NOTICES OF FINAL RULEMAKING

The Administrative Procedure Act requires the publication of the final rules of the state's agencies. Final rules are those which have appeared in the *Register* 1st as proposed rules and have been through the formal rulemaking process including approval by the Governor's Regulatory Review Council. The Secretary of State shall publish the notice along with the Preamble and the full text in the next available issue of the *Arizona Administrative Register* after the final rules have been submitted for filing and publication.

NOTICE OF FINAL RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 4. DEPARTMENT OF ENVIRONMENTAL QUALITY
SAFE DRINKING WATER

PREAMBLE

1. Section Affected — **Rulemaking Action**

R18-4-301.01	New Section
Table 1	New Table

2. The statutory authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):

Authorizing statutes: A.R.S. §§ 49-202(A) and 49-203(A)(8)

Implementing statute: A.R.S. § 49-353

3. The effective date of the rules:

The rule has a delayed effective date as requested by the Department of Environmental Quality. The rule shall be effective on the date that this Notice of Final Rulemaking is published in the *Arizona Administrative Register* (May 28, 1999).

4. A list of all previous notices appearing in the Register addressing the final rule:

Notice of Docket Opening: 3 A.A.R. 870, March 28, 1997.
Notice of Proposed Rulemaking: 3 A.A.R. 1830, July 11, 1997.
Notice of Public Information: 4 A.A.R 3548, October 30, 1998.

5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:

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6. An explanation of the rule, including the agency's reasons for initiating the rule:

Arizona's safe drinking water rules include a section that is commonly known as the surface water treatment rule [*See* R18-4-301]. Under Arizona's surface water treatment rule, each "surface water system" is required to filter and disinfect its source water to effectively remove or inactivate *Giardia lamblia* cysts and viruses. A public water system that uses a surface water [for example, river, stream, reservoir, lake, or pond] as a source of drinking water is a "surface water system" that is subject to the requirements of the surface water treatment rule. The term, "surface water system," also includes any public water system that uses "groundwater that is under the direct influence of surface water" as a source of drinking water [*See* definition of "surface water system" at R18-4-101(90)]. Under R18-4-301(C), a public water system must provide filtration and disinfection treatment within 18 months of the date that the Arizona Department of Environmental Quality [ADEQ] makes a final determination that groundwater is under the direct influence of surface water.

The term, "groundwater under the direct influence of surface water," is defined by federal regulation [*See* 40 CFR § 141.2] and a parallel ADEQ rule [*See* R18-4-101(40)]. "Groundwater under the direct influence of surface water"

means any water beneath the surface of the ground with: 1) a significant occurrence of insects or other macroorganisms, algae, large diameter pathogens, such as *Giardia lamblia*, or total coliform; or 2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions.

ADEQ has primary enforcement authority, or "primacy," to administer and enforce the requirements of the Safe Drinking Water Act [SDWA] in Arizona. The SDWA and its implementing regulations require that ADEQ develop and implement a program for evaluating each public water system that uses groundwater as a source to determine whether the groundwater is under the direct influence of surface water. The evaluation of groundwater systems for direct surface water influence is a special primacy requirement that is found in National Primary Drinking Water Regulations at 40 CFR §142.16(b)(2)(B). ADEQ is late in implementing this primacy requirement. Under 40 CFR §142.16(b)(2)(B), ADEQ was supposed to have completed the evaluation of all community groundwater systems for direct surface water influence by June 29, 1994. ADEQ must complete the evaluation of all noncommunity groundwater systems by June 29, 1999.

While both the National Primary Drinking Water Regulations and Arizona's safe drinking water rules define "groundwater under the direct influence of surface water," neither the National Primary Drinking Water Regulations nor the state's current safe drinking water rules say how ADEQ is to make the determination that a groundwater source is under the direct influence of surface water. The determination of direct surface water influence is left to state discretion. The federal definition of "groundwater under the direct influence of surface water" at 40 CFR § 141.2 states:

> Direct influence must be determined for individual sources *in accordance with criteria established by the State*. The State determination of direct influence may be based on site-specific measurements of water quality and / or documentation of well construction characteristics and geology with field evaluation [Emphasis added].

This rule prescribes the procedures and the decision criteria that ADEQ will use to determine if a groundwater source is under the direct influence of surface water. The determination procedure involves the preliminary identification of "suspect" groundwater sources, field evaluation of "suspect" sources through sanitary surveys, and direct measurements of groundwater quality using microscopic particulate analysis.

ADEQ proposes a multiple step process to determine if a groundwater source is under the direct influence of surface water. First, ADEQ will conduct records reviews to make preliminary identifications of public water systems that use groundwater sources that may be under the direct influence of surface water. The rule prescribes 8 criteria that ADEQ will use to make preliminary identifications of "suspect" groundwater sources. Springs, infiltration galleries, horizontal wells, radial collector wells, Ranney wells, hand-dug or auger-bored wells without casings, shallow wells [that is, < 50 feet to the well screen], wells that are located within 500 feet of a surface water that are or may be vulnerable to the direct influence of surface water, turbid groundwater sources, and groundwater sources with bacteriological contamination are preliminarily considered to be "suspect" groundwater sources by ADEQ.

The 2nd step in the determination process is a sanitary survey of each "suspect" groundwater source. ADEQ will conduct a sanitary survey of each public water system that ADEQ preliminarily identifies as using a "suspect" groundwater source. A sanitary survey is an on-site review of the water source, facilities, equipment, operation, and maintenance of a public water system to evaluate the system's adequacy to produce safe drinking water. One of the purposes of the ADEQ sanitary survey will be to confirm the preliminary identification of a "suspect" groundwater source that was based initially on a records review. ADEQ can obtain and evaluate information related to a "suspect" source during a sanitary survey. One purpose of a sanitary survey will be to identify any obvious construction deficiencies in a source that can be remedied before water quality monitoring to determine direct surface water influence is required. For example, an inspection may reveal obvious well or spring box construction deficiencies [for example, inadequate sanitary seal, direct openings into a well or springbox, collectors or laterals that are exposed to surface water] that should be repaired before water quality monitoring to determine direct surface water influence is conducted. ADEQ also can obtain and evaluate information related to the local hydrogeology at a source and to confirm distances to nearby surface waters. Finally, ADEQ can review available water quality data for a source [for example, turbidity, temperature, pH, conductivity, or bacteriological water quality data]. Water quality parameter data for a source may provide supporting evidence of the relative likelihood of direct surface water influence.

For a well that is suspected of being under the direct influence of surface water because it is located within 500 feet of a surface water, ADEQ will gather information during a sanitary survey to assess the vulnerability of the groundwater source to direct surface water influence [*See* discussion in preamble on vulnerability assessment]. The water supplier will be responsible for providing available information on the local hydrogeology in the area of the wellhead and on well construction, operation, and maintenance that ADEQ can use in a vulnerability assessment.

Third, if the weight of the evidence indicates that a source may be at risk of direct surface water influence, or, in the case of a well that is "suspect" because of its location within 500 feet of a surface water, ADEQ conducts a vulnerability assessment and determines that the groundwater source is either: 1) vulnerable to the direct influence of surface water, or 2) the vulnerability of the groundwater source cannot be assessed because of a lack of information or because of the uncertainty of the available information on the local hydrogeology and well construction characteristics, ADEQ will require that the water supplier conduct water quality monitoring of the "suspect" groundwater source. The rule requires that water suppliers take at least 2 samples of groundwater from a "suspect" groundwater source and have each sample analyzed using the "EPA Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis" [MPA]. ADEQ believes that microscopic particulate analysis provides the most direct, objective evidence that a groundwater source is under the direct influence of surface water. The MPA is a direct measurement of water quality that identifies and enumerates indicators of surface water influence that are found in a groundwater sample. ADEQ will make a final determination as to whether a groundwater source is under the direct influence of surface water based upon the MPA monitoring results.

Rule procedures are not determinative of water rights under Arizona water law

ADEQ is promulgating this rule to implement certain treatment technique requirements of the Safe Drinking Water Act and the National Primary Drinking Water Regulations. The purpose of the rule is limited to determining whether a groundwater source is under the direct influence of surface water and is subject to the requirements of the surface water treatment rule. The rule is *not* intended to be used to determine water rights or to determine whether water is groundwater, surface water, or subflow that is subject to appropriation under Arizona water law.

"Suspect" groundwater sources

"Suspect" groundwater sources include springs, infiltration galleries, horizontal wells, radial well collectors, Ranney wells, shallow wells that are less than 50 feet from the ground surface to perforations or well screens, and hand-dug or auger-bored wells without casings. Also, a well that is more than 50 feet deep may be considered a "suspect" groundwater source if 1 of the following conditions exist:

1. Turbidity data are available that indicate that untreated groundwater from the well exceeds an interim maximum contaminant level for turbidity [*See* R18-4-204] or there are turbidity fluctuations of 1 NTU or more in the groundwater over the course of a year.

2. Bacteriological water quality data are available that indicate that total coliform, fecal coliform, or *E. Coli* bacteria are present in untreated groundwater from the well and the presence of the bacteria is not related to new well development, rehabilitation, modification, or repair.

3. The well is located within 500 feet of a surface water, and:

   a. ADEQ determines from a vulnerability assessment that the groundwater is vulnerable to direct surface water influence, or
   b. ADEQ cannot assess the vulnerability of the groundwater source to direct surface water influence because of a lack of information or because of the uncertainty of the available information on the local hydrogeology or well construction characteristics.

Springs

EPA Region IX guidance on groundwater under the direct influence of surface water identifies springs as a type of water source that should be evaluated for direct surface water influence. Springs are considered to be "suspect" groundwater sources because: 1) they are normally associated with shallow aquifers that may be subject to the direct influence of surface water, 2) they may open to the atmosphere, and 3) they may be subject to contamination from surface runoff.

In general, only a small portion of a shallow aquifer, perhaps only the top of the aquifer, usually provides water to a spring. Springs flow by gravity and they are normally associated with shallow aquifers. For these reasons, they may be subject to the direct influence of surface water through infiltration or percolation. Also, spring construction deficiencies may result in a spring being subject to the direct influence of surface water. For example, a spring may be located in a topographically low area or in a floodplain that is subject to direct influence by surface runoff or flooding. Improper spring box construction or inadequate maintenance may allow surface runoff or debris to enter a spring box. For example, a necessary interceptor ditch may be absent or it may not adequately divert surface runoff away from the spring area. For all of these reasons, ADEQ considers springs to be "suspect" groundwater sources that should be evaluated for direct surface water influence using microscopic particulate analysis.

ADEQ recognizes that there may be some circumstances where a spring is not subject to the direct influence of surface water. For example, some springs are artesian springs that flow from deeper, well-protected aquifers. Artesian

springs flow from the natural pressure that is induced by formations overlying a confined aquifer. A developed artesian spring may be less vulnerable to direct surface water influence than a spring that flows by gravity from a shallow aquifer because the source is a deep, confined aquifer. However, there still may be a concern with the direct influence of surface water as groundwater moves from the source aquifer through shallower formations to the ground surface. An undeveloped artesian spring may be capable of collecting water from shallow water-bearing formations that are above the source aquifer. Concerns about direct surface water influence are lessened if a properly constructed artesian well is developed. For example, an artesian well that is constructed with a casing and grouting down to the confining layer that protects the source groundwater is probably not under the direct influence of surface water. ADEQ will consider hydrogeological and artesian well construction factors when making a determination as to whether to require MPA monitoring of an artesian spring.

Infiltration galleries

EPA Region IX guidance on groundwater under the direct influence of surface water identifies infiltration galleries as 1 of the types of sources that should be evaluated for direct surface water influence. An infiltration gallery can be described as a series of water collection lines that extend horizontally into a water-bearing formation. A typical installation of an infiltration gallery involves the construction of an under-drained sand filter trench located parallel to the stream bed of a surface water and about 10 feet from the high water mark. At the bottom of the sand filter trench, perforated or open joint tile is laid in a bed of gravel. The embedded tile is then covered with sand and the remainder of the trench is backfilled with relatively impervious material. The collection tile terminates in a watertight, concrete basin from which infiltrated water is diverted or pumped to the drinking water distribution system.

Infiltration galleries are frequently installed in close proximity to surface water sources, at shallow depths, in unconfined aquifers, in porous media, and at locations where there may be high rates of surface water recharge. The time-of-travel of infiltrated water from a surface water source to the collection lines of an infiltration gallery may be relatively short. In some cases, the time-of-travel may be less than the expected survival time of many pathogenic microorganisms that are typically found in surface water [for example, *Giardia lamblia* cysts]. ADEQ is aware of 1 infiltration gallery in Arizona that was constructed in the stream bed of a surface water and subsequently destroyed by the scouring of a flood event. An infiltration gallery that is destroyed by a flood event is obviously "under the direct influence of surface water." For all these reasons, ADEQ considers infiltration galleries to be "suspect" groundwater sources that should be evaluated for direct surface water influence using microscopic particulate analysis.

Horizontal wells, radial collector wells, and Ranney wells

ADEQ considers horizontal wells, radial collector wells, and Ranney wells to be "suspect" groundwater sources. A horizontal well, radial collector well, or Ranney Well is similar to an infiltration gallery. A radial collector well or a Ranney well can be described as a wagon wheel with a central caisson at the hub and horizontal collector wells projecting outward from the bottom of the central caisson like the spokes of the wheel. Water flows into the horizontal wells and is collected in the central caisson. Like infiltration galleries, radial collector wells and Ranney wells are typically constructed in close proximity to a surface water [for example, in the bank storage area of a lake or river]. Also, the horizontal collector wells are usually located in coarse, porous material to obtain adequate infiltration from a nearby surface water source. Horizontal collector wells may be arranged in the bank storage area of a surface water and, in some cases, may be extended under the bed of a surface water. For these reasons, ADEQ considers horizontal wells, radial well collectors, and Ranney wells to be "suspect" groundwater sources that should be evaluated for direct surface water influence using microscopic particulate analysis.

Shallow wells [<50 feet to well screen], hand-dug wells, and auger-bored wells

EPA Region IX guidance on groundwater under the direct influence of surface water identifies shallow wells with perforations or well screens less than or equal to 50 feet in depth as sources that should be evaluated for direct surface water influence. The EPA guidance states that "[w]hile most well sources have historically been considered to be groundwater, recent evidence suggests that some wells, especially shallow wells constructed near surface waters, may be directly influenced by surface water."

ADEQ also considers hand-dug or auger-bored wells that do not have casings to be "suspect" groundwater sources because of their typically shallow depths and their well construction characteristics. An auger-bored well is 1 that is excavated with a power or hand auger. An auger can be used only where the soil is relatively soft but will permit the boring of an unsupported hole to depths ranging from 20 to 60 feet without the hole caving in. Hand-dug wells typically range from 20 to 40 feet deep. Hand-dug wells typically have large surface openings that may allow the entrance of surface water. Also, a hand-dug or auger-bored well without a casing is capable of collecting water from all of the water-bearing formations it passes through, including groundwater from very shallow aquifers that may be under the direct influence of surface water.

Deep wells [>50 feet to well screens]

Wells where the depth to the well screen is more than 50 feet that are in deep, well-protected aquifers usually are not subject to the direct influence of surface water. A well where the well screen is more than 50 feet deep that meets all of the following criteria is *not* a "suspect" groundwater source and ADEQ will not require water quality monitoring for direct surface water influence.

♦ Well construction: The casing penetrates a confining layer, is screened only below the confining layer, and is properly installed and sealed to the surrounding formations and at the surface.

♦ Location: The well is located at least 500 feet from a surface water.

♦ Water quality records: There is no record of coliforms in untreated samples of groundwater taken from the well and no history of turbidity problems associated with the groundwater source.

♦ Water quality analyses: There is no indication of the presence of particulate matter that might be associated with surface water or any correlation between the turbidity of groundwater in the well with that of a nearby surface water.

A well where the well screen is more than 50 feet deep may be considered a "suspect" groundwater source if 1 of the following criteria apply:

♦ The well is located within 500 feet of a surface water, and: 1) ADEQ determines from a vulnerability assessment that the groundwater source is vulnerable to the direct influence of surface water, or 2) ADEQ cannot assess the vulnerability of the groundwater source because of a lack of information or the uncertainty of the available information on the local hydrogeology or the well's construction characteristics.

♦ Turbidity data for groundwater taken from the well are available and the data indicate that the turbidity of the groundwater exceeds an interim maximum contaminant level for turbidity prescribed in R18-4-204 or there are turbidity fluctuations in groundwater of 1 NTU or more over the course of a year.

♦ Bacteriological water quality data for untreated groundwater taken from the well are available and the data indicate the presence of total coliform, fecal coliform, or *E. coli* bacteria [This does not include bacteriological "hits" that are explained by new well development, rehabilitation, modification, or repair].

Turbidity analyses of groundwater provide supporting evidence that a groundwater source is under the direct influence of surface water. However, the turbidity of a groundwater source is only indirect and inconclusive evidence of direct surface water influence that, by itself, is not enough for ADEQ to determine that a groundwater source is or is not under the direct influence of surface water. While turbid groundwater may be caused by surface water influence, it also may be caused by other factors that are not related to the direct influence of surface water [for example, colloidal transport in the aquifer]. EPA Region IX guidance on the determination of groundwater under the direct influence of surface water identifies turbidity fluctuations in groundwater of greater than 0.5 to 1 nepholometric turbidity units [NTU] over the course of a year as *indicative* of surface water influence. When turbidity data for a groundwater source are available that indicate turbidity fluctuations of 1 NTU or more, ADEQ will consider the groundwater source to be a "suspect" source that should be evaluated for direct surface water influence using microscopic particulate analysis.

The bacteriological contamination of a groundwater source or a history of waterborne illness in the population served by a well [for example, cases of giardiasis, cryptosporidiosis, or other waterborne illness] may be a result of direct surface water influence. The primary purpose of the surface water treatment rule is to ensure the microbiological safety of drinking water and to prevent the transmission of waterborne disease caused by pathogenic microorganisms that are typically found in surface water. The filtration and disinfection requirements of the surface water treatment rule are established to ensure the adequate removal or inactivation of *Giardia lamblia* cysts and viruses from drinking water. Bacteriological contamination or a history of waterborne illness in a population that is served by a groundwater source is adequate cause to suspect that the groundwater source may be under the direct influence of surface water. A contaminated groundwater source should be evaluated for direct surface water influence to determine if filtration and disinfection treatment should be required or if groundwater disinfection alone will provide adequate treatment.

ADEQ recognizes that the bacteriological contamination of a groundwater source may be caused by new well development, rehabilitation, modification, or repair. In fact, ADEQ's Engineering Bulletin No. 10, "Guidelines for the Construction of Water Systems," specifically states that every new, modified, or reconditioned groundwater source *must be disinfected* after the final placement of pumping equipment

[*See* Disinfection Requirements on p. 2-20]. Information on well disinfection procedures also is contained in ADEQ's Engineering Bulletin No. 8. These disinfection requirements are based upon a recognition that bacteriological contamination is a normal result of well development, rehabilitation, modification, or repair. The rule therefore states that

the bacteriological contamination of a groundwater source that is due to new well development, rehabilitation, modification, or repair will *not* be considered an indicator of direct surface water influence.

A well that has perforations or well screens that are more than 50 feet below the ground surface may be considered to be a "suspect" source if the well is within 500 feet of a surface water, and: 1) ADEQ determines from a vulnerability assessment that the groundwater source is vulnerable to the direct influence of surface water, or 2) ADEQ cannot assess the vulnerability of the groundwater source to direct surface water influence because of a lack of information or because of the uncertainty of the available information on the local hydrogeology or well characteristics [*See* following discussion of vulnerability assessments].

Vulnerability assessments

ADEQ will assess the vulnerability of a groundwater source to the direct influence of surface water for a well that is located within 500 feet of a surface water. ADEQ will follow a step-by-step approach when making a vulnerability assessment, making a series of yes / no decisions based on the available information for the groundwater source. ADEQ will consider site-specific hydrogeological and well construction factors when assessing the vulnerability of a groundwater source to the direct influence of surface water.

An ADEQ vulnerability assessment will result in a general categorization of a well's vulnerability to the direct influence of surface water. There are 3 possible results: 1) the groundwater source is vulnerable to direct surface water influence, 2) there is a low probability that the groundwater source is under the direct influence of surface water, or 3) the groundwater source's vulnerability to the direct influence of surface water is unknown or uncertain. An ADEQ vulnerability assessment will *not* provide direct evidence that a groundwater source is or is not under the direct influence of surface water. Rather, the vulnerability assessment indicates only a relative probability that a groundwater source is or is not under the direct influence of surface water. The purpose of the vulnerability assessment is to inform the decision as to whether MPA monitoring of the source should be required or not. If ADEQ conducts a vulnerability assessment and determines that a well that is located within 500 feet of a surface water is vulnerable to direct surface water influence, ADEQ will require that the water supplier conduct MPA monitoring of the groundwater source to obtain more direct evidence that ADEQ can use to make a final determination as to whether the source is under the direct influence of surface water. If ADEQ determines from a vulnerability assessment that there is a low probability that a well that is located within 500 feet of a surface water is under the direct influence of surface water, then ADEQ will *not* require MPA monitoring of the groundwater source. If ADEQ cannot assess the vulnerability of a groundwater source because of a lack of information or because the available data on the local hydrogeology or well characteristics is too uncertain, ADEQ will err on the side of caution and require that a water supplier conduct MPA monitoring of the groundwater source to obtain more direct evidence that ADEQ can use to make a final determination as to whether the source is under the direct influence of surface water.

ADEQ will consider the following hydrogeological factors when making a vulnerability assessment of a groundwater source that is located within 500 feet of a surface water:

1. The depth to the well screen [> or < 100 feet?];

2. The lateral and vertical distribution of aquifers;

3. The presence or absence of a confining layer that adequately protects the source aquifer;

4. The presence or absence of karst topography, shallow fractured bedrock aquifers, shallow alluvial aquifers, creviced formations, large solution cavities;

5. The porosity and permeability of the materials in the vadose zone and in the source aquifer [sand, silt, gravel, clay];

6. The estimated time-of-travel from the nearest site of surface water recharge site to the well screen [that is, is time-of-travel more or less than 2 years?];

7. The rate of surface water recharge to the aquifer; and

8. Other relevant hydrogeological factors [for example, vertical hydraulic conductivity, percolation rates, hydrologic gradients, differences in water chemistry between the source aquifer and overlying aquifers, groundwater "age" of the source, the rate of groundwater withdrawal].

ADEQ will use the available hydrogeologic data to assess whether a natural hydrogeologic barrier to direct surface water influence exists and how effective that barrier may be. A "natural hydrogeologic barrier" means the existence of geologic or hydraulic conditions that, singularly or in combination, reduce or eliminate the risk of pathogenic microrganisms [especially *Giardia lamblia* cysts] entering the groundwater source from a surface water. The vulnerability of a groundwater source to direct surface water influence is a function of the characteristics of the geologic

materials that comprise the saturated zone [that is, the aquifer] and the unsaturated zone above the source aquifer [that is, the vadose zone]. Low vulnerability conditions are those where there is a low probability that pathogenic organisms will migrate to the groundwater source because of the site-specific hydrogeologic conditions. A groundwater source is vulnerable if the hydrogeologic conditions are such that they are not likely to prevent pathogenic microorganisms from migrating to the groundwater source. ADEQ's assessment of vulnerability is dependent on a knowledge of the sequence of geologic materials between a groundwater source and the nearby surface water. Consequently, it will be important for ADEQ to obtain a copy of the well boring log for any well that has been preliminarily identified as "suspect" because of its location within 500 feet of a surface water. For example, the following information may be obtained from a well boring log:

- Depth to the well screen
- Presence, thickness, and extent of confining layers
- Presence of overlying aquifers
- Nature of aquifer materials, and
- Nature of vadose zone materials

Additional hydrogeologic data obtained from well records and from published and unpublished reports can provide useful information for a vulnerability assessment. These data include:

- Results of hydraulic testing [for example, pump tests]
- Hydraulic head measurements of the source aquifer and overlying aquifer
- Water chemistries of the source aquifer and overlying aquifers
- Results of grain size analyses of aquifer and overlying materials
- Results of hydrologic modeling studies
- Groundwater sensitivity maps
- Surficial geologic maps, and
- Transport modeling and groundwater time-of-travel calculations

The 1st step in an ADEQ vulnerability assessment will be to determine whether a groundwater source is sufficiently confined to ensure protection against direct surface water influence. An assessment of the degree of confinement includes an analysis of the 3-dimensional distribution of the geologic materials that are present and the lateral and vertical distribution of confining units. If a confining layer is present, there are some key hydrogeologic criteria that can be used independently or in combination to define "sufficiently confined." These include the following:

- The vertical hydraulic conductivity of the confining layer is 10^{-6} to 10^{-7} cm / sec.;
- The minimum thickness of the confining layer is 30 feet;
- The head differential between the source aquifer and the overlying aquifer is at least 10 feet;
- There is a difference in water chemistry between the source aquifer and the overlying aquifer.

If a confining layer exists and the combination of geologic formation, lithologic materials, and hydraulic parameters indicates that a groundwater source is "sufficiently confined," ADEQ will determine that the groundwater source is probably not vulnerable to direct surface water influence. If a demonstration of the existence of confining conditions cannot be made, either because confining conditions do not exist or because sufficient information is unavailable, then ADEQ will make a further assessment of groundwater vulnerability to determine if a natural hydrological barrier exists. *The absence of a confining layer does not necessarily preclude an ADEQ determination of low vulnerability to direct surface water influence*.

If the groundwater source is in an unconfined hydrogeological setting (for example, unlithified sand, silt, clay, and gravel deposits in an alluvial aquifer), a combination of characteristics must exist to demonstrate that there is a natural hydrogeologic barrier to direct surface water influence. The following characteristics may be used to demonstrate that a natural hydrogeological barrier exists in an unconfined setting justifying an assessment of low vulnerability to direct surface water influence. First, ADEQ will assume that a natural hydrogeological barrier exists if it can be demonstrated through transport modeling that the time-of-travel from the nearest site of surface water recharge to the well screen or well perforations is more than 2 years. Second, ADEQ will assume that a natural hydrogeological barrier exists in an unconfined setting if *all* of the following conditions are present:

- The depth to the well screen is 100 feet or more,
- There are materials with low permeability [for example, clay and silt] in the vadose zone, and
- There is a low rate of recharge to the source aquifer [for example, the surface water is an ephemeral water].

In some settings, the existing hydrogeological conditions are expected to always result in a determination of vulnerability. These hydrogeological conditions include the presence of karst topography, large solution cavities, fractured bedrock aquifers, and any groundwater source where the time-of-travel from a surface water to the well screen or perforations is known to be less than 2 years.

The last step in the assessment of vulnerability to direct surface water influence is to evaluate well construction factors. As noted previously, well construction plans and specifications are important sources of information for an assessment of the vulnerability of a groundwater source to the direct influence of surface water. Well construction plans and specifications provide information on the depth of the well, well diameter, sanitary well seal and slab, the depth of screened intervals and screen size, well casing materials, cased intervals, casing joints, annular openings and seals, and grouting. A sanitary survey will provide important information on the actual siting and physical condition of a well. An ADEQ field inspector can confirm the actual distance from a well to a nearby surface water and observe whether the well is located within or outside the floodplain or in a topographically low area. A field inspector can inspect the physical condition of a well and observe whether there are any visible defects, such as the absence of or inadequate sanitary well seal and slab at the wellhead, damage to the well casing, direct openings into a well, or surface drainage that is directed towards the wellhead. A poorly constructed or deteriorated well may serve as a direct conduit for surface water runoff reaching the screened interval of the well, especially if the well is located in a topographically low area that may collect surface runoff. This information will be considered by ADEQ when assessing the vulnerability of a "suspect" groundwater source. Also, if there are obvious well construction defects, these can be corrected by the water supplier before water quality monitoring is required by ADEQ to determine direct surface water influence.

If, after considering the hydrogeological and well construction factors, the weight of the evidence indicates that the groundwater source is sufficiently confined or that a natural hydrogeological barrier exists between the groundwater source and a surface water *and* the well column does not present a pathway for surface water to enter the groundwater source, ADEQ will determine that the groundwater source falls within the low vulnerability category and make a determination that it is *not* under the direct influence of surface water. If a groundwater source is not sufficiently confined, a natural hydrogeological barrier does not exist, or well construction factors indicate that surface water may enter the well, ADEQ will determine that the well is vulnerable to the direct influence of surface water and require that the water supplier conduct MPA monitoring of the "suspect" groundwater source. If there is not enough information on the well construction or the local hydrogeology or the available information is too uncertain for ADEQ to assess the vulnerability of the groundwater source to direct surface water influence, ADEQ will require MPA monitoring of the groundwater source to obtain more direct evidence that can be used to make a final determination as to whether the source is under the direct influence of surface water.

The estimated number of public water systems with "suspect" groundwater sources

ADEQ has conducted a records review to obtain data on public water systems that use groundwater sources. ADEQ reviewed information gathered from sanitary surveys of public water systems, compliance records in ADEQ's Public Water System Supervision database, and Arizona Department of Water Resources records to identify public water systems that use springs, infiltration galleries, radial well collectors, Ranney wells, horizontal wells, shallow wells [< 50 ft.to perforations or well screens], hand-dug or auger-bored wells without casings, and wells that are located within 500 feet of a surface water as sources of drinking water. This records review resulted in a list of 221 public water systems located outside of Maricopa and Pima counties that ADEQ preliminarily identified as utilizing a "suspect" groundwater source that will require further evaluation. ADEQ's preliminary "suspect" source list does not include public water systems located within Maricopa and Pima counties because these 2 counties have delegated Public Water System Supervision programs. The counties with delegated programs will be responsible for implementing the surface water treatment rule within their respective jurisdictions and identifying public water systems that are using groundwater sources that may be under the direct influence of surface water.

There are approximately 1200 public water systems located outside of Maricopa and Pima counties. Thus, the 221 public water systems that ADEQ preliminarily identified as using a "suspect" groundwater source represent less than 20% of the public water systems in the state located outside of Maricopa and Pima counties. This means that more than 80% of the public water systems located outside of Maricopa and Pima County will *not* be affected by this rule. There are approximately 500 public water systems in Maricopa and Pima counties. Maricopa and Pima counties have not reviewed data on the public water systems located within their jurisdictions to preliminarily identify public water systems that may be using a "suspect" groundwater source. For purposes of the economic impact statement for this rule, ADEQ assumed that approximately the same percentage of public water systems in Maricopa and Pima counties will be preliminarily identified as using as a "suspect" groundwater source as ADEQ identified in the non-urbanized counties. That is, ADEQ assumes that approximately 20% of the 500 public water systems in Maricopa and Pima counties, or an estimated 100 public water systems, may be preliminarily identified as using a "suspect" groundwater source, will require further evaluation, and may be directly affected by the rule. This estimate is probably high because ADEQ believes that a larger percentage of public water systems in Maricopa and Pima counties rely on deep wells that are thought to be less vulnerable to the direct influence of surface water.

As of the date of the 1st submission of the rule to the Governor's Regulatory Review Council, ADEQ determined from sanitary surveys that 83 of the 221 public water systems that ADEQ identified preliminarily as using a "suspect"

groundwater source, or 38% of the 221 public water systems on the ADEQ "suspect" list, were still considered to be using a "suspect" groundwater source after completion of a sanitary survey. ADEQ has not completed sanitary surveys of all 221 public water systems on its original preliminary "suspect" source list. Consequently, the 83 public water systems identified by ADEQ so far represent ADEQ's estimate of the minimum number of public water systems that may be directly affected by the monitoring requirements of this rule. ADEQ will conduct a sanitary survey of each public water system that is on its preliminary "suspect" list after the effective date of this rule, including a resurvey of the 83 public water systems that were previously identified as using a "suspect" groundwater source. Unless circumstances change or a water supplier provides new information to rebut a preliminary identification of a "suspect" groundwater source, ADEQ estimates that at least 83 public water systems will be required to conduct MPA monitoring when the rule is effective. ADEQ expects that the number of public water systems that are directly affected by the rule will increase as ADEQ completes sanitary surveys of the 221 public water systems on its preliminary "suspect" source list. ADEQ estimates that approximately 50% to 75% of the 221 public water systems on its list, or 110 to 165 public water systems located outside of Maricopa and Pima counties, may be affected by the monitoring requirements of the rule. ADEQ assumes that there will be public water systems in Maricopa and Pima counties that will be directly affected by the monitoring requirements of the rule because they will be identified as using "suspect" groundwater sources. For purposes of the economic impact statement for this rule, ADEQ assumes that approximately the same percentage of public water systems in Maricopa and Pima counties will be preliminarily identified as utilizing a "suspect" groundwater source [that is, approximately 20% of 500 public water systems or 100 public water systems]. If one also assumes that 50% to 75% of these systems will be considered to be utilizing a "suspect" groundwater source after a sanitary survey of the public water system is completed, then as many as 50 to 75 public water systems in Maricopa and Pima counties may be directly affected by the monitoring requirements of the rule. Under these assumptions, ADEQ estimates that 160 to 240 public water systems in the state may be directly affected by the monitoring requirements of the rule.

Required Monitoring Using Microscopic Particulate Analysis

Under the rule, a public water system that is preliminarily identified as using a "suspect" groundwater source may be required to conduct water quality monitoring to determine whether the groundwater is under the direct influence of surface water. The rule prescribes the use of the "EPA Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)," EPA 910/9-92-029, U.S. Environmental Protection Agency, Manchester Environmental Laboratory (October, 1992).

Under the MPA method, a water supplier must sample 500 to 1000 gallons of groundwater from a "suspect" groundwater source. The groundwater is pumped through a polypropylene cartridge filter over a 8 - 24 hour period and the filter is sent to a laboratory for analysis. The particles that are captured in the filter are washed out and analyzed microscopically to determine if microorganisms that typically occur in surface water are present in the groundwater.

The MPA is a quantitative method that uses bioindicators that typically occur in surface water and whose presence in groundwater indicates that at least some surface water is mixed in with the groundwater. These bioindicators include: *Giardia lamblia* cysts, coccidia [for example, *Cryptosporidium*], pigment-bearing diatoms, chlorophyll-containing algae, insects, insect parts, insect larvae, rotifers, and "plant debris." Groundwater typically does not contain these bioindicators and their presence in groundwater in significant concentrations is indicative of the direct influence of surface water. The identification of *Giardia lamblia* cysts or coccidia in any concentration is considered conclusive evidence that groundwater is under the direct influence of surface water. The occurrence of a significant number of pigment-bearing diatoms and other chlorophyll-containing algae is considered strong evidence that groundwater is under the direct influence of surface water. The presence of insects, insect parts, and larvae also is considered evidence of direct surface water influence. Obviously, the presence of insects that are normally associated with a surface water [for example, stoneflies] is more significant than the presence of insects that live in soils [for example, soil mites]. The occurrence of rotifers indicates that a groundwater source is influenced by surface water. Rotifers are members of a major taxonomic group that are typically found in fresh surface waters. The presence of rotifers in groundwater generally is considered supporting evidence of direct surface water influence. Finally, the presence of "plant debris" in groundwater is indicative of direct surface water influence. "Plant debris" is the term that is used in the MPA method to describe fecal material from plant-eating animals, usually muskrat and beaver. The term also is interpreted to include unidentifiable plant material that contains chlorophyll.

Since the term, "groundwater under the definition of surface water," is defined in terms of the *significant* occurrence of insects, macroorganisms, and large-diameter pathogens, the MPA method utilizes a quantitative approach instead of a presence / absence test. The bioindicators that are in the groundwater sample are identified and counted. The MPA method prescribes a numerical range for each of the bioindicators that are counted per 100 gallons of water. The numerical count is categorized as either extremely heavy (EH), heavy (H), moderate (M), rare (R), or not significant (NS) [*See* Table 1 below].

Table 1. Numerical Range for Bioindicators

Bioindicators	EH	H	M	R	NS
Giardia	>30	16-30	6-15	1-5	<1
Coccidia	>30	16-30	6-15	1-5	<1
Diatoms	>150	41-149	11-40	1-10	<1
Other algae	>300	96-299	21-95	1-20	<1
Insects / larvae	>100	31-99	16-30	1-15	<1
Rotifers	>150	61-149	21-60	1-20	<1
Plant debris	>200	71-200	26-70	1-25	<1

The MPA method assigns a relative risk factor to each of the bioindicators based upon the health risk significance of the bioindicator, the significance of the bioindicator as an indicator of surface water influence, and the concentration of the bioindicator per 100 gallons of water [*See* Table 2 below].

Table 2. Relative Risk Factors

Bioindicators	EH	H	M	R	NS
Giardia	40	30	25	20	0
Coccidia	35	30	25	20	0
Diatoms	16	13	11	6	0
Other algae	14	12	9	4	0
Insects / larvae	9	7	5	3	0
Rotifers	4	3	2	1	0
Plant debris	3	2	1	0	0

Key: **EH** = extremely heavy, **H** = heavy, **M** = moderate, **R** = rare, **NS** = not significant

The relative risk factors for each of the bioindicators found in a groundwater sample are added and the result is a MPA risk rating. The MPA risk ratings categorize a groundwater source as being at either low, moderate, or high risk of direct surface water influence. If the sum of the relative risk factors from Table 2 is 20 or more, the result is a high risk rating. If the sum of the relative risk factors is 10 to 19, the result is a moderate risk rating. If the sum of the relative risk factors is less than 10, the result is a low risk rating.

Under the rule, ADEQ will use the MPA risk ratings as the basis for determining if a groundwater source is under the direct influence of surface water. If, after preliminary identification of a “suspect” source, the completion of a sanitary survey of a public water system, and, in some cases, a vulnerability assessment, ADEQ still suspects that the groundwater source is under the direct influence of surface water, ADEQ will require that the water supplier conduct MPA monitoring of the “suspect” groundwater source. A water supplier will have to take at least 2 and possibly 3 groundwater samples from each “suspect” groundwater source for microscopic particulate analysis.

If the initial MPA result indicates that the groundwater source is at high or moderate risk of direct surface water influence, ADEQ will require that a 2nd groundwater sample be collected and analyzed. If the 2nd sample result also indicates that the groundwater is at high or moderate risk of direct surface water influence, ADEQ will determine from the 2 sample results that the groundwater is under the direct influence of surface water. If the 2nd sample result indicates that the groundwater source is at low risk of direct surface water influence, ADEQ will require that a 3rd groundwater sample be taken for analysis. If the 3rd MPA sample result indicates a high or moderate risk of direct

surface water influence, ADEQ will determine that the groundwater is under the direct influence of surface water. If the 3rd MPA sample result indicates a low risk of direct surface water influence, ADEQ will determine that the groundwater is *not* under the direct influence of surface water [*See* decision matrix below].

If the initial MPA result indicates a low risk of direct surface water influence, ADEQ will require that a 2nd groundwater sample be collected for microscopic particulate analysis. If the 1st 2 MPA sample results both indicate that the groundwater source is at low risk of direct surface water influence, ADEQ will determine that the groundwater is *not* under the direct influence of surface water. If the 1st 2 MPA sample results are split [that is, the 1st sample result indicates a low risk of direct surface water influence and the 2nd sample result indicates a high or moderate risk of direct surface water influence], ADEQ will require that a 3rd sample be collected and analyzed. If the 3rd MPA sample result indicates a high or moderate risk of direct surface water influence, ADEQ will determine that the groundwater is under the direct influence of surface water. If the 3rd sample result indicates a low risk of direct surface water influence, ADEQ will determine that the groundwater is *not* under the direct influence of surface water

[*See* decision matrix below].

To summarize, if 2 out of 3 MPA tests indicate a high or moderate risk of direct surface water influence, ADEQ will determine that the groundwater source is under the direct influence of surface water. If 2 out of 3 MPA tests indicate a low risk of direct surface water influence, ADEQ will determine that the groundwater source is not under the direct influence of surface water. The following table presents this decision matrix:

Initial Sample MPA Risk Rating	Second Sample MPA Risk Rating	Third Sample MPA Risk Rating	Groundwater under the direct influence of surface water
High	High or Moderate		Yes
High	Low	High or Moderate	Yes
High	Low	Low	No
Moderate	High or Moderate		Yes
Moderate	Low	High or Moderate	Yes
Moderate	Low	Low	No
Low	High or Moderate	High or Moderate	Yes
Low	High or Moderate	Low	No
Low	Low		No

The rule requires that a public water system with a "suspect" groundwater source conduct MPA monitoring "as scheduled by the Department." ADEQ will schedule MPA monitoring for 3 reasons. First, some "suspect" groundwater sources may be seasonal sources that are only used for part of the year [for example, during the summer months when seasonal demand for water is high]. Seasonal sources should be evaluated for direct surface water influence when they are used. Second, some groundwater sources may be influenced by surface water only at certain times of the year. For example, a groundwater source may be susceptible to the direct influence of surface water only after a rainfall event when a nearby ephemeral stream is flowing or when winter snowmelt causes a nearby intermittent stream to flow. ADEQ will schedule MPA monitoring because a "suspect" groundwater source should be evaluated during the period of time when it is most susceptible to the direct influence of a surface water. Third, ADEQ will schedule MPA monitoring at times when ADEQ Field Services staff are available to observe and assist with sample collection and MPA sampling procedures.

Opportunity to Re-Perform MPA Monitoring After Taking Corrective Action

ADEQ received several public comments on the proposed rule requesting that ADEQ either establish a mechanism to: 1) refute individual MPA monitoring results, or 2) revise the proposed rule to clarify that a public water system may perform repairs, maintenance, or install other engineered controls for a "suspect" source and then re-perform MPA monitoring to determine if the corrective actions prevent direct surface water influence. ADEQ disagrees that there should be an appeal mechanism to challenge an individual MPA monitoring result. However, ADEQ agrees that a public water system should be given an opportunity to take corrective actions to modify, rehabilitate, or repair a "suspect" groundwater source where a corrective action is feasible and then perform a 2nd round of MPA monitoring before a final determination is made as to whether the groundwater source is under the direct influence of surface water.

ADEQ acknowledges in the economic impact statement [EIS] for this rule that the costs associated with a final determination that a public water system is using a groundwater source that is under the direct influence of surface water are significant. The current surface water treatment rule mandates the installation of filtration and disinfection treatment for each public water system that is determined to be using a groundwater source that is under the direct influence of surface water. There are no exceptions to these treatment requirements. ADEQ recognizes in the EIS for this rulemaking that the increased capital, operation, and maintenance costs of such treatment, especially filtration, are substantial and that these costs may be very burdensome or even prohibitive for a small public water system. ADEQ agrees that a public water system should be given an opportunity to take a less expensive corrective action where such action is feasible to prevent direct surface water influence and to avoid imposition of the high costs associated with the required installation of filtration and disinfection treatments. ADEQ seeks to avoid imposition of unnecessary costs associated with treatment requirements if a more cost-effective, non-treatment option is feasible. For this reason, ADEQ amended the proposed rule to establish a mechanism that allows a public water system to take a corrective action to modify, rehabilitate, or repair a "suspect" groundwater source and conduct a 2nd round of MPA monitoring before a final determination is made that a groundwater is or is not under the direct influence of surface water.

Appeal of an ADEQ Final Determination That A Groundwater Source Is Under the Direct Influence of Surface Water

Finally, the rule prescribes the administrative procedures for appealing a final ADEQ determination that a groundwater source is under the direct influence of surface water. A final ADEQ determination that groundwater is under the direct influence of surface water is an "appealable agency action" that may be appealed to an administrative law judge appointed by the Office of Administrative Hearings. Hearing procedures are governed by the uniform administrative appeal procedures of the State Administrative Procedures Act.

7. A reference to any study that the agency proposes to rely on its evaluation of or justification for the proposed rule and where the public may obtain or review the study, all data underlying each study, any analysis of the study, or other supporting material:

None.

8. A showing of good cause why the rule is necessary to promote a statewide interest if the rule will diminish a previous grant of authority of a political subdivision of this state:

Not applicable.

9. The summary of the economic, small business, and consumer impact:

The rule will directly affect public water systems that are suspected of utilizing a groundwater source that is under the direct influence of surface water. A public water system with a "suspect" groundwater source will be required to conduct MPA monitoring of the "suspect" source. Under the rule, a water supplier with a "suspect" groundwater source will have to collect 2 or 3 samples and pay for the MPA tests. If a groundwater source is determined to be groundwater under the direct influence of surface water, a public water system will have to install and operate filtration and disinfection treatment within 18 months of the date that ADEQ makes a final determination that the groundwater source is under the direct influence of surface water.

The estimated cost of MPA monitoring for public water systems in Arizona

ADEQ has preliminarily identified 221 public water systems outside of Maricopa and Pima counties that may be using groundwater sources that are under the direct influence of surface water and that may be required to conduct MPA monitoring. To ADEQ's knowledge, these 221 public water systems represent the entire universe of public water systems located outside of Maricopa and Pima counties that may be directly affected by the monitoring requirements of the rule.

ADEQ has not conducted sanitary surveys of all 221 public water systems that have been preliminarily identified as using a "suspect" groundwater source. As of the date of submittal of this rule to the Governor's Regulatory Review

Council [GRRC], ADEQ had conducted sanitary surveys and identified 83 public water systems that use a groundwater source that is suspected of being under the direct influence of surface water [that is, 38% of the 221 public water systems on the ADEQ list]. If this rule is approved by the GRRC and becomes effective, ADEQ will resurvey the 83 public water systems to confirm the preliminary identifications of "suspect" groundwater sources and to give each public water system an opportunity to submit information to ADEQ to rebut the preliminary identification. ADEQ estimates that, at a minimum, the water suppliers for these 83 public water systems will be required to conduct MPA monitoring of at least 1 "suspect" groundwater source. This estimate is based on the assumptions that a resurvey will show that circumstances have not changed and the water suppliers do not submit new information to rebut the preliminary identification of a "suspect" groundwater source.

It is likely that more than 83 public water systems in the state will be required to conduct MPA monitoring. When ADEQ resurveys the 83 public water systems that have been previously identified as using a "suspect" groundwater source and completes sanitary surveys of the remaining 138 public water systems preliminarily identified on its "suspect" list, ADEQ probably will identify more public water systems with "suspect" groundwater sources that will be required to conduct MPA monitoring. Also, an unknown percentage of the approximately 500 public water systems in Maricopa and Pima counties will be required to conduct MPA monitoring. For purposes of this economic impact statement, ADEQ assumes that 20% of the public water systems in Maricopa and Pima counties, or 100 public water systems, may be preliminarily identified by the counties as using a "suspect" groundwater source. ADEQ believes that it is reasonable to assume that 20% of the 500 public water systems in Maricopa and Pima counties may be preliminarily identified as using a "suspect" source because this has been ADEQ's experience with a larger sample of public water systems in the rural counties of Arizona. ADEQ preliminarily identified 18.6% of all public water systems located outside of Maricopa and Pima counties as using a "suspect" groundwater source. It is reasonable to assume that approximately the same percentage of public water systems in Maricopa and Pima counties may be preliminarily identified as using a "suspect" source. In fact, ADEQ believes that a 20% assumption probably overestimates the number of public water systems that may be preliminarily identified in Maricopa and Pima counties as using a "suspect" source because of greater reliance by public water systems in the 2 urbanized counties on deep, nonvulnerable wells.

The cost of conducting a single MPA test is approximately $300. Under the rule, a public water system will have to conduct 2 or 3 MPA tests per "suspect" groundwater source. Thus, each public water system that is required to conduct MPA monitoring will have to spend $600 - $900 per "suspect" groundwater source to comply with the monitoring requirements in the rule.

At a minimum, the total cost of MPA monitoring for all public water systems in Arizona is approximately $50,000. This least cost estimate is based on the following assumptions: 1) Only the 83 public water systems preliminarily identified by ADEQ that have already undergone a sanitary survey are required to conduct MPA monitoring and no additional public water systems are identified as having a "suspect" groundwater source, 2) that the 83 public water systems that have been preliminarily identified as using a "suspect" groundwater source have only 1 "suspect" groundwater source, and 3) that all 83 public water systems conduct only 2 MPA tests [that is, 83 x $600]. This least cost estimate establishes the "floor" for the cost of MPA monitoring but it is highly unlikely for several reasons. First, the 83 public water systems do not include any systems located within Maricopa and Pima counties. Second, ADEQ has not completed sanitary surveys of the 221 public water systems it has preliminarily identified as having a "suspect" groundwater source. Third, it is unlikely that all public water systems will conduct only 2 MPA tests. More than half of the possible outcomes in the ADEQ decision matrix result in a public water system taking 3 MPA tests. An unknown number of public water systems with a "suspect" groundwater source will conduct 3 MPA tests. Fourth, while the large majority of public water systems that have been preliminarily identified by ADEQ have 1 "suspect" groundwater source, some public water systems will have more than 1 "suspect" groundwater source that will require MPA monitoring.

By making additional assumptions regarding the number of public water systems in Maricopa and Pima counties that are required to conduct MPA monitoring, it is possible to develop a more reasonable least cost estimate for all public water systems in Arizona. If one assumes that 20% of the 500 systems in Maricopa and Pima counties will be preliminarily identified as having a "suspect" groundwater source, then 100 additional public water systems may be affected by the monitoring requirements of the rule. If one further assumes that approximately the same percentage of public water systems in Maricopa and Pima counties will be identified as using a "suspect" groundwater source after a sanitary survey is completed as ADEQ identified in the rural counties so far [83 of 221 or 38%], then an estimated 38 public water systems in Maricopa and Pima counties may be required to conduct MPA monitoring [38% of 100 systems]. If one assumes that the 38 public water have 1 "suspect" source and each system conducts 2 MPA tests each, the estimated cost of MPA monitoring for public water systems in Maricopa and Pima counties is $22,800 [that is, 38 x $600]. If each public water system conducts 3 MPA tests at 1 "suspect" groundwater source, the estimated cost of MPA monitoring for public water systems in Maricopa and Pima counties rises to $34,200 [that is, 38 x $900] Based

on these multiple assumptions, a more reasonable least cost estimate for all public water systems in Arizona for MPA monitoring is between $72,600 and $108,900 [that is, based on the assumptions that 121 public water systems (83 identified by ADEQ and 38 identified by Maricopa and Pima counties) conduct MPA monitoring at 1 "suspect" source and that each system conducts 2 or 3 MPA tests each].

The estimated monitoring costs of the program are higher if one assumes that a higher percentage of the public water systems that are preliminarily identified as using a "suspect" source are required to conduct MPA monitoring. For example, if one assumes that 50% of the 221 public water systems on the ADEQ list, or 110 public water systems, are required to conduct MPA monitoring and that each public water system conducts 2 MPA tests, the estimated total cost of MPA monitoring for systems located outside of Pima and Maricopa counties rises to $66,000 [that is, 110 x $600]. If one also assumes that 50% of 100 public water systems in Maricopa and Pima counties, or 50 public water systems, are required to conduct MPA monitoring and that each of these public water systems conducts 2 MPA tests at 1 "suspect" source, the estimated cost of MPA monitoring by 50 public water systems in Maricopa and Pima counties is $30,000 [that is, 50 x $600]. Thus, if one assumes that 50% of the public water systems that are preliminarily identified by ADEQ and the counties are required to conduct MPA monitoring and each public water system conducts 2 MPA tests at 1 "suspect" source, the estimated cost of MPA monitoring statewide is $96,000 [that is, 160 x $600]. If one uses the same analysis but assumes that each public water system conducts 3 MPA tests at 1 "suspect" source, the estimated cost of MPA monitoring statewide is $144,000 [160 x $900].

If one assumes that 75% of the public water systems that are identified by ADEQ [165 systems] and the counties [75 systems] have to conduct MPA monitoring and each public water system conducts 2 MPA tests at 1 "suspect" source, the estimated cost for MPA monitoring statewide is $144,000 [240 x $600]. If one assumes that each public water system conducts 3 MPA tests at 1 "suspect" source, the estimated statewide cost of MPA monitoring is $216,000 [240 x $900].

The estimated maximum cost of MPA monitoring for all public water systems in Arizona is $288,900. The estimated maximum cost is based upon the following assumptions: 1) 100% or all 221 public water systems that are included on the ADEQ "suspect" list are required to conduct MPA monitoring, 2) 100% of the public water systems that may be identified by Maricopa and Pima counties (assumed to be 100 public water systems) are required to conduct MPA monitoring, and 3) each public water system conducts 3 MPA tests, the maximum number of MPA tests possible under the rule, at 1 "suspect" source. Under these assumptions, the estimated maximum cost of MPA monitoring for all public water systems in Arizona is $288,900 [that is, 321 x $900]. This maximum cost estimate is unlikely for 2 reasons. First, it is highly unlikely that every public water system on the ADEQ preliminary "suspect" list and that 100 public water systems in Maricopa and Pima counties will be required to conduct MPA monitoring. Some public water systems will not be required to conduct MPA monitoring after a sanitary survey of the system is completed because the preliminary identification of the "suspect" source that was based on a records review is incorrect, the system provides information to rebut a preliminary identification of a "suspect" source, or a vulnerability assessment is performed and the source is found not to be vulnerable to direct surface water influence. Second, it is highly unlikely that every public water system that is required to conduct MPA monitoring will have to conduct the maximum number of MPA tests. Some public water systems will have MPA risk ratings that will allow a final determination of direct surface water influence to be made after 2 MPA tests are performed.

The previous estimates of the cost of MPA monitoring can be summarized as follows:

1. Least cost estimate: $72,600 [unlikely; assumes that only 38% of the public water systems that are preliminarily identified by ADEQ, Maricopa County, and Pima County as using "suspect" sources are required to conduct MPA monitoring and that each system conducts only 2 MPA tests at 1 "suspect" source].

2. Reasonable least cost estimate: $96,000 - $144,000 [assumes that 50% of public water systems that are preliminarily identified by ADEQ, Maricopa County, and Pima County as using "suspect" groundwater sources are required to conduct MPA monitoring and that each system conducts 2 or 3 MPA tests at 1 "suspect" source].

3. Reasonable high cost estimate: $144,000 - $216,000 [assumes that 75% of public water systems that are preliminarily identified by ADEQ, Maricopa County, and Pima County as using "suspect" groundwater sources are required to conduct MPA monitoring and that each public water system conducts 2 or 3 MPA tests at 1 "suspect" source].

4. Maximum cost estimate: $288,900 [unlikely; assumes that 100% of all public water systems that are preliminarily identified by ADEQ, Maricopa County, and Pima County as using "suspect" groundwater sources are required to conduct MPA monitoring and that each public water system conducts the maximum number of MPA tests at 1 "suspect" source].

The least cost and maximum cost estimates provide the outer boundaries of the range for the cost of MPA monitoring to Arizona's public water systems. The range for the probable cost of MPA monitoring for all public water systems in

Arizona is $96,000 to $216,000. This monitoring cost will be spread between 160 and 240 public water systems. The cost of MPA monitoring for an individual public water system is relatively low. Each public water system will pay between $600 - $900 per "suspect" groundwater source for MPA monitoring.

It is reasonable to assume that more public water systems will be identified as having a "suspect" groundwater source than the 38% of public water systems that ADEQ has preliminarily identified so far. However, it is unlikely that more than 75% of all public water systems that are preliminarily identified as having "suspect" groundwater sources will actually have to conduct MPA monitoring. ADEQ also believes it is reasonable to assume that most public water systems will conduct 2 or 3 MPA tests because ADEQ anticipates that most MPA tests will indicate low and moderate risks of direct surface water influence. The most likely scenario is that 50% to 75% of the public water systems that are preliminarily identified by ADEQ, Maricopa County, and Pima County will be required to conduct MPA monitoring and that each public water system will conduct 2 or 3 tests. Thus, the most likely cost estimate for MPA monitoring statewide for all public water systems falls between $96,000 and $216,000.

While the estimated total cost of MPA monitoring statewide may be in excess of $100,000, it must be remembered that this cost will be shared by many public water systems. Individual public water systems that are required to conduct MPA monitoring will have to conduct 2 or 3 MPA tests and pay approximately $600 - $900 per "suspect" groundwater source. The large majority of the public water systems that ADEQ has preliminarily identified as using a "suspect" groundwater source are small public water systems that have only 1 "suspect" groundwater source. Also, the cost of MPA monitoring will be spread out over time. ADEQ expects that required MPA monitoring will be spread out over several months.

Public water systems with multiple "suspect" sources

As noted above, the large majority of public water systems that are subject to this rule are small public water systems that have only 1 "suspect" source. However, there are some public water systems in Arizona that may have multiple "suspect" sources. For example, the City of Tucson currently relies on groundwater production wells for its drinking water supply. The Arizona Drinking Water System Inventory lists 238 wells for the Tucson Water Department. ADEQ has not evaluated these wells to make preliminary identifications of "suspect" groundwater sources to determine how many of the wells meet 1 of the "suspect" criteria prescribed in the new rule. Obviously, there is a possibility that the Tucson Water Department will have multiple "suspect" groundwater sources because some of its 238 groundwater production wells meet 1 or more of the proposed "suspect" criteria. That is, a well is shallow [less than 50 feet from the ground surface to the well screen], located within 500 feet of a surface water and thought to be vulnerable to direct surface water influence, or located within 500 feet of a surface water and there is no information that can be used to assess the well's vulnerability to direct surface water influence. The worst case scenario is that every well listed in the Arizona Drinking Water System Inventory for the Tucson Water system meets 1 of the "suspect" criteria. If Tucson Water conducts the maximum number of MPA tests (3) at each of the 238 listed wells, the maximum cost of MPA monitoring for Tucson Water alone would be $214,200 [238 x $900]. If this worst case scenario occurs, it would almost double ADEQ's maximum cost estimate for MPA monitoring. On the other hand, the best case scenario is that none of Tucson Water's 238 wells are considered to be "suspect" groundwater sources and the cost of MPA monitoring is zero. The actual cost of MPA monitoring for the Tucson Water system could be anywhere in the range between $0 and $214,200.

Another example is provided by the City of Phoenix Municipal Water System. The City of Phoenix relies principally on its surface water treatment plants for its drinking water supply. However, the City of Phoenix water system also includes groundwater production wells. The Arizona Drinking Water System Inventory lists 30 wells for the City of Phoenix water system. Again, ADEQ has not reviewed data on these wells to evaluate whether any of them meet 1 of the "suspect" criteria in the new rule. Obviously, there is a possibility that the City of Phoenix water system will be required to conduct MPA monitoring at multiple well sites. The worst case scenario is that the City of Phoenix is required to conduct 3 MPA tests at each of the 30 wells listed in the inventory. Under this worst case scenario, the maximum cost of MPA monitoring for the City of Phoenix would be $27,000 (30 x $900). Again, the best case scenario is that no well is considered "suspect" and the cost of MPA monitoring for the City of Phoenix municipal water system is zero.

These 2 examples illustrate that some public water systems will have more than 1 "suspect" groundwater source. In the absence of data, ADEQ cannot predict what the economic impact of the rule will be on individual public water systems with multiple groundwater sources or how this factor will affect the actual cost of MPA monitoring statewide. As ADEQ previously stated, the large majority of the public water systems that ADEQ preliminarily identified as using a "suspect" source are small systems with only 1 "suspect" source. ADEQ acknowledges that there are a few public water systems in the state that use multiple groundwater sources and that these systems may incur higher MPA monitoring costs than the large majority of public water systems in the state that only have 1 "suspect" source.

Benefit to testing laboratories

The cost of MPA monitoring under the rule translates into a benefit for testing laboratories that have the capability to perform the MPA test. Obviously, an ADEQ rule that requires MPA monitoring will result in increased business and revenues for laboratories that have MPA capability. ADEQ is aware of 1 laboratory in Arizona that currently performs the MPA test. There are other laboratories in the United States that perform the MPA test but it is likely that public water systems in Arizona will use the services of the 1 in-state laboratory. Thus, 1 in-state laboratory will be the primary beneficiary of the rule until other laboratories in Arizona develop the capability to perform the MPA test. Whatever the actual cost of MPA monitoring is to public water systems [that is, $49,800 to $288,900], that cost translates into a benefit that will accrue primarily to the 1 in-state laboratory. Obviously, other in-state laboratories may develop the capability to perform the MPA test or out-of-state laboratories that currently perform the MPA may compete for a share of the business and the revenues that are generated by the rule.

Cost of filtration and disinfection treatment

An ADEQ determination that a public water system is using a groundwater source that is under the direct influence of surface water will have significant economic consequences for that public water system. Under the current surface water treatment rule, R18-4-301(C), a public water system that uses a groundwater source that is determined to be under the direct influence of surface water *shall* provide filtration and disinfection treatment within 18 months of the date that ADEQ makes a final determination of direct surface water influence. The failure to provide the required treatment within the 18-month time frame is a treatment technique violation. Installation of treatment is mandatory. The only non-treatment option available to a public water system under the current surface water treatment rule would be to abandon the source that is under the direct influence of surface water and use an alternative source of drinking water.

Public water systems that use groundwater sources usually do not provide filtration or disinfection treatment. Consequently, a final ADEQ determination that a groundwater source is under the direct influence of surface water that triggers a requirement to install and operate filtration and disinfection treatment will result in *significant* capital expenditures and increased operation and maintenance [O&M] costs for each public water system that is required to install treatment. By "significant," ADEQ means that the 1-time capital cost to install filtration and disinfection technologies for even the smallest public water systems may exceed $20,000 with increased annual O&M costs of several thousand dollars per year. As the following cost tables and examples in the economic impact statement illustrate, the estimated total capital costs for installation of filtration technologies for large and medium-sized public water systems can exceed hundreds of thousands of dollars with annual O&M costs that approach $10,000 per year.

The current surface water treatment rule describes several filtration technologies that can be used to comply with its requirements, including: 1) conventional treatment, 2) direct filtration, 3) slow sand filtration, 4) diatomaceous earth filtration, and 5) "other" filtration technologies. "Other" filtration technologies include package filtration plants, cartridge filtration systems, and membrane filtration systems. The surface water treatment rule allows the use of "other" filtration technologies if a water supplier can demonstrate that an alternative filtration technology, combined with disinfection, can meet the requirements for the removal or inactivation of *Giardia lamblia* and viruses from the source water. Alternative filtration technologies, including cartridge filtration and small package filtration plants, with chlorine disinfection are probably the most cost-effective ways for a small public water system that is determined to be using groundwater under the direct influence of surface water to meet the treatment requirements of the surface water treatment rule. Since the large majority of the public water systems that may be affected by this rule are small public water systems that serve less than 1,000 persons, this economic impact statement focuses on the costs of alternative filtration technologies that are appropriate for these small public water systems.

The cost of installation and operation of filtration treatment will vary depending upon the size of the public water system, flow, and the type of filtration technology that is installed. Factors that determine which filtration technology is most appropriate include: 1) source water quality, 2) space limitations, 3) the complexity of the filtration technology, 4) the availability of a certified operator, and 5) the economic constraints faced by the public water system.

Each of the filtration technologies described in the surface water treatment rule and their estimated costs are discussed below. In general, the estimated total costs of treatment are divided into 1-time capital costs and annual O&M costs. The estimated costs that are presented in this economic impact statement are in 1992 dollars (unless otherwise noted) because the primary source for cost information on filtration technologies is an EPA document entitled, "Summary Report: Small Community Water and Wastewater Treatment," EPA/625/R-92/010, U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C. [September, 1992]. ADEQ also used cost information from "Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities," EPA/625/4-89/023, U.S. Environmental Protection Agency, Office of Drinking Water, Center for Research Information, Cincinnati, Ohio [March, 1990]. A 3rd source of cost information for treatment technologies used by small public water systems was EPA's "Very Small Systems BAT Document" ["BAT" means "best available technology]. Cost information from the "Very Small Systems BAT Document" was presented in an EPA report to Congress entitled,

"Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," U.S. EPA Office of Water, EPA 810-R-93-00 [September, 1993].

Most of the cost tables for the small system filtration and disinfection technologies that are reproduced in this economic impact statement are taken from Appendix B to "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations" cited above. The estimated capital costs presented here are for the minimum required equipment to provide the treatment at the listed design flows as described in the narrative that accompanies each cost table. Other infrastructure costs, such as costs associated with land acquisition or building construction may be incurred on a site-specific basis but they are not included in the capital cost estimates in the cost tables. Estimated annual O&M costs are based upon average flow and they include the estimated cost of chemicals, replacement materials, and energy costs. The O&M cost figures in the tables do *not* include the cost of labor. While labor costs are a major O&M cost component, EPA did not include labor costs in its cost tables because of the variance in manpower available nationally for small public water systems. To address the cost of labor issue, EPA estimated labor costs based on 3 general levels of operator attention. Labor costs were estimated assuming an hourly wage of $14.70 and 5 day / week operation. These labor costs are presented in the following table. To determine total estimated O&M costs in this economic impact statement, ADEQ added the appropriate labor cost from the "Annual Labor Costs for Small Systems" table to the O&M cost listed in the individual treatment process cost tables.

Annual Labor Costs for Small Systems

Type	Low Attention	Medium Attention	High Attention
Operation [hrs. / day]	0.5	1.0	2.0
Maintenance [hrs. / week]	1.0	2.0	4.0
Total labor [hrs. / year]	182	364	728
Annual labor cost	$2,675	$5,351	$10,702

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

ADEQ cannot estimate the total cost of filtration and disinfection treatment associated with the rule with any confidence because of the high degree of uncertainty regarding the number of public water systems that will be determined to be using a groundwater source that is under the direct influence of surface water and the many variables that affect the selection of filtration and disinfection technologies by individual public water systems. The estimated costs of the different filtration and disinfection technologies that are presented here are for purposes of illustration only. Estimated costs are provided only to illustrate the "significant" cost of installing and operating filtration and disinfection technologies.

Conventional water treatment

Conventional water treatment is the treatment technology that is most widely used by public water systems for removing turbidity and microbiological contaminants from surface water. Conventional water treatment means a series of treatment processes, including chemical coagulation, rapid mixing, flocculation, and sedimentation followed by rapid sand, dual-media, or multi-media filtration. In general, coagulation and flocculation processes are used to prepare non-settleable and dissolved solids for removal from the source water. During the coagulation step, coagulant chemicals are added to the influent water by rapid mixing. Examples of typical coagulants used in conventional water treatment plants include aluminum sulfate [alum], ferric sulfate, and lime. Polymers may be used in conventional water treatment plants to enhance the coagulation and filtration processes. Rapid mixing ensures the uniform distribution of the coagulant in the water. Rapid mixing generally takes place in 30 to 60 seconds within a tank that is equipped with a mechanical mixer. However, in-line static mixers, in-line mechanical blenders, and hydraulic mixers also have been used to mix coagulants and water. A flocculation basin usually follows rapid mixing. During flocculation, the coagulated water is gently mixed for a period of 30 to 60 minutes. The gentle mixing of the water and coagulant chemicals allows the suspended particles in the water to collide and form heavier particles called flocs. The flocs are subsequently removed from the water by sedimentation and filtration.

Sedimentation takes place in rectangular, circular, or square basins or tanks. The sedimentation tank, or clarifier, is sized to provide sufficient time for gravity settling of the flocs to take place. Inlet structures are provided to reduce the velocity of the water and to distribute the water uniformly across the clarifier. The outlet of the clarifier contains weirs that control the exit velocity of the water to prevent short-circuiting. An automated sludge collection system is

usually provided to remove the settled solids from the bottom of the clarifier. A clarifier may be optionally equipped with tube or plate settlers to improve the performance and efficiency of the sedimentation process. The 2 most common designs are called horizontal flow basins or upflow solids contact clarifiers. A major byproduct of the sedimentation process is sludge which must be removed on a continuous basis. There are costs associated with sludge collection, drying, and disposal.

Filtration is usually the final step in conventional water treatment, although disinfection is frequently provided after filtration. Three different types of filters are typically used in conventional water treatment. Older, existing conventional water treatment plants may use rapid sand filters. New conventional treatment plants typically use high-rate monomedia, dual-media, or multi-media filters. Dual media filters use a combination of anthracite coal and sand supported by a gravel bed to form a filter bed. Multi-media filters use coal, sand, and a 3rd material to form the filter bed [for example, garnet]. High-rate monomedia, dual media, and multi-media filters are used in new conventional water treatment plants because they are normally designed to operate at higher filtration rates than rapid sand filters.

Estimated costs of conventional water treatment

Conventional water treatment for a small public water system is usually provided in a single, factory-built package plant that incorporates all of the required treatment processes and equipment. The following estimated costs by EPA for coagulation / flocculation systems for small public water systems include the basic chemical feed system [mix tank, mixer, metering pump, valves, and piping], the rapid mix system, and the flocculator. Depending upon design flow, EPA construction cost estimates for chemical feed systems range from $1, 830 to $11,030. Annual O&M costs for chemical feed systems are dependent on the chemicals used and the chemical application rate. Estimated annual O&M costs for chemical feed systems range from $2,620 to $10, 950. The estimated costs presented above are for chemical feed systems with maximum chemical feed rates of 10 lbs. / day to 1,000 lbs. / day. The estimated construction costs for rapid mix facilities for small public water systems with flows less than 100,000 gallon per day [gpd] range from $23,000 to $31,800. O&M costs for rapid mix facilities do not vary significantly for flows under 100,000 gpd and EPA estimates them to be approximately $5,000 per year. The estimated construction costs for flocculators range from $17,600 to $32,000 for public water systems treating flows under 100,000 gpd. Annual O&M costs for flocculation are estimated to be $2,000 per year. Estimated construction costs for prefabricated, steel package filter units designed for flows less than 100,000 gpd with filtration rates between 2 to 5 gpm / sq. ft. range from $55,000 to $95,000 per unit. The number of filter units provided by a public water system will vary depending upon water treatment plant capacity. However most public water systems provide at least 2 filter units to permit continuous service when 1 filter unit is backwashed or is off-line for maintenance. Annual O&M costs are dependent on the filter size and the number of backwashes that are performed per day. Annual O&M costs for filtration are estimated to range between $4,200 to $9,500 for flows less than 100,000 gpd. The total estimated capital cost, not including costs associated with sedimentation, sludge treatment, and disposal is between $92,430 and $212,660. The total estimated annual O&M costs range from $13, 820 to $27,450 per year. [The source of the above cost estimates is an EPA document entitled “Summary Report, Small Community Water and Wastewater Treatment,” U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., EPA/ 625/ R-92/ 010 [September, 1992]. All of the estimated costs presented above are in $1992.

For another cost estimate of a package treatment plant, EPA estimated small system coagulation / filtration costs for very small public water systems in a document entitled “Very Small Systems BAT Document [U.S. EPA, 1992]. The following table presents estimated costs for small public water systems:

Small System Coagulation / Filtration Costs

Design flow [Kgpd]	Average flow [Kgpd]	Total Capital Cost [K$]	Total O&M Cost [c/Kgal]	Total Production Cost [c / Kgal]
24.0	5.6	42.6	102.7	347.4
26.0	13.0	60.1	ND[1]	ND
68.0	45.0	69.7	ND	ND
87.0	24.0	68.1	50.7	142.1
166.0	133.0	98.3	ND	ND
270.0	86.0	701.3	25.7	89.4
500.0	400.0	294.6	ND	ND

[1] ND = Data not available

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

The capital costs for the small public water systems in the previous table are based on the following equipment in a package treatment plant: alum, polymer, and caustic storage and chemical feed systems, in-line static mixing, hydraulic flocculation, clarifier with tube settlers, dual-media filters, backwash pumps, pipes, valves, instrumentation, and controls. The above table illustrates the high cost of installing and operating conventional treatment processes in a package plant for a small public water system. The estimated capital cost for a conventional treatment package plant for the smallest public water system in the table with a design flow of 24,000 gallons per day is $42, 600 [in $1992]. The estimated annual O&M cost, assuming 5 days of operation per week at an average flow of 5,600 gallons per day, including chemical costs, replacement materials, and energy costs, but not including labor costs, is $1,485. Since package treatment plants are usually highly automated, EPA estimates that the required operator attention is 1 hour a day. Using the "Small System Labor Cost" table, 1 hour a day translates to a medium level of operator attention with an estimated annual labor cost of $5, 351. By adding the O&M cost from the table with the estimated annual labor cost, ADEQ calculates that the estimated total O&M cost for the smallest public water system in the table to be $6,836.

Direct filtration

Direct filtration systems are similar to conventional water treatment systems except there is no sedimentation step. With direct filtration, all suspended particles in the source water are removed during the filtration stage and the filters are cleaned by periodic backwashing. Direct filtration consists of several combinations of treatment processes. Direct filtration always includes coagulation and filtration, and sometimes includes flocculation or a contact basin after coagulation. Direct filtration systems usually employ dual-media or multi-media filters because they have longer filter runs than rapid sand filters and they operate at higher filtration rates. Again, direct filtration technology is usually integrated into a package treatment plant for a small public water system.

Estimated costs of direct filtration

The estimated costs of direct filtration are similar to those presented for conventional water treatment. However, there are some cost savings with direct filtration. Cost savings of up to 30% can be realized by the elimination of sedimentation and possibly flocculation basins and related equipment. A 10% to 30% reduction in chemical costs is possible because less coagulant is usually required to produce a filterable floc in a direct filtration system. O&M costs may be reduced because the quantity of sludge that is produced by a direct filtration plant is generally less than that produced by conventional water treatment.

The following table presents estimated small system direct filtration costs from the "Very Small Systems BAT Document [USEPA, 1992]. Capital costs for the small public water systems listed in the following table are based on the following treatment equipment: Alum and polymer storage and chemical feed systems, in-line static mixing, hydraulic flocculation, dual media filters, pipes, valves, instrumentation, and controls. The direct filtration costs are additionally based on the following design assumptions:

1) a filtration rate of 2.5 gpm / ft^2, 2) alum dosage of 10 mg/L, and 3) polymer dosage of 0.4 mg/L.

Small System Direct Filtration Costs

Design flow [Kgpd]	Average flow [Kgpd]	Total Capital [K$]	Total O&M [c / Kgal]	Total Production [c / Kgal]
14.4	4.8	31	25	231
28.8	7.0	43	25	221
72	19.3	54	20	110
108	31.4	68	18	88
144	43.5	82	18	79
216	67.8	99	17	64
288	92.1	116	17	57

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Again, the estimated costs in the table illustrate the "significant" cost of installing and operating a direct filtration package treatment plant. Estimated capital costs range from $31,000 to $116,000 depending upon average flow. Estimated total annual O&M costs, based on the listed average flows, 5-day per week operation, and including labor costs, range from $5,663 for the smallest package plant in the table to $9,421 per year for the largest.

The simplest form of direct filtration is called in-line direct filtration. In this treatment process, chemical coagulant application and rapid mixing are followed by the addition of a polymer filtration aid and filtration. There is no separate flocculation step. EPA estimated in-line direct filtration costs for small package treatment plants in the following table based on the following equipment: Alum and polymer feed systems, in-line static mixing, dual-media filters, pipes, valves, instrumentation, and controls. Estimated in-line direct filtration costs are additionally based on the following design assumptions: 1) a filtration rate of 2.5 gp, / ft^2, 2) alum dosage of 10 mg/L, and 3) polymer dosage of 0.4 mg/L.

Small System In-Line Filtration Costs

Design flow [Kgpd]	Average flow [Kgpd]	Total capital [K $]	Total O & M [c / Kgal]	Total production [c / Kgal]
14.4	4.8	20	22	156
28.8	7.0	31	22	165
72	19.3	41	18	87
108	31.4	48	17	67
144	43.5	60	17	62
216	67.8	72	17	51
288	92.1	85	16	46

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Again, the estimated capital costs for a small in-line direct filtration system are significant, ranging from $20,000 to $85,000, depending upon the listed average flow. Estimated annual O& M costs, assuming 5-day per week operation, and including labor costs, range from $5,626 to $9,182 per year. These cost estimates are provided only to illustrate

the "significant" cost of installing and operating an in-line direct filtration package treatment plant for a small public water system.

Slow sand filtration

Slow sand filters consist of a bed of fine sand approximately 3 to 4 feet deep that is supported by a 1-foot layer of gravel and an underdrain system. Slow sand filters are designed to operate at very low water application rates and they have relatively extensive land requirements. Slow sand filters are operated under continuous submerged conditions that are maintained by adjusting a control valve located on the discharge line from an underdrain system. Biological processes and chemical / physical processes occur at the surface of the sand filter bed to form a biological slime or mat referred to as "schmutzdecke." The schmutzdecke forms on the surface of the sand filter bed and traps small particles present in the source water.

Slow sand filters usually perform poorly during the 1st 1 to 2 days of operation called the "ripening period." The ripening period is the time required by a slow sand filter after a cleaning cycle for the schmutzdecke to re-establish and the filter to become a functioning biological filter. In general, the overall poor water quality during the ripening period requires the provision of a filter-to-waste cycle. Also, redundant or stand-by systems are required to accommodate the extended cleaning and ripening periods that are associated with the operation of slow sand filters.

In climates that are subject to below freezing temperatures, slow sand filters usually must be housed. Unhoused sand filters in harsh climates develop an ice layer that prevents cleaning during the winter months. Uncovered slow sand filters will operate effectively in cold climates if the turbidity of the influent water is low enough to permit the filter to operate through the winter months without cleaning. Because of filter housing costs, slow sand filters are most appropriate for small public water systems with low potable water demands. Larger public water systems may be able to utilize slow sand filters when they are located in moderate climates that do not require housing.

Slow sand filters are relatively simple to operate. The primary operational consideration for a slow sand filtration system is maintaining a clean filter. Daily operation consists of checking the raw water temperature and turbidity, filter effluent turbidity, and filter head loss. Slow sand filter runs may last from 20 to 90 days depending upon the source water quality before cleaning is necessary. The normal length of time between cleanings will vary depending upon source water quality, sand size, and filtration rates. Slow sand filters are not backwashed. Instead, the top 1 or 2 inches of sand are manually removed from the surface of the filter bed. The removed sand may be either washed and stored for future use or discarded. A slow sand filter must be taken out of service to be cleaned. After cleaning, a ripening period of 1 or 2 days is required to allow the "shmutzdecke," or surface biological mat, to redevelop. During this ripening period, the filtered water is typically wasted due to poor water quality. New or washed sand is normally added to the filter bed whenever the filter bed depth reaches 24 inches. Replacing sand is not considered a normal operational and maintenance task because with careful cleaning, resanding may be necessary only once every 10 years.

Theoretically, slow sand filters are an attractive treatment option for small public water systems with low potable water demand, high quality source water [such as treatment of groundwater where source water turbidity is less than 10 NTUs], and available land. In general, slow sand filters are limited to treating water with low turbidity levels because of the surface biological mat that forms on the sand filter bed and the small void spaces in the filter bed. Water that is applied to a slow sand filter usually is not pretreated by coagulation, flocculation, and sedimentation processes.

Slow sand filtration has several advantages. These advantages include: 1) the simplicity and reliability of the filtration technology, 2) its relatively low O&M cost, and 3) its ability to achieve greater than 99.9% *Giardia lamblia* cyst removal. Also, slow sand filters do not require continuous monitoring of filtered water turbidity. However, slow sand filters have several significant disadvantages. First, slow sand filters require a relatively extensive land area because of their low filtration rates. Second, limitations exist on the quality of the raw source water that is suitable for treatment using slow sand filtration. In general, slow sand filtration units work best when the raw source water does not exceed a turbidity of 10 NTUs, does not contain high color [< 5 units] or high algae content [< 5 mg / cubic meter of chlorophyll A]. Third, slow sand filters are typically 50 to 100 times slower than normal filtration rates in rapid sand filters. They typically cannot provide enough drinking water where potable water demand is high. Fourth, the cleaning and ripening period requirements of slow sand filtration require the installation of redundant filtration units. Finally, slow sand filters may need to be housed in colder areas of Arizona.

The estimated construction and annual operation and maintenance costs for uncovered slow sand filters are presented below. Estimated construction costs are based on the following equipment: a clay-liner, earthen berms, PVC piping, steel tank reservoir, effluent flow control structure, flow meter, and pump for filter backfilling. Estimated costs for 2 slow sand filter sizes are as follows:

Table 1. Slow Sand Filter Construction and O&M Costs [in $1992]

Capacity [Gallons per day]	Construction Costs	Annual O&M Costs
50,000	$207,900	$6,800
100,000	$271,100	$8,100

Source: Small Community Water and Wastewater Treatment, EPA/625/R-92/010, U. S. Environmental Protection Agency Office of Research and Development, Washington D.C., [September, 1992].

EPA also estimated the capital and annual O&M costs for slow sand filtration in the "Very Small Systems BAT Document." The following table presents estimated slow sand filtration costs for a range of small public water systems. Estimated capital costs are based upon the following equipment: Filter box with cover, pipes, valves, turbidimeters, and flow controllers. Estimated slow sand filtration costs are additionally based on a filtration rate of 0.075 gpm / ft^2 and the removal of approximately 1 inch of sand every 1.5 months. Sand removal requires approximately 4.5 hours of labor per 100 ft^2 of filter surface area. This translates to 30 minutes of labor per removal for the smallest listed design flow to 11.25 hours of labor for the slow sand filter with the largest design flow.

Small System Slow Sand Filtration Costs

Design flow [Kgpd]	Average flow [Kgpd]	Total capital [K $]	Total O&M [c / Kgal]	Total Production [c / Kgal]
5.6	1.5	15.4	4.2	334.6
25.5	6.0	49.0	4.2	267.0
87.0	24.0	134.2	4.2	184.2
143.0	43.0	198.0	4.2	152.4
171.0	51.0	228.8	4.2	148.6
200.0	60.0	258.5	4.2	142.9
270.0	86.0	330.3	4.2	127.8

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Estimated capital costs for slow sand filters range from $15,400 for the smallest public water system listed in the table to $330,300 for the largest system. Estimated annual O&M costs, assuming 5-day / week operation and including labor costs based upon a low level of operator attention, range from $2,691 for the smallest system in the table to $3,614 for the largest.

A 3rd estimate for the capital and O&M costs for slow sand filtration for a medium-sized public water system [100 gallons per minute] is provided by RP Products, a private company that markets cartridge filtration systems. RP Products promotional materials include a table which compares the estimated costs for various water treatment systems based on flow rate with the costs of cartridge filtration. The table includes estimated costs for slow sand filtration. RP Products estimated the construction cost for a slow sand filtration system for a medium-sized public water system [100 gpm] at $246,854 with an estimated annual O&M cost of $5,260 per year. These estimated costs are similar to the costs estimated by EPA.

Package filtration systems

Package treatment plants are built in a factory, skid-mounted, and transported virtually assembled to the site of operation. Package treatment plants generally consist of coagulation / flocculation, sedimentation, and filtration components. Occasionally, the sedimentation step is omitted. Rapid sand filters in package treatment plants are backwashed automatically at a predetermined head loss or whenever the turbidity of the filtered water begins to increase. On-line turbidimeters continuously monitor and record the turbidity of the filtered water and head loss indicators are provided to continuously measure filter head loss. Rapid sand filters usually require the presence of a properly trained operator

on a daily basis to ensure continuous reliable operation. The temperature and turbidity of the raw water, filter flow rates, filter run time, filter head loss, backwash cycles, and filtered water turbidity should be monitored on a daily basis. The major advantages of package treatment plants are their compact size, cost effectiveness, relative ease of operation, and their design for largely unattended operation. Package filtration plants are frequently used by small public water systems.

In EPA's "Summary Report: Small Community Water and Wastewater Treatment," EPA estimated the construction costs for complete package treatment plants consisting of coagulation, flocculation, sedimentation, and multi-media gravity filtration to range from $98,000 to $160,000 for flows between 14,000 gpd and 144,000 gpd. Annual O&M costs were estimated to range from $10,100 to $14,400 for the same range of flows. These EPA cost estimates are similar to a cost estimate by RP Products, a private company that manufactures cartridge filtration systems. RP Products promotional literature includes a cost comparison that estimates the construction cost for a medium-sized package filtration plant [100 gpm] to be $173, 810 with an annual O&M cost of $13,280 per year. The following table presents a 2nd EPA estimate of the costs of a complete package treatment plant:

Estimated Costs for Supplementing Surface Water Treatment by Complete Treatment Package Plants [in $1978]

Category	Plant Capacity [MGD]	Average Flow [MGD]	Capital Cost [$1,000]	O&M Costs [$1,000 / yr]	O&M Costs [¢/1,000 gal]	Total Cost [¢/1,000 gal]
1	0.026	0.013	278	12.2	255.2	944.5
2	0.068	0.045	295	15.9	87.5	277.4
3	0.166	0.13	428	42.4	89.2	195.1
4	0.50	0.40	773	75.1	51.4	113.6
5	2.50	1.30	1,770	137	29.0	72.8
6	5.85	3.25	2,952	274	23.1	52.4

Source: "Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities, U.S. Environmental Protection Agency, Office of Drinking Water, Cincinnati, Ohio [March, 1990].

Again, the table illustrates the "significant" capital and O&M costs [in $1978] that are associated with complete package treatment plants. For the smallest package treatment plant in the table, the Category 1 facility with a design capacity of 26,000 gpd and an average flow of 13,000 gpd, the capital cost is estimated to be $278,000 with an annual O&M cost of $12,200 per year [in $1978].

The "significant" cost of installing a package filtration plant is illustrated by 2 recent Arizona examples. In 1997, a consulting engineering firm estimated the construction cost for a 100 gpm package filtration plant for the Grand Canyon National Park Airport at $365,766. In 1995, another consulting engineering firm estimated the construction cost for a 200 gpm package filtration plant at Camp Navajo, Arizona at $940,000 to $1,000,000.

Diatomaceous earth filtration

Diatomaceous earth filters have been used extensively for filtering swimming pool water and they may have applications for some small public water systems. In general, a diatomaceous earth filter is a small, compact pressure filter. The diatomaceous earth filtration method uses a process in which a "precoat" cake of diatomaceous earth filter media is deposited on a support membrane called a septum. The water is filtered through this filter cake and additional filter media, known as body feed, is continuously added to the feed water to maintain the permeability of the filter cake. The treatment plant operator must check the effluent turbidity of the filtered water periodically and adjust the application of body feed according to the measured turbidity levels. When the filter headloss reaches a predetermined level, the filter must be backwashed. After backwashing a new precoat layer of diatomaceous earth must be formed on the septum before filtration can be resumed.

While diatomaceous earth filters have been used for potable water treatment, there are some serious drawbacks to these systems. These include rigorous operating requirements, high operating costs, and increased sludge production. The operational difficulty of maintaining a complete and uniform thickness of diatomaceous earth on the filter has discouraged the wide use of diatomaceous earth filters for potable water treatment. A significant limitation of diatomaceous earth filters is that they do not effectively remove viruses unless the water is pretreated with coagulants and

filter aids. For most small system applications, diatomaceous earth filters are not technically or economically competitive with other available filtration technologies.

Estimated capital costs for package diatomaceous earth filters with design capacities of 28,000 gallons per day and 86,000 gallons per day are $71,000 and $80,000 respectively. Annual O&M costs for both systems are estimated to be $10,000 per year. The annual diatomaceous earth filter aid cost for each filter is estimated to range from $225 [28,000 gpd] to $700 [80,000 gpd].

EPA also estimated small system diatomaceous earth filtration costs in the "Very Small Systems BAT Document." EPA's estimated costs are presented in the table below. Capital costs for diatomaceous earth filtration are based on the following equipment: Skid-mounted, stainless steel filter housing, Goretex teflon membrane, pre-coat feed system, body feed system, high pressure sprayer to facilitate filter cleaning, pipes, valves, instrumentation, and controls. Diatomaceous earth filtration costs are additionally based on a filtration rate of 1 gpm / ft^2. EPA estimates the labor requirements for diatomaceous earth filtration to be 0.5 hours per day.

Small System Diatomaceous Earth Filtration Costs

Design Flow [Kgpd]	Average Flow [Kgpd]	Total Capital [K $]	Total O&M [¢ / Kgal]	Total Production [¢ / Kgal]
2.9	1.5	4.6	36.2	134.9
24	5.6	13.6	35.2	113.5
87	24.0	42.6	34.1	91.2
270	86.0	137.9	33.9	85.5

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Total capital costs for small system diatomaceous earth filtration range from $4,600 for the smallest system in the table to $137,900 for the largest. Annual O&M costs, including an annual labor cost based on a low level of operator attention, range from $2,815 for the smallest system to $10,255 for the largest system. For a non-EPA cost estimate, RP Products estimated construction costs and annual O&M costs of diatomaceous earth filtration for a medium-sized water system [100 gpm] in some of their promotional literature comparing the cost of available filtration technologies to cartridge filtration. RP Products estimated the construction cost of a diatomaceous earth filtration for a 100 gpm water system at $139,960 with an estimated annual O&M cost of $11,200. This cost estimate is similar to EPA cost estimates for diatomaceous earth filtration.

Membrane filtration

Membrane filtration is an emerging alternative filtration technology that may be appropriate for use by small public water systems. Membrane filtration systems use hollow fiber membranes to remove undissolved and suspended solids from the source water. The hollow fiber membranes are typically able to exclude all particles greater than 0.2 microns, including *Giardia lamblia* cysts. Typical membrane filters introduce feed water to the inside of the hollow fiber membranes, with the filtrate emerging on the outside of membrane. State-of-the-art membrane filters are designed to pass influent to either the inside or outside of the membrane. The hollow fiber membranes are usually contained in a pressure vessel or cartridge and they operate over a pressure range of 10 to 100 psi. Contaminants collect on the end of the hollow fiber membranes and are discharged to waste by reversing the water flow. Periodic backflushing and occasional chemical cleaning are necessary to maintain the hollow membrane fibers and to prevent fouling. The flush water must be treated and is either recycled or discharged after treatment. The sludge collected from a membrane filtration system is typically dried and disposed of in a landfill.

Membrane filtration systems are typically used for specialized applications that require highly purified water, including the treatment of drinking water supplies with influent turbidities of 1 NTU or less or fouling indexes of less than 10. Groundwater typically has a fouling index of less than 10. The fouling of the hollow fiber membranes by turbidity is a major problem with membrane filtration systems that has prevented the widespread application of this filtration technology.

A membrane filtration system may be an attractive option for a small public water system because of its small size and automated operation. Many membrane filtration systems are very compact package systems that are skid-mounted. A package membrane filtration system typically includes the following elements: hollow fiber membranes

in cartridges, automatic and manual valves for backwashing and unit isolation, flow meters, pressure gauges, integral supply pump, and control panel. In addition, membrane filtration systems include storage tanks and chemical feed pumps for membrane cleaning solutions and filtered water storage with chlorination capacity.

EPA estimated small system membrane filtration costs in the "Very Small Systems BAT Document." Estimated capital costs were based on the following equipment: spiral-wound, polyester membranes, membrane housing, raw water feed pump, cleaning pumps, PVC pipes and valves, instrumentation, and controls. The microfiltration costs were additionally based on a recovery rate of 98.5%, an operating pressure of 5-20 psi, and a membrane life of 5 years.

Small System Microfiltration Costs

Design flow [Kgpd]	Average flow [Kgpd]	Total Capital [K $]	Total O&M [¢ / Kgal]	Total Production [¢ / Kgal]
10.0	3.0	40.9	104.5	543.6
24.0	6.0	68.8	67.3	436.2
87.0	24.0	91.7	39.4	162.4
270.0	86.0	245.6	34.4	126.3

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Total capital costs range from $40, 900 for the smallest public water system in the cost table to $245,600 for the largest system. Annual O&M costs, including an assumed annual labor cost based on a low level of operator attention because of system automation, ranges from $3,494 for the smallest system to $10,277 for the largest system in the table.

The following table presents a 2nd EPA estimate of costs for membrane filter package treatment plants for small public water systems.

Estimated Costs for Supplementing Surface Water Treatment by Package Membrane Filtration Plants [$1978]

Category	Plant Capacity [MGD]	Average Flow [MGD]	Capital Cost [$1,000]	O&M Cost [$1,000 / yr]	O&M Cost [¢/1,000 gal]	Total Cost [¢/1,000 gal]
1	0.026	0.013	142	5.0	105.2	455.6
2	0.068	0.045	269	9.8	53.7	226.8
3	0.166	0.130	503	26.0	54.7	179.2
4	0.50	0.40	1,144	67.7	46.4	138.4

Source: "Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities," U.S. Environmental Protection Agency, Office of Drinking Water, EPA/ 625/4-89-023 [March, 1990].

Estimated capital costs range from $142,000 for a Category 1 package treatment plant with a design capacity of 26,000 gpd to $1,144,000 for the Category 4 facility with a design capacity of 500,000 gpd. Annual O&M costs range from $5,000 to $67,700.

Cartridge filtration

Cartridge filters are considered to be an emerging filtration technology that is appropriate for small public water system applications. Cartridge filtration systems use ceramic or polypropylene microporous elements that are packed into pressurized housings. They operate by the physical process of straining the water through porous membranes. Cartridge filtration systems can exclude particles down to 0.2 µm, including *Giardia lamblia* cysts. Prefiltration prior to cartridge filtration is sometimes necessary to remove larger suspended particles and to prevent rapid fouling of the cartridge filters. Cartridges are replaced when a specified headloss is reached, typically every 1 to 6 months. The ease of operation and maintenance of cartridge filtration systems makes them an attractive treatment option for small pub-

lic water systems. The table below presents estimated cartridge filter costs based on the following equipment: filter cartridges and housing, pipes and valves, pressure gauges, and controls. Cartridge filtration costs are additionally based on a filtration rate of 20 gpm per cartridge and a cartridge life of 3 months.

Small System Cartridge Filter Costs

Design Flow [Kgpd]	Average Flow [Kgpd]	Total Capital [$K]	Total O&M [¢ / Kgal]
24	5.6	5	99
87	24.0	9	82
270	86	20	72

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

As the above table indicates, a cartridge filtration system may be the most cost-effective solution for a small public water system that is determined to be using groundwater that is under the direct influence of surface water. A cartridge filtration system in combination with chlorine disinfection may be able to meet the requirements of the surface water treatment rule at the most reasonable cost. Total capital costs for cartridge filtration range from $5000 to $20,000. Annual O&M costs, based on average flow and not including labor costs, range from $1,456 to $16,099.

ADEQ obtained another cost estimate from a private sector company that manufactures cartridge filtration systems. RP Products estimates costs in its product literature for various water treatment systems based on 2 flow rates, smaller water systems with flow rates of 10-20 gpm and medium-sized systems with flow rates of 100 gpm. The estimated construction cost for cartridge filtration in the smaller system [10-20 gpm] is $12,000 to $20,000 with an annual O&M cost of $500 to $1000 per year. The estimated construction cost for the larger system is $30,000 to $50,000 with an annual O&M cost of $2,000 to $5,000 per year. This range of estimated capital costs is slightly higher than the range of capital costs estimated by EPA. Nonetheless, the cost estimates show that cartridge filtration has a significant cost advantage over other types of filtration systems and may be the most cost-effective option for a small public water system that is determined to be using groundwater under the direct influence of surface water.

Disinfection

The destruction or inactivation of pathogenic organisms in a community's drinking water supply is accomplished by disinfection processes. This is achieved in most small community water systems by using chlorine, ozone, or ultraviolet light [UV] to disinfect the water supply [primary disinfection] and by maintaining a chlorine residual in the community's water distribution system to prevent the regrowth of microorganisms [secondary disinfection]. Public water systems that ADEQ determines are using "groundwater under the direct influence of surface water" must provide disinfection.

The most commonly used disinfectant for small community water systems is chlorine. Ozone and UV may also be used as primary disinfectants but chlorine must still be added to the water to prevent the regrowth of microorganisms in the water distribution pipelines.

Chlorination may be accomplished by the application of chlorine gas or hypochlorite to the drinking water supply. Chlorine gas systems for small public water systems typically use 150-pound chlorine cylinders with cylinder mounted chlorinators. The chlorinator is used to regulate the chlorine gas feed rate. Chlorine gas is withdrawn from the cylinder by a vacuum that is created by circulating some of the water supply through an ejector. The chlorine gas mixes with the water flowing through the ejector. A chlorine solution is then ejected into the water supply at the entrance to a contact tank or directly into a water main leading to the distribution system.

Chlorination also may be accomplished by using sodium hypochlorite, a liquid, or calcium hypochlorite, a solid. Sodium hypochlorite is available in concentrations ranging from 5% to 15% chlorine. A dilute solution is generally prepared and fed into the water by a chemical feed pump that has a variable output. Calcium hypochlorite is available in tablet, granular, or powdered form and contains about 70% available chlorine. Chlorine solutions are prepared by dissolving the calcium hypochlorite in a solution tank. The solution is then applied to the water by a chemical feed pump with a variable output. Hypochlorite systems are generally safer and easier to use than gaseous chlorine systems.

Chlorination systems must be monitored on a daily basis. Gaseous chlorine systems are more labor intensive than hypochlorite systems. Regardless of which type of chlorination system that is used, the system should be checked daily for the following items: chlorine residual at the well house and at the farthest points in the distribution system, chlorine feed rate, and the amount of chlorine remaining in the cylinder or solution tank. An adequate supply of chlorine is essential to provide continuous disinfection of the water supply.

Estimated construction costs for small community gas chlorination systems do not vary significantly for capacities ranging from 10 to 80 lbs. / day. A typical gas chlorination system consists of the chlorinator, scale, booster pump, and injector housed in a 10 ft. X 10 ft. building. The estimated construction cost for such a system is $25, 350. The annual O&M cost is estimated to be approximately $3,500 per year. Hypochlorite systems (including housing) are estimated to have construction costs of $20,700 and annual O&M costs of $3,100 [Source: EPA Summary Report, Small Community Water and Wastewater Treatment, U.S. Environmental Protection Agency, Office of Research and Development, EPA 625/R-92/010, (September, 1992), p. 53].

EPA also estimated small system chlorination costs in the "Very Small Systems BAT Document." Capital costs were based on the use of a liquid sodium hypochlorite system as the most appropriate small system chlorination method because of its relatively low cost and minimal safety requirements. Estimated capital costs were based on the following equipment: A manually controlled diaphragm metering pump, fiberglass reinforced storage tank, pipes, and valves. O&M costs were based on the following operational parameters: 5 mg/L dosage of 15% sodium hypochlorite, pumping energy, and necessary maintenance materials.

Small System Chlorination Costs

Design Flow (Kgpd)	Average Flow (Kgpd)	Total Capital (K$)	Total O&M (¢ / Kgal)	Total Production (¢ / Kgal)
14.4	3.4	4.9	123.5	170.3
24.0	5.6	4.9	87.5	115.9
87.0	24.0	4.9	32.9	39.5
270.0	86.0	4.9	16.2	18.0

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Estimated capital cost for chlorination is $4,900 for systems with average flows ranging from 3,400 gpd to 86,000 gpd. Annual O&M costs, assuming 5-day per week operation at the listed average flows are $1105 per year for the smallest facility to $3578 per year for the largest.

Ozone also may be used as a primary disinfectant, especially in communities where chlorination may result in significant levels of trihalomethanes or other disinfection by-products. Ozone cannot be stored and must be generated on-site. Efficient contact with the water supply is critical because ozone is not highly soluble in water. A 2-stage ozone contactor is normally provided to satisfy ozone demand and to ensure adequate contact. Ozonation systems are complex to operate and they have high O&M costs. Chlorine must still be used as a secondary disinfectant. Most small community water systems have design capacities ranging from 5 to 20 lbs. / day of ozone. Estimated construction costs [including housing] range from $153,500 to $189,000. O&M costs are estimated to range from $12,000 to $16,000 per year [Source: EPA Summary Report, Small Community Water and Wastewater Treatment, U.S. Environmental Protection Agency, Office of Research and Development, EPA / 625/R-92/010, (September, 1992), p. 53].

The following table presents a 2nd EPA estimate of small system ozonation costs. The estimated costs are for ozonation systems using air as a feedgas. Ozonation systems that produce less than 100 lbs. / day generally use air as an ozone source because of its availability, safety, and cost effectiveness. Capital costs are based on an air-generated ozonation system with the following equipment: air filter, air compressor, air cooler / dryer, ozone generator, ozone contactor, ozone diffusers, pipes, valves, instrumentation and controls, and off-gas destruction unit. Costs were estimated for an ozone dosage of 1 mg/L. One mg/L is considered adequate to provide the required inactivation and oxidation in groundwater. Original equipment manufacturers estimate required labor to be 1 hour / day.

Small System Ozonation Costs

Ozone Concentration = 1 mg/L				
Design Flow [Kgpd]	**Average Flow [Kgpd]**	**Total Capital [K$]**	**Total O&M [¢ / Kgal]**	**Total Production [¢ / Kgal]**
24	5.6	66	11	390
120	36	95	4	89
270	86	121	3	49

Source: "Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations," Report to Congress, U.S. Environmental Protection Agency, EPA 810-R-93-001 [September, 1993].

Total capital costs for small system ozonation range from $66,000 to $121,000. Annual O&M costs, assuming 5-day / week operation at the listed average flow, including labor costs, range from $5511 for the smallest system in the table to $6021 for the largest.

Ultraviolet light may be used as a primary disinfectant for small groundwater systems. UV light disinfection by itself is not recommended for surface water systems because it is does not effectively inactivate *Giardia lamblia* cysts. However, in combination with filtration, UV light disinfection may provide adequate removal or inactivation of pathogens that complies with the requirements of the surface water treatment rule. UV disinfection systems typically consist of 1 or more UV lamps enclosed by quartz tubes. Water flows past the lamps and is exposed to UV radiation. The UV radiation penetrates the microorganisms it comes in contact with and destroys the genetic material inside the bacteria or virus cells. UV light disinfection systems cannot be used with turbid water supplies and they are usually installed downstream of filtration processes. Chlorine must be added to the water prior to the point-of-entry to the distribution system. UV light disinfection systems must be monitored on a daily basis. When the UV lamp intensity decreases, the surface of the quartz tubes must be cleaned. UV lamps may require periodic replacement. Costs for UV light disinfection systems vary widely. Generally, for systems treating less than 100,000 gpd, the estimated construction cost is $40,000. The annual O&M cost is estimated to be approximately $2,400 [Source: EPA Summary Report, Small Community Water and Wastewater Treatment, U.S. Environmental Protection Agency, Office of Research and Development, EPA / 625/R-92/010, (September, 1992), p. 53].

The following table presents a 2nd EPA estimate of the cost of small system ultraviolet light disinfection. Capital costs in the following table are based on a UV light disinfection system utilizing mercury vapor lamps with covered quartz sleeves equally distributed in baffled tanks. Capital costs are based on the following equipment: UV unit, UV intensity monitor, alarm system for system failure, and flow control valve.

Small System Ultraviolet Disinfection Costs

Design Flow [Kgpd]	**Average Flow [Kgpd]**	**Total Capital [K$]**	**Total O&M [¢ / Kgal]**	**Total Production [¢ / Kgal]**
4.3	2.1	3	16	62
14.4	3.4	4	10	48
24	5.6	5	8	38
87	24.0	12	4	19
270	86.0	27	3	13

Summary of Filtration and Disinfection Costs

The extended discussion of the estimated costs of filtration and disinfection treatment in the preamble is presented to illustrate the high cost of providing the required treatments by a small public water system that is determined to be using groundwater under the direct influence of surface water. ADEQ cannot predict how many public water systems, if any, will be determined to be using groundwater under the direct influence of surface water using the multiple step process that is described in the rule. However, if a public water system is required to install treatment, the most cost-effective treatment option will probably be a cartridge filtration system combined with chlorine disinfection. The estimated capital cost for installation of such treatment may range from $20,000 to $50,000 per year with annual O&M costs of between $1,500 to $8,500 depending upon the size of the public water system. ADEQ acknowledges that these costs are significant and may be prohibitive for many small public water systems.

Alternative Sources of Water

It is estimated that 160 to 240 public water systems in Arizona will be preliminarily identified as using a "suspect" groundwater source that may be under the direct influence of surface water. Many of these systems will be required to conduct MPA monitoring. ADEQ assumes that a small percentage of the systems will have MPA monitoring results that show that the groundwater source is under the direct influence of surface water. The large majority of the public water systems that may be affected by this rule are small public water systems that serve less than 1,000 persons. Because of the high cost of filtration and disinfection treatment processes and diseconomies of scale for small public water systems, ADEQ assumes that for the public water systems that are finally determined to be using groundwater under the direct influence of surface water, the compliance option of preference will be to develop an alternative source of water [for example, drill a deeper well or obtain an alternative source of water from another public water system] where that is a feasible option. ADEQ revised the proposed rule to allow a public water system to take corrective action to a "suspect" groundwater source after a 1st round of MPA monitoring results indicates that the groundwater source is under the direct influence of surface water. ADEQ revised the rule to preserve the compliance option of making less expensive repairs or installing engineered controls that are designed to prevent direct surface water influence where such options are feasible.

Cost to Consumers

The cost incurred by small public water systems to meet the requirements of the surface water treatment rule falls disproportionately on small public water systems. EPA estimates the projected annual cost of providing disinfection treatment by a very small public water system (that is, one that serves 25-100 persons) that uses a groundwater source is between $140 to $240 per household. For a public water system that serves between 1,000 and 3,300 the projected annual cost of disinfection per household is $35 [Source: U.S. Environmental Protection Agency, "Estimates of the Total Benefits and Total Costs Associated With Implementation of the 1986 SDWA," (March, 1990)].

EPA estimated the annual per household cost of installing filtration in public water systems serving less than 100,000 persons in the final surface water treatment rule [54 Federal Register 27520 (June 29, 1989)]. The bar chart below is taken from the Federal Register. It illustrates the disproportionate cost of filtration to consumers who are served by small public water systems. The costs shown in bar chart represent the approximate high and low extremes of cost per household of installing filtration. For a very small public water system serving 25 to 100 persons, EPA estimates that the cost per household of installing filtration ranges from approximately $500 to over $1000 per year. For a public water system serving 101 to 500 persons, the cost per household is between $250 to $300 per year. For a public water system serving 501 to 1000 persons, the cost per household is between $200 and $250 per year.

Cost of Installing Filtration in Systems Serving < 100,000

Cost to ADEQ

ADEQ does not anticipate increased costs to the agency resulting from the proposed rule. ADEQ does not expect any budget increase to implement the new rule. No additional full-time employees will be required to implement the proposed rule. The on-site evaluation of public water systems to determine whether they must conduct MPA monitoring will be integrated into normal inspections and sanitary surveys of public water systems that are conducted by ADEQ field services staff.

10. A description of the changes between the proposed rules, including supplemental notices, and final rules:

ADEQ made several changes to the proposed rule. Language that was deleted from the proposed rule is indicated by ~~strike-outs~~. Language that has been added to the proposed rule is indicated by underlining.

R18-4-301.01. Groundwater Under the Direct Influence of Surface Water

A. ~~A public water system which uses any of the following sources is suspected of using~~ The Department suspects the following sources to be groundwater ~~that is~~ under the direct influence of surface water:

1. ~~Springs~~ A spring;
2. ~~Infiltration galleries~~ An infiltration gallery;
3. ~~Horizontal wells~~ A radial well collector, Ranney well, or horizontal well;
4. ~~Any~~ A well that is less than 500 feet from a surface water, and:
   a. The Department conducts a vulnerability assessment and determines that the source is vulnerable to direct surface water influence, or
   b. The Department cannot assess the vulnerability of the groundwater source to direct surface water influence because of a lack of information or the uncertainty of available information on the local hydrogeology or well construction characteristics.
5. ~~Shallow wells that are less than 50 feet from the ground surface to perforations or well screens~~ A shallow well with perforations or well screens that are less than 50 feet below the ground surface;
6. ~~Hand-dug wells or auger-bored wells without casings~~ A hand-dug or auger-bored well without a casing;
7. ~~Any~~ A groundwater source ~~with recurring exceedances of the~~ for which turbidity data are available that show that the groundwater violates an interim maximum contaminant level for turbidity.
8. ~~Any~~ A groundwater source ~~that supplies a public water system with recurring violations of a maximum contaminant level for total coliform~~ for which data are available that show that total coliform, fecal coliform, or *E. Coli* are present in untreated groundwater from the source that are not related to new well development, source modification, repair, or maintenance.

~~9. Any groundwater source where the temperature of the groundwater fluctuates 15% to 20% from the mean groundwater temperature over the course of a year or where changes in the temperature of the groundwater correlate to similar changes in the temperature of surface water.~~

B. The Department shall conduct a sanitary survey of each public water system that it suspects is using a groundwater source under the direct influence of surface water.

~~B~~C. ~~The Department may require a public water system which is suspected of utilizing a groundwater source that is under the direct influence of surface water to conduct Microscopic Particle Analysis [MPA] monitoring of the groundwater source~~. The Department shall provide written notice to ~~the~~ a public water system that the ~~groundwater source is suspected of being~~ the Department suspects a groundwater source is under the direct influence of surface water ~~and shall schedule MPA monitoring of the groundwater source~~. A public water system may submit information to the Department to show that a groundwater source is not under the direct influence of surface water. Information that is submitted to show that a suspect groundwater source is not under the direct influence of surface water shall be prepared by a qualified professional, such as a professional engineer, registered geologist, water system operator, or hydrogeologist. The Department shall review any information submitted by a qualified professional to show a suspect groundwater source is not under the direct influence of surface water and determine if the source remains suspect within 90 days of receipt of the information. ~~The Department shall schedule MPA monitoring at a time when the groundwater source is most susceptible to contamination by surface water~~.

D. If a groundwater source continues to be suspect after the analyses required in subsections (A) through (C), the Department may require a public water system that is suspected of using a groundwater source that is under the direct influence of surface water to conduct Microscopic Particle Analysis [MPA] monitoring of the groundwater source. A public water system may request that the Director require an alternative method to determine whether a groundwater source is under the direct influence of surface water. An alternative method to determine whether a groundwater source is under the direct influence of surface water shall be approved by the Arizona Department of Health Services under R9-14-608.

~~C~~E. A water supplier shall conduct ~~Microscopic Particle Analysis [MPA]~~ MPA monitoring as follows:

1. Each sample ~~for Microscopic Particle Analysis~~ shall be representative of the groundwater source. A water supplier shall not take a sample of blended water or a sample of water from the distribution system.
2. Each sample shall be collected and analyzed according to the procedures prescribed in the "Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)," EPA 910/9-92-029, United States Environmental Protection Agency, Environmental Services Division, Manchester Environmental Laboratory, 7411 Beach Dr. E., Port Orchard, WA 98366, October 1992 (and no future editions or amendments) which is incorporated by reference and on file with the Office of the Secretary of State and the Department.
3. The Department shall schedule MPA monitoring at a time when the groundwater source is most susceptible to direct surface water influence.

~~3~~4. The Department shall use the MPA risk ~~rating~~ ratings to determine whether groundwater is under the direct influence of surface water.

a. ~~If the risk rating of the initial sample indicates a high risk of surface contamination, then the Department shall determine that the groundwater is under the direct influence of surface water.~~ If the MPA risk rating of the initial sample indicates a high or moderate risk of direct surface water influence, the water supplier shall collect a 2nd sample for MPA at the same location on a date scheduled by the Department. If the MPA risk rating of the 2nd sample indicates a high or moderate risk of direct surface water influence, the Department shall determine that the groundwater is under the direct influence of surface water. If the risk rating of the 2nd sample indicates a low risk of direct surface water influence, the water supplier shall collect a 3rd sample for MPA at the same location on a date scheduled by the Department. If a 3rd sample is taken, the Department shall determine whether the groundwater is under the direct influence of surface water under subsection (E)(4)(c).

b. If the MPA risk rating of the initial sample indicates a low risk of ~~surface contamination~~ direct surface water influence, ~~then~~ the water supplier shall collect a 2nd sample for ~~microscopic particle analysis~~ MPA at the same ~~sampling~~ location on a date scheduled by the Department. If the MPA risk rating of the 2nd sample indicates a low risk of ~~surface contamination~~ direct surface water influence, ~~then~~ the Department shall determine that the groundwater is not under the direct influence of surface water. If the MPA risk rating of the 2nd sample indicates a high or moderate risk of ~~surface contamination~~ direct surface water influence, ~~then~~ the water supplier shall collect a 3rd sample for ~~microscopic particle analysis~~ MPA at the same ~~sampling~~ location on a date scheduled by the Department. If a 3rd sample is taken, the Department shall determine whether the groundwater is under the direct influence of surface water under subsection (E)(4)(c).

c. If a 3rd sample is required and the MPA risk rating of the 3rd sample indicates a high or moderate risk of ~~surface contamination~~ direct surface water influence, ~~then~~ the Department shall determine that the groundwater is under the direct influence of surface water. If the MPA risk rating of the 3rd sample indicates a low risk of ~~surface water contamination~~ direct surface water influence, ~~then~~ the Department shall determine that the groundwater is not under the direct influence of surface water.

F. If the Department determines a source to be groundwater under the direct influence of surface water under subsection (E) and a public water system demonstrates to the Department that it is feasible to take corrective action to prevent direct surface water influence, the Department shall establish a schedule of compliance for the public water system to take corrective action instead of requiring installation of filtration and disinfection treatment. A schedule of compliance to take corrective action shall require:

1. Completion of corrective action no later than 18 months after receipt of the initial MPA monitoring results, and
2. A 2nd round of MPA monitoring to determine whether the source is under the direct influence of surface water after completion of the corrective action.

~~D~~**G.** Except as provided in subsection (F), ~~A~~ a public water system with a source that ~~is determined to be~~ the Department determines to be groundwater under the direct influence of surface water shall provide ~~treatment by~~ filtration ~~in accordance with~~ under R18-4-302 and disinfection ~~in accordance with~~ under R18-4-303 within 18 months of the date that the Department makes the final determination that the groundwater is under the direct influence of surface water.

~~E~~**H.** The Department shall provide a written notice to ~~the water supplier~~ a public water system of a final determination that a groundwater source is under the direct influence of surface water. The notice shall ~~state that the determination that a groundwater source is under the direct influence of surface water is an "appealable agency action" as defined in A.R.S. §41-1092(3). The notice shall state that the water supplier may request an informal settlement conference with the Department pursuant to A.R.S. §41-1092.06. A water supplier may appeal the Department's a determination that a groundwater source is under the direct influence of surface water by serving a Notice of Appeal with the Department pursuant to A.R.S. §41-1092.04. The water supplier shall file a Notice of Appeal with the Manager of the Drinking Water Section within 30 days after receiving notice of the Department's determination that the a groundwater source is under the direct influence of surface water. The water supplier shall briefly state the grounds for the appeal in the Notice of Appeal. The Department shall notify the Office of Administrative Hearings which shall schedule a hearing on the appeal within 60 days of the date that the Notice of Appeal is filed with the Department. Hearings shall be conducted according to the hearing procedures that are prescribed in A.R.S. §41-1092.07.~~ contain the following information:

1. A statement that the Department's determination that a groundwater source is under the direct influence of surface water is an "appealable agency action" as defined in A.R.S. §41-1092(3); and
2. Notice that the water supplier may request an informal settlement conference with the Department under the Uniform Administrative Appeal Procedures in A.R.S. Title 41, Chapter 6, Article 10.

I. A public water system may appeal a final determination that a groundwater source is under the direct influence of surface water by serving notice of appeal with the Department under the Uniform Administrative Appeals Procedures in A.R.S. Title 41, Chapter 6, Article 10. A public water system shall file notice of appeal with the Department within 30 days of receiving notice of the Department's determination that a groundwater source is under the direct influence of surface water. The Department shall notify the Office of Administrative Hearings which shall schedule a hearing on the appeal within 60 days of the date that notice of appeal is filed with the Department. Hearings shall be conducted according to the Uniform Administrative Appeals Procedures in A.R.S. Title 41, Chapter 6, Article 10.

Table 1. Decision Matrix for Determining Groundwater Under the Direct Influence of Surface Water

Initial Sample MPA Risk Rating	2nd Sample MPA Risk Rating	3rd Sample MPA Risk Rating	Groundwater Under the Direct Influence of Surface Water
High	High or Moderate		Yes
High	Low	High or Moderate	Yes
High	Low	Low	No
Moderate	High or Moderate		Yes
Moderate	Low	High or Moderate	Yes
Moderate	Low	Low	No
Low	High or Moderate	High or Moderate	Yes
Low	High or Moderate	Low	No
Low	Low		No

11. A summary of the principal comments and the agency responses to them:

Comment: The proposed rule is far too expansive regarding the types of public water systems that are specifically listed as systems suspected of using groundwater that is under the influence of surface water. In addition, the proposed rule is unfairly slanted towards classifying suspected groundwater systems as being under the direct influence of surface water. The proposed rule is especially troubling in light of the fact that ADEQ has chosen not to follow the federal surface water treatment rule which allows systems using groundwater under the direct influence of surface water to avoid the filtration requirement if certain criteria are met. In contrast, ADEQ automatically requires groundwater systems that are determined to be under the direct influence of surface water to provide treatment by filtration and disinfection. Accordingly, the rule should be signficantly revised, to provide a much more cautious and systematic approach to classifying groundwater systems as systems under the direct influence of surface water. If such significant revisions cannot be made because of administrative procedure constraints, ADEQ should strongly consider withdrawing the proposed rule. Such a withdrawal would be appropriate in light of the substantial and unnecessary cost that could be imposed on groundwater systems to install filtration and disinfection treatment under a defective and unworkable surface water influence determination procedure.

Response: ADEQ disagrees that the rule is "too expansive" regarding public water systems that are suspected of using groundwater under the direct influence of surface water. ADEQ lists 8 categories of sources that are suspected of being under the direct influence of surface water that will require further evaluation. These sources include springs, infiltration galleries, radial well collectors, Ranney wells, horizontal wells, shallow wells [< 50 feet to perforations or well screens], hand-dug or auger-bored wells without casings, groundwater sources with turbidity exceedances, groundwater sources with bacteriological contamination, and groundwater sources that are located within 500 feet of a surface water that are determined to be vulnerable to direct surface water influence through a vulnerability assessement. Of these 8 categories, EPA Region IX Guidance for the Determination of Groundwater Under the Direct Influence of Surface Water identifies springs, infiltration galleries, shallow wells that are less than 50 feet in depth, and wells into a shallow aquifer [that is, less than 50 feet to the water table] as sources that should be evaluated for direct surface water influence. ADEQ included radial well collectors, Ranney wells, horizontal wells, and hand-dug or auger-bored wells without casings in the list of "suspect" sources because these types of wells are either variations of infiltration galleries or types of shallow wells that should be evaluated for direct surface water influence.

The EPA Region IX Guidance for the Determination of Groundwater Under the Direct Influence of Surface Water also identifies wells that are greater than 50 feet deep as groundwater sources that should be evaluated for direct surface water influence if 1 of the following applies to the source: 1) the well casing does not penetrate a confining bed or the well casing is perforated or screened above a confining bed, 2) a well casing or collector lateral is located less than 200 feet from a surface water, 3) water quality records indicate that there is a record of total coliform or fecal coliform contamination in untreated samples collected from the well over the past 3 years, a history of turbidity problems associated with the source, or there is a known or suspected outbreak of *Giardia lamblia* cysts or other pathogenic microorganisms associated with surface water that has been attributed to the groundwater source, 4) there is evidence of particulate matter associated with a surface water in water from the well, or 5) data are available for turbidity or temperatures from the groundwater source and a nearby surface water that indicate that there is a correlation between the 2. The EPA Region IX guidance document states that any well that meets 1 of the above criteria should be evaluated to determine whether the groundwater source is directly influenced by surface water. In general, ADEQ's "suspect" criteria are consistent with this EPA guidance. ADEQ's list of "suspect" groundwater sources includes groundwater sources with exceedances of the interim MCL for turbidity and where total coliform, fecal coliform, or *E. Coli* are present in untreated groundwater from the source. ADEQ's list of "suspect" sources includes wells that are deeper than 50 feet if the well is located within 500 feet of a surface water and is determined to be vulnerable to direct surface water influence through a vulnerability assessment.

It should be noted that ADEQ has already made preliminary identifications of public water systems with a groundwater source that may be under the direct influence of surface water using the "suspect" criteria in the rule. Less than 20% of the public water systems in the state have been *preliminarily* identified as having a groundwater source that may be under the direct influence of surface water using the suspect criteria in the rule. A percentage of less than 20% can hardly be described as "far too expansive." Put another way, the adoption of this rule will have no effect on more than 80% of the public water systems in Arizona. It is reasonable to assume that 10% to 15% of the public water systems in the state will be minimally impacted by the monitoring requirements of the rule if it becomes effective. ADEQ expects that an even smaller percentage of public water systems will be finally determined to be using a groundwater source that is under the influence of surface water using the procedures in the rule (1% to 5%).

ADEQ does not agree that the rule is "unfairly slanted" towards classifying suspected groundwater systems as being under the direct influence of surface water. The rule establishes a multiple step process utilizing records reviews, sanitary surveys, and water quality monitoring to make the agency determination that groundwater is under the direct influence of surface water. The preliminary identification of suspect groundwater sources using the "suspect" criteria

in subsection (A) of the rule is only the 1st step in the process. Under the rule, ADEQ will conduct a sanitary survey of each public water system that has been preliminarily identified as using a "suspect" source to confirm that preliminary identification through an on-site evaluation of the source. The rule states that ADEQ will provide written notice to a public water system that it has a groundwater source that ADEQ believes meets 1 of the "suspect" criteria in the rule. ADEQ amended the rule to give the water supplier an opportunity to provide information to ADEQ to rebut a preliminary identification that a groundwater source may be under the direct influence of surface water. The rule requires evaluation of a "suspect" groundwater source using the EPA Consensus Method for Determining Groundwater Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis. The MPA method is a direct, quantitative measurement of groundwater quality that identifies specific bioindicators that typically occur in surface water that are found in groundwater samples. ADEQ believes that the MPA method is the most objective evaluation tool currently available to the Department to make the determination that a groundwater source is under the direct influence of surface water.

ADEQ revised the proposed rule to require 2 MPA test results indicating either a high or moderate risk of direct surface water influence before ADEQ will make a final determination that the groundwater is under the direct influence of surface water. In effect, the rule requires confirmation of a high or moderate risk of direct surface water influence before a final agency determination is made. ADEQ also revised the rule to allow a 2nd round of MPA monitoring if it is feasible to take corrective action to a source to prevent the direct influence of surface water. The rule provides for an appeal from a final determination by ADEQ that a source is under the direct influence of surface water. ADEQ disagrees that this multiple step process is "unfairly slanted" towards classifying groundwater sources as being under the direct influence of surface water. ADEQ disagrees that the proposed determination procedure is defective or unworkable. To use the commenter's words, the rule takes a "cautious and systematic approach" towards making final determinations as to whether a source is groundwater under the direct influence of surface water that is both substantively and procedurally fair.

Finally, ADEQ cannot consider the withdrawal or termination of the rulemaking because it would result in the further delay of implementation of a primacy requirement. The U.S. EPA Region IX guidance on groundwater under the direct influence of surface water states that each primacy agency was supposed to have developed a program for evaluating groundwater sources for direct surface water influence by December 30, 1990. Arizona is already more than 8 years late in developing its evaluation procedures. Arizona should have completed the evaluation of all community ground water systems for direct surface water influence by December 30, 1994, over 4 years ago. The deadline for completing the evaluation of noncommunity groundwater systems is June 29, 1999. ADEQ must have an effective rule in place before it can require MPA monitoring and complete the evaluations of groundwater systems for direct surface water influence.

Comment: Some public water systems using groundwater sources have already performed detailed parameter testing (an alternative method for determining surface water influence), under ADEQ supervision, to determine whether a groundwater source was under the direct influence of surface water. The Cyprus Bagdad Copper Corporation performed such testing on its Francis Creek system. The results from the water quality parameter testing (which took place over a 13-month period under ADEQ supervision) clearly indicated that the source is not under the direct influence of surface water. ADEQ recognized this determination in a letter dated March 21, 1997, from ADEQ to Cyprus Bagdad. ADEQ should not be allowed to use its new rule to force such systems, such as the Francis Creek system, to retest for surface water influence. Such an outcome suggests that ADEQ can change its sampling method whenever it chooses and subject public water systems to new sampling and testing requirements (double jeopardy). Cyprus Climax requests that ADEQ exempt public water systems, such as the Francis Creek system, from the monitoring requirements under its proposed rule if such systems have already demonstrated the lack of surface water influence by way of alternative methods.

Response: ADEQ disagrees that there should be an exemption in the rule for a public water system that has demonstrated a lack of surface water influence by way of an alternative method. In particular, ADEQ disagrees that the rule should specifically exempt a public water system that has conducted water quality parameter monitoring to determine whether a source is under the direct influence of surface water. First, ADEQ considered and specifically rejected alternative methods, including the use of the results from water quality parameter monitoring, as the basis for making a determination as to whether groundwater is under the direct influence of surface water. ADEQ rejected water quality parameter monitoring because it only provides indirect evidence of direct surface water influence.

Second, the Francis Creek system is the only public water system in Arizona that has conducted long-term water quality parameter monitoring of a source. The requested exemption would be for the benefit of 1 public water system in the state.

ADEQ also disagrees with the commenter's characterization of ADEQ's response to Cyprus Bagdad in the letter dated March 21, 1997. In the letter to Cyprus Bagdad cited by the commenter, ADEQ clearly states that a proposed

rule related to groundwater under the direct influence of surface water was under development. ADEQ's letter states that when the rule is finalized "sources such as your Francis Creek Spring Boxes, will in all probability be required to conduct the appropriate GWUDISW tests. Those test results will be used to determine, with physical evidence, whether or not the source water of that system is under the direct influence of surface water....The results from tests conducted on your system will dictate whether your spring boxes will be reclassified surface water [GWUDISW] or remain classified as groundwater." ADEQ's response clearly states that a final determination of direct surface water influence for the Francis Creek System had not been made. Cyprus Bagdad knew, or should have known, that ADEQ would require compliance with the monitoring requirements of the new rule when it became effective.

Fourth, the requested exemption for a GWUDISW determination based on "alternative methods" undermines the basic purpose of the rule. The intent of the rule is to establish a definitive method by which ADEQ will make the determination that a groundwater source is under the direct influence of surface water. ADEQ carefully considered and rejected the available methods for making this determination, including water quality parameter monitoring. If ADEQ creates the requested exemption in rule and allows public water systems to demonstrate that a groundwater source is not under the direct influence of surface water by alternative methods, it will create uncertainty as to what constitutes an acceptable alternative method and will undermine the determination procedure that is established by the rule. However, while ADEQ believes that the MPA is the best method currently available for making direct surface water influence determinations, ADEQ also recognizes that analytical technologies are constantly being developed and that a new method for determining direct surface water influence may become available in the future. For this reason, ADEQ amended the rule to permit a water supplier to submit a request for ADEQ to require the use of an alternative method.

Fifth, ADEQ revised the rule to provide water suppliers like Cyprus Bagdad with an opportunity to provide information to rebut a preliminary identification of a "suspect" source based upon the suspect criteria in the rule. ADEQ can and will consider the results of water quality parameter testing conducted by a water supplier before requiring MPA monitoring of a "suspect" source.

Finally, there is no "double jeopardy" associated with requiring Cyprus Bagdad to comply with monitoring requirements in a new safe drinking water rule when that rule becomes effective. Double jeopardy is a criminal law concept that refers to the constitutional prohibition against a 2nd prosecution after a 1st trial for the same offense. "Double jeopardy" has no relevance to compliance with a new administrative rule that imposes new monitoring requirements on public water systems.

Comment: ADEQ proposes to list springs as 1 of the sources suspected of using groundwater that is under the direct influence of surface water. Cyprus Climax agrees that springs may be more susceptible to surface water influences than typical groundwater wells. However, ADEQ should recognize that even the U.S. Environmental Protection Agency has determined that "[u]nder normal conditions, aquifers feeding springs are in a stable environment." In contrast, surface waters are subject to changing environments. Accordingly, springs generally are not connected with or influenced by surface water, unless there is some abnormality associated with the spring. The term, "springs," as proposed by ADEQ should be modified as follows: "Any spring (a) located within 500 feet of a perennial surface water, (b) with recurring violations of the maximum contaminant level for total coliform or turbidity, (c) with temperature fluctuations over the course of a year that correlate to similar changes in the temperature of surface water, or (d) with any significant visual evidence of surface water impacts."

Response: ADEQ disagrees. EPA Region IX "Guidance for the Determination of Groundwater Under the Direct Influence of Surface Water" states that springs are a source of water supply that should be evaluated for direct surface water influence. Springs normally flow by gravity and they are typically associated with shallow aquifers that may be under the direct influence of surface water. Also, springs may be open to the atmosphere or subject to surface water runoff. For these reasons, springs are preliminarily identified as "suspect" sources and a sanitary survey of every spring that is a source of drinking water supply should be conducted. ADEQ acknowledges that there may be some circumstances where MPA monitoring of a spring will not be required. For example, some springs are artesian springs that flow from deep, confined aquifers because of internal hydrostatic pressure. While all springs are preliminarily identified as "suspect" sources, a water supplier may rebut the preliminary identification of a "suspect" source by providing information that demonstrates that a spring is not subject to direct surface water influence because it is an artesian spring, the spring is adequately protected between the source aquifer and the ground surface, and the artesian spring is properly developed and located so that it is not open to the atmosphere or subject to surface water runoff. However, ADEQ disagrees that the "suspect" criterion of springs should be conditioned as recommended by the commenter. The location of a source within 500 feet of a perennial surface water, violations of an interim maximum contaminant level for turbidity, or bacteriological contamination of the source water are independent grounds for making a preliminary identification of a "suspect" source. No change to the rules.

Comment: ADEQ proposes to list "any well that is less than 500 feet from a surface water" as a category of "suspect" groundwater sources. There are several serious problems with this category of "suspect" groundwater sources. First, the fact that a well may be located within 500 feet of a water course has no meaning with respect to potential surface water impacts if the well is screened or perforated only in an aquifer deeper than the shallow alluvial aquifer associated with the water course. This category presumes that horizontal vicinity to a water course automatically implies some type of surface water influence. This is clearly not true in all instances. We recommend that ADEQ revise the 500 feet category to address the issue of depth as well as the issue of location within 500 feet of a surface water. With respect to depth, ADEQ should modify the 500 feet category to state that a well will qualify for the 500 feet "suspect" category only if it is screened or perforated in the upper alluvial aquifer.

Response: ADEQ agrees that the criterion which states that a well that is less than 500 feet from a surface water is suspected of being groundwater under the direct influence of surface water should be amended to include vulnerability criteria. ADEQ also agrees that the horizontal location of a well within 500 feet of a surface water should not, by itself, automatically result in the preliminary identification of a groundwater source as one that is suspected of being under the direct influence of surface water. ADEQ agrees that depth to groundwater and other hydrogeological factors should be considered in making decisions regarding whether to require MPA monitoring of a groundwater source that is located within 500 feet of a surface water. ADEQ amended subsection (A)(4) of the rule to include references to vulnerability assessment. The revised subsection states that a well that is less than 500 feet from a surface water is a "suspect" source if: 1) ADEQ determines by a vulnerability assessment that the source is vulnerable to direct surface water influence, or 2) ADEQ cannot assess the vulnerability of the groundwater source to the direct influence of surface water because of a lack of information or the uncertainty of available information on the local hydrogeology or well construction characteristics.

Comment: "Surface water" is not specifically defined for purposes of ADEQ's proposed rule. However, "surface water" is defined in the definition section of ADEQ's safe drinking water regulations as "any source that is exposed to the unenclosed atmosphere and that is subject to surface runoff." Surface water is also defined in ADEQ's surface water standards as equivalent to the "waters of the United States." "Waters of the United States" has been broadly construed to include the numerous dry (that is, ephemeral) washes, gullies, and arroyos that are found throughout Arizona. Reportedly, ADEQ has stated that it will apply the 500 feet category to not only perennial surface water sources but also to any other potential source (for example, dry washes, gullies, arroyos, etc.) that could have surface flows during stormwater events and are within 500 feet of a groundwater well. ADEQ's proposed application of the 500 foot category is inappropriate in a dry, arid state like Arizona. Virtually every groundwater well in the state likely will be within 500 feet of some type of dry gully, arroyo, or wash. The fact that a dry stream bed may occasionally have stormwater runoff does not mean that there is any connection with underlying groundwater. ADEQ has defined "ephemeral water" as "a surface water that has a channel that is at all times above the water table, that flows only in direct response to precipitation, and that does not support a self-sustaining fish population." The definition of "ephemeral water," which would apply to virtually every dry wash and arroyo in Arizona, clearly suggests that such waterways have no connection with underlying groundwater and therefore have no potential to directly influence groundwater. ADEQ should either change the term, "surface water," to "perennial surface water" or adopt a definition of surface water that excludes ephemeral waters from the definition.

Response: ADEQ disagrees that the phrase, "surface water," as used in the phrase "groundwater under the direct influence of surface water" should be defined to mean "perennial surface water" or that the definition should be limited to exclude ephemeral waters. ADEQ has no discretion to change the definition of "surface water" in the safe drinking water rules. The term, "surface water," as used in the phrase, "groundwater under the direct influence of surface water," is defined in the same way that the term is defined in the National Primary Drinking Water Regulations. As noted by the commenter, "surface water" means "any source that is exposed to the unenclosed atmosphere and that is subject to surface runoff" [*See* R18-4-101(89)] An ephemeral water is a "surface water" for purposes of the safe drinking water rules because it is open to the unenclosed atmosphere and subject to surface water runoff. In fact, an ephemeral water, by definition, is a water body that flows only in response to surface water runoff. Consequently, a groundwater source that may be directly influenced by recharge from an ephemeral water should be evaluated to determine whether it is under the direct influence of surface water.

ADEQ agrees that the location of a well within 500 feet of an ephemeral water does not necessarily mean that there is a hydrological connection between the ephemeral water and the underlying groundwater. For this reason, ADEQ added vulnerability assessment criteria to refine the 500-foot setback criterion that ADEQ proposed originally. ADEQ will consider hydrogeological factors such as depth to well screens, the rate of surface water recharge, the lateral and vertical distribution of aquifers, the presence or absence of confining layers, the permeability of materials in the vadose zone, and other relevant hydrogeological factors in making a determination regarding whether the source is vulnerable to direct surface water influence from an ephemeral water that is located within 500 feet. ADEQ expects that most wells that are 100 feet deep or more that are located within 500 feet of an ephemeral water will

probably not be vulnerable to direct surface water influence if there are materials of low permeability in the vadose zone.

Comment: ADEQ should review and revise its existing list of "suspect" groundwater systems because the list is based on over-expansive criteria. ADEQ is premature in listing certain systems as suspect systems before its proposed rule has been adopted or implemented.

Response: ADEQ disagrees that the list of criteria that will be used to identify groundwater sources that are suspected of being under the influence of surface water is "over-expansive." Less than 20% of the public water systems in the state have been preliminarily identified by ADEQ as utilizing a "suspect" groundwater source using the criteria in the proposed rule.

ADEQ also disagrees that it is premature in making preliminary identifications of public water systems using the "suspect" criteria in the proposed rule. ADEQ does not need a rule to conduct records reviews within the agency or to construct a list of public water systems that may be using a "suspect" groundwater source in anticipation of the effective date of the rule. There is no unfairness to public water systems from this internal agency action. A preliminary identification of a "suspect" groundwater source by ADEQ does not affect any public water system. ADEQ will not implement the rule in a way that affects a public water system until the rule is effective. ADEQ will conduct a sanitary survey of each public water system that is preliminarily identifies as using a "suspect" groundwater source after the effective date of the rule. This includes a resurvey of the 83 public water systems mentioned in the preamble to this rule that have already undergone a sanitary survey. ADEQ will not send a notice to a public water system informing the system that ADEQ believes it is using a "suspect" groundwater source until after the rule is effective and a sanitary survey or resurvey of the "suspect" source is conducted. Each public water system will have an opportunity to provide information to ADEQ to rebut a preliminary identification of a "suspect" groundwater source and no public water system will be required to conduct MPA monitoring of a "suspect" groundwater source until after the rule is effective.

Comment: There is no mechanism for a suspected groundwater system to refute past Microscopic Particle Analysis results to establish that the risk rating was the result of an anomaly or was corrected by remedial measures.

Response: ADEQ disagrees that there should be a specific appeal mechanism for refuting an individual MPA test result. An individual MPA test result is not an "appealable agency action" because it does not determine any legal rights, duties, or privileges of a public water system. The rule provides for an appeal from a final ADEQ determination that a groundwater source is under the direct influence of surface water. A final ADEQ determination that groundwater is under the direct influence of surface water is an "appealable agency action" as defined by A.R.S. § 41-1092(3). A water supplier may appeal a final ADEQ determination that a groundwater source is under the direct influence of surface water to an administrative law judge under the procedures that govern appeals before the Office of Administrative Hearings. Under A.R.S. § 41-1092.07(A), a water supplier has the right to a hearing and the right to submit evidence. All relevant evidence is admissible at the hearing before the administrative law judge. A water supplier may submit evidence that refutes individual MPA test results or that establishes that the MPA test results were the result of an anomaly. However, a water supplier cannot appeal and present such evidence until after a final determination by ADEQ is made.

ADEQ agrees that a water supplier should have an opportunity for a water supplier to take corrective action to a "suspect" groundwater source to prevent direct surface water influence if a corrective action is feasible. ADEQ revised the proposed rule to authorize schedules of compliance to take corrective actions and to permit a 2nd round of MPA monitoring [See R18-4-301.01(E)]. For example, a water supplier may be able to rehabilitate a well, drill a deeper well, make repairs to a spring box, or install other engineered controls to prevent direct surface water influence. A corrective action may be a technically feasible and less expensive than installing filtration and disinfection treatment. Ideally, the sanitary survey that is conducted prior to any MPA monitoring will identify feasible corrective actions that should be undertaken before the MPA monitoring of a "suspect" source is performed. However, ADEQ agrees that the rule should allow the option of taking corrective action when such action is feasible. The rule permits a 2nd round of MPA monitoring after a corrective action has been taken before a final determination of direct surface water influence is made. ADEQ revised the proposed rule by adding a new subsection (F) to allow this compliance option.

Comment: The proposed rule fails to exempt groundwater systems that have already performed sampling under ADEQ supervision using acceptable alternative methods to verify the absence of surface water influence.

Response: ADEQ disagrees that it should create a specific exemption for a groundwater system that used an alternative method to demonstrate the absence of direct surface water influence. As noted in a previous comment, ADEQ is aware of only 1 public water system in Arizona that used an alternative method. The public water system performed long-term water quality parameter monitoring to investigate whether a "suspect" source was under the direct influence of surface water. ADEQ will take a "weight of the evidence" approach and consider available water quality

parameter data before making a decision as to whether MPA monitoring will be required at any source that has been preliminarily identified as a "suspect" source. However, ADEQ intends to use the results of MPA monitoring to make the final determination as to whether a groundwater source is under the direct influence of surface water.

Comment: The requirement to use licensed laboratories for performing analyses of samples from public water systems does not appear to have been addressed or even considered. This raises numerous concerns regarding the availability or ability of licensed laboratories to perform MPA analyses.

Response: The requirement to use licensed laboratories is not addressed in the new rule because that requirement is already addressed in R18-4-107. R18-4-107 states that "[a]nalytical results from a sample taken by a public water system shall be valid only if the sample has been analyzed by a laboratory that is licensed to perform such analysis by the Arizona Department of Health Services...." The regulatory requirement to use a licensed laboratory applies to laboratories that conduct MPA analyses.

ADEQ shares the commenter's concern regarding the availability of licensed laboratories to perform the MPA. The EPA Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis [MPA] is not listed as an ADHS-approved method in A.A.C. R9-14-609, the applicable ADHS laboratory licensure rule. Since the MPA is currently not an ADHS-approved method, ADHS has not licensed any environmental laboratories to perform the MPA test. However, the ADHS rules on the licensing of environmental laboratories provide for approval of analytical methods under R9-14-608(B) when an approved method is not available for a particular testing program, category of testing, or parameter and a different method is required by ADEQ. Under R9-14-608(B)(1), a laboratory may submit a petition to ADHS for approval of an existing method that is not an ADHS-approved method under Title 9, Chapter 14, Article 6. A petition for method approval must include a reference to the ADEQ statute or rule which requires the use of the method. If this rule becomes effective, a laboratory can petition ADHS to approve the MPA method citing R18-4-301.01 which requires its use. Also, ADEQ will request that ADHS approve the MPA method as soon as possible after the rule is effective. ADEQ believes that a rule that requires the use of the MPA method must be effective before a request for ADHS approval under R9-14-608(B)(1) can be made.

ADEQ considered the availability of licensed laboratories to perform the MPA before proposing the rule. In the preamble to the proposed rule, there is a discussion of the benefits that will accrue to testing laboratories with the capability of performing microscopic particulate analysis. ADEQ is aware of 1 laboratory in Arizona that currently performs the MPA. ADEQ is aware of at least 20 out-of-state laboratories that perform the MPA. ADEQ anticipates that 1 or more of these laboratories will seek ADHS approval of the MPA method and seek laboratory licensure after the rule becomes effective.

Comment: The list of criteria provided in R18-4-301.01(A) should be more specific, as many of them can include a large number of sources than the more defined subset the Department is looking for. Instead of having nine, independent, evenly weighted factors, a tiered approach such as the one being considered for the Groundwater Disinfection Rule may be more beneficial. Not all factors are equal and therefore should not be treated the same.

Response: ADEQ disagrees that the "suspect" criteria in R18-4-301(A) should be weighted. ADEQ believes that a public water system that uses a source that meets any 1 of the suspect criteria identified in subsection (A) of the rule should be evaluated further to determine whether the source is under the direct influence of surface water. ADEQ believes that the rule, as proposed, already employs a "tiered" approach to making the determination that groundwater is under the direct influence of surface water. The rule establishes a multiple-step process that begins with the preliminary identification of "suspect" sources, on-site inspection of sources during sanitary surveys, and water quality monitoring using microscopic particulate analysis. In some cases, the rule also requires a vulnerability assessment. Finally, ADEQ does not have a rational basis for weighting the "suspect" criteria prescribed in subsection (A). No change to the rule.

Comment: R18-4-301(A)(4) of the proposed rule states that "any well that is less than 500 feet from a surface water" will be considered "suspect." More definitive well characteristics should be included, that is, depth to groundwater, topography, and geology, which can play a much larger role than distance to a surface water. The depth of the well is of critical importance and should be specified. "Surface water" should be more specifically defined. Does the fact that a wash flows continuously or is of a particular size and volume, when combined with specific well characteristics, make a groundwater source more or less vulnerable? The intent is to locate all the sources that may be potentially vulnerable, and data on well construction and screening should be available to eliminate many deep production wells that may be several hundred feet from the banks of a small intermittently flowing wash.

Response: ADEQ agrees that R18-4-301(A)(4) should be amended and that more specific "suspect" criteria for wells that are located within 500 feet of a surface water should be prescribed. ADEQ agrees that a specific reference to the vulnerability of the groundwater source to direct surface water influence should be added to the rule [*See* discussion

in the preamble on vulnerability assessment]. ADEQ disagrees that "surface water" should be more specifically defined. The definition of "surface water" is a restatement of the current definition of "surface water" that is found in the National Primary Drinking Water Regulations. ADEQ's definition of "surface water" must be consistent with the federal definition.

Comment: R18-4-301.01(A)(7) in the proposed rule states that "any groundwater source that has recurring exceedances of the MCL for turbidity" is considered to be suspect. Under the current R18-4-204, samples are analyzed for turbidity are collected once per day from a surface water system that does not provide filtration. The definition of a surface water system is "a public water system that uses surface water or groundwater under the direct influence of surface water, in whole or in part, as a source." If turbidity compliance data is already available for a groundwater source, presumably this monitoring is being done and the groundwater source is already recognized to be under the influence of surface water. This proposed criterion is redundant with other existing sections of the rule and may not be necessary.

Response: ADEQ agrees that R18-4-301.01(A)(7), as proposed, is circular and should be amended. ADEQ also agrees with the commenter that a groundwater system is *not* usually required to conduct routine monitoring to determine compliance with the interim maximum contaminant level for turbidity. The commenter is correct that "surface water systems" are the only public water systems that are required to conduct routine monitoring for turbidity. Consequently, compliance data on turbidity will generally be available only for a public water system that is a surface water system or one that has already been determined to be using a groundwater source that is under the direct influence of surface water.

R18-4-301.01(A)(7), as proposed, did not make sense as a criterion for identifying a *suspect* groundwater source because compliance data which demonstrates "recurring exceedances of the interim maximum contaminant for turbidity" will generally not be available for a groundwater system. However, as ADEQ discusses in the preamble to this rulemaking, turbid groundwater is an indicator that a groundwater source may be under the direct influence of surface water. Also, the current groundwater treatment rule, R18-4-304(B), states that the Department may require a groundwater system to monitor for turbidity to determine whether the groundwater system is under the direct influence of surface water. Thus, there may be situations where turbidity monitoring data for a groundwater source is available. ADEQ amended the proposed rule to be consistent with R18-4-304(B). The final rule states that if turbidity monitoring data *is available* for a groundwater source and the turbidity monitoring results demonstrate that the groundwater exceeds 1 of the interim maximum contaminant levels for turbidity that are prescribed in R18-4-204, ADEQ will preliminarily identify the groundwater source as "suspect." If a groundwater source is identified as a "suspect" source, ADEQ will conduct a sanitary survey of the source. The turbidity of the groundwater is just 1 of the factors that ADEQ will consider in making a decision whether to require the public water system to conduct MPA monitoring. If ADEQ requires MPA monitoring, the final determination as to whether the groundwater source is under the direct influence of surface water will be based on the MPA monitoring results, not the results of turbidity monitoring.

Comment: R18-4-301.01(A)(8) refers to recurring exceedances of the MCL for total coliform. Water systems are required to test their distribution systems, not their groundwater sources for compliance with the MCL for total coliform. As written, clarification is needed on what is meant by "recurring violations." Where, when, and the frequency of these violations needs to be defined. Does the proposed text refer to a sample from the wellhead or from anywhere in the distribution system?

Response: The proposed R18-4-301.01(A)(8) stated that a groundwater source "with recurring violations of a maximum contaminant level for total coliform" is a "suspect" groundwater source. ADEQ agrees with the commenter that this language is confusing. The commenter is correct that a public water system conducts routine monitoring to determine compliance with the maximum contaminant levels for total coliform at sampling sites that are representative of drinking water *in the distribution system*. Public water systems usually do not conduct total coliform monitoring at a source. ADEQ originally intended to refer to violations in untreated groundwater samples that are collected at the source, not from sampling sites in the distribution system. However, the language of the rule is confusing because violations of the MCL for total coliform are defined by reference to monitoring results from distribution system samples. ADEQ revised the rule and eliminated the reference to "recurring" violations of the MCL for total coliform. The final rule states that if bacteriological water quality data are available for a groundwater source that indicate the presence of total coliform, fecal coliform, or *E. Coli* bacteria *in untreated groundwater from the source*, ADEQ will consider the source to be a "suspect" source.

The bacteriological contamination of a groundwater source is cause for suspecting that a groundwater source may be under the direct influence of surface water. If there is a history of total coliform contamination in a groundwater system and the violations of the MCLs for total coliform cannot be attributed to a distribution system problem or there is no explanation for the violations, the groundwater source should be analyzed to see if it is contaminated. If bacteriological analysis of untreated groundwater from the source indicates that it is contaminated, then the source water

should be evaluated using microscopic particulate analysis to determine whether the source is under the direct influence of surface water. The MPA monitoring results will determine whether treatment by filtration and disinfection are necessary or whether groundwater disinfection alone will provide adequate treatment.

ADEQ acknowledges that new well development, well rehabilitation, source modifications, and repairs may result in the bacteriological contamination of a groundwater source. Bacteriological contamination that is explained by such factors is *not* a basis for preliminarily identifying a groundwater source as a "suspect" source. On the other hand, if water quality data for a groundwater source are available that indicate that a groundwater source is contaminated and the bacteriological contamination of the source cannot be explained by new well development, well rehabilitation, source modification, or repairs, then ADEQ may preliminarily identify the source as a "suspect" source, conduct a sanitary survey of the system, and may require MPA monitoring.

Comment: There is no discussion of the subject of recharge systems. How are they going to be looked at with regard to this proposed rule? How will recharged surface or groundwater fit into this scenario? Would a recharge system be considered a type of infiltration gallery system?

Response: The proposed rule does not specifically address recovery wells for groundwater recharge systems. In general, a recovery well that meets 1 of the suspect criteria prescribed in R18-4-301.01(A) will be considered "suspect." It is possible that ADEQ will require a water supplier to conduct MPA monitoring at a recovery well for a recharge system. A recharge system could be considered a type of infiltration gallery system depending upon the construction characteristics of the recharge system. Also, recovery wells could be evaluated under the "suspect" criteria that apply to wells in general. For example, a recovery well that is less than 50 feet to the well screen or one that is located within 500 feet of an infiltration basin and is determined to be vulnerable to the direct influence of the recharged surface water through a vulnerability assessment is "suspect" and may be required to conduct MPA monitoring.

Comment: The suspect criteria could and should be part of the routine sanitary survey and continuously evaluated. For example, under R18-4-118(C), groundwater systems and wellhead systems are specifically addressed. These areas need to be tied together: sanitary survey, wellhead protection, and the vulnerability of groundwater sources.

Response: ADEQ agrees that the preliminary identification of a "suspect" groundwater source should be followed by a sanitary survey of the public water system. ADEQ revised the proposed rule to clarify that ADEQ will conduct a sanitary survey of each public water system that is preliminarily identified as using a "suspect" groundwater source. ADEQ also agrees that groundwater vulnerability to direct surface water influence is an important factor that needs to be considered in identifying "suspect" groundwater sources. ADEQ revised the proposed rule to include vulnerability assessment criteria for wells that are located within 500 feet of a surface water.

Comment: The rule needs to include some written provision for allowing a system time to explain and document a source's susceptibility prior to MPA testing. A specified period of time should be given to produce any additional information or data that the department may not have already reviewed prior to their determination of vulnerability. Not all the information in the various state databases is reliable and current.

Response: ADEQ agrees. ADEQ revised the proposed rule to give the public water system an opportunity to provide information to ADEQ to rebut a preliminary identification of a "suspect" groundwater source [*See* subsection C in the final rule].

Comment: Our comment centers on determining "suspect" groundwater sources, specifically wells that are located within 500 feet of a surface water. Is "surface water" a continuous stream or a dry wash that runs infrequently and only as a result of heavy rain? This determination should not be left solely to the discretion of the inspector performing the sanitary survey because there are no guidelines to assist in making the decision. This situation would be worse for an inexperienced inspector.

Response: The term, "surface water," includes perennial, intermittent, and ephemeral streams. It includes dry washes that run infrequently in direct response to precipitation. A well that is located within 500 feet of a dry wash that flows in response to a storm event is "suspect" if ADEQ determines from a vulnerability assessment that the source is vulnerable to the direct influence from surface water when water flows in the ephemeral water. The well could be considered a "suspect" source if there is inadequate information to assess the vulnerability of the groundwater source. The preamble to this rule describes how ADEQ will conduct vulnerability assessments. ADEQ will develop implementation guidelines for its field services staff to provide consistent guidance on assessing vulnerability to direct surface water influence.

Comment: We understand that the Department is considering a standard under which all "waters of the United States" administered under the Clean Water Act [CWA] would be considered surface waters under this Safe Drinking Water Act regulation. We point out that "waters of the United States" under the CWA includes not just traditional surface waters such as lakes and perennial streams, but also intermittent and ephemeral streams. Under fairly aggressive

interpretations by EPA and the Corps of Engineers, ephemeral washes only a few feet wide are considered to be "waters of the United States." Such an aggressive interpretation of "surface water" under the Safe Drinking Water Act is not appropriate or necessary to protect water quality. The 500-foot standard may be appropriate for wells located in proximity to traditional surface waters such as lakes, rivers, or even intermittent streams, where the extended presence of water leads to a high water table and therefore direct communication between surface and groundwater. It would appear that in the context of ephemeral washes, only truly shallow wells [those under 50 feet in depth] would be susceptible. Since these wells are covered under another criterion, it would appear to exclude ephemeral waters from the definition of surface waters for the purposes of this rule. Therefore, a better standard would be to consider only intermittent or perennial streams, or other bodies of water in which water is physically present most of the time, as "surface water."

Response: ADEQ disagrees. The term, "surface water," includes perennial, intermittent, and ephemeral streams. As noted in the response to a previous comment, ADEQ included vulnerability criteria to the "suspect" criterion that is based on the 500-foot setback from a "surface water." ADEQ agrees that hydrogeological and well construction factors need to be considered in assessing whether a well that is located within 500 feet of an ephemeral water is vulnerable to direct surface water influence. The rate of surface water recharge, the depth to the well screen, travel time in the vadose zone, the existence of confining conditions or some other natural hydrogeological barrier are relevant factors that should be considered in assessing the vulnerability of a well that is located within 500 feet of an ephemeral water.

Comment: Another issue arises if the surface water is an ephemeral wash. When should the MPA test be taken at the well? The sample should be taken when water is running through the wash. However, if the well is located in a remote area, the operator may not know if it is raining or there is water in the wash. The water system could innocently violate the order to perform the test. Again, more guidance is needed than what is provided in the proposed rule if dry washes are considered surface water to protect the water system from innocently violating an order to perform the MPA test.

Response: The rule states that the Department shall schedule MPA monitoring at a time when the groundwater source is most susceptible to direct surface water influence. In the case of a well that is located near an ephemeral water, the time when a nearby well is most susceptible to direct surface water influence is at or near the time when surface water is running in the wash. The rule is written in a way that provides guidance as to when MPA monitoring should be conducted while preserving some flexibility in scheduling MPA monitoring.

Comment: The 1st sentence of R18-4-301.01(B) provides that ADEQ "may require a public water system which is suspected of utilizing a groundwater source that is under the direct influence of surface water to conduct [MPA] monitoring of the groundwater source." However, ADEQ's explanation of the proposed rule states that the rule *requires* suspect groundwater systems to conduct MPA monitoring. Cyprus Climax concurs with the existing language in the proposed rule that gives ADEQ discretion to require MPA analysis of suspect groundwater sources. Because of the broad suspect categories proposed by ADEQ, ADEQ clearly should have discretion to not require certain suspect systems to conduct MPA monitoring if other factors suggest that no surface water influence is present or expected. Such other factors should include prior testing performed by a system that demonstrates that the characteristics of the groundwater do not correlate to surface water conditions.

Response: ADEQ agrees that the rule should not require MPA monitoring of all sources that are preliminarily identified as "suspect" groundwater sources. The preliminary identification of a "suspect" groundwater source is only the 1st step in a multiple step process to determine whether the groundwater source is under the direct influence. ADEQ will conduct a sanitary survey of each public water system to confirm preliminary identifications of "suspect" groundwater sources. ADEQ will consider information provided by the water supplier to rebut a preliminary identification of a "suspect" groundwater source. The rule establishes a "weight of the evidence" approach to the decision whether to require MPA monitoring. For this reason, the rule retains the language which states that ADEQ *may* require MPA monitoring of a "suspect" source [*See* subsection (D) of the final rule].

Comment: While Cyprus Climax concurs that MPA monitoring ideally should be conducted during the period of highest susceptibility to direct influence by surface water, the examples listed by ADEQ in the rule explanation are unreasonable. ADEQ states that "a groundwater source may be subject to influence by surface water only after a rainfall event when a nearby ephemeral stream is flowing or when winter snowmelt causes a nearby intermittent stream to flow." This suggests that MPA monitoring will only be allowed when large enough storm events occur in the vicinity of the groundwater well or other source. This requirement could result in dangerous sampling conditions for many water systems, especially systems located in remote areas. In addition, occasional surface flows in ephemeral streams, as noted above, are not likely to have any impact on groundwater wells located in the vicinity given that the surface flow is not hydrologically connected to the underlying groundwater. Moreover, such events are infrequent and would not be representative of normal conditions. This is especially troubling when ADEQ has proposed that only 1

MPA high risk rating will automatically require a system to provide filtration and disinfection treatment. Consequently, ADEQ's proposed rule could subject groundwater systems to costly treatment processes based upon abnormal conditions.

Response: As stated in the final rule, MPA monitoring should be scheduled when a groundwater source is most susceptible to direct surface water influence. For a well that is located within 500 feet of an ephemeral water, MPA monitoring should be scheduled when there is flow or within a reasonable time after there is flow in the ephemeral water. In ADEQ's view, a groundwater source that is located near an ephemeral water is most susceptible to direct surface water influence when there is surface water in the ephemeral water to influence the source. The rule is written to provide some guidance regarding when MPA monitoring should occur while preserving regulatory flexibility and not being overly-prescriptive. ADEQ will implement the rule in a common sense manner. ADEQ will not schedule MPA monitoring during flash floods or at times when it would be unsafe or dangerous for a water supplier or ADEQ to conduct sampling. ADEQ disagrees with the part of the comment that states categorically that occasional flows in an ephemeral water are not hydrologically connected to the underlying groundwater or that surface water flow in an ephemeral water represents an abnormal condition. While it is true that surface water flows in Arizona's ephemeral waters may be infrequent, it is at such times that a groundwater source may be most susceptible to direct surface water influence from an ephemeral water. The purpose of the MPA monitoring is to determine objectively whether there is a hydrological connection between a groundwater source and a nearby ephemeral water. ADEQ will not make the assumption that groundwater sources are not hydrologically connected to ephemeral waters. While ephemeral waters are defined as being above the water table at all times, this does not mean that flow in ephemeral water cannot directly influence a groundwater source.

Comment: The proposed rule provides that if the MPA risk rating of the initial sample indicates a high risk of contamination, ADEQ shall determine that the groundwater is under the direct influence of surface water. The result of such a determination requires the affected system to provide filtration and disinfection treatment. There is no provision for escaping such a determination once a MPA high risk rating is applied to a particular system. This outcome is unfair and unreasonable. In the 1st place, the high risk rating may simply be the result of faulty well construction or other similar circumstance that could be remediated by inexpensive measures. In such a situation, the appropriate response should be allow the system to make any necessary repairs and then retest to confirm the absence of any surface water influence. ADEQ's proposed rule would not allow for such a simple and inexpensive resolution. ADEQ's proposed rule also ignores the possibility that the MPA risk rating obtained from an initial sample could be the result of extremely abnormal conditions, especially given ADEQ's predisposition to require sampling only during extraordinary circumstances. In addition, the results could be an unexpected anomaly. ADEQ's proposed procedure would not allow a water system to refute the results of an initial sample. The problem with using only 1 MPA result to require filtration and disinfection treatment is highlighted by the introductory language to EPA's Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis. EPA's Consensus Method expressly states that "it should be emphasized that surface water influence on a groundwater source cannot be determined solely on the basis of 1 or 2 MPA's. Other pertinent information...should be gathered from each individual source in accordance with criteria established by the primary agency." ADEQ's proposal to require only 1 high risk rating to force groundwater systems into providing filtration and disinfection treatment is directly contrary to EPA's Consensus Method. ADEQ's proposed procedure for determining whether groundwater systems are under the direct influence of surface water clearly should be substantially revised to allow facilities to refute high or moderate risk ratings or to perform necessary repairs to eliminate surface water impacts. If such changes are not made, the rule becomes very unworkable. In fact, the rule places ADEQ in a very difficult position since the rule requires ADEQ to declare a groundwater system subject to filtration and disinfection requirements based on 1 or 2 MPA analyses, even if subsequent MPA analyses indicate consistent low risk ratings. The only remedy provided for in the proposed rule is through the use of expensive and formal administrative appeal procedures. However, because of how the proposed rule is written [it states that ADEQ shall use the MPA risk rating to determine whether a groundwater source is under the direct influence of surface water], neither ADEQ nor an administrative law judge would have the legal flexibility to overturn the outcome from an initial MPA sample result.

Response: ADEQ agrees and revised the proposed rule to require at least 2 MPA results indicating a high or moderate risk of direct surface water influence before making a final determination that a groundwater source is under the direct influence of surface water. The amended rule does not allow a final determination to be made on the basis of a single MPA sample result. In effect, ADEQ revised the rule to require a confirmation MPA sample.

ADEQ also agrees that there may be some situations where well construction deficiencies or similar circumstances that can be remediated by relatively inexpensive repairs should be undertaken 1st before MPA monitoring of a "suspect" groundwater source is undertaken. One of the purposes of the sanitary survey of a public water system will be to evaluate whether such circumstances exist and permit a water supplier to undertake necessary repairs *before* MPA monitoring is done. ADEQ also revised the rule to provide an opportunity for a water supplier to undertake a correc-

tive action *after* an initial round of MPA monitoring is conducted and then to conduct a 2nd round of MPA monitoring.

The commenter is correct that the EPA Consensus Method for Determining Groundwater Under the Direct Influence of Surface Water specifically cautions against the use of 1 or 2 MPA results as the basis for making a direct surface water influence determination. EPA states in the method that "other pertinent information as described in the USEPA Guidance Manual and elsewhere should be gathered from each individual source in accordance with criteria established by the primary agency." ADEQ is not proposing to make groundwater under the direct influence of surface water determinations solely on the basis of MPA sample results. ADEQ has adopted EPA's recommended multiple step method of determining whether a groundwater source is under the direct influence of surface water. This multiple step approach includes the preliminary identification of "suspect" groundwater sources based upon a records review, the review of information gathered during a sanitary survey of a public water system, and consideration of any information provided by the water supplier to rebut the preliminary identification of "suspect" sources.

Comment: ADEQ's proposed rule does not address the regulatory requirement that "analytical results from a sample taken by a public water system shall be valid only if the sample has been analyzed by a laboratory that is licensed to perform such analysis by the Arizona Department of Health Services." Because ADEQ has not proposed an exemption from this laboratory requirement for MPA monitoring, system operators arguably would be required to use licensed laboratories. However it unclear whether the Arizona Department of Health Services has licensed any laboratories to perform such analyses or whether any licensed laboratories even have the required expertise to perform such analyses. Although ADEQ noted in the economic impact summary that it is aware of only 1 testing laboratory in Arizona with the capability to do MPA analyses, ADEQ did not indicate whether this laboratory is licensed. This issue needs to be carefully considered and explored before any final rule is adopted. Otherwise, water systems may be forced to use laboratories to perform MPA analyses that simply are not equipped to accurately or correctly perform MPA analyses.

Response: ADEQ agrees that the issues of method approval and laboratory licensure are important and must be carefully considered and addressed before the rule is implemented. The commenter is correct that ADEQ's current safe drinking water rules require the use of licensed laboratories for drinking water analyses. R18-4-107 states: "[a]nalytical results from a sample taken by a public water system shall be valid only if the sample has been analyzed by a laboratory that is licensed to perform such analysis by the Arizona Department of Health Services." R18-4-106(A) states that the analysis of a sample to determine compliance with a MCL, treatment technique, or monitoring requirement prescribed in Chapter 4 must be in accordance with an analytical method that is approved by the U.S. Environmental Protection Agency or a method that is approved by the Arizona Department of Health Services for drinking water.

ADHS has not licensed any laboratory to perform the MPA test because the MPA method is not an EPA or ADHS-approved analytical method. However, under R18-14-608(B), ADHS has the authority to approve an alternative analytical method if an approved method is not available for a particular testing program, category of testing, or parameter, and a different method is required by ADEQ. For an existing method (such as the MPA) that has not been approved by ADHS, a laboratory may submit a petition to ADHS requesting approval. A petition for approval of an alternative analytical method must include a reference to the ADEQ statute or rule which requires the use of the different method.

As noted in the preamble, at least 1 laboratory in Arizona has the capability of performing the MPA test. ADEQ expects that when the rule becomes effective, this laboratory will petition ADHS and request approval of the MPA method as an alternative analytical method. If this rule is effective, the petitioner will be able to cite R18-4-301.01 which requires the use of the MPA method. ADEQ also will request that ADHS approve the MPA method as an alternative analytical method. ADEQ will not require any public water system to conduct MPA monitoring until the MPA method has been approved by ADHS as an alternative analytical method and at least 1 laboratory has been licensed by ADHS to perform the MPA.

Comment: ADEQ's preliminary economic summary focuses almost exclusively on the cost of performing MPA analyses and the potential number of systems that may be required to perform such analyses. While the potential impact of the rule with respect to sampling costs is exhaustively covered, the summary does not adequately address the more significant impact of the rule on systems that may undergo MPA monitoring and receive 1 high risk rating or 2 moderate risk ratings. As currently written, such results will automatically require affected public water systems to implement costly filtration and disinfection treatment. The summary has not adequately addressed this potential economic impact which could easily result in capital expenditures exceeding many millions of dollars. It is not enough for ADEQ to simply state that "the cost of installing filtration and disinfection treatment will vary depending upon the size of the public water system and the type of technology that is installed." The potential economic impact of such expenditures completely overshadows the primary focus of ADEQ's economic impact summary on the potential cost

of groundwater systems of performing MPA monitoring. The potential cost to install filtration and disinfection treatment clearly must be more carefully reviewed and summarized, especially in light of the proposed procedure which unfairly imposes filtration and disinfection treatment requirements on groundwater systems without establishing a procedure to refute negative MPA monitoring results.

Response: ADEQ agrees. The final economic, small business, and consumer impact statement in the preamble describes more fully the significant costs that are associated with the associated regulatory requirements of the surface water treatment rule to install filtration and disinfection treatment.

Addendum to Concise Explanatory Statement

Background: The Notice of Proposed Rulemaking for the groundwater under the direct influence of surface water rule was published in the Arizona Administrative Register on July 11, 1997. Three oral proceedings to take public comment on the proposed rule were held in late August and early September, 1997. The original public comment period for the rulemaking closed on September 12, 1997. ADEQ submitted a Notice of Final Rulemaking to the Governor's Regulatory Review Council [GRRC] with a transmittal letter that was dated September 9, 1998. The submittal of the rule to GRRC approximately 1 year after the close of the public comment period did not comply with A.R.S. § 41-1024(B). A.R.S. § 41-1024(B) requires an agency to either submit a rule to the GRRC or terminate a rulemaking proceeding within 120 days after the close of the record on a proposed rulemaking. GRRC staff advised ADEQ that it could reopen the administrative record on the proposed rule, take additional comments, and resubmit the rule to GRRC. ADEQ published a Notice of Public Information in the October 30, 1998, issue of the *Arizona Administrative Register* to notice the reopening of the rulemaking record and the extension of the public comment period until December 1, 1998. The following public comments were received by ADEQ prior to close of the 2nd public comment period:

Comment: The proposed rule states at R18-4-301(A)(9) that a groundwater source for which temperature data are available that show that the temperature of the groundwater fluctuates 15% to 20% from the mean groundwater temperature over the course of a year is considered a "suspect" source. The proposed rule specifies the range of temperature fluctuation to be only between 15% and 20%. What about if the temperature fluctuation exceeds 20%? Although I think that the intention of the proposed rule is to classify a source where the temperature fluctuates more than 20% as groundwater under the direct influence of surface water, the rule does not reflect this intention explicitly and can it can be argued otherwise.

Response: ADEQ eliminated temperature changes as 1 of the criteria for the preliminary identification of a "suspect" groundwater source. While EPA guidance on groundwater under the direct influence of surface water identifies temperature changes of 15% or more from the mean groundwater temperature and groundwater temperatures that closely correlate to surface water temperatures as being indicators of direct surface water influence, it is extremely unlikely that temperature data will be available for either groundwater or surface water sources that ADEQ can use to make a preliminary identification of a "suspect" source. ADEQ amended the rule by removing the "suspect" criterion that relies on temperature data because public water systems do not routinely monitor groundwater temperatures at sources or monitor the temperature of nearby surface waters.

Comment: The preamble states at p. 9 that a well that is more than 50 feet deep to the well screen may be considered a "suspect" source if bacteriological water quality data for untreated groundwater taken from the well are available and the data indicate the presence of total coliform, fecal coliform, or *E. Coli* bacteria. A newly drilled well will often have coliform "hits" on its 1st sampling. It is not uncommon for a new well to take several pumping episodes followed by chlorination for the well to clean up. There should be some provision for new well development instead of the blanket "no record of coliforms in untreated samples of groundwater."

Response: ADEQ agrees that there may be coliform "hits" associated with new well development, well rehabilitation, source modification, repair, or maintenance that are not indicators of direct surface water influence. ADEQ revised the "suspect" criterion to clarify that the presence of coliform bacteria in untreated groundwater from a source that is explained by new well development, well rehabilitation, source modification, repair, or maintenance is *not* a ground for suspecting direct surface water influence.

Comment: The use of the MPA test should be reviewed. The MPA is a highly subjective test and directly dependent on the skill level of the microscopist doing the examination. If the stated purpose of the regulations is to protect the public from *Giardia lamblia* and other parasites, then why not test for *Giardia lamblia* and *Crypotsporidium* instead of bug parts? The University of Arizona has a laboratory which is certified for *Giardia lamblia* and *Cryptosporidium* testing. These are specific, harmful organisms. Continuous improvement in testing for these organisms can be expected. The Metropolitan Water District of Southern California has recently patented a test for *Crypotsporidium* which should be a much more sensitive test than the MPA. It is not a good idea to specifically tie a test into a regulation unless a codicil can be attached which permits it to be easily superseded by superior tests as they are developed.

I recommend that language to the effect that the best available test or the MPA be used to determine whether or not a well is under the direct influence of surface water.

Response: ADEQ disagrees that the use of the MPA test should be reviewed. ADEQ agrees with the commenter that certain aspects of the MPA test may be subjective because the interpretation of results from the MPA is dependent upon the level of training and the experience of the microscopist who employs the method. ADEQ also acknowledges that standardized reference methods for microscopic particulate analysis have not been developed and that the MPA is only a "consensus" method. However, despite its limitations, ADEQ believes that the MPA is the best method currently available to the Department for determining whether groundwater is under the direct influence of surface water.

While there is no standardized reference method, the incorporation by reference of the MPA consensus protocol will result in consistency in the way that groundwater samples are collected and analyzed. Strict adherence to the MPA consensus protocol and the standards of identity that are published in the MPA consensus method document will help to maintain intralaboratory and interlaboratory quality assurance. While the MPA consensus method document states that a quality assurance / quality control (QA / QC) program for the MPA is "somewhat limited," the consensus method does prescribe a number of specific areas that should be included in a QA / QC program for laboratories performing the MPA. ADEQ believes that the consensus method protocol, even with its limited QA / QC procedures, contains an adequate set of operating principles that, if strictly followed, will produce data of defensible quality that can be used to make direct surface water influence determinations.

ADEQ disagrees that the rule should rely on monitoring for specific parasites, such as *Giardia lamblia* or *Cryptosporidium*. While these parasites are important parameters of concern, they are not the only pathogenic organisms that are found in surface water or in groundwater that is under the influence of surface water. Also, it must be remembered that the purpose of the MPA monitoring is *not* to determine whether a specific groundwater sample contains these specific pathogens. The purpose of the MPA monitoring is to determine whether groundwater is under the direct influence of surface water. The MPA is a screening method that relies on the detection and quantification of indicator parameters in groundwater that are typically found in surface waters. The indicator parameters include both *Giardia lamblia* and coccidia [*Cryptosporidium*]. However, the MPA also includes other bioindicators of surface water influence such as diatoms, algae, insects, and plant debris. If ADEQ relied solely on *Giardia lamblia* or *Cryptosporidium* monitoring to make direct surface water influence determinations, there is a greater possibility of "false negatives." For example, a groundwater sample may contain significant concentrations of diatoms, chlorophyll-containing algae, aquatic insects, and plant debris, but not contain a single *Giardia lamblia* cyst or *Cryptosporidium* oocyst. A negative result for *Giardia lamblia* or *Cryptosporidium* may reflect intermittent shedding patterns of cyts or oocysts in the environment, poor recovery efficiency, insufficient sampling volume, insufficient sampling frequency, or an inability to make a positive identification rather than the absence of direct surface water influence. The absence of *Giardia lamblia* cysts or *Cryptosporidium* oocysts in 1 or 2 groundwater samples does not mean that groundwater is *not* under the direct influence of surface water. On the other hand, the significant presence of the bioindicators that are detected and enumerated by the MPA method is a better indicator of direct surface water influence.

It also should be noted that methods for the detection and enumeration of *Giardia lamblia* cysts and *Cryptosporidium* oocysts share many of the same analytical limitations as the MPA consensus method. There are no standard methods for the detection and quantification of either *Giardia lamblia* or *Cryptosporidium*. The most recent edition of Standard Methods for the Examination of Water and Wastewater (20th Edition), includes a general discussion of the methods for *Giardia lamblia* and *Cryptosporidium*. The editors of Standard Methods note that while methods for *Giarida lamblia* and *Cryptosprodium* have appeared in previous editions of Standard Methods, the most recent edition does not include those methods. The discussion also notes that the need for quantitative methods for *Giardia lamblia* and *Cryptosporidium* for regulatory purposes resulted in method evaluation studies that underscored the deficiencies of the existing antibody-based immunofluorescence methods for these parameters. The cited deficiencies include requiring analysts with a high degree of training and experience, lengthy analysis time, high expense, lack of specificity, erratic efficiency, low precision, and difficulty in determining viability.

ADEQ disagrees that the rule should be revised to permit the use of the "best available test" to determine whether or not a well is under the direct influence of surface water. In ADEQ's opinion, the MPA is the best available test for making the determination as to whether a groundwater source is under the direct influence of surface water. The MPA directly measures groundwater quality. The MPA detects and enumerates bioindicators that are not normally found in groundwater and that are indicative of surface water influence. If ADEQ were to revise the rule to allow the use of the "best available test," the rule would be more vague and it would provide no guidance to ADEQ staff or the regulated community on how ADEQ will make the determination that groundwater is under the direct influence of surface water. The inclusion of such language in the rule would inevitably raise questions about what tests could be used to make the direct surface water influence determination and which test is the "best available." In ADEQ's view, opening the rule to allow the use of the "best available test" will result in less principled decisionmaking and a lack of con-

sistency in agency determinations of direct surface water influence. However, ADEQ recognizes that analytical technologies are constantly evolving and that improved methods of determining direct surface water influence may be developed in the future. For this reason, ADEQ revised the rule to allow a water supplier to submit an alternative method to ADEQ for consideration and approval. A new method also would have to be approved by ADHS.

Comment: How does ADEQ intend to apply the revised coliform criterion in the proposed rule, R18-4-301.01(A)(8), that identifies a source as suspect if "bacteriological water quality data are available that show that the groundwater violates a maximum contaminant level for total coliform?" ADEQ revised this criterion for clarification and stated in the CES that a coliform violation is considered which is "attributable to the source." But the proposed rule does not include the "attributable to the source" statement, and ADEQ's comment response does not state how "attributable to the source" would be decided. How will the determination be made of coliform MCL violations as attributable to a source, particularly if the system is served by more than 1 well? Although coliform MCL violations often are suspected as being attributable to distribution system problems, in the majority of cases, coliform violations cannot be definitely attributed to either the source or a specific distribution system problem. Would the coliform MCL violation criterion in all cases be applied as attributable to all sources in a system? If not, how will the "attributable to the source" determination be made? In our experience, it is unlikely that groundwater monitoring at the source will, in itself, determine the cause of positive coliform results in the distribution system, except in extreme cases of gross and continuing contamination of the source, as indicated by positive total coliform test results, that never is demonstrated in the distribution system (due to disinfection, dilution). This remains the case even when both source and distribution system samples are quantified and speciated to identify actual coliform present. At the very least, if attribution to the source is inherent in this coliform source criterion, this should be stated in the rule. Perhaps ADEQ's response in the CES could be used in the rule: "If a violation of the MCL for total coliform is directly attributable to a contaminated groundwater source, then the source..." is considered suspect and MPA is required. However, we feel that actual application of data available to ADEQ in able to attribute total coliform MCL violations to specific sources serving distribution systems will remain a questionable practice.

Response: ADEQ is persuaded that it should not use the violation of the maximum contaminant level (MCL) for total coliform as a "suspect" criterion. In proposing this "suspect" criterion, ADEQ originally intended to limit its application to the bacteriological contamination of a groundwater source. That is, ADEQ would consider a groundwater source to be "suspect" if water quality data were available that indicated that groundwater *at the source* was contaminated. However, the rule as originally proposed and as submitted to the Governor's Regulatory Review Council on September 9, 1998, was confusing and did not clearly reflect that intent. In particular, the reference in the rule to the violation of the *maximum contaminant level* for total coliform was confusing. The MCLs for total coliform are prescribed in the safe drinking water rules at R18-4-202. The MCLs for total coliform are expressed in terms of the bacteriological results of routine and repeat samples collected at sampling sites *that are representative of water that is delivered throughout a distribution system*. The current total coliform rule does not require that routine or repeat bacteriological samples be taken at sources or even at points-of-entry. Also, the repeat monitoring requirements in the current rule are designed to locate where a total coliform problem may be in the distribution system, not to determine whether contamination is attributable to a source. The commenter is correct that it is unlikely that ADEQ will have data to attribute a total coliform MCL violation to a groundwater source. In most cases, total coliform MCL violations are explained by distribution system problems or the cause of the MCL violation is unknown. For these reasons, ADEQ amended the "suspect" criterion proposed in subsection (A)(8) by deleting the reference to the violation of the MCL for total coliform. Instead, the revised rule states that ADEQ will consider a groundwater source to be "suspect" if water quality data *are available for a source* that show that total coliform, fecal coliform, or *E. Coli* bacteria are present *in untreated groundwater from the source*. ADEQ acknowledges that bacteriological water quality data will generally not be available for sources. Data may be available from source approval records or if a water supplier conducts special monitoring at a groundwater source. Because of these anticipated data gaps, ADEQ expects that this "suspect" criterion will be rarely used.

Comment: Although we agree that temperature fluctuations of 15% or more would indicate direct influence of surface water, the actual use of the temperature data criterion in R18-4-301.01(A)(9) is not adequately specified. How recent will data have to be? Will data from only the most recently available year be considered, particularly if data for the most recent year vary widely from earlier years? If only 1 temperature value per year is available, will data from multiple years be used? If a single very unusual temperature is recorded, but many other temperatures are closely grouped, will the outlying value be averaged in without distinction? Will there be any concern at all about quality of data or need for seasonal temperature data? Will 2 temperatures in a year be adequate, and, if so, how far apart in time would they have to be? Will systems be allowed time to provide temperature data quarterly or seasonally over the course of a year if the determination hinges on temperature data but inadequate or questionable data are available? Why is 20% specified as an upper limit of the 15% to 20% fluctuation range? Would a 25% fluctuation not cause a source to be considered suspect? We feel that all these types of questions need further consideration, particularly considering that temperature data is typically not compliance data for groundwater sources.

Response: The comment raises legitimate questions regarding data acceptability and data quality related to the implementation of the "suspect" criterion related to temperature. Also, ADEQ expects that the temperature criterion in subsection (A)(9) would be used rarely (if at all) as a basis for the preliminary identification of a "suspect" groundwater source because temperature data for groundwater sources and surface waters are generally not available to ADEQ. As the commenter correctly points out, public water systems are not required to submit temperature data to ADEQ for compliance purposes and ADEQ will not request that public water systems provide temperature data to the Department. For these reasons, ADEQ deleted the "suspect" criterion at (A)(9).

Comment: The CES for the proposed rule indicates that a preliminary records review will be conducted by ADEQ or the delegated counties to identify sources as suspect, and that for coliform MCL violations and temperature fluctuations, data which are "available" will apply. For coliform and temperature data, we doubt that data available in ADEQ records as compliance data will serve the intended purposes, and may lead to the inappropriate identification of sources as "suspect." We recommend that the rule be revised to establish minimum criteria for coliform and temperature data to be used to identify a source as "suspect."

Response: ADEQ disagrees that minimum data requirements for temperature and bacteriological data need to be specified in the rule. ADEQ revised the rule to delete subsection (A)(9) that related to temperature change as a ground for identifying a "suspect" source. ADEQ acknowledges that it probably will have very little bacteriological water quality data for groundwater sources in its compliance database. While a public water system may generate such data through special monitoring of its groundwater sources, there is a relatively small likelihood that bacteriological water quality data for a source will be routinely available for purposes of making preliminary identifications of "suspect" sources. ADEQ anticipates that the "suspect" criterion at (A)(8) will be rarely applied. For this reason, ADEQ thinks that it is unnecessary to describe minimum data requirements for coliform in the rule. Sample invalidation and QA / QC procedures are more appropriately included in an implementation guidance for the rule.

Comment: Systems should be allowed to acquire and submit additional temperature or coliform data if an ADEQ decision to identify a source as suspect based on a review of available data in records hinges on existing data which do not meet minimum criteria established in rule, rather than automatically being required to have MPA testing done.

Response: The proposed rule states that a water supplier may submit information to the Department to rebut a preliminary identification of a groundwater source as one that is suspected of being under the direct influence of surface water [*See* R18-4-301.01(C)].

Comment: ADEQ's rule development unit has commendably stated in the CES: "ADEQ will not require any public water system to conduct MPA monitoring until the MPA method has been approved by ADHS as an alternative analytical method and at least 1 laboratory has been licensed by ADHS to perform the MPA." However, although ADEQ hopes that the single Arizona lab now doing MPA analysis will petition for licensure when the rule is final, and that other labs outside the state will also become licensed, the statement about MPA analysis capability should be included in the rule itself. This would clarify what would be done in the event that analytical capability does not become available in time following finalization of the rule. If ADEQ prefers not to state the language provided in the CES regarding availability of MPA analysis in the rule itself, then at least some type of statement regarding implementation timeframes as related to analytical availability for MPA testing should be developed and added to the rule.

Response: ADEQ disagrees. A statement in the R18-4-301.01 that addresses analytical capability for the MPA would unnecessarily repeat requirements that are prescribed elsewhere in the safe drinking water rules. The safe drinking water rules already address requirements for the use of approved analytical methods and licensed laboratories at R18-4-106 and R18-4-107. These general requirements apply to the MPA. The concise explanatory statement explains how ADEQ interprets the requirements of R18-4-106 and R18-4-107 as they apply to the use of the MPA. ADEQ has already stated in this Notice of Final Rulemaking that it will not require any public water system to conduct MPA monitoring until the MPA test is approved by the Arizona Department of Health Services and at least 1 laboratory is licensed to perform the MPA. It is unnecessary to include this explanation in the rule language itself.

Comment: ADEQ states in the concise explanatory statement that "the intent of the rule is to establish a definitive method by which ADEQ will make the determination that a groundwater source is under the direct influence of surface water." Although MPA as a final step does provide a definitive method, the presently proposed temperature and coliform criteria to determine whether a source is suspect and requires MPA testing are not adequately developed. Although the rule has been improved by ADEQ's latest revisions, specification of use of temperature and coliform data remain inadequate. The amount of such data, timing, recentness, quality control, and sampling protocol of the data are undefined. And stating that available data is to used brings into question the meaning of "available." Will a water system be required to notify ADEQ of any all temperature data they have on a source or will ADEQ only review compliance data already on hand at the agency? If ADEQ intends to question systems about temperature data that may be available in water system records, will the systems be allowed to select temperature data that they wish to be considered, and not report other data for review? Although trust and honesty is always fundamental to compliance

monitoring, water systems need to be told what ADEQ expects in regard to available data, including whether data may be qualified or selected among in any way. The proposed rule should be amended to establish some type of minimum criteria for the quality, amount, and time of sampling of such data.

Response: ADEQ agrees that the comment raises significant questions regarding the minimum criteria for the quality, amount, and time of sampling for temperature water quality data. ADEQ withdrew temperature changes as a basis for a preliminary identification of a "suspect" source because of these types of quality assurance / quality control (QA / QC) issues and because ADEQ recognizes that temperature data will not be available to ADEQ to make preliminary identifications of "suspect" sources.

Comment: The proposed rule is inconsistent with remediation procedures in the proposed federal groundwater disinfection rule framework from the U.S. Environmental Protection Agency. The ADEQ has included criteria in the proposed GWUDISW rule for determining well vulnerability and if significant sanitary seal deficiencies exist. However, the ADEQ has assumed that the actual vulnerability will be known prior to the MPA testing. If MPA testing indicates direct influence, the ADEQ should allow the water provider to further examine and eliminate pollution sources or rehabilitate the well, then complete additional testing before requiring filtration and disinfection.

Response: ADEQ has not assumed that actual vulnerability will be known prior to MPA testing. ADEQ will conduct vulnerability assessments to evaluate the relative likelihood of vulnerability based upon well construction and hydrogeological factors. The purpose of the vulnerability assessment is to evaluate whether there is a reasonable potential for direct surface water influence that justifies further evaluation and MPA monitoring. ADEQ agrees that water suppliers should be provided an opportunity to take feasible corrective actions to a "suspect" source after MPA monitoring has been completed. ADEQ amended the rule to allow a water supplier to take corrective action to a source and complete a 2nd round of MPA monitoring before requiring filtration and disinfection [*See* R18-4-301.01(F)].

Comment: Public water system should be replaced with point-of-entry in the 1st sentence of subsection (A) of R18-4-301.01. This change will be consistent with the ADEQ drinking water rules and the Safe Drinking Water Act that the point of compliance in drinking water systems is at the point-of-entry. Otherwise, the 1st sentence in subsection (A) implies that all wells in a public water system with multiple points-of-entry will have to be MPA tested, even if only 1 point-of-entry is found to have a vulnerable well. Also, the 1st sentence in (A)(8) does not specify the origin of the collected sample. The sentence is not clearly worded and implies that all total coliform violations found in distribution system samples having originated from groundwater supply wells would be interpreted as groundwater having MCL violations. The point-of-entry reference needs to be also added to the 1st sentence of R18-4-301.01(C).

Response: ADEQ disagrees that the rule should include references to the point-of-entry. The purpose of subsection (A) of the rule is to list groundwater sources that ADEQ will consider to be "preliminarily" suspect. If a public water system uses 1 of the sources listed in R18-4-301.01(A), it triggers additional steps in the multiple step process outlined in the rule, including a sanitary survey of the public water system. R18-4-301.01(C) clearly states that ADEQ may require a public water system that is suspected of utilizing a groundwater source that is under the direct influence of surface water to conduct MPA monitoring *of the groundwater source*. It is an incorrect reading of the rule to interpret this language as somehow requiring the MPA testing of all wells in a public water system. ADEQ intends to require MPA monitoring of only those specific groundwater sources that are "suspect." The language clearly specifies source water monitoring and it is unreasonable to interpret the rule as requiring point-of-entry sampling as is suggested in the comment.

ADEQ revised subsection (A)(8) in the proposed rule that referred to violations of the MCL for total coliform. ADEQ eliminated the reference to MCL violations and clarified that it is bacteriological contamination of untreated groundwater from a specific source that is the basis for the preliminary identification of that source as "suspect."

Comment: The accuracy of the MPA test method needs to be discussed in the preamble. It is not known if any MPA test data has been collected by ADEQ in relationship to Arizona hydrology, hydrogeology, and climate. It has not been stated or shown that this method is applicable to arid regions.

Response: ADEQ does not agree that the MPA test method needs to validated for the arid Southwest. Groundwater should not contain *Giardia lamblia*, coccidia, diatoms, insects, algae, and other "plant debris." In ADEQ's opinion, they are valid bioindicators of direct surface water influence in all regions of the country. Groundwater should not contain significant numbers of these constituents, regardless of whether the groundwater is located in an aquifer in the desert Southwest or the temperate rainforests of the Pacific Northwest.

Comment: The details of the GWUDISW vulnerability assessment are inadequate and incomplete. The information provided is not completely consistent with the methodology developed recently in ADEQ's Source Water Assessment Program. The proposed vulnerability assessment in the GWUDISW refers to evaluating the rate of surface water

recharge, but no methodology and criteria are provided to ascertain if a vulnerability determination will be feasible or not under Arizona hydrogeologic conditions.

Response: The details of the GWUDISW vulnerability assessment are not prescribed in the rule. They are explained in the preamble to the rule. ADEQ agrees that the vulnerability assessment methodology described in the preamble to the rule is not completely consistent with the sensitivity determination procedure developed for ADEQ's Source Water Assessment Program (SWAP). The vulnerability assessment procedures and criteria are based upon those contained in a "Draft Groundwater Disinfection Rule (GDWR) Vulnerability Assessment Plan" (June 4, 1997) prepared by the U.S. Environmental Protection Agency Office of Ground Water and Drinking Water. ADEQ closely followed EPA's approach to the assessment of hydrogeologic sensitivity from the GDWR Vulnerability Assessment Plan.

In general, the purposes of the sensitivity determination procedure for the SWAP program and the rule's vulnerability assessment procedure are similar. The purpose of both procedures is to determine if a hydrogeological barrier exists that either prevents the migration of contaminants or the direct influence of surface water. The sensitivity determination procedure for the SWAP program consists of examining the hydrogeological characteristics of a groundwater source and a well's physical integrity. This approach is consistent with that contemplated by ADEQ to implement this rule. The EPA vulnerability methodology for the GWDR Vulnerability Assessment Plan evaluates local hydrogeology, well construction and condition, the presence of contaminant sources, and the application of management controls such as wellhead protection and setback distances.

The SWAP sensitivity determination procedure is less flexible than the vulnerability assessment procedure described for the GWUDISW rule. The only basis for determining that an adequate hydrogeological barrier exists under the SWAP sensitivity determination procedure is if there is at least a minimum of 50 feet of clay between the ground surface and the top of the screened interval or perforated casing interval and there is evidence that the 50-foot clay layer extends beyond the source water delineation area. Under the SWAP sensitivity determination procedure, the presence of an adequate hydrogeological barrier is determined from well drillers' logs or a hydrogeological report or cross-section of a groundwater basin or sub-basin compiled by either the U. S. Geological Survey, the Arizona Department of Water Resources, or the water supplier. If a hydrogeological report is provided by the public water system, it must be prepared by a consultant under the direction of a registered geologist or engineer. The SWAP program also provides for area-wide sensitivity determinations. For example, the Arizona Source Water Assessment Draft Plan states that many public water system drinking water supply wells in the state are located in the large alluvial basins of Arizona's Basin and Range Lowlands hydrogeologic province. The draft SWAP plan characterizes the entire hydrogeologic province as containing broad alluvial-filled basins with large, regional aquifers and states that the aquifers contain "highly conductive unconsolidated sediments which provide few barriers to the migration of contaminants." The SWAP draft plan goes on to state that "[a]ny wells located in such areas would be *automatically designated as sensitive*." The SWAP draft plan also automatically designates fractured bedrock aquifers and volcanic aquifers as hydrogeologically sensitive.

In contrast, the vulnerability assessment methodology for the groundwater under the direct influence of surface water rule is site-specific. Like the SWAP sensitivity determination procedure, ADEQ's vulnerability assessment methodology for the new rule seeks to determine whether confining conditions or a natural hydrogeological barrier exists to prevent the direct influence of surface water. However, the vulnerability assessment criteria for the GWUDISW rule are not limited only to the presence of a 50-foot clay layer. As explained in the preamble to this rule, a number of key hydrogeological criteria may be used independently or in combination to define whether a source aquifer is "sufficiently confined." These criteria include: a vertical hydraulic conductivity of a confining layer of 10^{-6} or 10^{-7} cm / sec., a 30-foot confining layer, a head differential between the source aquifer and the overlying aquifer, or a difference in water quality between a source aquifer and the overlying aquifer. Unlike the SWAP sensitivity determination procedure, the absence of a confining layer does not necessarily preclude a finding of low vulnerability. The vulnerability assessment procedure for the GWUDISW rule does not make areawide sensitivity designations such as automatically designating alluvial aquifers as hydrogeologically sensitive. By contrast, the vulnerability assessment criteria for the GWUDISW rule specifically addresses how to demonstrate the presence of a natural hydrogeological barrier in an unconfined setting like an alluvial aquifer.

ADEQ disagrees that the details of the vulnerability assessment procedures are inadequate and incomplete. The preamble to the Notice of Final Rulemaking describes how ADEQ will conduct vulnerability assessments for the rule. The level of detail on vulnerability assessment that is provided in the preamble to the rule is greater than that contained in ADEQ's Source Water Assessment Draft Plan. Finally, ADEQ disagrees that there must be a prior determination that the vulnerability assessment methodology that is described in the rule is "feasible under Arizona... hydrogeologic conditions." The vulnerability assessment methodology that is described in the preamble of the rule is a site-specific evaluation procedure that focuses on local hydrogeological conditions.

Comment: The economic impact analysis for the maximum cost scenario is likely underestimated. The maximum scenario treats all public water systems as having only 1 well. Reason stands that the 2 highly urbanized counties, Pima and Maricopa, will have public water systems having more than 1 well and greater densities of wells, thus having a higher probability of a well near an ephemeral water body. The preamble does not clarify why the ADEQ has failed to assess how many wells are vulnerable at the 2 largest water providers in Pima County after the comment period was closed in 1997 on the draft rule. These 2 water providers are not regulated by Pima County but by the ADEQ and should have been included in the economic impact review. For this reason, the District strongly disagrees with ADEQ's assessment that no new staff is required to implement and manage this rule.

Response: ADEQ acknowledges that certain large public water systems in Pima County and Maricopa County may have more than 1 "suspect" well and greater densities of wells. ADEQ discusses this possibility in the final economic impact statement for the rule. ADEQ's statement that no new staff will be required to implement and manage this rule is intended to apply to ADEQ staff. The statement is based upon the fact that no additional funds will be budgeted for the safe drinking water program for staff to implement the requirements of the rule. ADEQ will have to implement the rule within current staff and budget constraints.

Comment: The District does not support the forwarding by ADEQ of the proposed rule in January 1999, to the Governor's Regulatory Review Council as written because of previous comments and the need for public involvement for drafting the final rule. It would be inappropriate for the rule to go to GRRC due to the significant number of public comments on the draft rule and the lack of public involvement in formulating the revised rule since the close of the public comment period in 1997. A technical committee needs to be formed such as was used by ADEQ in developing the vulnerability methodology for the Source Water Assessment Program.

Response: ADEQ disagrees. There has been significant public involvement in the drafting of this rule. ADEQ conducted 3 oral proceedings and there were 2 rounds of public comment on proposed rule language. The public had 2 opportunities to comment on the formally proposed rule language. Several commenters took advantage of these opportunities for public involvement and submitted 2 sets of extensive written comments. As this lengthy Notice of Final Rulemaking makes clear, ADEQ considered the significant number of public comments received and was responsive to them. ADEQ met all of the legal requirements for public involvement in rulemaking for this rule. ADEQ submits that it has gone well beyond the public involvement requirements of the State Administrative Procedures Act.

Several significant changes have been made to the proposed rule in response to public comments received by the agency. For example, ADEQ revised the decision matrix for making a groundwater under the direct influence of surface water determination to require at least 2 moderate or high risk MPA results instead of one. ADEQ revised several of the suspect criteria that are grounds for the preliminary identification of suspect groundwater sources, including the addition of vulnerability assessment criteria for wells that are located within 500 feet of a surface water, the deletion of the "suspect" criterion related to temperature, and the revision of the suspect criterion related to bacteriological contamination of a source. ADEQ revised procedural aspects of the rule to permit the submittal of information by a water supplier to rebut a preliminary identification of a "suspect" groundwater source and to allow a water supplier to take corrective action to a source and to conduct a 2nd round of MPA monitoring. ADEQ substantially expanded the economic impact statement for the rule to more fully describe the impact of an ADEQ determination that a groundwater source is under the direct influence of surface water in response to criticisms of the preliminary summary of economic impacts of the proposed rule.

Finally, ADEQ would have to terminate this rulemaking to provide additional public involvement in the drafting of the rule or to form a technical advisory committee to assist in the development of a vulnerability assessment methodology. This rule has been under development for almost 2 years. The Notice of Docket Opening for this rule was published in the Arizona Administrative Register on March 28, 1997. If ADEQ terminates the rulemaking and starts over to provide additional public involvement, it will probably delay the effective date of this rule for at least another 9 months to a year. ADEQ cannot afford further delay in the adoption of this rule. As has been pointed out elsewhere in this document, ADEQ is already 5 years late in implementing the special primacy requirement to evaluate community groundwater systems for direct surface water influence. If the rulemaking is delayed further, ADEQ will miss the deadline in the National Primary Drinking Water Regulations for completing the evaluation of noncommunity water systems. ADEQ cannot complete the evaluations of public water systems without an effective rule in place that prescribes the procedures and decisionmaking criteria for evaluation of "suspect" groundwater sources and making direct surface water influence determinations.

Comment: One of the primary concerns with the proposed GWUDISW rule is the rule's failure to establish a mechanism by which a "suspected" groundwater system may refute past Microscopic Particle Analysis (MPA) results to demonstrate that the MPA risk rating was the result of a sampling anomaly or was later corrected by remedial measures (for example, repair and / or maintenance of engineered controls associated with the groundwater system). In

fact, ADEQ states in its September 9, 1998, submittal to GRRC that it "disagrees that there should be a specific mechanism for refuting MPA test results." ADEQ's rationale for this statement is that an individual MPA test results is not an appealable agency action until ADEQ makes a final determination that groundwater is under the direct influence of surface water. While [we] agree that ADEQ's final determination that a public water system is using groundwater under the direct influence of surface water is an "appealable agency action," the GWUDISW rule needs to provide that individual MPA test results can be disproved by subsequent repairs and / or alterations to a public water system to avoid potential surface water impacts. If the ability to overturn individual MPA test results by subsequent repairs and / or alterations is not specifically recognized in the rule, the rule becomes very burdensome and unworkable. ADEQ clearly should have the flexibility in the GWUDISW rule to recognize subsequent repairs and / or alterations in order to avoid subjecting a groundwater system to expensive filtration and disinfection requirements based on MPA test results that are no longer representative of the particular groundwater source used by a public water system. This revision is especially critical when viewed in light of the substantial expense that could be incurred by a groundwater system that is ordered by ADEQ to provide filtration and disinfection treatment when less expensive remedial measures could be encouraged and recognized.

Response: ADEQ agrees. ADEQ revised the rule to allow a water supplier to take corrective action to a source and to conduct a 2nd round of MPA monitoring before a final determination of groundwater under the direct influence of surface water is made [See R18-4-301.01(E)]. This amendment to the rule provides needed flexibility and allows a water supplier to avoid the installation of expensive filtration and disinfection treatments if less expensive corrective actions to a source are feasible that will prevent the direct influence of surface water.

Comment: With respect to the multiple step process, ADEQ states that 1 of the purposes of the sanitary survey of each public water system is to identify situations in which obvious well construction deficiencies or similar circumstances that can be remediated by relatively inexpensive repairs should be undertaken 1st before MPA monitoring of the suspect groundwater source is undertaken. However, ADEQ seems to imply that because it has already conducted sanitary surveys of a substantial number of "suspect" groundwater sources, it will not reconduct surveys of such systems. Rather, such systems will automatically be pushed into the MPA monitoring of ADEQ's proposed GWUDISW process. [We] request that ADEQ clarify that it will conduct a new or updated sanitary survey after the effective date of the GWUDISW rule for each groundwater source preliminarily identified as a "suspect" source. If this clarification is not made, the rule will be very unfair to systems that have already undergone sanitary surveys. This is especially true because the focus of sanitary surveys performed before the effective date of the GWUDISW rule will not have reviewed or considered potential measures that could be conducted to either upgrade the system prior to MPA monitoring or avoid the need to perform MPA monitoring altogether. This revision is especially critical when viewed in light of the substantial expense that could be incurred by a groundwater system that is ordered by ADEQ to provide filtration and disinfection treatment when less expensive remedial measures could be encouraged and recognized.

Response: The rule states that the Department shall conduct a sanitary survey of each public water system that it preliminarily identifies as using a "suspect" groundwater source [*See* R18-4-301.01(B)]. The preamble to the Notice of Final Rulemaking (and this response) clarifies that this subsection includes *all* public water systems, even those for which ADEQ has previously conducted sanitary surveys. ADEQ clarified that it will either resurvey or conduct a new sanitary survey of every public water system that ADEQ preliminarily identifies as using a "suspect" groundwater source. Every water supplier will be given the opportunity to take advantage of the new rule's provisions to submit information to ADEQ to rebut a preliminary identification of a "suspect" source by ADEQ or to take corrective actions to a source to avoid MPA monitoring requirements.

Comment: The proposed rule states that all wells with screens less than 50 feet below the surface will be considered suspect. This is fine except that ADEQ Bulletin #10 requires grouting (and therefore no screen) only down to 20 feet of depth. Surely solid casing below a grout seal of 20 feet deep will transmit water down the well bore to the level of the screen, even when below 50 feet of depth. Therefore, altering Bulletin #10 to require grouting to 50 feet, minimum will automatically keep new wells from falling under the suspect category in many cases. The cost is minor and it is good insurance.

Response: ADEQ agrees that requiring grouting to 50 feet would be more consistent with the shallow well "suspect" criterion of the new rule and ADEQ will consider appropriate revisions to its Engineering Bulletin #10. It should be noted that the current Engineering Bulletin #10 guidance on grouting to a depth of 20 feet is based upon minimum well construction requirements that are prescribed by the Department of Water Resources [*See* R12-15-811]. While ADEQ can revise its engineering guidance, it will take rulemaking by DWR to change the minimum well construction requirements in their rule.

Comment: With respect to the economic impact statement of the rule, no cost was representative of many systems such as the U.S. Forest Service has that have no possibility of acquiring line (AC) electric power with which to run filtration and disinfection equipment. Approximately half our systems have no electric power within a reasonable dis-

tance (at least several miles). Solar power is expensive, particularly in sites without sufficient hydraulic head to run filtration equipment (which would then require pumps to supply that hydraulic head), which includes most of our remote sites. The cost to upgrade most of our remote systems will be far greater than the costs indicated in the proposed rule package.

Response: ADEQ acknowledges that the economic impact statement for the rule did not consider the cost of filtration and disinfection treatment for water systems at remote U.S. Forest Service campgrounds. ADEQ agrees with the commenter that for small water systems at these campgrounds, the costs of providing filtration and disinfection are probably prohibitive. The only practical alternative for remote campground water systems that are determined by ADEQ to be under the direct influence of surface may be to abandon the drinking water source and require campground users to bring their own drinking water. Another option may be to post appropriate notice that the drinking water that is provided by the campground is under the direct influence of surface water and may be contaminated. Users may be advised that the water should be either be filtered, boiled or otherwise treated to remove potential pathogenic microorganisms.

Comment: The economic impact statement includes a discussion of alternative sources of water. The likelihood of acquiring an alternative source of water at the majority of Forest Service systems is extremely poor. These systems are frequently near the top of watersheds, often in bedrock, or very shallow aquifers on bedrock. The chances of drilling a producing well that is not under the influence of surface water are small. The result will be that the majority of such systems, once determined to be under the influence, will most likely be abandoned permanently. This will leave many public facilities with a long history of water supply without any legal drinking water. As a result, many users will undoubtedly bring their own water, while still others will drink untreated and even less safe surface water on an "as available" basis (many of these sites are near ephemeral streams in the mountains). I am not sure the public health will be served in such cases.

Response: ADEQ agrees that there may not be practical alternative sources of water for U.S. Forest Service campgrounds that are determined to be using groundwater sources that are under the direct influence of surface water. For such systems, the only practical alternative may be to abandon the source and require persons who use the campgrounds to bring their own drinking water. Another option may to require the posting of notice that the water is not potable and that users should either filter, boil, or purify the water before drinking it. ADEQ will consider whether there is flexibility to permit appropriate public notice at transient, noncommunity public water systems such as at remote U.S. Forest Service campgrounds. It may be possible to allow the posting of appropriate notice for a campground water source that the source has been determined to be groundwater under the direct influence of surface water, that it may be contaminated, and that persons should treat the water by filtering, boiling, or purifying it.

Comment: Cyprus Bagdad Copper Corporation (Cyprus Bagdad) performed detailed parameter testing over a 13-month period which clearly demonstrated that its Francis Creek system is not under the direct influence of surface water. These lengthy and expensive efforts were performed by Cyprus Bagdad at the direct insistence of ADEQ. It is entirely unfair to discount the results of such parameter testing, especially when such testing was specifically requested by ADEQ. Moreover, ADEQ is premature in listing certain systems as suspect groundwater systems before its proposed rule has been adopted or implemented. ADEQ stated in the preamble that it would not send notices to public water systems informing them that the system is utilizing a "suspect" groundwater source until the rule is effective. ADEQ also stated that it would not require any public water systems to conduct MPA monitoring until the rule is effective. Unfortunately, ADEQ already violated these promises with respect to the Francis Creek system. ADEQ informed Cyprus Bagdad that the Francis Creek system was suspected of being under the influence of surface water, required Cyprus Bagdad to perform detailed parameter testing over a 13-month period, and has suggested that it will not even consider the results of such testing in determining whether the Francis Creek system is under the direct influence of surface water.

Response: ADEQ disagrees that a public water system should be allowed to rely solely on the results of water quality parameter monitoring to make the final determination of whether a groundwater source is under the direct influence of surface water. Water quality parameter monitoring [that is, turbidity, temperature, pH, conductivity] provides supporting, but less direct, evidence of surface water influence than microscopic particulate analysis. ADEQ has never suggested that it would not consider the results of water quality parameter monitoring conducted by Cyprus Bagdad or that it "discounts" the results. On the contrary, ADEQ restates its position that it will consider the results of water quality parameter testing performed by Cyprus Bagdad in a weight of evidence approach before making a decision as to whether MPA monitoring is required for the Francis Creek system spring boxes.

A history of ADEQ's interactions with Cyprus Bagdad regarding the Francis Creek water system may help to explain ADEQ's response to this comment. The history goes back almost 5 years. On March 28, 1994, ADEQ issued a Notice of Violation to the Town of Bagdad (hereafter Cyprus Bagdad) for various violations of the safe drinking water rules. One of the deficiencies cited in the March 28, 1994, Notice of Violation (NOV) was a failure to maintain continuous

disinfection and filtration as required by public water systems that use surface water sources or groundwater sources under the direct influence of surface water. At the time, ADEQ considered the Francis Creek spring boxes to be surface water sources. The NOV stated that Cyprus Bagdad would have to submit plans and specifications for filtration and disinfection facilities within 60 days. On May 9, 1994, representatives of Cyprus Bagdad and ADEQ met to discuss compliance issues raised in the March 28, 1994, NOV. One of the primary purposes of the May 9th meeting was to discuss the source classification of the Francis Creek spring boxes and the requirements for complying with the surface water treatment rule. At the May 9th meeting, it was decided that a site visit would be necessary to determine whether the Francis Creek spring boxes were groundwater or surface water sources. An ADEQ inter-office memorandum describes the results of the May 9th meeting. The memo describes the Francis Creek springs as artesian wells drilled to a depth of approximately 30 feet. The memorandum states that the Francis Creek spring boxes are located approximately 40 feet horizontally and 15 feet vertically from Francis Creek and that the estimated cost of construction of filtration and disinfection facilities for the system was $300,000. The water from the spring boxes was found to be consistently low in turbidity (< 0.30 NTUs) and that due to the height of the springs above Francis Creek, the water supplying them could not be subflow from the creek. When ADEQ staff asked whether the spring boxes were subject to infiltration from Francis Creek, representatives for Cyprus Bagdad stated that artesian pressure provided a gradient of 10 pounds per square inch towards the creek and that the artesian pressure prevented infiltration of surface water into the springs. ADEQ staff stated that a site visit to the springs would be necessary to determine whether the spring boxes were groundwater. The memorandum also states, in relevant part, that ADEQ staff:

> "[E]xplained that criteria are being developed for use in determining whether a water source is suspect of being under the influence of surface water. Given the proximity of the springs to the creek, the springs will most likely be suspect and will incur physical characteristics testing of the springs' water to verify that they are not under the influence of surface water."

An ADEQ site visit to the Francis Creek spring boxes was made on May 23, 1994. In a letter from Cyprus Bagdad dated May 24, 1994, that summarizes the May 23rd site visit, Cyprus Bagdad stated that possible structural changes to the Francis Creek spring boxes could be made, including the construction of water control diversion devices to protect them from surface water runoff. Cyprus Bagdad also stated in the letter that "[w]e understand that your office will probably recommend a MPA (Microscopic Particulate Analysis) of the water exiting the main spring-box to determine if any surface water contaminants are present." In a certified letter dated August 11, 1994, ADEQ acknowledged a Cyprus Bagdad request that ADEQ change the source classification of the Francis Creek spring boxes from surface water to groundwater. ADEQ requested the submittal of information related to the Francis Creek spring boxes. The letter stated that Cyprus Bagdad would have to enter into a consent order to resolve compliance issues from the March 28, 1994, Notice of Violation. The letter also states, in relevant part, that:

> The Consent Order will incorporate testing, if the springs are classified as ground water, to determine whether the springs are under the direct influence of surface water. It will also include modifications to provide filtration and disinfection in accordance with the Surface Water Treatment Rule in the event that the springs are under the direct influence of surface water....

By letter to ADEQ dated August 26, 1994, Cyprus Bagdad stated its intent to enter into a consent order with ADEQ, reiterating that their primary concern was to change the source classification of the Francis Creek spring boxes from surface water to groundwater. A meeting with representatives of Cyprus Bagdad was subsequently held at ADEQ on September 12, 1994. This meeting was summarized in a certified letter from ADEQ to Cyprus Bagdad dated October 11, 1994. The October 11th letter states the following with regard to classification of the Francis Creek spring boxes as surface water or groundwater:

> Bagdad wishes to have the classification changed to ground water. You acknowledge that these springs, if classified as ground water, would be suspect of being under the direct influence of surface water. According to the guidelines for surface water influence established by ADEQ, determination of influence shall be made by performing the following:
>
> a. Physical Parameter Testing. This testing shall include temperature readings directly at the source, and either turbidity, conductivity, or pH testing weekly of water from the source before it enters the distribution system. These tests would be performed at least weekly. Testing will be performed for 1 year, however, ADEQ may at any time determine that the water characteristics changed sufficiently to continue suspicion of being under the influence, in which case the water system is considered under the influence unless they choose to perform microscopic particulate analysis (MPA) testing. If 12 months worth of testing reveals no surface water influence, the classification can remain as ground water.
>
> b. MPA Testing- If physical characteristics warrant further testing, or if the water system chooses to forego physical parameter testing, MPA testing is necessary. Initial testing will consist of 2 samples taken at times of the year specified by ADEQ. After initial testing, subsequent testing may be necessary, also specified by ADEQ.

The letter clearly states that MPA monitoring may be necessary if water quality parameter testing results warrant further testing.

A proposed consent order was sent to Cyprus Bagdad on November 1, 1994. On or about December 23, 1994, Cyprus Bagdad provided information to ADEQ about recent construction modifications to the Francis Creek spring boxes. Correspondence in the facility file indicates that ADEQ and Cyprus Bagdad agreed that the spring box modifications addressed most of the ADEQ's concerns and that a consent order would be unnecessary. By letter dated December 29, 1994, ADEQ acknowledged that significant improvements had been made to the Francis Creek spring boxes but stated that some additional steps would have to be taken before ADEQ could change the classification of the Francis Creek spring boxes from surface water to groundwater. These included installation of a diversion structure to prevent surface water runoff from infiltrating the main spring box, submittal of as-built plans showing details of the overflow pipe system and drain piping, and changes to the system's emergency operations plan to address detection of a high water event, shutoff of the springs, and contingency plans for the use of an alternative source of water if flooding occurred since each of the Francis Creek spring boxes was located within the 100-year floodplain.

On February 17, 1995, ADEQ met with representatives of Cyprus Bagdad and determined that the violations cited in the March 28, 1994, Notice of Violation had been satisfactorily resolved. By letter dated March 6, 1995, ADEQ stated that it no longer believed it was necessary to pursue a consent order because of the modifications that had been made to the Francis Creek spring boxes. The letter also states, in relevant part:

> Effective March 6, 1995, the Francis Creek spring site will be considered ground water suspected of being under the direct influence of surface water. Parameter monitoring will be required to determine if the ground water is under the direct influence of surface water.

On March 13, 1995, ADEQ issued another Notice of Violation on March 13, 1995 to Cyprus Bagdad. The ADEQ inspector's comments state that the spring boxes at Francis Creek are the primary source of water for the town of Bagdad and that "[d]uring the summer of 1995 we need to visit the Francis Creek site to verify the spring box modifications as well as to collect GPS data for the spring boxes. Parameter monitoring and / or MPA testing will be required for the Francis Creek spring box in the near future."

In April, 1995, Cyprus Bagdad initiated water quality parameter monitoring for temperature and turbidity at the Francis Creek spring boxes and in nearby Francis Creek. Water quality parameter monitoring was performed by Cyprus Bagdad at least through April, 1996. A memo to the ADEQ facility compliance file dated March 20, 1997, states that the Francis Creek spring boxes had been refurbished. The memo to the file states in relevant part:

> The spring boxes have been considered groundwater under the direct influence of surface water. Recently, the GWUDISW rule was interpreted [by the Office of Administrative Counsel]...as being unenforceable. Due to that interpretation, and the refurbishing of the spring boxes, the spring boxes have been changed from surface water to groundwater sources. *However, when the GWUDISW rule is changed and becomes enforceable, the water system will then be required to conduct the appropriate GWUDISW testing. The results of the GWUDISW tests will dictate whether the spring boxes will be classified groundwater or surface water sources* [Emphasis added]

By letter dated March 21, 1997, ADEQ informed Cyprus Bagdad that the source classification for the Francis Creek spring boxes had been changed from surface water to groundwater. With regard to the direct influence of surface water issue, ADEQ stated the following:

> GWUDISW rules are currently in the process of being finalized. The reconstruction / refurbishing of the spring boxes, plus the current status of the GWUDISW rules, prompted us to change the Source Identification. However, when the GWUDISW rules are finalized, sources such as your Francis Creek Spring Boxes, will in all probability be required to conduct the appropriate GWUDISW tests. Those test results will be used to determine, with physical evidence, whether or not the source water is under the direct influence of surface water. If a source is determined to be under the direct influence of surface water, the source will be classified surface water (GWUDISW). The results from the tests conducted on your system will dictate whether your spring boxes will be reclassified surface water (GWUDISW) or remain classified as groundwater.

While ADEQ reclassified the Francis Creek spring boxes as groundwater, ADEQ made it clear that they were considered to be "suspect" groundwater sources. ADEQ also stated at various times in this chronology, that when the groundwater under the direct influence of surface water rule was finalized, Cyprus Bagdad would have to conduct the appropriate tests to determine whether the groundwater was under direct surface water influence. At different times, ADEQ stated that Cyprus Bagdad may have to perform MPA monitoring. As early as 1994, representatives of Cyprus Bagdad stated their understanding that ADEQ may recommend that MPA tests be performed. By 1995, ADEQ was stating that water quality parameter testing and / or MPA monitoring may be required. In 1997, ADEQ clearly stated that Cyprus Bagdad would have to perform the monitoring that was required by the groundwater under the direct influence of surface water rule when the rule was effective. Given this history, ADEQ thinks that it is fair to require compliance with the monitoring requirements of the new rule when it becomes effective.

Comment: Cyprus Climax disagrees with ADEQ's statement that the recognition of alternative methods would undermine the basic purpose of the rule. As revised, the basic purpose of the rule is to carefully analyze whether cer-

tain groundwater systems should be required to conduct MPA monitoring, which could result in the requirement to install expensive disinfection and filtration treatment equipment. ADEQ states in the preamble to its revised rule that it has developed a multiple step process to determine whether a groundwater system is under the direct influence of surface water. This multiple step process consists of a sanitary survey of each groundwater system that is preliminarily suspected of being under the direct influence of surface water. In addition, ADEQ has revised its proposed rule to provide that a water system may submit information to ADEQ to rebut a preliminary determination that the system is under the direct influence of surface water. Finally, ADEQ has reaffirmed that it has the discretion to determine whether or not a particular "suspect" system will be required to undergo MPA monitoring. Clearly, this multiple step process should account for and consider any and all factors, including results from alternative methods, before resulting in a determination that a particular system will be required to conduct MPA monitoring. As applied to the Francis Creek system, even if ADEQ is unwilling to grant an exemption for systems that have already performed monitoring to determine potential surface water influence, ADEQ should recognize that any prior testing will be acknowledged and considered as part of its multiple step process in determining whether a system will be required to perform MPA monitoring.

Response: The basic purpose of the rule is to describe the procedures and decision criteria that ADEQ will use to make determinations regarding whether a groundwater source is under the direct influence of surface water. ADEQ will employ a weight of evidence approach in evaluating groundwater sources and will consider the results of water quality parameter monitoring before making a decision to require MPA monitoring.

Comment: Several statements in the preamble to the revised rule either ignore the existence of the multiple step process or imply that ADEQ is inclined to discount the multiple step process with respect to certain types of groundwater systems. For example, ADEQ states that it "considers springs to be suspect groundwater sources that should be evaluated for direct surface water influence using microscopic particulate analysis." This statement suggests that springs, regardless of location, construction, or maintenance, and regardless of the results of a sanitary survey or rebuttal information submitted by the owner or operator of the spring, will nevertheless be subjected to MPA monitoring. ADEQ's statement should be revised to provide that ADEQ considers springs to be sources that should be identified as preliminary suspect sources that should be the focus of a sanitary survey.

Response: Springs are only preliminarily identified as "suspect" groundwater sources. ADEQ will conduct a sanitary survey of each public water system that uses a spring as a source to determine whether MPA monitoring will be required. ADEQ agrees that there may be circumstances where ADEQ will not require MPA monitoring of a spring. For example, a properly developed artesian spring may not be vulnerable to direct surface water influence [*See* discussion in preamble on springs as "suspect" sources].

Comment: ADEQ states in the preamble that "under the rule, a public water system that utilizes a suspect groundwater source is required to conduct [MPA] monitoring to determine whether the groundwater is under the direct influence of surface water." This statement should be revised to provide that under the rule, a public water system that utilizes a "suspect" groundwater source will 1st be subject to a sanitary survey and that after such review, including consideration of any rebuttal information submitted by the owner or operator of the system, ADEQ may require the system to conduct MPA monitoring. This clarification is consistent with the current regulatory language in proposed R18-4-301.01(C) which provides that ADEQ "*may* require a public water system that is suspected of utilizing a groundwater source that is under the direct influence of surface water to conduct [MPA] monitoring of the groundwater source." In other words, as noted by ADEQ in the preamble, the preliminary identification of a suspect source is only the 1st step in a multiple step process to determine whether the groundwater source is under the direct influence of surface water. After the preliminary identification of a "suspect" source, ADEQ retains discretion regarding whether to require a particular water system to conduct MPA monitoring. There are several other statements in ADEQ's preamble that are either inconsistent with ADEQ's multiple step process or imply that preliminarily-identified suspect groundwater systems will automatically be required to conduct MPA monitoring. ADEQ should carefully review its preamble, (including its responses to comments) and appropriately revise any statements that are inconsistent with ADEQ's multiple step process or with ADEQ's discretion to require MPA monitoring.

Response: ADEQ agrees. The preamble and the final rule state that ADEQ *may* require MPA monitoring.

Comment: ADEQ declined to qualify its inclusion of springs in the regulatory list of "suspect" groundwater sources. In support of its action, ADEQ states that "springs flow by gravity and are typically associated with shallow aquifers that may be under the direct influence of surface water." This statement is inaccurate. For example, the Francis Creek spring is associated with a deep aquifer that flows not by gravity but as a result of artesian conditions. ADEQ should recognize that some springs are artesian-based and / or associated with deep aquifers. ADEQ also should reconsider Cyprus Climax's request to qualify the term "spring" as it is used in the regulatory list of "suspect" groundwater sources. Springs should be considered as "suspect" groundwater sources only if they are associated with a shallow

aquifer that may be subject to the direct influence of surface water or if they have other similar characteristics that may subject the springs to contamination from surface runoff.

Response: ADEQ disagrees. ADEQ believes that springs should be included in the list of criteria that are grounds for a preliminary identification of a "suspect" source for the reasons stated in the preamble discussion on springs. The preamble includes a discussion of artesian springs and recognizes that there may be circumstances where a spring is not vulnerable to direct surface water influence. ADEQ disagrees that the "springs" criterion for *preliminary* identification of a "suspect" source should be qualified or limited.

Comment: While Cyprus Climax agrees generally with ADEQ's suggestion that it will conduct a sanitary survey of each public water system that it preliminarily identifies as using a suspect groundwater source, the regulatory language should be revised to clarify that ADEQ will conduct the sanitary survey before it may make a determination to require a public water system to conduct MPA monitoring. ADEQ also should clarify that it will conduct new or updated sanitary surveys of all systems that are preliminarily identified as using suspect groundwater sources under ADEQ's final rule. If new or updated sanitary surveys are not conducted, this will dilute the benefit of ADEQ's multiple step process as applied to systems that already have been subject to a sanitary survey. Sanitary surveys conducted before the effective date of ADEQ's proposed rule will not have included an evaluation of whether the source can be remediated by relatively inexpensive repairs before requiring MPA monitoring, and therefore, should be redone or appropriately updated.

Response: ADEQ agrees. The rule states that ADEQ will conduct a sanitary survey of each public water system that has been identified as using a "suspect" groundwater source. ADEQ clarified in the response to comments and in the preamble that ADEQ will either conduct a new sanitary survey or resurvey each public water system with a "suspect" groundwater source after the effective date of the rule. The purpose of the sanitary survey is confirm the preliminary identification of a "suspect" source and obtain information from an on-site inspection to inform the decision as to whether MPA monitoring will be required or not.

Comment: ADEQ should clarify the procedures and timing for the submittal and agency consideration of information to rebut a preliminary identification of a groundwater source as being under the direct influence of surface water. Cyprus Climax supports ADEQ's revision of its proposed rule to provide that a water supplier may submit information to ADEQ to rebut a preliminary identification of a groundwater source as one that is suspected of being under the direct influence of surface water. However, the regulatory language needs to be further clarified to establish the timeframes in which ADEQ may review and respond to any information submitted in response to a notice that a public water system is suspected of being under the direct influence of surface water. ADEQ also should clarify that it will send written notice to a source that is suspected of being under the direct influence of surface water, and receive and consider any rebuttal information, before issuing a determination that a public water system is required to conduct MPA monitoring. The rule also should provide that after consideration of all information, including rebuttal information and information from the sanitary survey, that ADEQ may require MPA monitoring only after providing written notice to a public water system. The rule should provide that the agency determination to require MPA monitoring is an appealable agency action.

Response: The final rule states that ADEQ will provide written notice to a public water system that the system has been preliminarily identified as using a "suspect" groundwater source and that a water supplier may submit information to ADEQ to rebut a preliminary identification of a "suspect" groundwater source. ADEQ opposes the establishment of inflexible time-frames regarding the submittal of rebuttal information or ADEQ consideration of rebuttal information and a decision on whether MPA monitoring will be required or not. ADEQ disagrees that MPA monitoring requirements are appealable agency actions.

Comment: ADEQ's proposed rule provides that a public water system with a source that is determined to be groundwater under the direct influence of surface water shall provide treatment by filtration in accordance with R18-4-302 and disinfection in accordance with R18-4-303 within 18 months after ADEQ makes a final determination that a system has a source under the direct influence of surface water. This language is very inflexible and should be revised to clarify that a system can perform repairs or other maintenance on the engineered controls associated with a particular source (for example, spring, well) and re-perform MPA monitoring to determine if such repairs or maintenance have eliminated the potential surface water influence before expiration of the 18-month deadline for providing treatment by filtration and disinfection. If ADEQ does not provide a procedure for refuting or resolving prior MPA monitoring results, ADEQ will be placed in the difficult and unworkable position of requiring expensive filtration and disinfection under its rule even if a particular system has repaired the source and eliminated any potential for surface water influence. The ability to appeal ADEQ's determination of whether a groundwater source is under the direct influence of surface water is not sufficient to prevent the unnecessary imposition of disinfection and filtration requirements. A notice of appeal must be filed within 30 days after receiving the final determination. The owner or operator may not have completed necessary repairs or modifications at this point in time. Consequently, the owner or operator may lose

the appeal but later conduct repairs or modifications that may remove the potential for surface water influence. The rules do not recognize this potential situation and should be revised accordingly.

Response: ADEQ agrees that a public water supplier should be given an opportunity to make source modifications or repairs to a source and then re-perform MPA monitoring before a final determination is made [*See* discussion in preamble on *Opportunity to Re-Perform MPA Monitoring After Taking Corrective Action*]. ADEQ revised the rule to permit a 2nd round of MPA monitoring after corrective action is taken to a "suspect" source.

Comment: It is implied that a well located within 500 feet of a surface water will automatically be considered vulnerable regardless of other data that may indicate otherwise. Why? What will occur if it can be determined that a well is not vulnerable? Additionally, what constitutes a "lack of information or because of the uncertainty of the available information?" More direction and definition must be provided in the rule concerning this issue to minimize the application of the rule by ADEQ without proper justification.

Response: A well that is located within 500 feet of a surface water is not "automatically" presumed to be vulnerable to direct surface water influence. ADEQ revised the proposed rule to require a vulnerability assessment for each well that is located within 500 feet of a surface water. If ADEQ conducts a vulnerability assessment and determines that a well is probably not vulnerable to surface water influence, ADEQ's evaluation of the groundwater source is complete. That is, a water supplier will not be required to conduct MPA monitoring of a groundwater source where there is a low probability of direct surface water influence as determined through a vulnerability assessment. If the vulnerability assessment shows that the groundwater source is vulnerable or if there isn't enough information for ADEQ to assess the vulnerability of the source, then ADEQ will require MPA monitoring of the groundwater source to obtain more direct evidence that the agency can use to make a final determination.

Comment: In subsection (A)(8) of the rule, what will the "interim maximum contaminant level for turbidity" be? This should be established as a part of the rule.

Response: The interim maximum contaminant level for turbidity is prescribed in the safe drinking water rules at R18-4-204.

Comment: More explanation and definition is required for waterborne diseases that are "suspected to have occurred, or there are customer complaints regarding suspected waterborne disease or illness."

Response: The references to water borne diseases that are suspected to have occurred and customer complaints regarding suspected waterborne disease or illness were contained in the preamble to the Notice of Proposed Rulemaking. ADEQ did not include this language from the preamble in the Notice of Final Rulemaking to avoid confusion.

Comment: In subsection (A)(8), the maximum contaminant level for total coliform should be specified.

Response: ADEQ revised subsection (A)(8) and deleted the reference to the maximum contaminant levels for total coliform. The revised rule states that a groundwater source is "suspect" if bacteriological water quality are available that demonstrate that total coliform, fecal coliform, or *E. Coli* bacteria are present in untreated groundwater from the source.

Comment: In subsection (A)(9), is the temperature fluctuation for groundwater a minimum of 15% or a maximum of 20% from the mean groundwater temperature? This should be clarified. Additionally, the criteria for correlating the temperature of groundwater to surface water should be specified.

Response: ADEQ deleted the temperature criterion at subsection R18-4-301.01(A)(9).

Comment: ADEQ should add MPA monitoring to the Monitoring Assistance Program to ensure that small public water systems will be able to do the testing.

Response: ADEQ disagrees. ADEQ was required by A.R.S. § 49-360 to establish a monitoring assistance program by January 1, 1999 to assist small public water systems (serving < 10,000 persons) in complying with monitoring requirements established under the Safe Drinking Water Act. A.R.S. § 49-360(A) states that the monitoring assistance program is intended to provide for the collection, transportation, and analysis of *baseline samples* from public water systems to keep the systems in compliance with Safe Drinking Water Act requirements. The statute says that, at a minimum, the monitoring assistance program must include monitoring assistance for volatile organic chemicals, synthetic organic chemicals, and certain inorganic chemicals. The language of § 49-360(A) appears to reflect a legislative intent to establish a program to assist public water systems in complying with routine monitoring requirements to ensure compliance with maximum contaminant levels. This is made clear by the recently adopted state rules that implement the MAP program (effective December 8, 1998). The preamble for the Notice of Final Rulemaking for the MAP rules clearly states that the monitoring assistance program provides assistance for chemical monitoring for a total of 98 regulated and unregulated contaminants under the following categories: volatile organic chemicals, syn-

thetic organic chemicals, and inorganic chemicals (except for asbestos, copper, lead, nitrates, and nitrites). The preamble also states that chemicals not covered by the MAP rule (the remaining inorganic chemicals, radiochemicals, and other contaminants, including total coliform) will still be monitored as required by existing state rules but the monitoring will be the responsibility of the public water system [*See* 5 A.A.R. 100, January 15, 1999]. "Baseline monitoring" is specifically defined by R18-4-101(6) to mean "the routine monitoring of contaminants covered under the monitoring assistance program for the purpose of determining compliance with the MCLs listed in Article 2 and the monitoring requirements listed in Article 4, not including repeat monitoring necessary for compliance after detection of a contaminant or an MCL violation." This definition clearly excludes MPA monitoring that may be required to make groundwater under the direct influence of surface water determinations.

Comment: EPA's proposed groundwater disinfection rule makes the groundwater under the direct influence of surface water rule moot.

Response: ADEQ disagrees. EPA may promulgate additional federal regulations that will require groundwater systems to install disinfection. However, the proposed federal groundwater disinfection rule does not render the state's groundwater under the direct influence of surface water rule moot. ADEQ is still required to evaluate all groundwater systems to determine whether they are using groundwater sources that are under the direct influence of surface water and are subject to the requirements of the surface water treatment rule.

Comment: The economic consequences of the rule are enormous. The rule should recognize that there will be public water systems that will require financial assistance in order to comply with treatment requirements.

Response: ADEQ disagrees that the rule should specifically recognize that some public water systems will require financial assistance to comply with surface water treatment rule requirements. ADEQ acknowledges in the economic impact statement for the final rule that the economic consequences for small public water systems that are required to install filtration and disinfection treatment are significant and may be prohibitive for many small systems. ADEQ has no authority to establish a financial assistance program to implement the groundwater under the direct influence of surface water or surface water treatment rules. However, the Water Infrastructure Finance Authority of Arizona (WIFA) can provide financial assistance to small public water systems through the Drinking Water Revolving Fund. Eligibility requirements for financial assistance to public water systems are governed by the WIFA rules found in Title 18, Chapter 15, Article 3 of the *Arizona Administrative Code*.

12. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:

None applicable.

13. Incorporation by reference and their location in the rules:

"Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)," EPA 910/9-92-029, United States Environmental Protection Agency, Environmental Services Division, Manchester Environmental Laboratory, 7411 Beach Dr. E., Port Orchard, WA 98366 (October, 1992) (and no future editions or amendments) which is incorporated by reference in (E)(2).

14. Was this rule previously adopted as an emergency rule?

No.

15. The full text of the rules follows:

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 4. DEPARTMENT OF ENVIRONMENTAL QUALITY
SAFE DRINKING WATER

ARTICLE 3. TREATMENT TECHNIQUES

Section
R18-4-301.01. Groundwater Under the Direct Influence of Surface Water
Table 1. Decision Matrix for Determining Groundwater Under the Direct Influence of Surface Water

Explanatory note: The table of contents for Title 18, Chapter 4, Article 3, Treatment Techniques is amended by adding R18-4-301.01 after R18-4-301 and Table 1.

R18-4-301.01. Groundwater Under the Direct Influence of Surface Water

A. The Department suspects the following sources to be groundwater under the direct influence of surface water:

1. A spring;

2. An infiltration gallery;
3. A radial well collector, Ranney well, or horizontal well;
4. A well that is less than 500 feet from a surface water, and:
   a. The Department conducts a vulnerability assessment and determines that the source is vulnerable to direct surface water influence, or
   b. The Department cannot assess the vulnerability of the groundwater source to direct surface water influence because of a lack of information or the uncertainty of available information on the local hydrogeology or well construction characteristics;
5. A shallow well with perforations or well screens that are less than 50 feet below the ground surface;
6. A hand-dug or auger-bored well without a casing;
7. A groundwater source for which turbidity data are available that show that the groundwater violates an interim maximum contaminant level for turbidity; and
8. A groundwater source for which data are available that show that total coliform, fecal coliform, or *E. Coli* are present in untreated groundwater from the source that are not related to new well development, source modification, repair, or maintenance.

B. The Department shall conduct a sanitary survey of each public water system that it suspects is using a groundwater source under the direct influence of surface water.

C. The Department shall provide written notice to a public water system that the Department suspects a groundwater source is under the direct influence of surface water. A public water system may submit information to the Department to show that a groundwater source is not under the direct influence of surface water. Information that is submitted to show that a suspect groundwater source is not under the direct influence of surface water shall be prepared by a qualified professional, such as a professional engineer, registered geologist, water system operator, or hydrogeologist. The Department shall review any information submitted by a qualified professional to show a suspect groundwater source is not under the direct influence of surface water and determine if the source remains suspect within 90 days of receipt of the information.

D. If a groundwater source continues to be suspect after the analyses required in subsections (A) through (C), the Department may require a public water system that is suspected of using a groundwater source that is under the direct influence of surface water to conduct Microscopic Particle Analysis [MPA] monitoring of the groundwater source. A public water system may request that the Director require an alternative method to determine whether a groundwater source is under the direct influence of surface water. An alternative method to determine whether a groundwater source is under the direct influence of surface water shall be approved by the Arizona Department of Health Services under R9-14-608.

E. A water supplier shall conduct MPA monitoring as follows:
1. Each sample shall be representative of the groundwater source. A water supplier shall not take a sample of blended water or a sample of water from the distribution system.
2. Each sample shall be collected and analyzed according to the procedures prescribed in the "Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)," EPA 910/9-92-029, United States Environmental Protection Agency, Environmental Services Division, Manchester Environment Laboratory, 7411 Beach Dr. E., Port Orchard, WA 98366, October 1992 (and no future editions or amendments) which is incorporated by reference and on file with the Office of the Secretary of State and the Department.
3. The Department shall schedule MPA monitoring at a time when the groundwater source is most susceptible to direct surface water influence.
4. The Department shall use the MPA risk ratings to determine whether groundwater is under the direct influence of surface water.
   a. If the MPA risk rating of the initial sample indicates a high or moderate risk of direct surface water influence, the water supplier shall collect a 2nd sample for MPA at the same location on a date scheduled by the Department. If the MPA risk rating of the 2nd sample indicates a high or moderate risk of direct surface water influence, the Department shall determine that the groundwater is under the direct influence of surface water. If the risk rating of the 2nd sample indicates a low risk of direct surface water influence, the water supplier shall collect a 3rd sample for MPA at the same location on a date scheduled by the Department. If a 3rd sample is taken, the Department shall determine whether the groundwater is under the direct influence of surface water under subsection (E)(4)(c).
   b. If the MPA risk rating of the initial sample indicates a low risk of direct surface water influence, the water supplier shall collect a 2nd sample for MPA at the same location on a date scheduled by the Department. If the MPA risk rating of the 2nd sample indicates a low risk of direct surface water influence, the Department shall determine that the groundwater is not under the direct influence of surface water. If the MPA risk rating of the 2nd sample indicates a high or moderate risk of direct surface water influence, the water supplier shall collect a 3rd sample for MPA at the same location on a date scheduled by the Department. If a 3rd sample is taken, the Department shall determine whether the groundwater is under the direct influence of surface water under subsection (E)(4)(c).

c. If a 3rd sample is required and the MPA risk rating of the 3rd sample indicates a high or moderate risk of direct surface water influence, the Department shall determine that the groundwater is under the direct influence of surface water. If the MPA risk rating of the 3rd sample indicates a low risk of direct surface water influence, the Department shall determine that the groundwater is not under the direct influence of surface water.

F. If the Department determines a source to be groundwater under the direct influence of surface water under subsection (E) and a public water system demonstrates to the Department that it is feasible to take corrective action to prevent direct surface water influence, the Department shall establish a schedule of compliance for the public water system to take corrective action instead of requiring installation of filtration and disinfection treatment. A schedule of compliance to take corrective action shall require:

1. Completion of corrective action no later than 18 months after receipt of the initial MPA monitoring results, and
2. A 2nd round of MPA monitoring to determine whether the source is under the direct influence of surface water after completion of the corrective action.

G. Except as provided in subsection (F), a public water system with a source that the Department determines to be groundwater under the direct influence of surface water shall provide filtration under R18-4-302 and disinfection under R18-4-303 within 18 months of the date that the Department makes the final determination that the groundwater source is under the direct influence of surface water.

H. The Department shall provide a written notice to a public water system of a final determination that a groundwater source is under the direct influence of surface water. The notice shall contain the following information:

1. A statement that the Department's determination that a groundwater source is under the direct influence of surface water is an "appealable agency action" as defined in A.R.S. §41-1092(3); and
2. Notice that the water supplier may request an informal settlement conference with the Department under the Uniform Administrative Appeal Procedures in A.R.S. Title 41, Chapter 6, Article 10.

I. A public water system may appeal a final determination that a groundwater source is under the direct influence of surface water by serving notice of appeal with the Department under the Uniform Administrative Appeals Procedures in A.R.S. Title 41, Chapter 6, Article 10. A public water system shall file notice of appeal with the Department within 30 days of receiving notice of the Department's determination that a groundwater source is under the direct influence of surface water. The Department shall notify the Office of Administrative Hearings which shall schedule a hearing on the appeal within 60 days of the date that notice of appeal is filed with the Department. Hearings shall be conducted according to the Uniform Administrative Appeals Procedures in A.R.S. Title 41, Chapter 6, Article 10.

Table 1. Decision Matrix for Determining Groundwater Under the Direct Influence of Surface Water

Initial Sample MPA Risk Rating	2nd Sample MPA Risk Rating	3rd Sample MPA Risk Rating	Groundwater Under the Direct Influence of Surface Water
High	High or Moderate		Yes
High	Low	High or Moderate	Yes
High	Low	Low	No
Moderate	High or Moderate		Yes
Moderate	Low	High or Moderate	Yes
Moderate	Low	Low	No
Low	High or Moderate	High or Moderate	Yes
Low	High or Moderate	Low	No
Low	Low		No