Attachment 3

Summary of Delta Water Quality Issues

Attachment 3

Summary of Delta Water Quality Issues

Public health and water treatment experts have acknowledged that source water quality should be a primary consideration in any effort to secure additional water supplies. In particular, the State Water Resources Control Board has supported EBMUD's objective for the highest quality water supply by acknowledging that "[p]rudence requires that public water suppliers should minimize treatment uncertainties by seeking water from the best available source and as removed from the potential for degradation as possible" (pp.14, 15 in California State Water Resources Control Board 1988a).

Both the federal and state governments have established strong policies to encourage the use of the highest quality supply available for drinking water. These principles are embodied in the 1996 federal Safe Drinking Water Act (see for example 42 USC 300j-13 and 300j-14). More recently, the California Department of Health Services, Drinking Water Program have developed Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Source. While this policy memo is generally directed towards uses of impaired drinking source waters, it contains several key statements that support obtaining the highest quality water for drinking purposes in the "General Philosophy" section of the memo. These statements include the following:

> The Drinking Water Program continues to subscribe to the basic principle that only the bast quality sources of water reasonably available to a water utility should be used for drinking.
>
> Where reasonable alternatives are available, high quality drinking water should not be allowed to be degraded by the planned addition of contaminants. In other words, the maximum levels should not be used to condone contamination up to those levels where the addition of those contaminants can be reasonably avoided.
>
> Drinking water quality and public health shall be given greater consideration than cost or cost savings when evaluating alternative drinking water sources or treatment processes.

In addition, the CALFED Bay-Delta Program has identified drinking water quality as a key concern. In the Final Water Quality Program Plan published in tandem with the Final EIR/EIS in July, 2000 (certified in August, 2000). CALFED states, in part:

Source water from the Bay-Delta poses treatment challenges and public health concerns for the 22 million Californians who drink the water. Low water quality reduces options for recycling the water and blending with other source, and increases utility costs of treating the water to meet drinking water regulations and protect public health. (page 3-4)

Several source water constituents create difficulties for the production of a safe drinking water supply from Delta sources. These include bromide, natural organic matter, microbial pathogens, nutrients, salinity, and turbidity. All are naturally occurring, to one degree or another, and some are magnified by anthropogenic actions. Changes in treating drinking water and reducing sources of contaminants can improve the quality of drinking water from the Delta. Future drinking water regulations may, however, require improvements beyond those that can be gained through the actions specified in this section. (page 3-1)

Pollutants in Delta waters come from tidal interaction with the ocean and from point and non-point sources located throughout the Delta and tributary watersheds. Other pollutants can enter the aqueducts and reservoirs of the drinking water supply system. Pathogens largely come from urban stormwater runoff; livestock operations; recreation users of the Delta; storage reservoirs; and, potentially, inadequately treated discharges of wastewater. Sources of organic matter, primarily organic carbon (usually expressed as total organic carbon [TOC]), include runoff from the following sources: soils, agricultural drainage, urban stormwater tidal wetlands as a result of natural plant decay, algae, and wastewater treatment plant discharges. The most important source of bromide is sea water intrusion, which also is reflected in agricultural drainage from areas irrigated with Delta water. Other sources of bromide may include geological formations, groundwater influenced by ancient sea salts, and chemicals used in the watersheds of the Delta. Salt, as reflected in TDS, comes from sea water intrusion and, to a lesser extent, from natural leaching of soils, agricultural drainage, wastewater treatment plants, and stormwater runoff. Turbidity results from storm events, all types of runoff, resuspended sediments, and phytoplankton populations. Nutrients largely result from erosion; agricultural runoff, including livestock operations; and wastewater treatment plant discharges. (p. 3-2)

Pathogens are a direct health concern., A primary purpose of drinking water treatment is to remove or inactivate pathogens. TOC and bromide react with disinfectants during the treatment process to form disinfection by-products (DBPs) that are a public health concern and will be more stringently regulated in the near future. Nutrients contribute to excess growth of algae in storage reservoirs and in aqueducts, which can result in treatment difficulties and production of unpleasant flavors and odors. (pp. 3-2 through 3-2)

High levels of TDS, salinity, and turbidity adversely affect consumer acceptance and treatment plant operations. High TDS reduces the ability to implement local water management programs, such as water recycling and groundwater replenishment, results in direct economic impacts on residential and industrial water users, and reduces options for blending with other supplies. (p. 3-3)

Delta waters are used to produce drinking water for approximately 22 million people in California. Utilities divert source water at several points in the Delta, each with distinct water quality characteristics. These waters are subsequently treated by a variety of technologies to control pathogens and other contaminants of concern, and to meet federal and state drinking water regulatory requirements. Depending on the specific source water at the intakes, existing treatment plant configurations, attendant operational constraints, and regulatory requirements, utilities may have difficulty in simultaneously providing adequate supplies of drinking water while complying with drinking water regulations and meeting customer requirements for palatability. Therefore, two interrelated concerns arise from source water quality: (1) the treated water may not meet applicable drinking water standards, and (2) the treated water may not be aesthetically acceptable to the consumers. Because treated water quality is a product of source water quality and treatment methods, treatment options can be significantly narrowed based on source water quality and drinking water regulations. (p. 3-5)

The process of treating surface waters generally involves mixing coagulant chemicals with the source water. This process causes the removal of some dissolved organic material and also causes most of the particulates to aggregate and to settle out. The settled water is then filtered, usually through beds of special sand and anthracite mixtures, removing many more microbial contaminants. At one or more points in the process, chemical disinfectants and physical pathogen inactivation (ultraviolet, ozonation) are applied for specific contact times. Water that flows from the treatment facility into the pipes that distribute the water to homes and businesses must additionally contain a sufficient disinfectant residual (usually chloride or chloramine) to prevent regrowth of harmful bacteria or other organisms in the distribution system, up to the taps of customers. (p. 3-5)

The constituents on American River, Sacramento River, and Delta waters identified of most concern with respect to drinking water include microbial pathogens, bromide, natural organic matter, dissolved solids, salinity, turbidity, and nutrients. Some other contaminants of Delta waters, including pesticides, metals, and methly tert-butyl ether (MTBE), were evaluated and considered to be of limited significance to drinking water at this time because of their relatively low concentrations in Delta waters. (p. 3-5)

Microbial pathogens are a direct threat to public health. The primary purpose of drinking water treatment is to remove or kill pathogens. Under the 1989 Surface Water Treatment Rule (SWTR), surface water must be treated by filtration or disinfection to minimize disease risks from microbes. In addition, turbidity, which can compromise disinfection, must be removed. Emphasis in this rule was on reducing risks from *Giardia*, *Legionella*, and viruses. The Interim Enhanced Surface Water Treatment Rule was promulgated in December 1998 and adopted more stringent turbidity removal requirements. The Long-Term 2 Enhanced Surface Water Treatment Rule (to be promulgated by May 2002) is expected to include requirements for the control of *Cryptosporidium*. (p. 3-6)

Filtration and disinfection are required for drinking water from Delta Sources. Levels of microbial pathogens in Delta waters do not specifically influence the degree of these treatments, since current regulations are based on uniform treatment requirements. However, future regulations may require treatment that is proportional to pathogen levels in source waters. Pathogen levels in Delta waters are largely unknown at this time. Primary disinfection by utilities using Delta water sources usually is accomplished by physical inactivation and oxidation with chlorine. An increasing number of utilities are using ozone or a combination of disinfectants. (p. 3-6)

Chlorine has been used as a primary disinfectant for drinking water for decades. It is effective for bacteria, viruses, and *Giardia* at technically feasible concentration and contact times. It is well understood, relatively simple, and inexpensive. However, it is not effective in inactivating *Cryptosporidium*. If future regulations required disinfection of *Cryptosporidium*, alternative disinfectants would be needed. (p. 3-6)

Some utilities have adopted ozone treatment in addition to other conventional treatment measures. Ozone is a strong oxidant that is effective for inactivation of most pathogenic microorganisms, including *Cryptosporidium*. However, in the presence of bromide such as found in Delta waters, bromate is formed. Bromate is a health concern and is the subject of new drinking water regulations and ongoing health effects research. Optimized conventional filtration is not completely effective to remove all *Cryptosporidium* from drinking water, and chlorinated disinfectants are relatively ineffective in killing or inactivating it. However, physical removal, including low-pressure ultrafiltration membranes, does effectively remove *Cryptosporidium* and *Giardia*, and may provide an alternative to additional ozone inactivation. Membrane filtration has been used successfully in small systems, but it is not known whether the technology is adaptable to large systems such as generally are used to treat Delta waters. For this and other reasons, more California water systems are considering converting to ozone for their primary pathogen inactivation. Ozone treatment is also very effective in controlling adverse tastes and odors that are frequently associated with algae in source water. Other emerging treatment technologies include ultraviolet and chlorine dioxide disinfection, but their potential to produce unwanted chemical byproducts and their economic feasibility are as yet unproven (p. 3-6, 7).

An unfortunate side effect of oxidative pathogen inactivation is the formation of unwanted chemical by-products, some of which result in adverse health impacts. Additionally, the objectionable taste and odor (T&O) characteristics of some DBPs affect consumer acceptance. Different oxidants and different sources of water yield different types and concentrations of by-products.

The Safe Drinking Water Act Amendments of 1996 directed EPA to set regulations that protect against microbial pathogens while simultaneously decreasing the occurrence if DBPs. EPA promulgated the first stage of rules (Stage 1 Disinfectants/Disinfection By-Product (D/DBP) rule and Interim Enhanced Surface Water Treatment rule) in December 1998. These rules must be implemented by December 2001. The Stage 1 D/DBP Rule lowers the maximum contaminant level (MCL) for total trihalomethanes to 80 μg/l, and sets MCLs for haloacetic acids (60 μg/l) and bromate (10 μg/l). EPA is required to promulgate the Stage 2 D/DBP Rule and Long-Term 2 Enhanced Surface Water Treatment Rule by 2002. These rules are currently being negotiated. (p. 3-7)

Ozone does not produce halogenated by-products such as chloroform and the other chloro-bromo-THMs, although it produces bromoform in the presence of organic carbon bromide. Therefore, ozone use, combined with chloramines, enables utilities to more easily meet lower TTHM standards. However, ozonation is more complex and expensive than chlorination. Ozonation of natural organic matter generates higher levels of assimilable organic carbon that can support bacterial regrowth in drinking water distribution systems. Because ozonation does not produce a disinfectant residual, other chemical disinfectants (generally chloramines) must be used to protect distribution systems from

> bacterial regrowth and to minimize TTHM formation in the distribution system. Perhaps more importantly, ozone produces chemical by-products of its own. In the presence of bromide, ozone produces bromate, which appears to have the highest cancer-causing potential of the DBPs measured to date. Apart from bromate, ozone has the capacity to produce a number of other oxidized organic by-products, the potentially harmful effects of which are unknown. However, these by-products may be reduced through biological filtration. (p. 3-7)
>
> Bromide is present in Delta water supplies because of sea water intrusion into the Delta and agricultural return flows into the San Joaquin River from Delta water (Bromide in agricultural return flows primarily due to recycling ocean-derived bromide from areas irrigated with Delta water). TOC from natural and human sources, and bromide react with disinfectant chemicals to produce a broad range of chemical DBPs with different effects, depending on the disinfectant employed. The presence of bromide in source waters shifts the proportion of bromide-containing DBPs to higher levels. Because of the higher molecular weight of brominated versus chlorinated by-products, it is more difficult for utilities to meet MCLs that are based on weight/volume. Moreover, recent health effects studies suggest that brominated by-products may cause more serious health problems than chloroform, including the possibility of causing miscarriages and birth defects. In addition, nutrients affect disinfection treatment indirectly by supporting the growth of algae and other organisms, which subsequently adds to the TOC concentrations of the water. (p. 3-8)

Additionally, in his opinion in EDF et al. v. EBMUD, Judge Hodge concluded that:

> "providing high quality drinking water is a significant public policy objective that is furthered by EBMUD's diversion at the Folsom-South Canal." (p. 2)

He further acknowledged that:

> "from the evidence presented, this court is satisfied that the health risk concerns of EBMUD are well founded." (p. 72)
>
> "and if defendant's (EBMUD) risk assessment proves prophetic, then it would have been a judicial act of exceptional irresponsibility not to have taken the safer course." (p. 73)

The court also determined "that water quality for municipal purposes is appreciably superior when drawn directly from the reservoir at the Folsom-South Canal". (p. 74)

The key concept in the configuration of alternatives is maintaining the quality if the existing EBMUD supply consistent with basic drinking water quality principles. The State Water Resources Control Board, the Hodge Decision, and CALFED each support taking water from the highest quality source and exceeding regulatory standards to minimize treatment and the risks associated with the production of DBPs. The fact that another water utility uses a different treatment process for <u>existing</u> operations (as opposed to future conditions) does not alter the basic principle. While Delta water can be treated to meet drinking water quality standards and that many users use these sources, these standards represent the minimum acceptable quality of water that can be provided for potable uses. EBMUD's current water supply is of substantially better quality than those minimum standards and EBMUD's treatment systems are designed around that quality of water. The water quality criterion is appropriate because it protects the quality of EBMUD's delivered water supplies, it ensures a quality of water consistent with historic water supplies, and it minimizes risks to EBMUD customers.

Additionally, EBMUD staff developed a policy paper identifying the value of high quality source water and a protected water shed. (See attached.) This policy paper dated September 22, 2000 explains why selecting a high quality source water and source water protection are the best means of ensuring drinking water quality. EBMUD has adopted policy 81, which states that:

> "supplying water from the highest quality source water available is the safest and most prudent way to enable the district to make current and future state and federal health base drinking water quality standards. Given current and future increasingly stringent drinking water standards, EBMUD will minimize public health risks by seeking the best available water source, protected from potential degradation, thereby reducing the uncertainty of technologies ability to eliminate health risks and the potential for added risks from treatment by products."

Selecting and protecting a high quality water source is a logical and prudent step in responding to higher customer drinking water quality expectations, more stringent regulatory requirements and the uncertainties presented by the growing number of microbiological and chemical drinking water contaminants of concern.

THE IMPORTANCE OF SOURCE WATER
IN PROVIDING THE HIGHEST LEVEL OF PUBLIC HEALTH PROTECTION
SEPTEMBER 22, 2000

INTRODUCTION

This paper explains why selecting a high quality source water and source water protection are the best means of ensuring drinking water quality. It reviews the uncertainties and risks of choosing lower quality, unprotected sources of drinking water, and provides an important portion of the information base for future decisions concerning water supply sources for East Bay Municipal Utility District (EBMUD).

SUMMARY/CONCLUSIONS

All water agencies strive to supply their customers with high quality water, in reliable amounts at affordable rates. Selecting the highest quality source water available is endorsed by the American Water Works Association (AWWA):

> "AWWA is dedicated to securing drinking water from the highest quality water sources available and protecting those sources to the maximum degree possible."[1]

EBMUD has also adopted a policy (Policy 81) that supports this approach:

> "Supplying water from the highest quality source water available is the safest and most prudent way to enable the District to meet current and future state and federal health-based drinking water quality standards.
>
> "Given current and future increasingly stringent drinking water standards, EBMUD will minimize public health risks by seeking the best available water source, protected from potential degradation, thereby reducing the uncertainty of technology's ability to eliminate health risks and the potential for added risks from treatment by-products."[2]

EBMUD Policy 81 is consistent with the direction of the drinking water industry which is to integrate high quality source water selection and protection into a comprehensive approach to water quality that includes treatment and distribution system management. Selecting and protecting a high quality source water is a logical and prudent step in responding to higher customer drinking water quality expectations, more stringent regulatory requirements and the uncertainties represented by the growing number of microbiological and chemical drinking water contaminants of concern.

Improved science and lowering of detection limits continue to expand the number of contaminants of concern, the population potentially impacted, and the nature and effect of these

---

[1] American Water Works Association, Policy Statement on Quality of Water Supply Sources, adopted 6/19/88, revised 6/11/00.

[2] East Bay Municipal Utility District Policy 81, 4/22/97.

impacts. Contaminants of concern primarily result from polluting activities within the water supply watersheds and increasingly from unintended collateral effects of the treatment processes employed to deal with the contaminants in the source water. Therefore, selecting and maintaining the highest quality source water is increasingly the first and most effective barrier in preventing contaminants from entering or being created within the water supply. Treatment of contaminated or lower-quality source water may or may not require more expense but always results in less reliability. Possible contaminants of source water are listed in Table 1..

Table 1.

CONTAMINANTS OF SOURCE WATER

POTENTIAL SOURCES OF CONTAMINANTS	REGULATED AND EMERGING CONTAMINANTS
Commercial/Industrial Discharges (e.g., food processing, mines/gravel pits, sewer lines)	▪ Volatile organics (e.g. solvents, fuels) ▪ Synthetic organic (e.g. pesticides, herbicides) ▪ Inorganics (e.g. chromium, cyanide, metals) ▪ Pathogens (e.g. bacteria, viruses) ▪ Radionuclides ▪ Carcinogenic precursors ▪ Endocrine Disruptors ▪ Particulates
Agricultural/Rural Runoff (e.g., confined animal feeding operations, irrigated crops, agricultural drainage, silviculture)	▪ Pathogens (e.g. bacteria, viruses, protozoa) ▪ Synthetic organics (e.g. pesticides, herbicides) ▪ Inorganics (e.g. nitrates) ▪ Volatile organics (e.g. solvents, fuels) ▪ Particulates ▪ Carcinogenic precursors ▪ Endocrine disurptors
Residential/Municipal Discharges and Runoff (e.g., golf courses, housing, waste transfer/recycling stations, wastewater)	▪ Pathogens (e.g. bacteria, viruses, protozoa) ▪ Synthetic organics (e.g. pesticides, herbicides) ▪ Inorganics (e.g. cadmium) ▪ Volatile organics (e.g. solvents, fuels) ▪ Particulates ▪ Carcinogenic precursors ▪ Endocrine disruptors
Other (e.g., construction/demolition, historic waste dumps/landfills, transportation corridors, storage tanks)	▪ Synthetic organics (e.g. pesticides, herbicides, PCBs) ▪ Volatile organics (e.g. solvents, fuels) ▪ Carcinogenic precursors ▪ Inorganics (e.g. asbestos) ▪ Radionuclides ▪ Pathogens (e.g. bacteria, viruses) ▪ Particulates

COSTS

Both high quality source water selection and building treatment facilities can have high initial costs for land, treatment and transmission facilities. High quality source water often requires a higher initial investment. However, maintaining a high quality source water is achieved at lower cost by low-tech source protection and pollution prevention activities. In addition to reduced reliability and increased risk to water quality, treatment of contaminated source water often entails much higher life cycle costs. Continuous addition of treatment chemicals, energy for treatment and modification or addition of new technologies to address new contaminants are cost factors to be considered in initial source water selection. Higher cost for treatment not only applies to water agencies but increasingly impacts customers directly as well. Customers needing higher quality water than delivered by a utility incur substantial costs in purchasing commercially bottled water or expensive point-of-use treatment devices. Reliance upon individual point-of-use devices raises questions of social equity and has been shown to create additional public health risks due to lack of adequate maintenance.

Cleaning up a drinking water contamination incident is a complicated, costly, and sometimes impossible process. When compared to the costs of cleaning up after a contamination incident, the costs of preventing contamination are very small.[3]

KNOWN & REGULATED CONTAMINANTS

Drinking water supply contaminants that pose health risks include microbial contaminants such as bacteria, viruses, and protozoa; inorganic contaminants such as metals; and organic chemicals such as disinfection by-products, pesticides, herbicides and industrial solvents. As analytical capabilities and public health information on microbial and chemical contaminants has improved, regulation of these contaminants in drinking water has increased.

Between 1975 and 1985, 23 contaminants were regulated by the United States Environmental Protection Agency (EPA). In adopting the 1986 Amendments to the Safe Drinking Water Act (SDWA), Congress required EPA to set Maximum Contaminant Levels (MCLs), and Maximum Contaminant Level Goals (MCLGs) for 83 named contaminants by 1989, and to set regulations beyond the 83 contaminants for 25 additional contaminants every three years. By 1992, EPA had issued regulations for 76 of the mandated contaminants. As a result of these legislative actions, the number of contaminants regulated under SDWA has quadrupled since 1974[4], and water utilities must now meet regulations for over 100 health-related and aesthetic-based contaminants.

Many identified contaminants are not easily removed or may lead to secondary contamination. For example, "…processes in conventional water treatment[5] are not effective in removing certain pesticides belonging to traizine, acetanilide, carbamate, and urea derivative classes. During

[3] EPA Office of Ground Water and Drinking Water. December, 1998.
[4] EPA Document 816-F-00-002, 2/2000.
[5] "Conventional Water Treatment is the use of coagulation, flocculation, sedimentation, filtration, and disinfection, together as sequential unit processes, in water treatment. This process is also called complete treatment." As found in Symons, et al., The Drinking Water Dictionary 1999, AWWA, Denver, Colorado, USA.

disinfection with chlorine, pesticides such as organophosphates can be oxidized to form toxic degradation products."[6]

Two factors contribute to increasing public health concerns:

- Development of new and more sensitive analytical methods allows for detection of chemicals and microbial pathogens that previously were unquantified or unidentified potential health threats. These advances in analytical methodology enable the detection of new contaminants and existing contaminants at ever-lower concentrations. For example, the latest analytical method for perchlorate is 50 times more sensitive than the methodology used five years ago.

- New toxicological and epidemiological studies correlate the low-level occurrence of contaminants with human health effects. As an example, a recent study by the California Department of Health Services reported an increased number of spontaneous abortions in pregnant women drinking water contaminated with bromodichloromethane, a chemical by-product of disinfection.[7]

EMERGING CONTAMINANTS

As stated above, new analytical methods and better science have led to identifying new contaminants and relating low levels of contaminants to human health effects. These emerging contaminants represent a significant challenge as they exhibit health effects at extremely low levels and are generally not removed through conventional treatment.

Two examples of emerging contaminants, which result from new toxicological data and/or new analytical methods, are described below:

Endocrine Disruptors. Endocrine disruptors are chemicals that interfere with the endogenous hormones in the body. These chemicals have been demonstrated to cause a variety of developmental, behavioral and reproductive problems in humans. There are a variety of sources for these chemicals including discharges from municipal and industrial wastewater treatment plants, industrial discharges runoff from livestock, poultry and agricultural operations, as well as storm water runoff among other sources.

A recent study published in the AWWA Journal[8] describes the discovery of a number of endrocrine disruptors in the Las Vegas Wash and Lake Mead. In Japan, 37 endocrine disruptors are currently required by the Ministry of Health & Welfare to be monitored.[9]

N-Nitrosodimethylamine (NDMA). NDMA is a by-product of current and historical manufacturing processes. It is associated with pesticides, rocket fuel, cosmetics, and some foods and beverages. It has recently been found in some drinking water supplies in California and

---

[6] James Hetrick, et al. Briefing Document for a Presentation to the FIFRA Scientific Advisory Panel (SAP), September 2000.

[7] Swann et al, Epidemiology, Vol. 9, No. 2, pp 126-140, 3/18/98.

[8] Roefer, et al, AWWA Journal, *92*, 52-58, 8/2000

[9] Japan Water Research Center, Information Network System 1999.

other areas in North America. NDMA is believed to be a possible human carcinogen at very low levels. It is in a very early stage in the EPA regulatory process, and no federal MCL has been proposed. In California, an action level at 20 parts per trillion has been established.

A survey of raw and treated water for NDMA, as well as development of an analytical method is in progress. EBMUD is currently involved in the survey.

The continuing discovery of new contaminants in the watersheds, in source water, and in treated water will spur additional state and federal regulations. Traditional treatment strategies cannot be expected to effectively deal with these emerging contaminants at extremely low concentrations and across the spectrum of pathogens and organic and inorganic chemicals, which may exhibit toxic or carcinogenic effects.

OTHER EMERGING ISSUES

In addition to the threat of emerging contaminants, there are other public health issues to consider in selecting a water supply source.

Sensitive Sub-Population. "In assessing the potential impact of food and waterborne disease, it is important to recognize that certain individuals may be at greater risk of serious illness than the general population."[10] This was dramatically demonstrated in 1993 in Milwaukee when more than 100 people died from ingestion of waterborne *Cryptosporidium.*[11] The vast majority of deaths occurred in sensitive sub-populations including young children, the elderly, and people who were immuno-compromised. **Current data suggest that sensitive sub-populations now exceed 30% of the US population.** *Cryptosporidium* has recently emerged as one of the most critical new pathogens of concern. After more than 10 years of research, there is no analytical method for *Cryptosporidium* that can assure treated water quality, nor commonly used treatment technologies that can assure 100% safety for sub-populations. The emergence of contaminants such as *Cryptosporidium* that disproportionally affect growing sensitive sub-populations is a strong incentive for selection and protection of high source water quality.

Water Treatment Effectiveness. Optimization of traditional water treatment technologies (coagulation, sedimentation, filtration, and disinfection) has been effective at reducing microbial and chemical health risks. However, it is not clear that this success can be achieved with the growing list of new contaminants. Emerging contaminants may require further optimization of the current treatment process and/or other processes (e.g. activated carbon and membrane technology) that would be added to current treatment trains. However, the effectiveness of these new treatments is uncertain. Research spanning many years will be required to assess the control of new contaminants. It is impossible to determine what treatment is required without knowing the treatment characteristics of a specific contaminant and the concentration at which there is a health concern. The possibility exists that treatment technology may simply not be available for a specific contaminant. Treatment also invariably involves increased environmental and economic impacts such as disposal of waste products and energy consumption.

---

[10] Charles P. Gerba, Joan B. Rose, and Charles N. Haas, Sensitive Populations, IJ of Food & Microbiology, 1996.
[11] John DeSuarez, Drinking Water Quality, Jon Wiley & Sons, 1997.

Accountability for Unknown Drinking Water Risks. Water purveyors are held to strict legal responsibility for ensuring that drinking water delivered to consumers meets current regulations. Recently, several water utilities have been named as defendants in lawsuits based on having historically delivered water suspected to contain chemicals potentially dangerous to drinking water customers even though, at the time the water was delivered, the chemicals in question were not regulated. The claim was that contaminated water had been delivered to customers over the past 25 years. The claims are based on current knowledge, not what was known or detectable in the past. Hence, a water company could potentially be held accountable for delivering water that contained perchlorate 25 years ago, even though it was not regulated and could not be detected in the water at the time. The outcome of these suits remains in the courts but may well rest on a determination as to how diligent and responsible the water agency had been in the selection of its source water from the alternatives available to it at the time.

Public Awareness of and Intolerance for Risk. Public expectations for water that not only meets regulatory requirements but that is perceived to be safe places the responsibility squarely on the shoulders of the water industry. Water agencies are now required to disclose contaminants detected in source and treated water even if they are not currently regulated. Nationwide, water agencies must annually provide a public accounting of the quality of the drinking water that is delivered to the consumer in a "Consumer Confidence Report".

In California, Public Health Goals (PHGs) have been established to define levels of drinking water contaminants at which there is no known risk. These levels may be significantly lower than current regulations. PHGs must be listed in the annual Consumer Confidence Report to all consumers. Additionally, where PHGs are exceeded, the water agency must inform its customers through a public meeting/hearing of what action the agency is taking to address that contamination.

Risk Balance. New water treatment processes or modifications to existing processes produces a desired effect but may also bring with them process by-products or other risks. These process by-products or risks may be in the form of increased waste, new chemical contaminants, new biological contaminants, taste and odor and/or interference with other processes. The most noted risk balance in drinking water treatment occurs when a disinfectant is added to water to prevent acute illnesses from pathogens and the reaction produces an unintended disinfection by-product which present a possible chronic (long term) risk of cancer. Thus, to eliminate a known immediate health risk a potential long term health risk is created. For example, when ozone is used as a disinfectant in a contaminated source water, bromate is formed. EPA has considered lowering the bromate MCL and subsequently the chronic risk of cancer. However, EPA decided not to lower the MCL as this would preclude the use of ozone and dramatically increase the acute microbial risks. The most effective method for reducing the need for these risk trade-off decisions is to begin with the highest quality, least contaminated source water reasonably available and maintain that quality through source protection.