost of treatment. Under that approach, a typical system is created with the following parameters: design flow, average daily flow, and population served within the size category. Water systems that purchase 90% or more of their water were excluded from the baseline determinations. These systems were assumed to obtain high quality finished water from larger systems that can achieve economies of scale necessary to mitigate the increased cost of SDWA treatment requirements. Data from water systems with zero values for critical variables were also excluded from the baseline determinations. The data for current household water bills was one such critical variable. The remaining observations were graphed as a scatter plot to examine the dispersion of data points. After evaluating this data, all data outside of three standard deviations (+/-) of the mean value were excluded from the analysis.

Two data sources were required to derive the median household income (MHI) for small systems. The median household income data were derived by linking the CWSS data with data in the 1990 Census using zip codes. The CWS Survey provided information on zip codes served by individual water systems. The Census income data were converted from 1990 dollars to 1995 dollars using the consumer price index to facilitate comparison with the CWS Survey data. Some data had to be excluded from this analysis because it did not represent a typical small system. Zip codes were reported using either the three-digit zip codes or five-digit zip codes depending upon the water system's service area. The use of the three-digit zip code placed several large metropolitan areas in the overall sample. Because the three-digit zip codes observed in the CWS Survey data consistently represent large metropolitan area, these values were removed from the analysis of small system income.

The "National-Level Affordability Under the 1996 Amendments to the SDWA" (EPA, 1998e) presents data for the annual water consumption, current water bills and median household income. Both means and medians were determined for each parameter for each size category. Mean values can be considered better estimates of items in their given distributions and are better suited to further mathematical manipulation. However, median values, are considered a better estimate of typical systems because the median represents the middle value and are not affected by extremely high or low values. Stakeholders were asked whether mean or median values for the three parameters should be used to establish the national-level affordability criteria. Stakeholders recommended consistency rather than a preference for using means or medians. EPA selected median values for all three parameters. EPA has chosen to express the water system financial and operational characteristics using their median values, which is a measure of their respective central tendencies. EPA believes that the national-level affordability criteria should describe the characteristics of typical systems and should not address extreme situations where costs might be extremely low or excessively burdensome. The mean values were higher than the median values for all of the parameters and size categories. For a given affordability threshold, the available expenditure margin was lower when median values were used.

The annual water consumption rates derived from the CWS Survey data are contained in Table 2. Only the median values for water consumption are included for each size category. The data are reported in 1,000 gallons per connection (kgal/connection). These consumption rates are considerably lower than the 100,000 gallons per household per year that was used in the development of the regulations before 1996. This consumption rate was based on large systems and was extrapolated to all system size categories. The use of the annual consumption rate in making affordable technology determinations is discussed in detail in Chapter 4.

Table 2
Residential Consumption at Small Water Systems

System Size Category (Population Served)	Median Annual Consumption (kgal/connection)
25 - 500	72
501 - 3,300	74
3,301 - 10,000	77

The current annual water bills were also derived from the CWS Survey data. The CWS Survey did not directly ask for data on annual water bills. The CWS Survey did ask for data on annual sales revenue per connection by customer type. The data on residential connections were used to represent the total amounts that customers were billed during the year.

EPA evaluated the effect of source type on current annual water bills during the development of the national-level affordability criteria. Since the surface water treatment rule was promulgated in 1989, in-place treatment might be much more extensive in surface water systems than ground water systems. Since existing treatment would likely lead to higher costs, EPA looked at current water bills in both types of systems. For this analysis, the ground water systems were those systems that relied exclusively on ground water. All mixed systems were placed in the surface water system category. Ground water systems significantly outnumbered the surface water systems in all three size categories, even with the inclusion of mixed systems in the surface water category. This relationship is consistent with the profile of CWS in that ground water dominates as the source in smaller systems and surface water dominates as the source in larger systems. Table 3 contains the current annual water bills by source type for each size category. Table 4 contains the current annual water bills for all systems for each size category.

Table 3
Baseline Household Water Bills by Source Type

System Size Category (Population Served)	Current Annual Water Bills ($/household/yr)	
	Surface Water Systems	Ground Water Systems
25 - 500	$179	$211
501 - 3,300	$228	$183
3,301 - 10,000	$225	$173

Stakeholders were asked if separate baselines should be established for ground water systems and surface water systems. Stakeholders stated that separate baselines should be established, but that the distinction between ground water and surface water systems was less significant in small systems because most rely on ground water. EPA evaluated the data in Table 3 and determined that there was very little distinction between current annual water bills for ground water systems as compared to surface water systems. Thus, separate baselines were not established and the data in Table 4 were used for each size category. If separate baselines are established in the future, an in-place treatment baseline would also need to be established for surface water systems since most filtration technologies can be modified to remove other contaminants. Thus, future treatment decisions would likely involve modification of the existing process rather than installation of a new process. The technology cost evaluation is discussed in more detail in Chapter 4.

Table 4
Baseline Household Water Bills

System Size Category (Population Served)	Median Current Annual Water Bills ($/household/yr)
25 - 500	$211
501 - 3,300	$184
3,301 - 10,000	$181

The baseline annual household water bills include existing water quality, water production, and water distribution costs. Water production costs include labor and energy for pump operation to supply water to customers. Water distribution costs include costs of infrastructure repair (mains and service lines) and administrative costs (customer billing and meter checking). The existing water quality costs include both treatment and monitoring. The CWS Survey data were collected in 1995, so treatment costs for many of the regulated contaminants may already be accounted for in the baseline. For the majority of the small systems, the bulk of the current `annual household water bills are related to water production and distribution. Most ground water systems do not have extensive treatment trains.

The median household income data were derived from the 1995 CWS Survey and the 1990 Census. The linking procedure was discussed earlier. A MHI value was derived for each zip code served by the system. An average MHI was then determined for those systems that reported serving multiple zip codes. Means and medians were determined after the MHIs for each system were then grouped by size category. The median of the system-MHI values is presented for each size category in Table 5.

Table 5
Baseline Median Household Income

System Size Category (Population Served)	Median System-MHI (Census MHI - updated to 1995$)
25 - 500	$30,785
501 - 3,300	$27,058
3,301 - 10,000	$27,641

It should be noted that the data in Table 15 - National-Level Affordability Criteria - published in the Announcement of Small System Compliance Technology Lists for Existing National Primary Drinking Water Regulations and Findings Concerning Variance Technologies 63 Fed. Reg. p. 42046 (August 6, 1998) presented mean values for current water bills instead of median values. Use of mean values in Table 15 was in error. As stated in the Federal Register notice, EPA's intent was to use the median values, and this intent has not changed. The data in Table 4 are the median values for current annual water bills. The median household income for the two smallest size categories in Table 5 is slightly higher than the values in Table 15 of the Federal Register notice. A verification run of the MHI data produced slightly higher MHIs for these two size categories. The calculations using the data in Tables 4 and 5 of this document do not alter the affordability determinations discussed in the Federal Register notice in any way.

Section 3.4.2: Derivation of the Affordability Threshold

The affordability threshold was determined by comparing the cost of public water supply for households with other household expenditures and risk-averting behavior. National expenditure estimates were derived to illustrate the current allocation of household income across a range of general household expenditures. This consumer expenditure data provided a basis for determining the affordability threshold by comparing baseline household water costs to median household income (MHI) to determine the financial impact of increased water costs on households.

Chapter 3 in "National-Level Affordability Criteria Under the 1996 Amendments to the SDWA" (EPA, 1998e) describes how comparative household expenditures were used to identify a range of options for the affordability threshold. The options range from 1.5% to 3.0% MHI. This approach is summarized below.

Data from the Consumer Expenditure Survey (CES) conducted by the Bureau of Labor Statistics (BLS) were used as the source for many of the household expenditures. The BLS defines an individual household as any of the following: 1) all members of a particular household related by blood, marriage, adoption, or other legal arrangements; 2) a financially independent person living alone or sharing a household with others, including a private home, lodging house, or permanent living quarters in a hotel or motel; or 3) two or more individuals living in the same residence, utilizing their combined income for joint expenditure decisions. For the second criterion, financial independence is defined as sole responsibility for any two of the following three expenses: housing, food, and other living expenses.

Direct comparisons between the CES data and the data derived from the CWS Survey are not possible for several reasons. The BLS's survey methodology is not designed to establish an exclusive cost for drinking water. CES data are based on reported household expenditures for water and other public services. This category includes wastewater and solid waste collection expenditures. In addition, the CES data values represent the average for all consumer units within specific demographic strata, such as size of consumer unit, income level, and region. Some expenditures may appear lower than anticipated because the value for this expenditure category is averaged over all consumer units regardless of whether they purchased the item. Another factor that may make the water expenditures appear lower is that data from households in large systems are included in the CES data. These households may experience lower water bills due to the greater economy-of-scale in large systems. The impact of these two factors is illustrated by comparing the CES data for water and other public services with the current water bill baseline for households in small systems. The CES data indicate that households are paying about 0.7% of their before tax income on water and other public services. Using the data in Tables 4 and 5, current water bills range from 0.65% to 0.69% of the median household income in the three small system size categories. Wastewater and solid waste collection will be higher than 0.05%, so direct comparison of the two data sources is not possible. However, the CES data can be used as a relative benchmark to compare the cost of water with other expenditures.

The complete range of household expenditures is described in the National-Level Affordability Document. A subset of the complete list was selected for use as comparable expenditures. In the CES data, there is a category for utilities, fuels, and other public services. Water and other public services is included in this category. Expenditures for natural gas, electricity, and fuel oils and other fuels are also included in this category. These three utilities are competitors for power and heating, so households that do not purchase one or more of these utilities would bias the individual percentages. These three utilities were combined into one category called energy and fuels in the analysis in the National-Level Affordability Document (EPA, 1998e). The subset of comparable expenditures from the CES data is contained in Table 6.

Table 6
Summary of Select Consumer Expenditures for All Consumer Units - 1995$

Item	Consumer Expenditure as % of Income before taxes
Housing	28.3%
Transportation	16.3%
Food	12.2%
Energy and Fuels	3.3%
Telephone	1.9%
Water and other Public Services	0.7%
Entertainment	4.4%
Alcohol and Tobacco	1.5%

EPA identified an initial range of options using the CES data for the national-level affordability criteria. A floor of 1.5% of income was based on the expenditures for alcohol and tobacco in the CES data. The upper limit of 3% was based on rounding down the energy and fuels percentage listed in Table 6. Stakeholders were presented with an initial range for the affordability threshold of 1.5% to 3% of the MHI for each size category. Stakeholders, in general, did not express a strong opinion about where the affordability threshold should be set within the range. EPA selected 2.5% based on the rationale described below.

The National-Level Affordability Document contained several other comparable expenditures that were used to identify a specific affordability threshold within the range of 1.5% to 3%. The telephone expenditures in Table 6 would support an affordability threshold of 2%. The other two expenditures looked at risk-reduction activities for drinking water. Installation of a point-of-use device or the use of bottled water as an alternative to the water supplied by the system was examined.

Section 1412(b)(4)(E)(ii) of the SDWA identifies both Point-of-Entry (POE) and Point-of-Use (POU) treatment units as options for compliance technologies. A POE treatment device is a treatment device applied to the drinking water entering a house or building for the purpose of reducing contaminants in the drinking water distributed throughout the house or building. A POU treatment device is a treatment device applied to a single tap used for the purpose of reducing contaminants in drinking water at that one tap. POU devices are typically installed at the kitchen tap.

The SDWA also identifies requirements that must be met when POU or POE units are used by a water system to comply with a NPDWR. Section 1412(b)(4)(E)(ii) stipulates that "point-of-entry and point-of-use treatment units shall be owned, controlled, and maintained by the public water system or by a person under contract with the public water system to ensure proper operation and maintenance and compliance with the MCL or treatment technique and equipped with mechanical warnings to ensure that customers are automatically notified of operational problems." Other conditions in this section of the SDWA include: "If the American National Standards Institute has issued product standards applicable to a specific type of POE or POU treatment unit, individual units of that type shall not be accepted for compliance with a MCL or treatment technique unless they are independently certified in accordance with such standards."

A supporting document entitled "Cost Evaluation of Small System Compliance Options: Point-of-Use and Point-of-Entry Treatment Units" (EPA, 1998g) summarizes EPA's approach to meeting the SDWA requirements on these devices as compliance technologies. Since programs for long-term operation, maintenance, and monitoring must be provided by water utilities, this option is probably limited to the first size category (25 - 500 people). A system serving 500 people probably has between 150 and 200 households. The system would be responsible for operation, maintenance, and monitoring of a unit at or in each of these households. This is probably the realistic upper bound for the effective management of either of these options. The median number of connections for systems in the 25 - 500 size category is 50. The data in Tables 4.4.3 of the POU/POE report were used to evaluate the cost of centrally-managed POU and POE options. Household cost increases for this option were developed for several technologies: reverse osmosis, anion exchange, activated alumina, and granular activated carbon. The affordability threshold would need to be at or above 2% for the POU treatment units option to be affordable. The affordability threshold would need to be above 2.5% for the POE treatment unit option to be affordable once waste disposal costs were included. EPA does not believe that the affordability threshold should be set so low that two options specifically identified in the SDWA as compliance technologies would never qualify as compliance technologies. As it is, POE devices would not be listed as an affordable compliance technology using the selected affordability threshold. The POU costs support an affordability threshold between 2 and 2.5%. The POE costs support an affordability threshold of 2.5% or greater.

The cost of bottled water as an alternate source of water that meets the NPDWRs was also investigated as a risk-reduction activity. For this analysis, a household of three people was assumed. Water consumption was estimated at 2 liters per person per day. This same assumption is used to derive the drinking water equivalent level (DWEL) that was discussed briefly in Section 2.2.3. The DWEL is used to determine the MCLG for the regulated non-carcinogenic contaminants. A cost per gallon rate of $0.98 was used for this analysis. This rate is the average price for home delivery from the International Bottled Water Association. A cost per household per year of approximately $570 was derived from these data. The bottled water costs would be in addition to what the household is currently paying for water. The bottled water costs support an affordability threshold of 2.5% or higher, depending upon the size category.

Another factor in the decision of where to set the affordability threshold was that EPA believes that small system variances are intended to be very rare, based on the requirements of the SDWA. Variance technologies are intended for systems with very poor source water such that the costs of compliance would not be affordable. Thus, the affordability criteria should be set, in EPA's view, high enough that the majority of the systems will proceed down the compliance pathway. The compliance and variance pathways are illustrated in Figure 2 in Section 1.3. The right-hand side of this figure shows the steps that a small system must pass through before receiving a small system variance and installing a variance technology.

The first step is to determine if there is an affordable compliance technology. Variance technologies are only identified when there are no affordable compliance technologies. As long as one potential compliance technology can pass the affordability criteria, there won't be variance technologies. If there are five potential compliance technologies and only one passes the affordability criteria, variance technologies would not be identified for that system size/source water quality combination. This shows that the goal for most systems should be compliance with the NPDWR, since only one technology needs to meet the affordability criteria to eliminate the availability of variance technologies. When affordable compliance technologies are not available, variance technologies will be identified. However, small systems must evaluate the affordability of treatment, alternate source, and restructuring at the system-level before a small system variance can be considered. Thus, the structure of the SDWA requirements indicates that small system variances should be considered as a last resort.

The approach to establishing the national-level affordability criteria did not establish a baseline for in-place treatment technology. The baseline for annual water bills was determined for each size category rather than creating many smaller sub-categories based on the degree of existing treatment. There were two reasons for this approach. The difference between annual water bills in ground water and surface water systems was not significant even though there would be differences in existing treatment. The second reason is that the sample size of the data that would be used to determine the baseline for annual water bills would be very small for some of the sub-categories. One consequence of this approach is that some of the treatment costs for the regulations covered in this guidance are already included in the baseline of annual water bills. The regulations for the contaminants that were initially eligible to receive small system variances were promulgated between 1986 and 1992. The CWS Survey was conducted in 1995. Some of the treatment costs are already incorporated into the baseline for current annual water bills. A group of five small surface water systems with annual water bills above $500 per household per year were examined. All of these systems had installed disinfection and filtration technologies to comply with the surface water treatment rule (SWTR). The SWTR was promulgated in 1989. The treatment cost comparisons in Chapter 4 assumed that there was no existing treatment capable of removing the contaminant or being modified to remove the contaminant. This is a conservative assumption for some systems (especially surface water systems) because they have already made an investment in technology that is reflected in the customer's annual water bills. The assumption that these systems would need to install a new technology overestimates the costs of compliance for these systems.

Another important factor is that under this approach to national-level affordability criteria, the affordability threshold is set at 2.5% of MHI for existing and future regulations. The baseline for annual water bills will increase as treatment is installed to comply with regulations and as backlog infrastructure needs are met. EPA intends to conduct the Community Water Supply Surveys every five years and will be able to track the increases in water bills due to treatment or infrastructure repair. In the interim, between CWS Surveys, EPA will adjust the baseline for annual water bills to incorporate the projected impact of regulations. For example, if arsenic follows the disinfection by-product, and radon rules, the impact of these rules will be incorporated into the baseline annual water bills used to make the affordable technology determinations for arsenic. Since the baseline water bills will be higher, the available expenditure margins for comparison with arsenic treatment costs will be lower than that listed in Section 3.5. The consumer price index data shows water prices increasing at a faster rate than all items over the last 10 years (EPA, 1998e). This implies that water prices should increase faster than median household income and that the available expenditure margin will decrease over time. The impacts of new regulations will further decrease the available expenditure margin over time. Thus, while variance technologies are not available for the currently regulated contaminants, a decreasing available expenditure margin increases the likelihood of variance technologies for future regulations.

The final piece of supporting rationale is that EPA believes that the goal of the SDWA is still to provide the same high quality drinking water for all customers of public water systems. The SDWA does not, in EPA's view, envision a two-tiered approach for standards where large systems are complying with the NPDWR and small systems are operating at some level above the MCL that is protective of public health for the duration of a small system variance. The small system variance option should be the exception and not the rule. Ideally, only a small subset of small systems would ever operate under a small system variance. If the affordability threshold were set so low that variance technologies were needed for regulations that were promulgated at least six years ago, then affordability would be a significant issue for all future regulations. Under such an affordability threshold, the small system variance option would become the rule rather than the exception.

Section 3.5: National-Level Affordability Criteria

The national-level affordability criteria are based on an affordability threshold of 2.5% of the median household income (MHI). As discussed in Section 3.4.1, the baseline values for median household income and current water bills have changed slightly from the Federal Register notice. The correct baseline water bills ranged from 0.65% to 0.69% MHI in the three size categories. Thus, the available expenditure margins were approximately 1.8% MHI for each size category. Table 7 summarizes the national-level affordability criteria and shows the maximum increase that could occur using these criteria.

Most systems would not be expected to actually experience cost increases of this magnitude if a compliance technology was installed. Many compliance technologies impose substantially lower household costs. For example, the screening process examined several technologies that imposed less than $300/household per year increases in all three size categories. The treatment costs used for the affordable technology determinations were based on treatment of all of the water to achieve the maximum removal efficiency. Most systems will not need the maximum removal efficiency to comply with a NPDWR. As was noted in Section III of the August 6, 1998 Federal Register notice, blending is an option to reduce the cost of treatment when lower removals are needed for compliance. A portion of the influent stream can be treated and blended with an untreated portion to still meet the MCL. Under this scenario, both capital and operating and maintenance costs would be lower than the estimates for the full stream treatment. Since blending would lower the rate increase for water, household costs would be lower.

Another factor that would result in lower household costs is that the approach to establishing the national-level affordability criteria assumes that all treatment costs are borne by the systems and passed along to customers. The national-level affordability criteria do not consider the impact of financial assistance from State Revolving Fund loans or Rural Utility Service. Loans or grants would reduce the amortized capital costs in these systems. This would lead to lower impacts at the household level in those systems that qualify for financial assistance. There are other mitigating measures that can reduce the impact on households. Rate design, consolidation strategies and regionalization approaches are discussed in Appendix F of the "National-Level Affordability Criteria Under the 1996 Amendments to the Safe Drinking Water Act" report.

Table 7
National-Level Affordability Criteria

System Size	Baseline			Affordability	Available Expenditure
Population Served	MHI ($/yr)	Water Bills ($/hh/yr)	Water Bills (%MHI)	Threshold (2.5% MHI)	Margin ($/hh/year increase)
25 - 500	$30,785	$211	0.69%	$770	$559
501 - 3,300	$27,058	$184	0.68%	$676	$492
3,301 - 10,000	$27,641	$181	0.65%	$691	$474

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4.0 AFFORDABLE TECHNOLOGY DETERMINATIONS

Section 4.1: Overview

The two-stage screening process for variance technologies was described in Chapter 2. Only 5 of the 80 regulated contaminants passes through this screening process and remained eligible for variance technologies. These five contaminants were: antimony, asbestos, atrazine, di-(2-ethylhexyl) phthalate, and lindane. The national-level affordability criteria were described in Chapter 3. Table 6 lists the derived criteria for each of the three size categories. This chapter describes how the affordable technology determinations were made for these five contaminants.

Section 4.2: Results of SDWIS Run of Violations

The last screen in the two-stage screening process utilized the violation data in the Safe Drinking Water Information System (SDWIS) to identify systems that might need to install treatment to comply with one of the existing NPDWRs (EPA, 1997a). MCL violations were found in SDWIS for the five contaminants that passed through the screening process. There were 142 MCL violations listed for these five contaminants. The breakdown was as follows: 34 violations for antimony, 6 for asbestos, 92 for atrazine, 8 for di-(2-ethylhexyl) phthalate and 2 for lindane. The concentration listed in SDWIS as the MCL exceedance was examined for all 142 violations. The States were contacted to inquire about the compliance status of the system and to verify the concentration reported in SDWIS. The compliance status was checked to see how many of these systems had already complied with the NPDWR after the violation occurred. The concentration listed in SDWIS was verified because several appeared to be reported using incorrect units. Some values were reported in μg/L instead of mg/L. It was important to get the correct units for the violations because this data was used to estimate the removal efficiency needed to comply with the NPDWR. Asbestos posed a unique problem since it has different units than the other chemical regulations. The MCL for asbestos is measured in million fibers per liter rather than milligrams per liter. For asbestos, violations had to be verified because some were reported as fibers per liter instead of million fibers per liter. The asbestos violations were also checked to determine the source of the asbestos. Asbestos can be found in the raw water entering the treatment plant or it can occur from the corrosion of asbestos-cement pipe in the distribution system. Different treatment technologies would be applied depending upon the source of the asbestos.

The States indicated that 140 of the 142 systems were back in compliance with the NPDWRs. The two systems that were not yet in compliance had violations of the asbestos standard. The source of the asbestos in both of these systems was the corrosion of asbestos-cement pipe. Even though the vast majority of the systems were back in compliance, the violation data was used to determine if affordable compliance technologies existed for these five contaminants. The concentrations for the highest violations (after verification of the units) were used to compare with the MCL to determine the maximum removal efficiency needed for compliance. This maximum removal efficiency was used to estimate treatment costs that were compared with the national-level affordability criteria. If the treatment costs for one technology were found to be affordable, then variance technologies were no longer available. This approach is very conservative on the cost side because the worst-case system was used to determine the removal efficiency.

For the five contaminants, the derived maximum removal efficiency exceeded 80 percent. Since most treatment technologies are generally capable of achieving removal efficiencies between 90 and 95 percent, treatment costs were based on this upper limit of performance. Thus, the costs assume treatment of all of the water. Treatment of a portion of the influent water and blending it with an untreated portion to reduce costs was not assumed in the development of the treatment costs. When the concentration above the MCL is low enough, blending can be used to reduce costs while still meeting the MCL. Both capital and operating and maintenance (O&M) costs can be reduced by blending as described above. For the systems that do not need the maximum removal efficiency, the treatment costs used to make the affordable technology determinations are an overestimate of the costs their customers would see if a technology were installed for compliance.

Section 4.3: Treatment Cost Models

The potential compliance technologies identified for these five contaminants included both central treatment options and point-of-use (POU) options. Under the central treatment options, all of the water supplied by the system is treated. Under the POU options, only the water at one tap within a residence is treated. All of the other water in the house is not treated to reduce contaminant concentrations. It was assumed that the kitchen tap would be treated for these options.

For the central treatment options, three cost models were used to make treatment cost estimates. The cost models have different ranges of applicability based on design flow. The design flow is related to the production capacity of the treatment unit and is larger than the peak daily flow for the system. The design flow is used to estimate capital costs for the system. The average daily flow is used to make estimates for the O&M costs. Thus, the treatment unit is sized based on production capacity and the operating costs are based on the volume of water being treated for distribution.

The first cost model is for very small systems with a design flow below 270,000 gallons per day. The document entitled “Very Small Systems Best Available Technology Document” provides equations for estimating capital and O&M costs for these systems (EPA, 1993a). The Water Model is a set of cost curves for various technologies contained in the document entitled “Small System Water Treatment Costs (EPA, 1984). The third model is the WATERCO$T model (Computer Software for Estimating Water and Wastewater Treatment Costs, Version 2.0, 1994). This is a computer model used for the estimation of costs for systems with flows larger than 1 million gallons per day. The costing models generate discrete cost estimates corresponding to specific design and average daily flow inputs.

A byproducts stream is produced by some of the technologies used to treat drinking water contaminants. These byproducts streams are typically associated with the treatment of inorganic contaminants. Coagulation/filtration and lime softening produce sludges that require disposal. Membrane technologies produce a concentrate stream. Ion exchange and activated alumina produce brine streams. Two additional cost models are used to estimate the costs of disposal of these residual byproduct streams. The document entitled “Small Water System Byproducts Treatment and Disposal Cost Document” (EPA, 1993b) provides equations for capital and O&M costs for technologies to dispose of residual byproducts. These cost equations are intended for systems in the first two size categories (25 - 500 and 501 - 3,300 people). The equations for capital and O&M costs for systems in the 3,301 - 10,000 people served category were taken from the document entitled “Water System Byproducts Treatment and Disposal Cost Document” (EPA, 1993c).

For the POU options, the document entitled “Cost Evaluation of Small System Compliance Options: Point-of-Use and Point-of-Entry Treatment Units” (EPA, 1998a) was used. This document contains capital and O&M cost equations for a variety of POU and POE options. Table 4.4.3 contains the data on total costs that was used to generate the equations for each of the processes.

Section 4.4: Model Systems

As described in Section 4.3, the capital costs are based on design flow and the O&M costs are based on average daily flow. The capital costs were amortized over 20 years at an interest rate of 7%. The annualized capital costs were combined with the annual O&M costs to determine the total production costs. The units for the total production cost are dollars per thousand gallons ($/kgal).

In order to derive capital and O&M costs for central treatment options, design and average daily flows are needed for a typical system within each size category. The selected design and average daily flows are based on the flows that were used in the regulations developed during the early 1990s. The design and average daily flows for the five size categories that were used to derive the flows for this analysis are contained in Table 8. For small systems, the design and average daily flow are reported in thousand gallons per day (kgpd). Since the categories used in the regulations are more stratified than the small system categories in the SDWA, a weighted average of the flows was derived for each of the first two SDWA small system categories from the data in Table 8. The number of systems within each size category in Table 8 was used for the weighting factor in determining the flows for the SDWA categories. The design and average daily flows used to derive costs for the affordable technology determinations are contained in Table 9.

Table 8
Design and Average Daily Flows Used for Regulations (early 1990s)

System Size Category (population served)	Design Flow (kgpd)	Average Daily Flow (kgpd)
25 - 100	24	5.6
101 - 500	87	24
501- 1,000	270	86
1,001 - 3,300	650	230
3,301 - 10,000	1,800	700

Table 9
Design and Average Daily Flows Used for Affordable Technology Determinations

System Size Category (population served)	Design Flow (kgpd)	Average Daily Flow (kgpd)
25 - 500	58	15
501 - 3,300	500	170
3,301 - 10,000	1,800	700

As discussed in Section 3.4.2, the centrally-managed point-of-use options is probably only cost-effective in the 25 - 500 size category. In the POU/POE report (EPA, 1998a), costs for POU and POE options were compared against central treatment costs. The costs for the centrally-managed POU option had to be converted to the same flow basis for this comparison and to make the affordable technology determinations. The cost estimates for the centrally-managed POU treatment options are presented in dollars per thousand gallons used by the household. This is very different than the cost per gallon treated by the POU device. By converting the cost per gallon treated into the cost per thousand gallons used by the household, the POU costs are comparable with central treatment costs. The breakpoint for POU options was between 70 and 180 households depending upon the technology. The central treatment costs did not include waste disposal costs. The inclusion of waste disposal would shift the breakpoint for central treatment costs being cheaper than centrally-managed POU costs to a higher number of households. It is unlikely that the centrally-managed POU would be more cost-effective than central treatment after the 25 - 500 size category (upper bound of approximately 200 households). Due to increasing administrative costs and increasing coordination difficulties, it is not expected that larger communities will find the implementation of centrally-managed POU or POE devices to be cost-effective. However, affordable technology determinations were made for the larger size categories.

The POU option cost equations use the number of households as the dependent variable. The subset of data from the Community Water Supply Survey (EPA, 1997a) that was used to develop the baseline for current water bills also contained data on residential connections. This data was used to determine the median number of residential connections within each size category. The number of connections was assumed to be the number of households for each size category. The POU costs were derived using the number of households in Table 10.

Table 10
Number of Households by Size Category for POU/POE Options

System Size Category (population served)	Number of Residential Households (Median for size category)
25 - 500	50
501 - 3,300	425
3,301 - 10,000	1935

Both the central treatment and the POU treatment costs provide the rate increase associated with the installation of treatment. The treatment cost models produce rate increases measured in dollars/thousand gallons ($/kgal). Annual household water consumption (kgal/year) is needed to convert the treatment technology costs into the increase in annual household water bills. The water consumption data in Table 2 were used with the cost increases derived by the models to estimate annual household cost increases for each treatment technology. The water consumption estimates in Table 2 were multiplied by 1.15 to account for lost water due to leaks. Since the water lost to leaks is unbilled, the water bills for the actual water used were adjusted to cover this lost water by increasing the household consumption. The adjusted consumption rates were then multiplied by the rate increase imposed by treatment to determine the annual cost increase for the household. This annual water bill increase was compared with the available expenditure margin to determine if there was an affordable technology.

Section 4.5: Treatment Cost Estimates

Affordability only played a role in removing some of the options in the smallest size category. In the larger two size categories, all of the treatment technologies produced annual household water bill increases below the available expenditure margin. However, in the smallest size category, the centrally-managed POU option was typically the only affordable option. The cost estimates for the centrally-managed POU options were all below $400 per household per year in all of the size categories. For antimony, the only affordable treatment option was the centrally-managed POU reverse osmosis option. For the three SOCs (atrazine, di-(2-ethylhexyl)phthalate, and lindane), the centrally-managed POU granular activated carbon units were one of the two technologies identified as affordable in the 25 - 500 size category. The other affordable compliance technology was powdered activated carbon. This technology is only affordable when the system already has a process train that includes basins, mixing, precipitation or sedimentation, and filtration. Since the affordability of this technology is linked to existing treatment, the centrally-managed POU GAC option is the only affordable option identified for the majority of the systems in this size category. The affordable compliance technologies and the technologies that did not pass the affordability criteria are identified in Table 11. For a detailed description of the compliance technologies for the five contaminants, see the Compliance Technology List for Non-Microbial Contaminants Regulated Before 1996 (EPA, 1998c).

Table 11
Affordable and Other Compliance Technologies in the 25 - 500 Size Category

Contaminant	Affordable Compliance Technologies	Other Compliance Technologies
Antimony	POU RO	RO, C/F
Asbestos	DF, DEF, CC	C/F
Atrazine	POU GAC, PAC	GAC
di-(2-ethylhexyl) phthtalate	POU GAC, PAC	GAC
Lindane	POU GAC, PAC	GAC

KEY:
POU = Point-of-Use; RO = reverse osmosis
C/F = coagulation/filtration; DF = direct filtration
DEF = diatomaceous earth filtration; CC = corrosion control
PAC = powdered activated carbon (for plants with existing filtration)
GAC = granular activated carbon

As previously discussed, the worst-case system based on occurrence was selected to determine the removal efficiency for treatment costs. Since many of the other systems that exceed an MCL would need lower removals to comply with the MCL, other treatment alternatives may be affordable through the use of blending. Systems and States should consider the technologies in the “other compliance technologies” category when blending can be performed to reduce costs while still meeting the MCL.

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5.0 SUMMARY OF VARIANCE TECHNOLOGY FINDINGS FOR CONTAMINANTS REGULATED BEFORE 1996

As previously discussed, compliance and variance technologies are mutually exclusive. The two compliance technology lists developed by EPA for contaminants regulated before 1996 identified compliance technologies for all of the 80 regulated contaminants, including affordable compliance technologies for all classes of small systems where appropriate. The two-stage screening process removed all but five contaminants. Affordable compliance technologies were identified for those five contaminants as discussed in Chapter 4. *Thus, EPA will not, at this time, be listing variance technologies for any existing NPDWR..*

Because this is the first time that EPA has undertaken the variance technology analysis required under the amended SDWA (which includes new findings concerning "affordability" and "protectiveness") and given the relatively short time for development of this analysis, EPA considers the methodology described here and the resulting finding of no variance technologies to be an initial screening effort, rather than a final determination of any kind. In addition, by enabling EPA to list compliance and variance technologies rather than specifying them by regulation, the statute specifically contemplates that this analysis (and any resulting list) will be subject to revision based on new information and petitions from interested parties. EPA would be very interested in suggestions from the public, and particularly from States, about how to improve the methodology outlined here and discussed in the guidance and in variance technologies that EPA should consider in revising and updating any future variance technology list. EPA identified several elements of the methodology in this document that would undergo further review over the course of the next year.

EPA stated in Chapter 2 that the procedures used to determine unreasonable risk to health (URTH) values were under review. EPA will issue a revised guidance manual for determining URTH as a result of that process. The URTH values listed in Table 1 will be modified or recalculated using the new procedures for determining URTH values. The revised URTH values for the 19 contaminants removed from consideration for variance technologies by the URTH screen will be examined to see if there is a level above the MCL that may be protective of public health for the expected useful life of a technology. Contaminants for which this screen is no longer applicable would continue through the remainder of the screening process before proceeding into the affordable compliance technology determination step.

EPA stated in Chapter 2 that it would re-examine the SDWIS violation data to see if violations were reported for the contaminants removed by the "lack of violation" screen. There were five contaminants removed by this screen. If MCL violations are found in a subsequent SDWIS run, then the violation data would be used to determine if there is an affordable compliance technology.

EPA indicated in Chapter 3 that a link was not established between baseline annual water bills and existing treatment in the national-level affordability criteria. EPA will examine whether this link should be established including an examination of the sample sizes. If a baseline for treatment is deemed necessary, then separate baselines would need to made for each source type because surface water systems should have a more extensive treatment technology baseline.

EPA will evaluate the comments that are received on the initial variance technology findings. If these evaluations indicate a need for variance technologies for the contaminants regulated before 1996, then a list with variance technologies may be issued in August 1999; or sooner, if warranted.

APPENDIX A

RELEVANT PARTS OF SECTION 1412 OF THE 1996 SDWA AMENDMENTS

SEC. 105. TREATMENT TECHNOLOGIES FOR SMALL SYSTEMS.

Section 1412(b)(4)(E) (42 U.S.C. 300g-1(b)(4)(E)) is amended by adding at the end the following:

``(ii) List of technologies for small systems.--The Administrator shall include in the list any technology, treatment technique, or other means that is affordable, as determined by the Administrator in consultation with the States, for small public water systems serving--

``(I) a population of 10,000 or fewer but more than 3,300;

``(II) a population of 3,300 or fewer but more than 500; and

``(III) a population of 500 or fewer but more than 25;

and that achieves compliance with the maximum contaminant level or treatment technique, including packaged or modular systems and point-of-entry or point-of-use treatment units. Point-of-entry and point-of-use treatment units shall be owned, controlled and maintained by the public water system or by a person under contract with the public water system to ensure proper operation and maintenance and compliance with the maximum contaminant level or treatment technique and equipped with mechanical warnings to ensure that customers are automatically notified of operational problems. The Administrator shall not include in the list any point-of-use treatment technology, treatment technique, or other means to achieve compliance with a maximum contaminant level or treatment technique requirement for a microbial contaminant (or an indicator of a microbial contaminant). If the American National Standards Institute

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has issued product standards applicable to a specific type of point-of-entry or point-of-use treatment unit, individual units of that type shall not be accepted for compliance with a maximum contaminant level or treatment technique requirement unless they are independently certified in accordance with such standards. In listing any technology, treatment technique, or other means pursuant to this clause, the Administrator shall consider the quality of the source water to be treated.

``(iii) List of technologies that achieve compliance.--Except as provided in clause (v), not later than 2 years after the date of enactment of this clause and after consultation with the States, the Administrator shall issue a list of technologies that achieve compliance with the maximum contaminant level or treatment technique for each category of public water systems described in subclauses (I), (II), and (III) of clause (ii) for each national primary drinking water regulation promulgated prior to the date of enactment of this paragraph.

``(iv) Additional technologies.--The Administrator may, at any time after a national primary drinking water regulation has been promulgated, supplement the list of technologies describing additional or new or innovative treatment technologies that meet the requirements of this paragraph for categories of small public water systems described in subclauses (I), (II), and (III) of clause (ii) that are subject to the regulation.

``(v) <<NOTE: Records.>> Technologies that meet surface water treatment rule.--Within one year after the date of enactment of this clause, the Administrator shall list technologies that meet the Surface Water Treatment Rule for each category of public water systems described in subclauses (I), (II), and (III) of clause (ii).''.

SEC. 111. TECHNOLOGY AND TREATMENT TECHNIQUES.

(a) Variance Technologies.--Section 1412(b) (42 U.S.C. 300g-1(b)) is amended by adding the following new paragraph after paragraph (14):

``(15) <<NOTE: Regulations.>> Variance technologies.--

``(A) In general.--At the same time as the Administrator promulgates a national primary drinking water regulation for a contaminant pursuant to this section, the Administrator shall issue guidance or regulations describing the best treatment technologies, treatment techniques,

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or other means (referred to in this paragraph as `variance technology') for the contaminant that the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available and affordable, as determined by the Administrator in consultation with the States, for public water systems of varying size, considering the quality of the source water to be treated. The Administrator shall identify such variance technologies for public water systems serving--

``(i) a population of 10,000 or fewer but more than 3,300;

``(ii) a population of 3,300 or fewer but more than 500; and

``(iii) a population of 500 or fewer but more than 25,

if, considering the quality of the source water to be treated, no treatment technology is listed for public water systems of that size under paragraph (4)(E). Variance technologies identified by the Administrator pursuant to this paragraph may not achieve compliance with the maximum contaminant level or treatment technique requirement of such regulation, but shall achieve the maximum reduction or inactivation efficiency that is affordable considering the size of the system and the quality of the source water. The guidance or regulations shall not require the use of a technology from a specific manufacturer or brand.

``(B) Limitation.--The Administrator shall not identify any variance technology under this paragraph, unless the Administrator has determined, considering the quality of the source water to be treated and the expected useful life of the technology, that the variance technology is protective of public health.

``(C) Additional information.--The Administrator shall include in the guidance or regulations identifying variance technologies under this paragraph any assumptions supporting the public health determination referred to in subparagraph (B), where such assumptions concern the public water system to which the technology may be applied, or its source waters. The Administrator shall provide any assumptions used in determining affordability, taking into consideration the number of persons served by such systems. The Administrator shall provide as much reliable information as practicable on performance, effectiveness, limitations, costs, and other relevant factors including the applicability of variance technology to waters from surface and underground sources.

``(D) Regulations and guidance.--Not later than 2 years after the date of enactment of this paragraph and after consultation with the States, the Administrator shall issue guidance or regulations under subparagraph (A) for each national primary drinking water regulation promulgated prior to the date of enactment of this paragraph for which a variance may be granted under section 1415(e). The Administrator may, at any time after a national primary drinking water regulation has been promulgated, issue guidance or regulations describing additional variance technologies. The Administrator shall, not less often than

every 7 years, or upon receipt of a petition supported by substantial information, review variance technologies identified under this paragraph. The Administrator shall issue revised guidance or regulations if new or innovative variance technologies become available that meet the requirements of this paragraph and achieve an equal or greater reduction or inactivation efficiency than the variance technologies previously identified under this subparagraph. No public water system shall be required to replace a variance technology during the useful life of the technology for the sole reason that a more efficient variance technology has been listed under this subparagraph.".

(b) Availability of Information on Small System Technologies.--Section 1445 (42 U.S.C. 300j-4) is amended by adding the following new subsection after subsection (g):

``(h) Availability of Information on Small System Technologies.--For purposes of sections 1412(b)(4)(E) and 1415(e) (relating to small system variance program), the Administrator may request information on the characteristics of commercially available treatment systems and technologies, including the effectiveness and performance of the systems and technologies under various operating conditions. The Administrator may specify the form, content, and submission date of information to be submitted by manufacturers, States, and other interested persons for the purpose of considering the systems and technologies in the development of regulations or guidance under sections 1412(b)(4)(E) and 1415(e).".

APPENDIX B

RELEVANT PARTS OF SECTION 1415 OF THE 1996 SDWA AMENDMENTS

SEC. 116. SMALL SYSTEMS VARIANCES.

Section 1415 (42 U.S.C. 300g-4) is amended by adding at the end the following:

``(e) Small System Variances.--

``(1) In general.--A State exercising primary enforcement responsibility for public water systems under section 1413 (or the Administrator in nonprimacy States) may grant a variance under this subsection for compliance with a requirement specifying a maximum contaminant level or treatment technique contained in a national primary drinking water regulation to--

``(A) public water systems serving 3,300 or fewer persons; and

``(B) with the approval of the Administrator pursuant to paragraph (9), public water systems serving more than 3,300 persons but fewer than 10,000 persons,

if the variance meets each requirement of this subsection.

``(2) Availability of variances.--A public water system may receive a variance pursuant to paragraph (1), if--

``(A) the Administrator has identified a variance technology under section 1412(b)(15) that is applicable to the size and source water quality conditions of the public water system;

``(B) the public water system installs, operates, and maintains, in accordance with guidance or regulations issued by the Administrator, such treatment technology, treatment technique, or other means; and

``(C) the State in which the system is located determines that the conditions of paragraph (3) are met.

``(3) Conditions for granting variances.--A variance under this subsection shall be available only to a system--

``(A) that cannot afford to comply, in accordance with affordability criteria established by the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413), with a national primary drinking water regulation, including compliance through--

``(i) treatment;

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``(ii) alternative source of water supply; or

``(iii) restructuring or consolidation (unless the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) makes a written determination that restructuring or consolidation is not practicable); and

``(B) for which the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) determines that the terms of the variance ensure adequate protection of human health, considering the quality of the source water for the system and the removal efficiencies and expected useful life of the treatment technology required by the variance.

``(4) Compliance schedules.--A variance granted under this subsection shall require compliance with the conditions of the variance not later than 3 years after the date on which the variance is granted, except that the Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) may allow up to 2 additional years to comply with a variance technology, secure an alternative source of water, restructure or consolidate if the Administrator (or the State) determines that additional time is necessary for capital improvements, or to allow for financial assistance provided pursuant to section 1452 or any other Federal or State program.

``(5) <<NOTE: Review.>> Duration of variances.--The Administrator (or the State in the case of a State that has primary enforcement responsibility under section 1413) shall review each variance granted under this subsection not less often than every 5 years after the compliance date established in the variance to determine whether the system remains eligible for the variance and is conforming to each condition of the variance.

``(6) Ineligibility for variances.--A variance shall not be available under this subsection for--

``(A) any maximum contaminant level or treatment technique for a contaminant with respect to which a national primary drinking water regulation was promulgated prior to January 1, 1986; or

``(B) a national primary drinking water regulation for a microbial contaminant (including a bacterium, virus, or other organism) or an indicator or treatment technique for a microbial contaminant.

``(7) Regulations and guidance.--

``(A) In general.--Not later than 2 years after the date of enactment of this subsection and in consultation with the States, the Administrator shall promulgate regulations for variances to be granted under this subsection. The regulations shall, at a minimum, specify--

``(i) procedures to be used by the Administrator or a State to grant or deny variances, including requirements for notifying the Administrator and consumers of the public water system that a variance is proposed to be granted (including information regarding the contaminant and variance) and requirements for a public hearing on the variance before the variance is granted;

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``(ii) requirements for the installation and proper operation of variance technology that is identified (pursuant to section 1412(b)(15)) for small systems and the financial and technical capability to operate the treatment system, including operator training and certification;

``(iii) eligibility criteria for a variance for each national primary drinking water regulation, including requirements for the quality of the source water (pursuant to section 1412(b)(15)(A)); and

``(iv) information requirements for variance applications.

``(B) <<NOTE: Publication.>> Affordability criteria.--Not later than 18 months after the date of enactment of the Safe Drinking Water Act Amendments of 1996, the Administrator, in consultation with the States and the Rural Utilities Service of the Department of Agriculture, shall publish information to assist the States in developing affordability criteria. The affordability <<NOTE: Review.>> criteria shall be reviewed by the States not less often than every 5 years to determine if changes are needed to the criteria.

``(8) Review by the administrator.--

``(A) In general.--The Administrator shall periodically review the program of each State that has primary enforcement responsibility for public water systems under section 1413 with respect to variances to determine whether the variances granted by the State comply with the requirements of this subsection. With respect to affordability, the determination of the Administrator shall be limited to whether the variances granted by the State comply with the affordability criteria developed by the State.

``(B) Notice and publication.--If the Administrator determines that variances granted by a State are not in compliance with affordability criteria developed by the State and the requirements of this subsection, the Administrator shall notify the State in writing of the deficiencies and make public the determination.

``(9) Approval of variances.--A State proposing to grant a variance under this subsection to a public water system serving more than 3,300 and fewer than 10,000 persons shall submit the variance to the Administrator for review and approval prior to the issuance of the variance. The Administrator shall approve the variance if it meets each of the requirements of this subsection. The Administrator shall approve or disapprove the variance within 90 days. If the <<NOTE: Notification.>> Administrator disapproves a variance under this paragraph, the Administrator shall notify the State in writing of the reasons for disapproval and the variance may be resubmitted with modifications to address the objections stated by the Administrator.

``(10) Objections to variances.--

``(A) By the administrator.--The Administrator may review and object to any variance proposed to be granted by a State, if the objection is communicated to the State not later than 90 days after the State proposes to grant the variance. <<NOTE: Notification.>> If the Administrator objects to the granting of a variance, the Administrator shall notify the State in writing of each basis for the objection and propose a

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modification to the variance to resolve the concerns of the Administrator. The State shall make the recommended modification or respond in writing to each objection. If the State issues the variance without resolving the concerns of the Administrator, the Administrator may overturn the State decision to grant the variance if the Administrator determines that the State decision does not comply with this subsection.

``(B) Petition by consumers.--Not later than 30 days after a State exercising primary enforcement responsibility for public water systems under section 1413 proposes to grant a variance for a public water system, any person served by the system may petition the Administrator to object to the granting of a variance. The Administrator shall respond to the petition and determine whether to object to the variance under subparagraph (A) not later than 60 days after the receipt of the petition.

``(C) Timing.--No variance shall be granted by a State until the later of the following:

``(i) 90 days after the State proposes to grant a variance.

``(ii) If the Administrator objects to the variance, the date on which the State makes the recommended modifications or responds in writing to each objection.''.