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April 17, 2000

Ken Williams
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United States Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202-2733

Dear Mr. Williams:

Enclosed are three copies of the revised Source Water Assessment and Protection Program document for the State of New Mexico. The text addresses the issues and concerns raised by the Environmental Protection Agency in its Consolidated Comments of August 15, 1999, and includes some language revisions that hopefully improve readability.

Comment #1 of the Consolidated Comments alluded to the difficulty of finding specific information on stakeholder participation on the SWAPP Advisory Committee. An introductory section and table of contents have been added to Appendix A (Public Involvement) to remedy this problem. Because of the large volume of material contained in Appendix A, hard-bound copies and internet-accessible versions of the SWAPP document available to the general public will include only this introduction and table of contents, and will not include the material content of the appendix. Interested persons are directed to request copies of the material from the New Mexico Environment Department Drinking Water Bureau. Three complete sets of Appendix A are submitted with this enclosure.

Appendices B and C are expanded versions of the Contaminants of Concern and Potential Sources of Contamination lists previously found in Appendices B and E, respectively.

The discussion in Chapter 3 on Surface Water Source Delineations is revised to eliminate the "semi-circular critical zone" of Type B watersheds. The revised text is more in keeping with Consolidated Comment #8, which references the ½ mile buffer zone delineated on either side of an active stream channel for a distance of ten miles upstream from the intake structure.

Vulnerability ranking procedures are revised for ground water systems in Section 5.2, and for surface water systems in Section 5.5. Revision of the procedures was in response to the concern expressed during SWAPP public meetings that the choice of a single ranking would not accurately reflect the susceptibility of water supplies. The revised procedures are intended to

help water users associations and utility companies better manage their water resource by linking the vulnerability ranking to specific, identifiable groups or categories of contaminant sources.

Finally, the reproduction in Chapter 1 of material contained in the USEPA State Source Water Assessment and Protection Programs Final Guidance (EPA 816-R-97-009) is replaced with a discussion more pertinent to public water systems in New Mexico.

Should you have any questions about the revisions or need additional information, please contact me at (505) 827-1400, extension 1043.

Sincerely,

John Gillentine
Source Water Assessment and Protection Program
NMED/DWB

State of New Mexico

Source Water Assessment And Protection Program

February 2000

Drinking Water Bureau
Field Operations Division
New Mexico Environment Department

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LIST OF ACRONYMS

BLM	Bureau of Land Management (United States Department of the Interior)
BOR	Bureau of Reclamation (United States Department of the Interior)
CCR	Consumer Confidence Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CSB	NMED Community Services Bureau
CTAC	SWAPP Citizens and Technical Advisory Committee
DRASTIC	Depth to Water; (Net) Recharge; Aquifer Media; Soil Media; Topography; Impact of Vadose Zone Media; Conductivity (Hydraulic) of the Aquifer
DWB	New Mexico Environment Department Drinking Water Bureau
DWPL	Drinking Water Priorities List
DWSRF	Drinking Water State Revolving Fund
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
GPS	Global Positioning System
GWPAP	NMED/GWQB Ground Water Protection and Abatement Program
GWQB	NMED Ground Water Quality Bureau
GWUDI	Ground Water Under the Direct Influence of Surface Water
HUCS	USGS Hydrologic Unit Codes
IBWC	International Boundary and Water Commission
LWP	NMED/CSB Liquid Waste Program
MCL	Maximum Contaminant Level
NAS	National Academy of Sciences
NGWA	National Ground Water Association
NMCCAW	New Mexico Citizens for Clean Air and Water
NMED	New Mexico Environment Department
NMERI	New Mexico Engineering Research Institute
NMML	New Mexico Municipal League

NMRWA	New Mexico Rural Water Association
NMWUA	New Mexico Water Users Association
NPDES	National Pollutant Discharge Elimination System
NPS	Non Point Source
NTNCWS	Non-Transient Non-Community Water System
NTU	Nephelometric Turbidity Units
PSOC	Potential Sources of Contamination
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
SWAA	Source Water Assessment Areas
SWAP	Source Water Assessment Plan
SWAPP	Source Water Assessment and Protection Program
SWB	NMED Solid Waste Bureau
SWP	NMED/SWB Solid Waste Program
SWQB	NMED Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
TNCWS	Transient Non-Community Water System
UIC	Underground Injection Control
USFS	Forest Service (United States Department of Agriculture)
USGS	United States Geological Survey
UST	Underground Storage Tank
USTB	NMED Underground Storage Tank Bureau
USTP	NMED/USTB Underground Storage Tank Program
USWPP	Unified Source Water Protection Plan
VA	Vulnerability Assessment (NMED Drinking Water Bureau)
WCF	Water Conservation Fund
WhAEM	Well Head Analytic Element Model
WHPP	New Mexico Wellhead Protection Program
WQCC	New Mexico Water Quality Control Commission
WRASTIC	Wastewater Presence; Recreational Impact; Agricultural Impact; Size of Watershed; Transportation Avenues; Industrial Impact; Vegetative Ground Cover

CHAPTER ONE

Introduction and Program Summary

Throughout New Mexico history, the ability to find good sources of drinking water has played a key role in the location of our cities, towns and homesteads. Even today, the availability of safe drinking water influences the pattern of our communities' growth. Clean water remains an essential element in the quality of New Mexico community life.

1.1 Background

New Mexico's Source Water Assessment and Protection Program (SWAPP) is a federally-funded program that assists communities in protecting their drinking water supplies by identifying potential sources of contamination, evaluating the susceptibility of supply wells and surface water intakes to contamination, and working with water associations and service providers to develop source water protection strategies. The SWAPP is an information-gathering tool that follows on earlier drinking water initiatives mandated by the federal Safe Drinking Water Act.

The Safe Drinking Water Act ("the Act"), enacted by the United States Congress in 1974, had as its primary purpose the promulgation of national, enforceable standards for drinking water, and the implementation of a monitoring scheme to ensure that public water systems continue to meet those standards. The Act established Maximum Contaminant Levels for twenty-two known chemical contaminants, and set non-enforceable Secondary Maximum Contaminant Levels for chemical constituents that may adversely affect the aesthetic qualities of drinking water. The Act was amended in 1986 with the establishment of the Drinking Water Priorities List, which is a list of contaminants "known or anticipated to occur" in public water systems that pose a health risk and that may warrant regulation under the Act. The 1986 amendments also provided for routine expansion and revision of the Priorities List.

The 1986 Amendments expanded the Act's original mandate for chemical monitoring and reporting activities to include pollution prevention measures. To carry out the new law, Congress authorized the EPA to require each state to develop and implement a Wellhead Protection Program. The EPA approved New Mexico's Wellhead Protection Program in 1991. The 1996 Reauthorization and Second Amendment of the Act extended the concept of source water protection of systems relying exclusively on groundwater to include systems that draw water from lakes, rivers and reservoirs. The New Mexico SWAPP thus builds on earlier state efforts by employing existing data, and developing new information where existing data is lacking.

1.2 Public Water Supplies in New Mexico

Section 1401 of the Safe Drinking Water Act defines a public water system as "a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals." The Act further defines public water systems as either "community water systems" or "non-community water systems." Community water systems must have at least fifteen service connections used by year-round residents, or must regularly serve at least twenty-five year-round residents. Non-community systems include all other facilities or businesses having their own water supply for use by employees, customers and patrons, such as schools, office buildings, factories and industrial centers, restaurants, automobile service stations and campgrounds. Non-community systems are typically found in rural or remote settings.

Of the approximately 1,340 active public water systems in New Mexico, 48% are classified as community water systems, 40% are classified as transient non-community systems (campgrounds, restaurants, etc.), and 12% are classified as non-transient non-community systems (schools, places of work, etc.). Nearly 96% of the state's public water systems rely exclusively on ground water. The remaining systems rely either exclusively on surface waters (lakes and reservoirs or stream intakes), or a combination of surface and ground waters. Slightly fewer than 10% of systems currently regulated as surface water systems are classified as Ground Water Under the Direct Influence (GWUDI) of surface water.

1.2.1 Surface Water Sources

New Mexico's surface water sources include the headwaters reaches of three national drainage systems: the Colorado River, which receives waters from the San Juan River and Lower Colorado River basins; the Mississippi River, which receives waters from the Arkansas River Basin; and the Gulf of Mexico, which receives waters from the Upper, Middle and Lower Rio Grande and Pecos River basins. Many New Mexico streams terminate in topographically closed drainage basins with no outflow to larger river systems. New Mexico's eleven principal drainage basins, as adopted by the New Mexico Water Quality Control Commission (NMWQCC, 1974), are shown in Figure 1.

Because New Mexico streams and rivers flow through many miles of sparsely populated, mountainous terrain, the upland reaches of the state's waterways remain among the most pristine in the nation. Further downstream, however, New Mexico's surface water supplies may be impacted from a wide variety of specific, or "point sources," and diffuse, or "non-point" sources of contamination. Near municipalities, water quality problems may arise from urban runoff, industrial discharges and high nutrient loads from wastewater treatment plants. In rural areas, overgrazing, logging and intensive recreational uses may contribute to turbidity and siltation problems, and over-application of pesticides and herbicides by agricultural operations may impact aquatic systems, particularly where runoff from fields is uncontrolled.

This page intentionally left blank for Figure 1: WQCC Eleven Principal Drainage Basins

This page intentionally left blank for Figure 2: USGS Principal Aquifers in NM

1.2.2 Ground Water Sources

Ground water supplies may be withdrawn from unconfined, confined or semi-confined aquifer zones. For purposes of this discussion, an "aquifer" is defined as a saturated water-bearing geologic unit capable of transmitting significant quantities of water under ordinary hydraulic gradients (Freeze and Cherry, 1979). A "confined aquifer" is defined as an aquifer bounded by less-permeable stratigraphic units, wherein hydraulic head pressure is elevated above atmospheric pressure. In some regions of the state, artesian conditions may exist where hydraulic head pressure is elevated above ground level. In contrast, an unconfined or "water table" aquifer is a geologic unit whose upper surface is not bounded by confining beds or less permeable strata, and where fluid pressure within the pore spaces of sand grains or other geologic media is equal to atmospheric pressure.

Ground water in New Mexico occurs in a variety of geologic settings, but the most productive aquifers are generally of sedimentary origin. The United States Geological Survey 1984 National Water Summary (USGS Water Supply Paper 2275) categorizes New Mexico aquifers into one of four principal lithologies: valley-fill, basin-fill, consolidated or semi-consolidated sandstone, and fractured or dissolutioned limestone (Fig. 2).

Valley-fill aquifers typically support only shallow supply wells, and occur where geologically recent fluvial deposits backfill old river channels and small structural depressions. Aquifer materials consist of poorly sorted sand, silt and gravel deposits derived from adjacent uplands, and terrace gravels deposited during periods of stream channel aggradation. Valley-fill aquifers are usually unconfined.

In contrast, basin-fill aquifers occur on a regional scale and may be very deep (the Albuquerque Basin, for example, is estimated at upwards of 13,000 ft deep (Lozinsky et al, 1991). Aquifer materials consist of sediment originating hundreds of miles away and range from silts and clays deposited in quiescent periods, to boulders and cobbles deposited during intense flood events. Coarse-grained, poorly sorted alluvial fan deposits from basin margins may prograde onto the finer-grained basin floor deposits, creating an interfingering wedge of dissimilar materials with dissimilar hydraulic properties (Hawley and Haase, 1992).

Regional sandstone aquifers in New Mexico occur primarily in the northwest and east central regions of the state. These units vary in age from late Permian or early Jurassic to Eocene, and vary in productivity and water quality both regionally and with depth below ground level. Shales, siltstones or less permeable sandstones bounding the regional sandstone aquifer may impart undesirable chemical constituents to ground water, degrading its quality as a drinking source (Dam, 1994). Some regulated ground water contaminants, such as sulfate, may be introduced through natural sources.

Ground water in limestone aquifers flows through a complex network of solution channels and crevices before exiting the rock through springs or in pumping wells. This network, developed preferentially along bedding planes, joints, fractures or similar planes of weakness, results where circulating ground water dissolves the primary carbonate minerals. Limestone aquifers are

generally productive only where the rock's original porosity and permeability is enhanced by dissolution (Freeze and Cherry, 1979). Limestone and carbonate rocks form important aquifers primarily in the east-central and southeast parts of the state, and in some parts of northwest New Mexico.

Not all aquifers occur as discrete geologic units, but may demonstrate characteristics of more than one of the principal types, or as a combination of the principal types discussed above. A valley-fill aquifer, for example, may become inset within a basin-fill aquifer through stream incision, and a limestone aquifer may pinch-out into a regional sandstone aquifer. Though an important community water source in some areas of the state, fractured igneous and metamorphic rocks in general yield only small amounts of ground water and are not considered a principal aquifer type.

Perhaps the greatest single threat to ground water supplies in New Mexico is the combined effluent from numerous household septic tank and leach field disposal systems. NMED estimates that there are over 200,000 septic tanks statewide, discharging roughly 40,000,000 gallons of wastewater into the subsurface every day. Where ground water is shallow or where percolation rates through the geologic media are rapid, soil microorganisms normally responsible for the break down of waste products are less effective in removing contaminants and pathogenic organisms. Organic contaminants such as trichloroethylene are a well-documented ground water contaminant associated with household cleaning agents discharged through septic tanks (WQCC Water Quality and Water Pollution Control in New Mexico, 1996 305b report, p. 76). Other wide-spread ground water contaminants from non-point sources include pesticides, herbicides and the by-products of their decomposition found in both agricultural and residential areas; nitrate and ammonia contamination from dairy and concentrated animal feeding operations; and oil, grease, heavy metals, nutrients and high sediment loads from urban runoff. Contaminants from point sources, listed in order of prevalence, include hydrocarbons and related organic contaminants from leaking under ground fuel and chemical storage tanks; natural and synthetic organic compounds from industrial sites; waste organic and inorganic products leaked or spilled from oil and gas exploration and production and underground injection of oil field brines; inorganic compounds released in mining and mineral milling operation; and hydrocarbons, solvents and miscellaneous inorganic compounds leached from landfills and uncontrolled dump sites. New Mexico is also home to a number of CERCLA, or "Superfund" hazardous waste sites in various stages of investigation or remediation.

1.3 Program Goals and Objectives

The State of New Mexico Source Water Assessment and Protection Program (SWAPP) is part of a national effort to gather information on public drinking water sources and to make that information available to water consumers. To carry out New Mexico's portion of this task, our SWAPP follows four basic steps:

1. delineating source water protection areas
2. taking inventory of potential contaminant sources within protection areas

3. determining the susceptibility of water sources to contamination
4. making assessments available to the public

The source water protection area is the land area about each ground water well or surface water intake where spills, leaks, accidents or other forms of discharge will have a direct impact on the community water supply. The size of this area depends on soil characteristics, site geology and ground water flow rate for ground water systems, and on drainage area and upstream land uses within the watershed of surface water systems. The list of contaminant generators inventoried within source water protection areas is taken from industries and activities which produce, use, distribute or handle contaminants for which a Maximum Contaminant Level has been established under the Safe Drinking Water Act. The third step, determining the susceptibility of water sources to contamination, involves comparing the location of potential contaminant sources to the ground water well or surface water intake, taking into consideration the geologic and hydrologic characteristics of the site. Susceptibility analysis also identifies those contaminant threats posing the greatest risk to the water supply, based on the solubility, mobility and toxicity of the contaminant. Once the analysis is completed, a Source Water Assessment Report is prepared that summarizes NMED's findings and makes recommendations for community action.

In addition to assessing the risk to which public water supplies are exposed, the SWAPP aims to involve individual communities in source water protection through public outreach and education, and through the formation of local planning teams. The ultimate goal of the SWAPP is to generate active community involvement in the management and protection of the local water supply.

1.4 SWAPP Implementation

Factors considered in each Source Water Assessment include 1) the construction and integrity of wells or intakes; 2) the hydrogeology, soil characteristics and topography of critical areas; 3) the proximity of facilities or activities posing a potential threat to wells or intakes; and 4) the transport characteristics of potential contaminants and their persistence in the environment. Based on these factors, each well or intake will be assigned a susceptibility ranking indicating the relative risk of that well or intake to contamination. The 1996 SDWA Amendments require that Source Water Assessments be completed for all public water systems in the state within two years after EPA approves the state's program. New Mexico applied for and received an eighteen-month extension from the EPA, giving the New Mexico SWAPP until May 2003 to complete its assessment work.

Source Water Assessment reports compiled for each public water system will be made available to the general public through several different avenues (see Section 6.2). EPA does not consider an assessment "complete" until such reports are publicized. Once the assessments are generally available, it is hoped that interest in the development of local source water protection programs will increase throughout New Mexico communities.

As the assessment process for public water systems progresses, it is anticipated that modifications and amendments to the SWAPP may become necessary. Information contained in this document is therefore subject to change. Any new edition of this document, pending approval by the EPA, will be made available to the general public.

1.5 Existing Programs

New Mexico currently operates two drinking water programs that closely resemble the SWAPP: the New Mexico Wellhead Protection Program (WHPP), adopted in 1991 to spark voluntary community efforts to protect ground water supply wells from contamination, and the Vulnerability Assessment Program, designed to assist public water systems in meeting the chemical monitoring requirements of the Safe Drinking Water Act. These programs are discussed in more detail in Chapter 7.

1.5.1 Wellhead Protection Program

The New Mexico Wellhead Protection Program is a voluntary, five-step program designed to encourage community involvement in protecting local water supplies. These five steps are:

1. Formation of a Wellhead Protection Committee
2. Delineation of Wellhead Protection Areas around water supply wells
3. Completion of an inventory of potential contaminant sources within each delineated Wellhead Protection Area
4. Development of management strategies for implementing the local Wellhead Protection Plan
5. Planning for emergencies and for future water system development and maintenance as the community grows

The Wellhead Protection Program forms the core of the New Mexico SWAPP, and follows on assessment activities by promoting source water protection measures within the community. It operates in conjunction with the SWAPP through community outreach and education, through relationships cultivated with various non-profit community advocacy and stakeholder groups, and through a shared funding mechanism created under the DWSRF set-asides.

1.5.2 Vulnerability Assessment Program

The Vulnerability Assessment program, adopted in 1994, was created to provide a scientific basis for determining whether chemical monitoring waivers are appropriate for public water systems regulated under and subject to the monitoring requirements of the Safe Drinking Water Act. This state-sponsored program was intended to assist public water systems meet the Safe Drinking Water Act Phase II and Phase V chemical monitoring requirements by determining whether or not particular classes of regulated contaminants pose a threat to the water supply. By conducting Vulnerability Assessments, NMED was able to issue chemical monitoring waivers to many water systems, thereby reducing the amount and/or frequency of sample collection and analysis done by the system for a period of time specified in the waiver.

CHAPTER TWO

Public Participation

Section 1428 (b) of the SDWA requires that, "to the maximum extent possible, each state shall establish procedures, including but not limited to the establishment of technical and citizens advisory committees, to encourage the public to participate in developing the protection program for wellhead areas and SWAP's under Section 1453. Such procedures shall include notice and opportunity for public hearing on the state program before it is submitted to the Administrator." New Mexico's technical and citizens advisory committee was instrumental in shaping the Source Water Assessment and Protection Program, and continues to advise the program during its implementation. Chapter Two presents a very brief discussion of public involvement in the State of New Mexico Source Water Assessment and Protection Program; for more information on public meeting dates, locations, agendas, and advisory committee membership, the reader is directed to Appendix A.

2.1 SWAPP Advisory Committee

The New Mexico Environment Department Drinking Water Bureau (NMED/DWB) solicited membership for a statutorily required technical and citizens advisory committee from industry leaders, citizen's organizations and state and federal government agencies. This committee was created to provide various viewpoints for technical feasibility and effectiveness, and for the appropriateness and acceptability of assessment methodologies.

The SWAPP Advisory Committee is composed of members of many organizations around New Mexico including the New Mexico Rural Water Association, the New Mexico Municipal League, the New Mexico Engineering Research Institute, the New Mexico Citizens for Clean Air and Water, the City of Albuquerque, the City of Santa Fe, Forest Trust, and the League of Women Voters. This committee held four meetings during 1999 to assist in the development of the SWAPP. Documentation supporting the NMED/DWB's effort to include representatives from various stakeholder, public interest and vulnerable population groups is included in Appendix A.

2.2 Public Meetings

To encourage wider participation from around the state, NMED/DWB held public meetings in Las Cruces and Santa Fe on February 22, and 23, 1999, respectively. Notice of the meetings was provided by bulk mailings and faxes--over 1,300 flyers were mailed to public waters systems, organizations, state agencies, tribes, and newspapers located throughout New Mexico. During these meetings, NMED/DWB made formal presentations on the SWAPP at 10:00 am and at 1:00 pm, and was available from 9:00 am to 3:00 pm for individual discussion. The public was provided with a copy of the DRAFT-Final SWAPP and with a form for submitting written

comments. Several of the participants stated that they would like to mail their comments to NMED at a later date. Of the forms completed during and after these meetings, none provided negative feedback about the program. Documentation of the public meetings can be found in Appendix A.

2.3 Ongoing Public Participation

NMED/DWB believes ongoing and active participation by the public is essential to the success of the program. The New Mexico SWAPP will periodically reconvene the technical and citizens advisory committee during implementation of the program to solicit the views and opinions of committee members once a SWAPP track record is established.

CHAPTER THREE

Delineation of Assessment Areas

An area of land bounding the source areas from which Public Water Systems receive their drinking water will be delineated for each drinking water supply in New Mexico. These Source Water Assessment Areas are the focal points for the contaminant inventories and susceptibility analyses discussed in Chapters 4 and 5, respectively, and are the targets for protective action. Sources of drinking water in New Mexico include ground water wells, springs, and surface water intakes on streams, rivers and lakes.

3.1 Ground Water Source Delineation

The methods used to delineate ground water assessment areas depend on the type of information available on the aquifer, which may be collected by SWAPP staff from published professional reports and water supply papers or from field investigations. More than one method of delineation may be employed for a single source area, and the assessment area boundaries selected from a comparison of the results. Once an appropriate method is chosen, ground water assessment areas will be subdivided into three zones of influence, designated zones A, B and C, delineated on the basis of an estimated time-of-travel required for a hypothetical "slug" of contaminated water to be drawn into the well bore. Because of the uncertainty associated with such estimates, the innermost Zone A for all ground water sources in New Mexico is a circular zone having a fixed radius of 200 ft from the wellhead. Capture zones B and C are delineated for two-to-five year, and greater than five-year times of travel, respectively.

3.1.1 Method of Delineation

Capture zones for pumping wells are affected by a number of variables, and the method used to delineate wellhead protection areas necessarily varies according to the complexity of area hydrogeology and the amount of information available on the well and underlying aquifer. Selection of a delineation method follows a three-tiered approach, where each "tier" represents a different level of available hydrogeologic information in terms of quality and/or quantity of data, and a corresponding difference in our understanding of the hydrogeologic complexity of the aquifer.

Tier 1. The volume of aquifer contributing ground water to a pumping well during a given period of time can be calculated with reasonable accuracy if certain physical properties of the fluid and porous media are known. Unfortunately, aquifer properties that must be determined in order to make such calculations are not easily obtained. This information is available for some areas of the state, however, due to unique geologic setting, water system size, or other factors that prompted study of the area. Hydrogeologic mapping, test drilling and sampling or aquifer testing procedures may be used to gather new information about an area, depending on site-specific conditions, resource availability and the number of public water systems affected.

Ground water systems assessed under Tier 1 delineation methods are conceivably the most accurate and realistic in terms of risk analysis.

Information gathering tools used for Tier 1 delineations include a) hydrogeologic maps, reports and aerial photographs compiled by federal, state, and local agencies; b) site-specific geological mapping; c) test drilling and borehole sampling; and d) subsurface geophysical exploration. Hydrogeologic mapping of aquifer units may be an appropriate means of delineation where physical features such as impermeable rock outcroppings that form hydrologic boundaries are visible at the land surface. Hydrogeologic maps may be supplemented by subsurface geophysical methods and test drillings.

In areas where sufficient hydrogeologic data exists to simulate ground water flow using mathematical modeling techniques, the size and shape of the wellhead protection area may be delineated or modified using widely available computer flow models such as the EPA WHPA 2.2 or WhAEM programs. These semi-analytical ground water flow models were written specifically for states and communities to use in delineating Wellhead Protection Areas, and simulate capture zones created by the withdrawal of ground water by pumping wells. Because ground water flow conditions may be complex and may change both spatially and temporally, mathematical models necessarily make simplifying assumptions in order to solve their flow equations. The WHPA and WhAEM models contain semi-analytical capture zone solutions, applicable to homogeneous aquifers exhibiting two-dimensional, steady-state ground water flow. Modeling results consequently reflect average flow conditions during a typical year and do not accommodate atypical ground water withdrawals or abnormal precipitation and recharge patterns. In order to evaluate the risk associated with migration of potential contaminants toward a pumping well over time, multiple capture zones may be calculated using NMED-approved mathematical models for three-year, six-year, nine-year or ten-year contaminant travel times. Where the potential for contamination from pathogenic organisms exists, capture zones are calculated using a two-year contaminant travel time, reflecting the survival rates of virulent microbial organisms in the subsurface.

Note that the WHPA and WhAEM models do not map the growth and development of a contaminant plume. Instead, the models project the most probable plan-view dimensions of the zone around a pumping well from which water is drawn into the well. Particle-tracking subroutines written into the model's code predict the intersection of a contaminated ground water flow path line, originating from a point source, with the perimeter of the well's zone of influence.

Where several public water systems lie in close proximity and draw water from the same aquifer, construction of large scale, or "regional" computer models may justify the added time, effort and expense of obtaining necessary modeling data.

Tier 2. Tier 2 delineation methods apply to areas where a limited amount of aquifer data exists, or where water-bearing geologic units are not easily mapped. In such cases, a combination of techniques may be used, including simplified ground water modeling and calculation of a fixed radius of influence using volumetric equations. Calculated Fixed Radius methods estimate the volume of aquifer providing water to a pumping well using a variation of the equation used for

calculating the volume of a cylinder. The main advantages of this method are the minimal data requirements (volume of water pumped, length of well screen and aquifer porosity) and the minimal investment of staff time to complete the delineation.

Tier 3. Where hydrogeologic mapping, mathematical models or Calculated Fixed Radius methods are impractical because necessary hydrogeologic information is nonexistent or of questionable utility, the three zones of influence will be delineated at a fixed distance from the wellhead. The Arbitrary Fixed Radius method consists of designating a circular ground water source area with an Arbitrary Fixed Radius from the wellhead of 200 ft for Zone A; 500 ft for Zone B; and 1,000 feet for Zone C. In sensitive aquifer zones, the Arbitrary Fixed Radius method may be used instead of Tier 1 or Tier 2 methods if the Tier 1 or Tier 2 methods indicate a set back distance less than 1,000 feet for a ten-year contaminant travel time.

In the event that an aquifer supplying the public water system is confined or semi-confined, or consists of fractured crystalline rock, fractured and/or dissolutioned carbonate rocks or karst topography, the most likely and probable ground water recharge area for that aquifer will be delineated on the basis of geologic mapping and field investigation. Permeable rock units outcropping in upland regions known or suspected to extend in the subsurface into the region of a public supply well will be noted and, to the extent practical, will be included in the source water assessment area for that well.

3.1.2 Delineated Area Zonation

Source area delineations are subdivided into three zones of influence, or “capture zones,” denoted zones A, B and C. Each zone is established on the basis of the time required for a hypothetical “slug” of contaminated water to travel from a contaminant source to the well bore.

Zone A. Because of the uncertainty involved in contaminant flow and transport prediction, the innermost zone of influence is defined as a circle having a 200 ft radius from the wellhead, unless additional information is available to justify more precise delineation.

Zone B. Tier 1 and Tier 2 delineations containing time of travel estimates will define Zone B on the basis of contaminant travel times estimated at between two-to-five years. Tier 2 and Tier 3 delineations lacking travel time calculations are defined as a circle having a 500 ft radius from the wellhead, excluding Zone A.

Zone C. Tier 1 and Tier 2 delineations containing time of travel estimates will define Zone C on the basis of estimated travel times greater than five-years. Tier 2 and Tier 3 delineations lacking travel time calculations are defined as a circle having a 1000 ft radius from the wellhead, excluding Zones A and B.

3.2 Surface Water Source Delineation

Areas adjacent to stream channels that produce storm runoff also generate sediment, bacteria and other pollutants (Dunne and Leopold, 1978), and in many New Mexico watersheds brief but intense rainfall is coupled with low soil infiltration capacity. The result is that pollutants and nutrient loads normally filtered through soil media may be carried great distances by high intensity storm events and eventually deposited into streams and lakes. For this reason, source water protection areas for surface water systems are delineated according to watershed area, and subdivided into "buffer zones" established at fixed linear distances from the active stream channel. Watersheds having a total land area less than thirty square miles are categorized as *Type "A" Watersheds*. Watersheds having a total land area greater than thirty square miles are categorized as *Type "B" Watersheds*. Watershed boundaries and land area are determined from U.S.G.S. topographic maps or from U.S.G.S. hydrologic unit codes (HUC's).

3.2.1 Type A Watersheds

Watersheds under thirty square miles, which include most watersheds in New Mexico but exclude most public water systems utilizing surface water sources, are designated Type "A" watersheds. Source water protection areas delineated for Type A watersheds include the entire watershed upstream of the lowermost stream intake, or up gradient of the most down-stream bank of the source impoundment. Source area delineations in Type A watersheds are subdivided into three zones of influence, or "buffer zones," denoted Buffer Zones A, B and C. The Susceptibility Ranking for a surface water system's intake structure (Section 5.6) is directly related to the type and number of potential sources of contamination occurring within each buffer zone.

Buffer Zone A. A 200 foot-wide strip of land paralleling either bank of an active stream channel is designated Buffer Zone A. Buffer Zone A begins at a point 500 ft below a public water system intake and extends to the upper watershed boundary. For water systems having multiple intake structures, Buffer Zone A is delineated from 500 feet below the lowermost intake to the uppermost watershed boundary. Tributaries and low-order streams contributing to the active channel of the intake stream are also included in Buffer Zone A, up to the first point of channel divergence (or "branch) of the tributary into a lower-order stream or smaller tributary.

Where a public water system intake is located within a surface water impoundment such as a lake or reservoir, a 200 foot-wide Buffer Zone A is delineated outward from the high water mark of the impoundment. Buffer Zone A also extends from the mouth or inlet of the impoundment to the uppermost watershed boundary.

Buffer Zone B. A 300 foot-wide strip of land paralleling an active stream channel and beginning at the outside margin of Buffer Zone A is designated Buffer Zone B. Buffer Zone B begins at a point 500 ft below a public water system intake and extends to the upper watershed boundary. For water systems having multiple intake structures, Buffer Zone B is delineated from 500 feet below the lowermost intake to the uppermost watershed boundary. Tributaries and low-order streams contributing to the active channel of the intake stream are also included in Buffer Zone

B, up to the first point of channel divergence (or "branch) of the tributary into a lower-order stream or smaller tributary.

Where a public water system intake is located within a surface water impoundment such as a lake or reservoir, Buffer Zone B is delineated around the perimeter of the impoundment outward from the outside margin of Buffer Zone A, and upstream from the mouth or inlet of the impoundment to the uppermost watershed boundary.

Buffer Zone C. The balance of land area lying outside of Buffer Zones A and B and extending to the topographic boundary of the Type A watershed is designated Buffer Zone C.

An example of a Type A watershed and its designated buffer zones is illustrated in Figure 3.

3.2.2 Type B Watersheds

Watersheds over thirty square miles, which include most watersheds serving public water systems utilizing surface water sources, are designated Type "B" watersheds. As in Type A watersheds, the source water protection area delineated for Type B watersheds includes the entire watershed upstream of the lowermost stream intake, or up gradient of the most down-stream bank of the source impoundment. However, contaminant source inventories (Chapter 4), and susceptibility analyses (Chapter 5) apply only to that portion of watershed defined as a critical stream segment.

Critical Stream Segments. Once the topographic boundaries of the Type B watershed are determined, the reach of watercourse beginning 500 ft below a public water system intake and extending for a distance of ten miles upstream is designated a "critical stream segment." Critical stream segments are subdivided into Buffer Zones A, B and C. For water systems having multiple intake structures within the ten-mile critical segment, the critical segment is delineated from 500 feet below the lowermost intake to ten miles upstream of the uppermost intake. Tributaries and low-order streams contributing to the ten-mile critical segment of the intake stream are also designated critical segments, up to the first point of channel divergence (or "branch") of the tributary into a lower-order stream or smaller tributary.

Buffer Zone A. A 200 foot-wide strip of land paralleling either bank of an active stream channel is designated Buffer Zone A. Buffer Zone A begins at a point 500 ft below a public water system intake and extends for a distance of ten miles upstream. For water systems having multiple intake structures, Buffer Zone A is delineated from 500 feet below the lowermost intake to a point ten miles upstream of the uppermost intake. Tributaries and low-order streams contributing to the active channel of the intake stream are also included in Buffer Zone A, up to the first point of channel divergence (or "branch) of the tributary into a lower-order stream or smaller tributary.

Where a public water system intake is located within a surface water impoundment such as a lake or reservoir, a 200 foot-wide Buffer Zone A is delineated around the perimeter of the impoundment outward from the high water mark, and upstream from the mouth or inlet of the impoundment for a distance of ten miles along the tributary stream or watercourse.

Buffer Zone B. A 300 foot-wide strip of land paralleling an active stream channel and beginning at the outside margin of Buffer Zone A is designated Buffer Zone B. Buffer Zone B begins at a point 500 ft below a public water system intake and extends for an upstream distance of ten miles. For water systems having multiple intake structures, Buffer Zone B is delineated from 500 feet below the lowermost intake to a point ten miles upstream of the uppermost intake. Tributaries and low-order streams contributing to the active channel of the intake stream are also included in Buffer Zone B, up to the first point of channel divergence (or "branch) of the tributary into a lower-order stream or smaller tributary.

Where a public water system intake is located within a surface water impoundment such as a lake or reservoir, Buffer Zone B is delineated around the perimeter of the impoundment outward from the outside margin of Buffer Zone A, and upstream from the mouth or inlet of the impoundment for a distance of ten miles along the tributary stream or watercourse.

Buffer Zone C. A ½ mile-wide corridor of land paralleling either bank of an active stream channel, but excluding buffer zones A and B, is designated Buffer Zone C. Buffer Zone C begins at a point 500 ft below a public water system intake and extends for an upstream distance of ten miles. For water systems having multiple intake structures, Buffer Zone C is delineated from 500 feet below the lowermost intake to a point ten miles upstream of the uppermost intake. Tributaries and low-order streams contributing to the active channel of the intake stream are also included in Buffer Zone C, up to the first point of channel divergence (or "branch) of the tributary into a lower-order stream or smaller tributary.

Where a public water system intake is located within a surface water impoundment such as a lake or reservoir, Buffer Zone C is delineated around the perimeter of the impoundment outward from the high water mark, excluding buffer zones A and B, and upstream from the mouth or inlet of the impoundment for a distance of ten miles along the tributary stream or watercourse.

Figure 4 illustrates a typical Type B watershed, the critical stream segment for the intake stream and the designated buffer zones.

3.3 Conjunctive Source Delineation (GWUDI)

Where it is determined that ground water sources are under the direct influence of surface waters (GWUDI), the interface zone will be delineated upstream from the public water system for a distance determined by watershed area. In areas where aquifer units outcrop near an active stream channel and where geological interpretation allows more accurate definition of the interface zone, the length of critical stream segment may be reduced. Investigation and confirmation of GWUDI systems is the responsibility of the NMED-Ground Water Under the Direct Influence Program.

This page intentionally left blank for Figure 3, Type A Watershed delineation.

This page intentionally left blank for Figure 4, Type B Watershed delineation

3.4 Transient, Non-community Water Systems and Non-transient, Non-community Water Systems

Source Water Assessments of Transient Non-Community and Non-Transient Non-Community ground water systems follow similar procedures to that of Community water systems except in the method of assessment area delineation. Instead of a three-tiered approach to ground water source delineation (Section 3.1), non-community water sources are delineated using Arbitrary Fixed Radius methods. Non-community systems relying on surface water sources are assessed using a single, 300 ft buffer zone extending ten miles upstream of the intake structure, or to the uppermost watershed boundary, whichever is less. Following the initial round of assessments and after the May 2003 deadline for completion of assessment work, non-community water systems may be reassessed using the three-tiered methodology.

CHAPTER FOUR

Contaminant Source Inventories

The State of New Mexico or its designated agent will inventory all Potential Sources of Contamination (PSOC) within delineated source water assessment areas. PSOC are broad land-use categories, facilities or activities that store, use or produce as a product or by-product any contaminant regulated under the Safe Drinking Water Act, including microbiological contaminants *giardia lamblia*, *cryptosporidium* and *total coliform bacteria,* and synthetic organic contaminants included in the New Mexico Pesticide Management Plan. These "Contaminants of Concern" are listed alphabetically in Appendix B according to chemical class. Appendix C lists PSOC and their associated Contaminants of Concern according to land use category. Note that most PSOC are associated with multiple Contaminants of Concern. For example, most residential liquid waste systems are a source not only of nutrient and heavy metals contamination, but also of solvents, cleaners and other synthetic organic contaminants. The inventory list of PSOC shown in Appendix C may be expanded or modified periodically to reflect experience gained during field investigation.

4.1 Ground Water Source Inventories

An extensive inventory of all actual and potential sources of contamination will be conducted within delineated ground water assessment areas. The inventory will be compiled through 1) research of city, county, state, or federal files and databases for documented sources of contamination, and 2) on-site investigations.

Geographic coordinates of PSOC within delineated assessment areas will be obtained using a Global Positioning System (GPS) or other approved land survey method. This information, along with a facility identifier and/or contaminant source type, will be entered into an NMED Drinking Water Database. Businesses, facilities and residences identified as potential contaminant sources will be identified in Source Water Assessment reports only by Contaminant Code, and will not be identified by name or street address.

PSOC will be located on a map, aerial photo or scale plot containing an appropriate legend, scale bar and directional reference. The boundaries of the delineated source water assessment area must also appear on the map, photo or plot. Multiple maps, photos or plots are to be used where scale considerations preclude adequate detail.

4.2 Surface Water Source Inventories

Actual and potential sources of contamination within delineated surface water assessment areas will be inventoried through 1) research of city, county, state, or federal files and databases for documented sources of contamination, and 2) on-site investigations.

Geographic coordinates of PSOC within delineated assessment areas will be obtained using a Global Positioning System (GPS) or other approved land survey method. This information, along with a facility identifier and/or contaminant source type, will be entered into an NMED Drinking Water Database. Businesses, facilities and residences identified as potential contaminant sources will be identified in Source Water Assessment reports only by Contaminant Code, and will not be identified by name or street address.

PSOC will be located on a map, aerial photo or scale plot containing an appropriate legend, scale bar and directional reference. The boundaries of the delineated surface water assessment area and associated buffer zones must also appear on the map, photo or plot. Multiple maps, photos or plots are to be used where scale considerations preclude adequate detail.

4.2.1 Type A Watersheds

All potential contaminant sources within Type A watersheds (Section 3.2.1) will be identified and located on an appropriate map. In Buffer Zones A and B, GPS coordinates and PSOC codes (Appendix C) are used to increase the level of detail and the accuracy of mapping. In Buffer Zone C, the level of inventory detail may vary from watershed to watershed, and consist of either a detailed PSOC inventory or an inventory that identifies only principal land uses and facilities permitted by state or federal agencies to discharge wastes or wastewater or to store or landfill waste materials. The decision on level of inventory detail in Buffer Zone C will consider historic, current and potential land uses, disturbances in runoff-producing areas, watershed geomorphology, and storm water runoff processes.

4.2.2 Type B Watersheds

Potential contaminant sources located within critical stream segments of Type B watersheds (Section 3.2.2) will be identified and located on an appropriate map. In Buffer Zones A and B, GPS coordinates and PSOC codes (Appendix C) are used to increase the level of detail and the accuracy of mapping. In Buffer Zone C, PSOC inventories will consist only of an identification of principal land use, and information on the location and nature of facilities permitted by state or federal agencies to discharge wastes or wastewater or to store or landfill waste materials.

4.3 Assessment Areas Crossing State Boundaries

Source water assessment areas crossing interstate boundaries will be delineated after obtaining all reasonably available hydrogeologic information on the area supplying water to New Mexico. Sources of information may include USGS topographic, geologic and Hydrologic Unit Code maps, published hydrogeologic reports or surveys, and field validation exercises coordinated with appropriate agencies in adjoining states.

Inventories of potential contaminant sources within transboundary assessment areas will be completed to the fullest extent possible, and will be based in part on information provided by the adjoining state. Thus far, the only drainage basins determined to extend beyond New Mexico's

borders lie within the State of Colorado. The states of Texas, Oklahoma, Utah and Arizona have drainage basins extending into New Mexico, for which NMED is willing to provide source water protection information upon request.

Specific watersheds for which New Mexico seeks transboundary assessment information include the Rio Grande, the Rio Chama, the Animas River, the San Juan River and the Canadian River. Hydrogeologic information will be sought where ground water assessment area delineations overlap into Arizona, Colorado and Texas.

Transboundary water resource issues are an incentive for coordinating interstate SWAP activities and for maintaining open lines of communication with water resource staff from adjoining states. NMED staff meets annually with Source Water Protection Program staff from other EPA Region 6 states and with EPA Region 6 Source Water Protection Branch staff to discuss source water protection program activities and to resolve transboundary water resource issues.

The State of New Mexico is one of the participants in an on-going Colorado River Interstate SWAP project with the states of Arizona, Nevada, California, Utah, Colorado and Wyoming. The CRISWAP working group meets semi-regularly to coordinate source area delineations and to share PSOC inventory data collected in Colorado River drainage basins. The State of New Mexico also participates in an Interstate Coordination project on SWAP activities with the states of Colorado, Texas, Nebraska, Wyoming and Kansas. The State of Colorado received a $20,000 grant from EPA to coordinate this effort, and to cover the costs of travel and data sharing. New Mexico participated in a similar Interstate Coordination meeting with Arizona, Oklahoma, and Texas on May 1, 1998. During this meeting, EPA and the states discussed the requirements associated with cross boundary assessments, and exchanged ideas on information needs and data sharing.

There are no drinking water systems that receive surface waters from the Republic of Mexico. However, two public drinking water systems in Dona Ana County have ground water wells located within ½-mile of the border between the State of New Mexico and the Republic of Mexico. International coordination of SWAPP activities will involve interaction with the Republic of Mexico through the New Mexico Border Authority and the International Boundary and Water Commission (IBWC). NMED will contact the IBWC to seek their input and/or comments on the delineation of watersheds bordering the international boundary.

CHAPTER FIVE

Susceptibility Analysis

Susceptibility Analysis is a means to evaluate the potential for a public water system to draw contaminated water at concentrations posing a health risk to consumers. Susceptibility is defined for purposes of the SWAPP as a combination of the **sensitivity** of the water source to contamination due to characteristics of the source area, and the **vulnerability** of the water source to contamination due to characteristics of the contaminant.

Susceptibility = Sensitivity + Vulnerability

Sensitivity and vulnerability of water sources to contamination are analyzed using a series of decision matrices that compare individual variables and assign a relative rank to the associated risk. A comparison of the risks assigned to each component of the analysis results in assignment of a "high," "moderate" or "low" susceptibility of the water source to each of the contaminant source categories (PSOC) outlined in Appendix C.

5.1 Sensitivity of Ground Water Sources to Contamination

Sensitivity of groundwater sources to contamination is determined by evaluating the depth of screened interval (i.e., the depth below ground from which a well draws water), the adequacy and integrity of well construction, and the DRASTIC index calculated for the water source. The acronym DRASTIC and its calculation are discussed in Appendix D. An overall Sensitivity Ranking is then assigned, which is compared to the well's Vulnerability Ranking discussed in Section 5.2.

5.1.1 Depth of Screened Interval

The sensitivity of supply wells to contamination is ranked according to the depth below ground of the uppermost, screened interval of the well. In general, shallow unconfined aquifers are more sensitive to contamination than are deeper aquifers because greater thickness of geologic media retards the migration into ground water of most surface-released contaminants. Wells screened at shallow depths are therefore assessed a higher Well Depth Sensitivity Ranking.

Table 5.1.1. Well Depth Sensitivity Ranking

Screened Interval Depth	Sensitivity Rank
less than 200 feet	high
200 – 700 feet	moderate
greater than 700 feet	low

If no information exists documenting the depth of screened interval, the well is automatically assessed a '*high*' well depth sensitivity ranking.

If a confining layer of a thickness greater than ten feet is present above the entire screened interval, the sensitivity ranking may be reduced by one level, *provided* the confining layer can be shown to continue beyond the wellhead for a distance of at least 1,000 ft in all directions. A confining layer is defined as a layer of impermeable geologic material (clay, shale, etc.) that provides significant protection to the aquifer from existing or potential surface contamination.

Example: Well #1 is screened from a depth of 130 ft to a depth of 150 ft. A confining layer 20 feet thick occurs from 90 ft to 110 ft below ground, and continues for at least one-half mile in all directions beyond the wellhead. Despite the shallow depth of Well #1, the Well Depth Sensitivity Ranking may be reduced from *high* to *moderate.*

5.1.2 Well Construction and Integrity

The sensitivity of a supply well to contamination is highly dependent on the adequacy of construction for the geologic environment, on the physical integrity of the well, and on the level of maintenance the well receives. Improperly constructed wells, wells in need of repair and wells subject to vandalism are assessed a higher sensitivity ranking in the following analyses.

Well Construction Ranking. In order to evaluate the adequacy of well construction, supply wells are ranked according to the quality of information available on their construction, with a point value assigned for each factor in Table 5.1.2a, below. For every piece of information available, the point value for that item is added to the total for the well. Higher scores indicate a higher level of certainty regarding the adequacy of construction for the well's geologic setting.

Table 5.1.2a. Well Information Point Values

Construction Information Available for Supply Well	Points
Casing diameter, casing length and casing materials	2
Location of screened interval(s)	2
Total completion depth	3
Static water level at completion	1
Pump type, size and setting	1
Drilling log or equivalent	3

Drilling method, materials used in construction and borehole lithology are typically provided by the well drilling contractor in the form of a well record or well log. In the absence of such records, the adequacy of construction and the sensitivity of the well to contamination cannot be accurately determined. Summing the point values from Table 5.1.2a and selecting the corresponding rank from the following matrix determine the Well Construction component of the Sensitivity Ranking.

Table 5.1.2b. Well Construction Sensitivity Ranking

Information Points	Sensitivity Rank
0-5	high
6-9	moderate
10-12	low

Well Integrity Ranking. On Table 5.1.2c, a point value is assigned to each supply well based on how the well conforms to each criterion. For every 'Yes' answer, the point value for that question is added to the total for the well.

Table 5.1.2c. Well Integrity Point Values

Physical Integrity of Supply Wells	Points
Is the well located above the elevation of the 100-year flood plain?	1
Does well casing terminate at least 18 inches above floor or ground level?	2
Is annular space pressure-grouted to depth of at least 20 feet?	3
Is the wellhead properly sealed?	3
Is there a concrete pad around the wellhead that slopes away from the casing?	2
Does the well vent terminate at least 18 inches above floor or ground level, and is the vent screened and oriented to open downward?	1
Are check valves, blow-off valves and flow meters properly maintained and operated?	1
Is the wellhead fenced, housed or properly protected?	2

Summing the point values from Table 5.1.2c and selecting the corresponding rank from the following matrix determine the Physical Integrity component of the Sensitivity Ranking. The higher the point score, the less sensitive the well is to contamination.

Table 5.1.2d. Physical Integrity Sensitivity Ranking

Integrity Points	Sensitivity Rank
0-7	high
8-11	moderate
12-15	low

A combined Sensitivity Ranking for well construction and integrity is assigned in Table 5.1.2e by comparing the rankings derived in Tables 5.1.2b and 5.1.2d.

Table 5.1.2e. Combined Sensitivity Ranking for Well Construction and Integrity

		Construction Rank		
		high	**moderate**	**low**
Integrity Rank	**high**	high	high	moderate
	moderate	high	moderate	moderate
	low	moderate	moderate	low

5.1.3 DRASTIC Index

DRASTIC is a method developed by the National Ground Water Association in 1987 to evaluate the potential for ground water contamination in any hydrogeologic setting in the United States. DRASTIC is an acronym for depth to water (D); net recharge (R); aquifer media (A); soil media (S); topography (T); impact of vadose zone media (I); and aquifer hydraulic conductivity (C). The method assigns a relative weight to each of these factors to determine the relative sensitivity of a given supply well to surface-derived contamination. Appendix D discusses the DRASTIC system and index calculation. The higher the DRASTIC Index, the more sensitive the well is to contamination.

Table 5.1.3. DRASTIC Index Sensitivity Ranking

DRASTIC Index	**Sensitivity Rank**
greater than 200	high
101 – 200	moderate
less than 101	low

5.1.4 Sensitivity Ranking for Ground Water Sources

Each of the sensitivity rankings determined above are given a numerical value, and a composite sensitivity ranking is assigned using the formula

Sensitivity Rank = Well Depth Rank + Well Construction/Integrity Rank + DRASTIC Index Rank

Point values for use in the formula are applied to each of the three rankings assigned in Section 5.1, where

high = 10
moderate = 5
low = 1

Point values for independent sensitivity components are summed on Table 5.1.4, and a composite sensitivity ranking is assigned for each ground water supply.

Note: All wells screened in karst or highly fractured rock aquifers will automatically be assigned a composite Sensitivity Rank of *high*.

Table 5.1.4. Composite Sensitivity Ranking for Ground Water Sources

Sum of Sensitivity Points	Composite Sensitivity Rank
20-30	high
11-19	moderate
0-10	low

Example: Well #2 is screened at a depth of 175 feet and is assigned a *high* sensitivity ranking for well depth. Under well construction and integrity, Well #2 is given a well information score of 10 (*low* sensitivity) and a physical integrity score of 8 (*moderate* sensitivity), for a combined construction and integrity ranking of *moderate*. The DRASTIC Index calculated for Well #2 is 160, which equates to a *moderate* sensitivity ranking. After going through each step of Section 5.1, Well #2 is assigned the following overall sensitivity rank:
Sensitivity = Well depth (H) + Well Construction/Integrity (M) + DRASTIC Index (M)
Sensitivity = 10 + 5 + 5 = 20
Using Table 5.1.4, the Composite Sensitivity Rank assigned to Well #2 is *'High'*

5.2 Vulnerability of Ground Water Sources to Contamination

The sensitivity of ground water sources to contamination was defined in Section 5.1 as a function of source area characteristics and of the design, installation and maintenance of conveyance facilities. Vulnerability, on the other hand, is determined from characteristics of the contaminant, from the likelihood of contaminant discharge, spill or accidental release, and from the number of potential contaminant sources and their proximity to the ground water supply.

5.2.1 Chemical Characteristics

Vulnerability is specifically applicable to substances dissolved or dissolvable in ground water, and to immiscible substances that do not mix with ground water but are capable of moving

through the ground water system, such as oils and certain other organic compounds. All substances capable of entering ground water have intrinsic chemical properties that affect both their behavior within the geologic medium and the health hazards they pose to water consumers. Of particular concern are the

- *health risks* or toxicity associated with exposure to the contaminant
- *concentration* or quantity of the contaminant
- *continuity* of contaminant release
- *persistence* or survivability of the contaminant in the environment
- *mobility* of the contaminant through aquifer media
- *reactivity* of the contaminant with aquifer media or other aquifer constituents
- *density* of the contaminant relative to the density of water

Health Risks. The Safe Drinking Water Act of 1974 authorized the USEPA to set federal standards for contaminants in drinking water, and tasked the National Academy of Sciences with studying the health effects associated with those and other contaminants under consideration for inclusion on the Drinking Water Priorities List. The Act set Interim Maximum Contaminant Levels (MCL's) for twenty-two chemical contaminants known or anticipated to occur in drinking water, and set non-enforceable, Secondary MCL's for contaminants adversely affecting the aesthetic qualities of drinking water. The Act also provided for periodic revision of the list of regulated contaminants and their MCL's. Drinking water standards are thus set for substances considered to pose significant potential harm to human health when present at concentrations above the allowable limit. In establishing MCL's, factors considered by the EPA include the effects of the contaminant on the general population, and the effects on subgroups within the general population likely to be at greater risk of adverse health effects because of higher exposure rates or greater medical sensitivity to contamination than the general population. Appendix B lists the Contaminants of Concern for which a Maximum Contaminant Level or Health Advisory has been established.

Contaminant Concentration. Health risks associated with a particular contaminant are directly related to the concentration of the contaminant, which is the amount of solute present in a given volume of solution. For this reason, MCL's are expressed in units of milligrams per liter (mg/L), which is the mass of contaminant contained in a one-liter volume of water. MCL's for microbiological contaminants are an exception, and are based on the presence or absence of organisms in a water sample. Some contaminants pose little or no health threat when present at low concentrations, while others are unacceptable in any amount. Dilution of contaminant concentration sometimes occurs in ground water, depending on the chemical nature of the contaminant. However, with prolonged release, some contaminants may also accumulate to dangerous concentrations over time.

Release Continuity. The consistency with which contaminants are discharged has a direct impact on the concentration and pervasiveness of the contaminant. Constant, continuous or repeated releases over time result in higher concentrations and prolonged chemical viability through replenishment. The hydraulic head created by continuous or repeated releases also provides a "driving force" to the growth and spread of a contaminant plume within the aquifer.

Unless ground water is relatively shallow, periodic or one-time releases pose less of a threat to supply wells than continuous or repeated releases.

Environmental Persistence. Natural processes of degradation and decomposition, through chemical or biochemical transformations, often work to reduce the concentration or viability of the original substance. Such transformations are specific to individual chemical species, however, and the rate at which decomposition occurs, how completely the substance degrades, and the byproducts created by degradation all vary from one contaminant to another. Some contaminants degrade readily when exposed to the environment, while refractory compounds resist degradation and persist in the environment for extremely long periods of time.

Subsurface Mobility. Physical processes controlling the flux of contaminants into and out of an aquifer are *advection* and *hydrodynamic dispersion*. Advection is the process whereby dissolved substances are transported by the bulk motion of flowing ground water. Dispersion explains the tendency for substances dissolved in water to spread out from the expected path due to mechanical mixing. Diffusion is a special case of dispersion where substances mix at a molecular level under the influence of a concentration gradient. For substances perfectly miscible in water, the rate of ground water flow controls the movement of contaminants from their source to the supply well. The movement of other substances through the ground water system may be retarded by chemical reactions between the contaminant and the media, and by reactions between the contaminant and other chemical species present in ground water.

Chemical Reactivity. Chemical and biochemical reactions occurring in ground water and affecting the concentration and transport characteristics of contaminants may be grouped into six categories: adsorption-desorption reactions; acid-base reactions; solution-precipitation reactions; oxidation-reduction reactions; ion-pairing or complexation; and microbial cell synthesis (Freeze and Cherry, 1979). Which of these reactions occur and the magnitude of their effects are functions of the chemical characteristics of the contaminant, the geologic media, and the ambient ground water quality.

Contaminant Density. Significant contrast between the density of a contaminant and the density of water results in important differences in the flow and transport characteristics of the contaminant. For example, a contaminant with a density similar to ground water will tend to spread in a shallow zone close to the water table. If the contaminant is significantly denser than water, the contaminant plume will “sink” into the lower aquifer. All other things being equal, whether or not such a plume jeopardizes a supply well depends on the depth of well screens and the pumping rate.

How the chemical characteristics of a contaminant effect its flow and transport through geologic media, and what effect those characteristics have on human health should the contaminant be introduced into ground water are important considerations in the evaluation of source water vulnerability. However, the physical and chemical characteristics of water-born contaminants affect the vulnerability of ground water supplies in differing and often unpredictable ways. A particular contaminant may behave differently if released into a different environment, and dissimilar contaminants may behave differently from each other if released into the same

environment. Assessing vulnerability based on the chemical characteristics of a specific contaminant is therefore difficult at best, and that difficulty is compounded by site-specific conditions that reduce realistic evaluation to a case-by-case basis.

5.2.2 Likelihood of Release

Evaluating the risk to public water systems posed by potential contaminant sources is in part a calculation of the probability of occurrence of certain undesirable outcomes. For an accidental spill or release to occur, some sequence of independent, unintended events must take place that lead to the release. From a statistical standpoint, calculating the probability of occurrence of such a chain of events requires determining the probability that each independent event contributing to the spill may occur, then summing the probabilities assigned to all the elementary outcomes leading to the spill event. In a uniform probability model, each elementary outcome is as likely to occur as any other. In tossing a coin, the probability of getting "heads" is equal to the probability of getting "tails." When this assumption does not apply, calculating probability requires collecting data on the historical frequency of events and making statistical inference on relative frequency over the long run. For example, evaluating the probability that a gasoline tanker truck may be involved in a traffic accident near a wellhead requires knowledge of the number of traffic accidents that have occurred along the route, the frequency of gasoline deliveries along the route, and the frequency at which fuel tanks rupture during traffic accidents. Quantifying the probability of an accidental release in complex, real-world situations may become extremely unwieldy.

Rather than attempt to quantify the likelihood of some form of accident occurring near the water source, the New Mexico SWAPP takes the conservative position that every PSOC has at least some potential for spill, discharge or accidental release. Likelihood of release is evaluated on a qualitative basis by considering the nature of contaminant discharge and the likely pathway or migration route a contaminant may follow. For example, discharges to the subsurface, such as through leach field disposal systems, are considered highly likely to impact shallow ground water because the process of decomposition normally operating in such systems does not occur. Discharges to the land surface under controlled conditions, such as application of agricultural wastes to cropland, are considered unlikely to impact ground water if properly managed because the natural processes of aeration and decomposition reduce organic wastes to an agronomically useful form. Wastewater storage lagoons, fuel or chemical storage tanks, or other structures not designed to discharge but having potential for accidental release, are considered moderately to highly likely to impact ground water, depending on the location, construction and method of facility operation. Unless a history of sampling results from dedicated monitoring wells indicates ground water is not impacted, wastewater storage lagoons constructed of compacted local materials are considered a high risk to shallow ground water. Synthetically lined lagoons that rely on the use of heavy machinery for periodic cleanout are also considered highly likely to impact ground water. Facilities and industrial sites operating under the federal Risk Management Program (40 CFR 68), and communities having local emergency planning committees formed under the 1986 Emergency Planning and Community Right-to-Know Act are less likely to suffer ground water impacts from contamination due to their prior preparation for chemical accidents.

5.2.3 Number and Proximity of PSOC to Supply Well

How vulnerable a water supply well is to contamination depends only in part on the number of nearby contaminant sources and the distance between those sources and the well. And determining vulnerability based solely on contaminant proximity also neglects the intrinsic chemical characteristics of contaminants and the likelihood of accidental spills and releases. Nonetheless, the number and proximity of contaminant sources capable of impairing a supply well are easily quantified, and are less subjective measurements of vulnerability.

In Section 3.1, ground water assessment areas are subdivided into three zones of influence arranged more or less concentrically about the wellhead. Each zone is established on different lengths of time required for a hypothetical slug of contaminated water to travel into the well bore from an inventoried PSOC. Vulnerability is determined for each category of PSOC identified during the inventory process discussed in Chapter 4, by totaling the number of PSOC within each zone of influence (Zone A, B or C) and reading the Vulnerability Rank from the right-hand column of Table 5.2.3, below. Where PSOC occur in more than one zone of influence, the highest rank obtained from Table 5.2.3 will be the Vulnerability Rank for that water source.

Note: Any PSOC located within Zone A (i.e., within 200 ft of a supply well) automatically places the well in the *high* vulnerability rank.

Table 5.2.3. Vulnerability Ranking for Ground Water Sources

	Zone of Influence			**Ranking**
Number of PSOC in Each Zone	**Zone A**	**Zone B**	**Zone C**	
	1+	5+	7+	high
	0	3 - 4	4 - 6	moderate
	0	1 -2	1 - 3	low

Example: An inventory of PSOC within the delineated protection area for Well #1 identified six non-sewered residences and one gasoline service station within Zone B, and ten non-sewered residences and one commercial dry cleaning business in Zone C. No PSOC were identified in Zone A. Using Table 5.2.3 and Appendix C, Well #1 is ranked as having a *high vulnerability* to contamination from wastewater generated by Residential/Municipal septic systems (RMS); a *low vulnerability* to leaking or ruptured underground storage tanks from Historic Gasoline Service Stations (CHG); and a *low vulnerability* to spills and accidental releases from Commercial Dry Cleaning operations (CDC). The highest ranking for Well #1 is *high vulnerability* due to the number of non-sewered residences located nearby.

Assigning multiple vulnerability rankings to a single water source according to the number of PSOC categories inventoried is intended to help water consumer associations and utility companies address specific contaminant sources in their local area. For the majority of public water systems in New Mexico, the variety of contaminant types threatening a given water supply will be relatively limited. In some locations, however (particularly in urban or industrial settings

where a greater number and variety of PSOC are likely), ranking vulnerability according to individual PSOC codes is a less cogent procedure. In these cases, if three or more categories of PSOC occur within the same zone of influence, a single vulnerability ranking for each water source will be assigned by increasing the highest ranking obtained when PSOC categories are considered independently by a minimum of one rank. Each category of PSOC will still be identified and addressed in the water system's Source Water Assessment report, but will not merit an independent vulnerability ranking. As with all vulnerability determinations, the use of professional judgment outweighs any ranking obtained using "cookbook" methods alone.

5.2.4 Chemical Monitoring History and Neighboring Environmental Permits

Prior detection of a Contaminant of Concern in the ground water supply suggests the possibility for repeat occurrences, and analytical results from a public water system's SDWA compliance sampling may by used to substantiate a higher vulnerability ranking for a water source. Results of past Vulnerability Assessments (Chapter 7.1) may, however, be used to reduce the vulnerability ranking if the assessment resulted in a chemical monitoring waiver for the ground water source. Similarly, efforts to remedy the cause of prior contamination may be grounds for a reduction in vulnerability ranking if subsequent sampling results verify the effectiveness of corrective action.

Another indicator of water supply vulnerability is the monitoring history of neighboring facilities or industries operating under state or federal discharge permitting systems. Records maintained for facilities operating under an NMED Ground Water Discharge Plan, Abatement Plan, Solid Waste Facility Permit or Underground Storage Tank registration, or operating under an EPA National Pollutant Discharge Elimination System permit or any other federal or state permitting system indicate the effectiveness of treatment processes used and the compliance status of the facility with the terms and conditions of it's permit. A poor compliance track record or ineffective waste treatment processes at permitted facilities impact public water systems by increasing the vulnerability ranking of an affected water source by a minimum of one rank.

5.3 Susceptibility Ranking for Ground Water Sources

The susceptibility of ground water sources to contamination is assessed by comparing the Sensitivity Ranking determined for the source in Section 5.1 to the Vulnerability Ranking determined in Section 5.2. Susceptibility Rankings assigned in Table 5.3 are conservative: as a safety factor, the rank assigned to each source is biased towards higher susceptibility.

Table 5.3. Susceptibility Ranking for Ground Water Sources

	Sensitivity Ranking for Ground Water Source			
Vulnerability Ranking for Ground Water Source		**High**	**Moderate**	**Low**
	High	high	high	moderate
	Moderate	high	moderate	moderate
	Low	moderate	moderate	low

5.4 Sensitivity of Surface Water Sources to Contamination

The susceptibility of surface water sources to contamination is evaluated in a similar manner to ground water sources by comparing the characteristics of the source area (sensitivity) to the characteristics of the contaminant (vulnerability). The sensitivity of surface water sources to contamination is determined by evaluating 1) the stream flow rate or area of reservoir; 2) the adequacy of construction and the physical integrity of intake structures; and 3) the WRASTIC Index calculated for the system or intake.

5.4.1 Stream Flow Rate or Reservoir Size

Smaller streams and reservoirs suffer proportionately greater impacts from accidental spills, releases or discharges. For this reason, the relative reservoir size and stream flow rate are considered in the analysis of source water sensitivity. Rankings are assigned in Table 5.4.1 based on surface water data compiled from the WQCC Water Quality and Water Pollution Control in New Mexico, 1996 305b report to the United States Congress, and from United States Geological Survey stream and reservoir historical records (Appendix F).

Table 5.4.1. Stream Flow Rate or Reservoir Area Sensitivity Ranking

Average Annual Reservoir Size (acres)	**Average Annual Stream Flow (cfs)**	**Sensitivity Ranking**
<100	<75	high
100 – 1,000	75 - 400	moderate
>1,000	>400	low

5.4.2 Surface Water Intake Construction and Integrity

The sensitivity of surface water intakes to contamination is highly dependent on the adequacy of

intake construction for the hydrologic environment, on the physical integrity of intake structures, and on the level of maintenance the facility receives. Improperly constructed intakes, intakes in need of repair and intakes subject to vandalism defeat the design of water treatment works and are more likely to contribute to water quality problems than are properly constructed and maintained intakes. Objective measurement of construction and integrity considers the method by which water is drawn from the stream or reservoir, and the average daily raw water turbidity as measured at the intake. The primary inspection tool used to determine appropriate construction and integrity is the Sanitary Survey conducted by NMED/DWB staff.

Intake Method. Surface water intakes that draw water directly from a stream or reservoir are referred to as a *direct intake*. Intakes that draw water through natural or artificial filtering media, such as an infiltration gallery, are referred to as an *indirect intake*. Direct intakes are considered to be at greater risk to surface-derived contamination than are indirect intakes due to the absence of filtration.

Direct Intake = high sensitivity
Indirect Intake = low sensitivity

Average Daily Turbidity. Turbidity refers to suspended solids and colloidal or soluble organic matter that do not settle out of water (Driscoll, 1995). Turbidity is an important measure of water quality because of the tendency of contaminants and microorganisms to cling to suspended particles, and because it interferes with disinfection processes. Turbidity is measured in Nephelometric Turbidity Units, or NTU. Public water systems in New Mexico that rely on surface water sources are required to monitor turbidity at least every four hours that the system serves water to the public. If the highest daily average turbidity value for raw source water (measured immediately prior to the first point of treatment or disinfection) is greater than 10 NTU, the source is considered to be at a high risk to contamination. Highest daily average turbidity will be determined from data collected during the preceding twelve-month period.

Highest Daily Average NTU > 10 = high sensitivity
Highest Daily Average NTU < 10 = low sensitivity

Table 5.4.2, below, is used to obtain the construction and integrity ranking for surface water intakes by comparing the intake method to the average daily turbidity.

Table 5.4.2. Construction and Integrity Ranking for Sensitivity of Surface Water Intakes

		Intake Method Ranking	
		high	**low**
Average Daily Turbidity Ranking	**high**	high	moderate
	low	moderate	low

5.4.3 WRASTIC Index

WRASTIC is a method developed by NMED/DWB to evaluate watershed susceptibility to surface water contamination in any hydrogeologic setting based on major watershed characteristics and land uses. WRASTIC is an acronym for wastewater discharges (W); recreational land use impacts (R); agricultural land use impacts (A); size of watershed (S); transportation avenues (T); industrial land use impacts (I); and amount of vegetative ground cover (C). The method assigns a relative weight to each of these factors to determine the relative sensitivity of a given surface water supply to surface-derived contamination. Appendix E discusses the WRASTIC system and index calculation. The higher the WRASTIC Index, the more sensitive the water supply is to contamination.

Table 5.4.3. WRASTIC Index Sensitivity Ranking

WRASTIC Index	Sensitivity Rank
greater than 50	high
26 – 50	moderate
less than 26	low

5.4.4 Sensitivity Ranking for Surface Water Sources

Each of the sensitivity rankings determined above are given a numerical value, and a composite sensitivity ranking is assigned using the formula

Sensitivity Rank = Source Flow/Size Rank + Intake Integrity Rank + WRASTIC Index Rank

Point values for use in the formula are applied to each of the three rankings assigned in Sections 5.4.1, 5.4.2 and 5.4.3, where

high = 10
moderate = 5
low = 1

Point values for independent sensitivity components are summed on Table 5.4.4, and a composite sensitivity ranking is assigned for each surface water intake or source.

Note: All intakes within Type A Watersheds will automatically be assigned a Composite Sensitivity rank of *high*.

Table 5.4.4. Composite Sensitivity Ranking for Surface Water Sources

Sum of Sensitivity Points	Composite Sensitivity Rank
20-30	high
11-19	moderate
0-10	low

Example: An infiltration gallery located on a stream with an annual average flow of 520 cfs had its highest daily average turbidity of 15 NTU recorded during the month of April. Evaluation of the watershed around the structure resulted in a WRASTIC index calculation of 58. Because of relatively rapid stream flows, the gallery has a *low sensitivity* to the impacts of accidental spills and releases into the stream; a *moderate sensitivity* to perturbations in the watershed because of an indirect intake method but high turbidity source water; and a *high sensitivity* to watershed land uses reflected in the WRASTIC Index.
Sensitivity = Stream Flow Rate (L) + Intake Construction/Integrity (M) + WRASTIC Index (H)
Sensitivity = 1 + 5 + 10 = 16
Sensitivity Rank for this intake is *'Moderate'*

5.5 Vulnerability of Surface Water Sources to Contamination

The vulnerability of surface water sources to contamination is determined from the characteristics of the contaminant, from the likelihood of contaminant discharge, spill or accidental release, and from the number of potential contaminant sources and their proximity to surface water intake structures.

5.5.1 Chemical Characteristics

Unlike ground water systems, surface water vulnerability is not necessarily limited to water-soluble substances and immiscible compounds transportable through geologic media. Virtually any chemical contaminant may pose a risk to surface water intakes, regardless of chemical form. Intrinsic chemical properties of contaminants affect the behavior of the substance both within the water column and within the watershed, and determine the health hazards posed to water consumers. Of particular concern are the

- *health risks* or toxicity associated with exposure to the contaminant
- *concentration* or quantity of the contaminant
- *continuity* of contaminant release
- *persistence* or survivability of the contaminant in the environment
- *mobility* of the contaminant through both soil and water
- *reactivity* of the contaminant with air, other constituents in the water and watershed soils
- *density* of the contaminant relative to the density of water

5.5.2 Likelihood of Release

Discharges onto land surfaces with potential for runoff into streams or surface water bodies are considered highly likely to impact surface water. Discharges under controlled conditions, where runoff is diverted from surface water bodies, are considered less likely to impact surface water. Wastewater storage lagoons, fuel or chemical storage tanks, or other structures not designed to discharge but occurring within critical segments or buffer zones of a surface water intake and having potential for accidental release, are considered highly likely to impact surface water supplies.

5.5.3 Number and Proximity of PSOC to Surface Water Intake

How vulnerable a surface water intake is to contamination depends only in part on the number of nearby contaminant sources and the distance between those sources and the intake. And determining vulnerability based solely on contaminant proximity also neglects the intrinsic chemical characteristics of contaminants and the likelihood of accidental spills and releases. Nonetheless, the number and proximity of contaminant sources capable of impairing an intake structure are easily quantified, and are less subjective measurements of vulnerability.

In Section 3.2, surface water assessment areas are subdivided on the basis of watershed area into Type A and Type B watersheds. Within each watershed are buffer zones established on either side of a stream channel or around the perimeter of a reservoir that approximate a "reaction time" between the time of a spill or accidental release and the time required for emergency response. Buffer zones are set from the stream channel outward at distances of 0-200 ft, 200-500 ft, and from 500 ft to the edge of the delineation. Evaluation of source water vulnerability is determined from Table 5.5.3, below, by totaling the number of PSOC within each buffer zone and reading the Vulnerability Rank from the right-hand column. Vulnerability is determined for each category of PSOC identified during the inventory process discussed in Chapter 4 and outlined in Appendix C. Where PSOC occur in more than one buffer zone, the highest rank obtained from Table 5.5.3 will be the Vulnerability Rank for that water source. If three or more categories of PSOC occur within the same buffer zone, a single vulnerability ranking for each intake structure will be assigned by increasing the highest ranking obtained when PSOC categories are considered independently by a minimum of one rank. Each category of PSOC will still be identified and addressed in the water system's Source Water Assessment report, but will not merit an independent vulnerability ranking. As with all vulnerability determinations, the use of best professional judgment outweighs any ranking obtained using "cookbook" methods alone.

Note: Any PSOC located within 200 ft of a surface water intake automatically places the intake in the *high* vulnerability rank.

Table 5.5.3. Vulnerability Ranking for Surface Water Sources

	Buffer Zone A	Buffer Zone B	Buffer Zone C	Ranking
Number of PSOC in Each Zone	1+	5+	7+	high
	0	3 - 4	4 - 6	moderate
	0	1 - 2	1 - 3	low

Example: An inventory of PSOC located upstream of an infiltration gallery built within a Type A watershed identified a federally operated campground (MPR) and vehicle maintenance facility (MMP) located 485 feet from the stream bank; an active gravel mining operation (IMO) located 350 feet from the stream bank; an old trash dump (IUD) located 475 feet from the stream bank; and a livestock grazing operation (ARL) fenced to within 1500 feet of the stream bank. Using Table 5.5.3, the intake is assigned a vulnerability rank of *moderate* for each of MPR, MMP, IMO and IUD categories located in Buffer Zone B, and *low* vulnerability for the single ARL category located in Buffer Zone C. Because there are more than three different PSOC categories in a single buffer zone, the vulnerability ranking for the infiltration gallery is increased to *high*.

5.5.4 Chemical Monitoring History and Neighboring Environmental Permits

Prior detection of a Contaminant of Concern in the surface water supply suggests the possibility for repeat occurrences, and analytical results from a public water system's SDWA compliance sampling may by used to substantiate a higher vulnerability ranking for a water source. Results of past Vulnerability Assessments (Chapter 7.1) may, however, be used to reduce the vulnerability ranking if the assessment resulted in a chemical monitoring waiver for the surface water source. Similarly, efforts to remedy the cause of prior contamination may be grounds for a reduction in vulnerability ranking if subsequent sampling results verify the effectiveness of corrective action.

Another indicator of water supply vulnerability is the monitoring history of neighboring facilities, industries or operations operating under state or federal discharge permitting systems. Records maintained for facilities operating under an NMED Ground Water Discharge Plan, Abatement Plan, Solid Waste Facility Permit or Underground Storage Tank registration, or operating under an EPA National Pollutant Discharge Elimination System permit or any other federal or state permitting system indicate the effectiveness of treatment processes used and the compliance status of the facility with the terms and conditions of it's permit. A poor compliance track record or ineffective waste treatment processes at permitted facilities impact public water systems by increasing the vulnerability ranking of an affected water source by a minimum of one rank.

5.6 Susceptibility Ranking for Surface Water Sources

The susceptibility of surface water sources to contamination is assessed by comparing the Sensitivity Ranking determined for the source in Section 5.4 to the Vulnerability Ranking

determined in Section 5.5. Susceptibility Rankings assigned in Table 5.6 are conservative--as a safety factor, the rank assigned to each source is biased towards higher susceptibility.

Table 5.6. Susceptibility Ranking for Surface Water Sources

	Sensitivity Ranking for Surface Water Source			
Vulnerability Ranking for Surface Water Source		**High**	**Moderate**	**Low**
	High	high	high	moderate
	Moderate	high	moderate	moderate
	Low	moderate	moderate	low

5.7 Public Water Systems Using Conjunctive Sources

For systems using a combination of surface water and ground water supplies, and ground water systems determined to be under the direct influence of surface water (GWUDI), NMED SWAPP staff will conduct susceptibility analyses for both ground water and surface water components. The highest susceptibility ranking determined for either the surface or ground water source will be used as the overall susceptibility rank for that system.

CHAPTER SIX

Assessment Documentation

A written report drafted for each Source Water Assessment will describe the results of the assessment in non-technical language intended for the average reader. Maps delineating source water protection areas, intakes or wells, critical zones and identified potential sources of contamination are to be incorporated into the report. Copies of the report are to be delivered to the public water system, and will be made available to the general public through the avenues discussed in Section 6.2, below. Source Water Assessments are not considered complete until a formal written report on the results of assessment work is made available to the general public.

6.1 Source Water Assessment Reports

Upon completing each Source Water Assessment, a report will be drafted for public consumption discussing the methods and procedures used to conduct the assessment, how the Susceptibility Ranking was derived for the system, and how NMED's Vulnerability Assessment process for chemical monitoring waivers may apply to the water system. Susceptibility Rankings will also be provided to system operators for inclusion in their Consumer Confidence Reports, as will be NMED-drafted language explaining the reason for the ranking. An interim Susceptibility Ranking of "Undetermined" will be assigned to a system for purposes of Consumer Confidence Reporting, until a Source Water Assessment is completed for that system.

Source Water Assessment reports are intended primarily to provide water consumer associations, utility companies and water customers with information on the condition of their water supply. Included in the reports will be a set of recommendations for improving Susceptibility Rankings and correcting deficiencies in treatment and delivery works.

6.2 Availability of Source Water Assessment Reports to the Public

Source Water Assessment reports will be made available through several avenues:

- Consumer Confidence Reports prepared by public water systems for their customers may contain a reference to the Source Water Assessment report for that system, along with a brief explanation of what the report contains and how the customer can obtain a copy.

- The Source Water/Wellhead Protection Internet site linked to the NMED Home Page contains general information on SWAPP functions, and directs the public to NMED/DWB for Source Water Assessment reports.

- A toll-free telephone number advertised in Consumer Confidence Reports, Drinking Water Bureau literature and on the Source Water web page allows water consumers to

request Source Water Assessment reports directly from NMED.

- Flyers and handbills delivered by NMED to public water systems and to consumers during Water Fairs will announce the availability of Source Water Assessment reports.

Consumer Confidence Reports are required by 40 CFR 141.153 (b) to provide information to the consumer on the source or sources of water serving the public, the level of contaminants in water purveyed, and the potential health risks associated with contaminants detected in the water system. Elements of the Consumer Confidence Report specific to SWAP include:

- The type and location of water sources, and the name or common reference for each source

- Disclosure of significant potential sources of contamination

- A summary of the system's susceptibility to contamination

- Notification of the availability of completed Source Water Assessment reports

CHAPTER SEVEN

Existing State Programs and SWAPP

Existing programs operated by the New Mexico Environment Department Drinking Water Bureau that have components similar to the SWAPP are the Wellhead Protection Program and the Vulnerability Assessment Program. Because of differences in their purpose, these two programs will continue to function independently from the SWAPP, but are implemented by SWAPP staff to ensure consistency between programs.

7.1 New Mexico Vulnerability Assessment Program

New Mexico's Vulnerability Assessment program as approved by the EPA was created to relieve the cost burden imposed on public water systems by the Safe Drinking Water Act Phase II and Phase V chemical monitoring requirements. This state-sponsored program provides a scientific basis for assessing the risk posed to New Mexico water systems by certain contaminants, and for determining whether or not chemical monitoring waivers are appropriate for specific contaminants or classes of contaminants. By conducting Vulnerability Assessments, NMED is able to issue chemical monitoring waivers to many water systems, thereby reducing the amount and/or frequency of sample collection and analysis required for the system for a period of time specified in the waiver.

The Phase II and Phase V chemical monitoring rules made three different waiver types available to public water systems through the Vulnerability Assessment process. A "Use Waiver" is available if a particular contaminant has never been applied, manufactured, transported, stored and/or disposed of in an area covered by the waiver. A "Waiver by Rule" is available if three consecutive analytical results from the water system are reliably and consistently below either the MCL or the detection limit set for each contaminant. Under the Waiver by Rule option, if there is no evidence of a contaminant, monitoring may be reduced but not eliminated for a maximum of three years. The third waiver type is the "Susceptibility Waiver," which may be issued only after calculation of a DRASTIC or WRASTIC index, delineation of a source water protection zone, and evaluation of a number of risk factors associated with potential contaminant sources under local hydrogeologic conditions. Contaminants and classes of contaminants eligible for chemical monitoring waivers are Dioxin, volatile organic chemicals and synthetic organic chemicals. Waivers for inorganic contaminants may be issued to water systems under the Susceptibility Waiver protocol, and to surface water systems only under the Waiver by Rule option. Asbestos waivers may be issued either as a Use Waiver or as a Susceptibility Waiver.

In 1991, the EPA standardized monitoring requirements and sampling frequency for chemical contaminants in drinking water by promulgating the "Standardized Monitoring Framework," which is organized into nine-year compliance cycles. Compliance cycles are subdivided into a series of three, three-year compliance periods. Chemical monitoring waivers issued under the Vulnerability Assessment program are granted for particular three-year compliance period or periods specified in the waiver.

Although intended primarily for the issue of chemical monitoring waivers, the NMED Vulnerability Assessment program meets many of the requirements of the 1996 Amendments to the Safe Drinking Water Act for a state-sponsored Source Water Assessment Program. Specific components of the Vulnerability Assessment program capable of fulfilling the Act's SWAP mandate include the following:

1. Delineation of source water protection areas for public water systems, whether the source is a ground water supply well, spring or surface water intake

2. Inventory of all potential sources of contamination within each delineated source water protection area

3. Analysis of the susceptibility of public water systems to contamination by calculation of a DRASTIC or WRASTIC index for each source, evaluation of source area hydrogeology, review of the type and proximity of potential sources of contamination within source water protection areas, evaluation of the construction and integrity of ground water wells or surface water intakes, and review of system chemical monitoring history

NMED Source Water Assessment and Protection Program staff will perform source water assessments on all public water systems within New Mexico, regardless of any existing chemical monitoring waivers. However, NMED will integrate into the SWAP as much previous work done under the Vulnerability Assessment program as possible. The Source Water Assessment and Protection Program thus provides an opportunity to broaden and enhance previous NMED efforts by making use of existing Vulnerability Assessment data, and developing new information where existing data is lacking.

7.2 New Mexico Wellhead Protection Program

The EPA approved the New Mexico Wellhead Protection program in 1991. Since that time, the program has undergone significant modifications.

The New Mexico Wellhead Protection Program is a voluntary, five-step program designed to encourage community involvement in protecting local water supplies. These five steps are:

1. Formation of a Wellhead Protection Committee
2. Delineation of Wellhead Protection Areas around water supply wells
3. Completion of an inventory of potential contaminant sources within each delineated Wellhead Protection Area
4. Development of management strategies for implementing the local Wellhead Protection Plan
5. Planning for emergencies and for future water system development and maintenance as the community grows

Once a community has satisfactorily completed the five components of a Wellhead Protection

Plan, NMED will review the plan and, if approved, will issue a certificate of approval. The Department provides full technical support throughout the development of each local Wellhead Protection Plan.

The Wellhead Protection Program follows on SWAPP assessment activities by promoting source water protection measures within the community. It operates in conjunction with the SWAPP through community outreach and education, through relationships cultivated with various non-profit community advocacy and stakeholder groups, and through a shared funding mechanism created under the DWSRF set-asides.

Additional Wellhead Protection Program activities that strengthen the SWAPP include the development of new partnerships with the New Mexico Farm-A-syst program and with other educational and cooperative extension entities in New Mexico. NMED is currently involved with the Unified Source Water Protection Plan (USWPP) coordinated by the University of New Mexico Environmental Finance Center. This project is a cooperative effort among numerous communities in Mora County to develop regional source water protection strategies. The USWPP initiative will allow communities to achieve full technical, managerial, and financial capacity.

Local wellhead protection efforts may also receive indirect promotion through the Vulnerability Assessment process. NMED provides the results of completed Vulnerability Assessments to public water systems, and includes with the results a brief description of the Wellhead Protection Program along with an NMED contact name and telephone number. The Vulnerability Assessment provides public water systems with some of the more difficult to obtain information needed to develop a local Wellhead Protection Plan.

CHAPTER EIGHT

SWAPP Implementation

Chapter eight presents miscellaneous information related to implementation of the program, including funding mechanisms; extension of assessment deadlines; priority systems; coordination with other agencies; program modifications; SWAPP reporting and updates.

8.1 SWAPP Funding

The USEPA allotted the State of New Mexico approximately $12,800,000 through a Safe Drinking Water Act capitalization grant to develop and implement a drinking water state revolving loan fund (DWSRF). Of this allotment, the State of New Mexico requested the full 10% of the DWSRF set-aside component allowed by the grant for development and implementation of the state's source water program. The total dollar amount thus available for SWAPP is $1,200,000. An additional $254,000 has been allocated to implement related source water protection efforts, such as wellhead protection and watershed protection activities. The New Mexico DWSRF Intended Use Plan (copies available from NMED/DWB) outlines the anticipated use of the $1,200,000 SWAPP fund during the development and implementation of the program.

Other funding sources available for Source Water Assessment work include the New Mexico Water Conservation Fund (WCF). The WCF is funded by a fee of three cents ($0.03) per thousand (1,000) gallons of water produced by all public water systems in New Mexico. The WCF is administered by NMED. The WCF is also used by the Vulnerability Assessment Program to collect and analyze chemical monitoring samples required under the SDWA, and for providing training to water system operators throughout New Mexico.

8.2 Request for Extension

The State of New Mexico requested and received from the USEPA an eighteen-month extension to perform the source water assessment mandate of the 1996 SDWA Amendments. This gives NMED a maximum of 3.5 years to complete source water assessments of all 1,365 active public water systems in New Mexico. NMED has until May 2003 to complete the assessment task.

8.3 Prioritization

Because of the number of public water systems in New Mexico and the limited agency resources available to complete assessment work, NMED/DWB has established a prioritization scheme for assessing surface water and ground water systems.

8.3.1 Ground Water Systems

Community ground water systems will be assessed before Non-community ground water systems because of the larger number of persons affected, and because of the oftentimes greater length of time required to implement managerial changes through water boards and municipal governments. Community water systems having a history of Maximum Contaminant Level violations or that pose other health risks to their consumers will be assigned highest priority. Water systems recently evaluated under the Vulnerability Assessment Program and demonstrating a history of compliance with all regulatory requirements will be assigned lowest priority. Assessments of Non-Transient-Non-Community water systems will follow Community systems, and will be followed in turn by Transient Non-Community water systems.

8.3.2 Surface Water Systems

The State of New Mexico has entered into an interstate source water agreement with six neighboring states that contribute water to or receive water from the Colorado River. The states of Arizona, Colorado, Wyoming, Utah, Nevada and California have agreed with the State of New Mexico to perform a Source Water Assessment on all public water systems drawing surface water from the Colorado River and its major tributaries, and to share that information amongst an interstate SWAP working group. New Mexico public water systems affected by this agreement are located along the San Juan, Animas and La Plata rivers in northwest New Mexico, and along the Rio Pescado, San Francisco and Gila rivers in west central New Mexico. Following assessment of Colorado River drainages, NMED/DWB will prioritize those Community water systems located in Category 1 Watersheds, as defined in New Mexico's Unified Watershed Assessment Plan.

8.4 Agency Coordination

During the development of the New Mexico SWAPP, numerous partnerships have been formed or initiated among various environmental groups, native tribes, and state agencies. Partnerships formed with other agencies within NMED include the Total Maximum Daily Load and Non-Point Source programs of the Surface Water Quality Bureau; the Underground Storage Tank Program; the Solid Waste Program; the Liquid Waste Program; and the Underground Injection Control, CERCLA, RCRA, and Ground Water Protection and Abatement programs of the Ground Water Quality Bureau. Coordination among these partners during SWAPP implementation will focus on mutual needs and mutual benefits. Anticipated new regulatory initiatives such as the Enhanced Surface Water Treatment/Disinfection Byproducts Rule, the Ground Water Rule, Capacity Development, and Chemical Monitoring Reform, place even greater emphasis on the need for agency coordination.

Coordination between tribes, local stakeholders and federal agencies is under continual development. All native tribes in the State of New Mexico were contacted, and were asked to participate in the development of the SWAPP. Federal agencies targeted for assistance in implementing the program include the Forest Service, Geological Survey, Bureau of Land

Management, and Bureau of Reclamation.

Organizations outside of state and federal government with whom the State of New Mexico has formed partnerships include the New Mexico Rural Water Association, the New Mexico Water Users Association and the New Mexico Engineering Research Institute.

To fully implement the SWAPP, the State of New Mexico may delegate specific components of the Source Water Assessment process to other entities. Available options include the use of staff from other NMED programs, and contractual agreements with entities outside NMED. All contracts for services granted to non-NMED/DWB entities will strictly comply with state and federal laws, and with all pertinent policies and procedures of the State of New Mexico.

8.5 SWAPP Modifications and Program Optimization

As the assessment process for public water systems progresses, it is anticipated that modifications and amendments to the SWAPP may become necessary. NMED/DWB will retain the SWAPP Citizens and Technical Advisory Committee during implementation of the program, and will continue to meet with the committee on a semi-regular basis. Topics anticipated to need periodic review include, but are not limited to:

1. Evaluation of completed assessments and means of improvement
2. Incorporation of unique situations arising during the assessment process
3. Refinements needed to the Contaminant/PSOC List
4. Evaluation of the remaining workload

8.6 SWAPP Reporting and Updates

Due to the link between the New Mexico Wellhead Protection Program and the SWAPP, NMED/DWB will report to the EPA on the progress of the SWAPP through the Wellhead Protection Biennial Report.

Once the State of New Mexico has completed Source Water Assessments for all public water systems, NMED staff will conduct periodic Assessment Updates. Since the DWSRF set-asides funding the SWAPP are a limited, discontinuous source of funding, Assessment Updates will be less in-depth assessments performed in conjunction with Sanitary Surveys and Vulnerability Assessments.

A timeline for the development and implementation of the New Mexico SWAPP can be found in Appendix G.

Appendix A

Public Involvement

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APPENDIX A

Public Involvement

Public participation in developing the SWAPP, a requirement of Section 1428 (b) of the Safe Drinking Water Act Amendments of 1996, was implemented by the New Mexico Environment Department Drinking Water Bureau (DWB) by establishing a Technical/Citizen Advisory Committee and by convening a series of public meetings. Appendix A documents the issues and concerns identified, the information disseminated, the comments solicited, and the response by the DWB and the Technical/Citizen Advisory Committee during these meetings. Documents are compiled and organized in chronological order.

The process of public involvement in the formulation of the New Mexico SWAPP began with the Safe Drinking Water Advisory Committee meetings, and was followed by the formation and meetings of the SWAPP Technical/Citizen Advisory Committee, and by the Public Meetings held during February 1999. The DWB continues to work with the Technical/Citizen Advisory Committee during implementation of the SWAPP, which will aid in maintaining and developing linkages to New Mexico stakeholders as the assessments are completed. Additionally, the Committee may advise the DWB on the use of the assessments in implementing prevention programs and in improving treatment methods in a cost effective manner.

Appendix B

Contaminants of Concern

APPENDIX B.

CONTAMINANTS OF CONCERN

Volatile Organic Chemicals(VOC's)			
Name of Contaminant	**MCL ***	**Potential Contaminant Source (by Contaminant Code)*** **	**Health Effects**
Benzene	0.005	AAP, APP, CAI, CAR, CBS, CBY, CCY, CDC, CHW, CHM, CHN, CSY, CPP, CPR, CPS, CRL, CRY, CUS, CVS, ICC, ICE, ICL, ICP, IEE, IFW, IFM, IHD, ILS, IMI, IMW, IMP, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, IST, ITS, ITT, IUD, IUI, IUR, MMF, MMP, MSW	Anemia; Decrease in blood platelets; Nervous system disorders; Immune system depression; Increased risk of cancer
Carbon Tetrachloride	0.005	AAP, APP, CAI, CDC, CHM, CHN, CHW, CPP, CPR, CRL, CUS, CVS, ICE, ICL, ICP, IEE, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, IST, ITS, ITT+, IUD, MLF, MMF, MMP, MSC, MSW	Liver problems; Kidney, lung damage; Increased risk of cancer
Ortho-Dichlorobenzene	0.6	CAR, CBS, CBY, CCY, CDC, CFR, CHM, CHW, CPP, CPR, CPS, CRL, CRY, CUS, ICE, ICP, ICL, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, IST, ITS, ITT, IUD,MHM, MMF, MMP, MSC	Liver, kidney, nervous system or circulatory problems
Para-Dichlorobenzene	0.075	ACS, AFI, AFN, AHC, AHF, ASC, ASP, CAR, CDC, CPP, CHW, CPP, CPR, CPS, CRL, CRY, CUS, ICL, ICP, ILS, IMP, IMW, IPL, IPP, IPU, IRG, ISF, ITS, ITT, MMF, MMP, MSC	Eye, respiratory, gastrointestinal tract irritation; Anemia; Skin lesions; Liver, kidney, spleen damage; Blood changes
1,2-Dichloroethane	0.005	ACS, AFI, AFN, AHC, AHF, ASC, ASG, ASP, CFR, CHN, CPP, CPR, CRL, CUS, CVS, ICL, ICP, IEE, IFM, ILS, ITT, IMW, IPL, IPP, IRG, ISD, ISF, IUD,MMF, MSC	Nervous system disorders; Lung, kidney, liver, circulatory, gastrointestinal effects; Increased risk of cancer
1,1-Dichloroethene	0.007	CPP, CPR, CRL, CUS, ICP, ICL, IHD, ILS, IMW, IPL, IPM, IPU, IRG, ISD, ISF, ISM, ITS, ITT, IUD, MSC	Liver, kidney damage; Increased risk of cancer; Fetal toxicity
Cis-1,2-Dichloroethene	0.07	AAP, CAI, CAR, CBS, CCY, CFR, CHG, CHM, CPP, CPR, CPS, CRL, CRY, CSS, CSY, ICP, ICL, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, ITS, ITT, IUD, IUI, MMF, MMP, MSP, MST	Nervous system disorders; Liver, circulatory system damage
Trans-1,2-Dichloroethene	0.1	AAP, CAI, CAR, CBS, CCY, CFR, CHG, CHM, CPP, CPR, CPS, CRL, CRY, CSS, CSY, IEE, IFM, ICP, ICL, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, ITS, ITT, IUD, IUI, MMF, MMP, MSP, MST	Nervous system disorders; Liver, circulatory system damage

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Dichloromethane	0.005	AAP, APP, ACS, AFI, AFN, AHC, AHF, ASC, ASG, ASP, CAI, CAR, CBS, CBY, CCE, CCY, CFC, CFR, CHN, CHW, CHM, CPP, CPR,CPS, CRY, CRL, CSS, CUS, CVS, ICC, ICE, ICP, ICL, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, IST, ITS, ITT, IUD, MHM, MMF, MMP, MSC, MSP, MSW	Nervous system, liver, blood damage; Increased risk of cancer
1,2-Dichloropropane	0.005	ACS, AFI, AFN, AHC, AHF, ASC, ASG, ASP, CAW, CPP, CPR, CRL, CUS, ICL, ICP, IHD, ILS, IPM, IPP, IRG, ISD, ISF, ISM, ITT, IUD, IUI, MLF, MSP	Liver, kidney, adrenal glands, bladder, gastrointestinal tract, respiratory tract damage; Increased risk of cancer
Ethylbenzene	0.7	CAI, CFR, CHM, CRL, CUS, ICC, ICP, ICL, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IRG, ISD, ISF, ISM, ITS, ITT, IUD, IUI, MSC, MSP	Eye, liver, kidney, central nervous system damage; Respiratory irritation
Chlorobenzene	0.1	CAR, CBS, CDC, CHW, CHM, CPP, CPR, CRL, CUS, ICP, ICL, IEE, IHD, ILS, IMI, IMP, IMW, IPL, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, MMF, MSC, MSP	Liver, kidney, central nervous system damage
Styrene	0.1	CHM, CPP, CPR, CRL, CUS, ICC, ICP, ICL, IEE, IHD,ILS, IMI, IMP, IMW, IPL, IPM, IPP, IRG, ISD, ISF, ISM, ITS, ITT, IUD, IUI, MSP	Liver, kidney, circulatory problems; Nerve damage; Increased risk of cancer
Tetrachloroethene	0.005	AAP, APP, CAI, CAR, CBS, CCY, CDC, CHM, CHN, CHW, CPP, CPR, CRL, CRY, CSS, CSY,CUS, CVS, ICC, ICL, ICP, IEE, IHD, ILS, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, ITS, ITT, IUD, IUI, MMF, MMP, MSC, MSP, MWP	Liver, kidney, central nervous system damage; Increased risk of cancer
Toluene	1	AAP, APP, CFR, CHW, CHM, CHN, CPP, CPR, CRL, CUS, CVS, ICC, ICP, ICL, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, ITS, ITT, IUD, MMF, MSC, MSP, MWP	Nervous system, liver, kidney damage
1,2,4-Trichlorobenzene	0.07	CRL, CUS, ICL, ICP, IHD, ILS, IPM, IPP, IRG, ISD, ISF, ISM, ITS, IUD	Liver, kidney, adrenal gland changes
1,1,1-Trichloroethane	0.2	AAP, APP, CAR, CAI, CBS, CBY, CCY, CDC, CFR, CHM, CHN, CHW, CPP, CPR, CRL, CUS, CVS, ICP, ICL, IEE, IFM, IHD, IHM, ILS, IMI, IMO, IMP, IMW, IPM, IPP, IRG, ISD, ISF, ISM, ITS, ITT, IUD, MHM, MMF, MMP, MSC, MSP, MWP	Liver, nervous system, circulatory problems
1,1,2-Trichloroethane	0.005	AAP, CDC, CPP, CPR, CRL, CUS, ICP, ICL, IEE, IFW, IHD, ILS, IMI, IMP, IMW, IPL, IPP, IRG, ISD, ISF, ITS, IUD, MSP	Liver, kidney, gastrointestinal tract, immune system problems; Lung damage; Increased risk of cancer
Trichloroethene	0.005	AAP, AFM, APP, CAI, CAR, CBS, CBY, CFR, CHG, CHM, CHW, CPP, CPR, CRL, CRY, CSY, CUS, ICE, ICL, ICP, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, ITS, ITT, IUD, IUI, MHM, MMF, MMP, MSC, MSP	Liver damage; Increased risk of cancer

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Vinyl Chloride	0.002	CRL, ICP, ICL, IEE, IHD, IMI, IMP, IMW, IPL, IPP, IRG, ISF, IST, ITT, IUD,	Liver, nervous system damage; Increased risk of cancer
Xylenes (Total)	10	AAP, APP, ASC, CAI, CAR, CBS, CBY, CCY, CFR, CHM, CHN, CHW, CPP, CPR, CPS, CRL, CUS, CVS, IAS, ICC, ICL, ICP, IEE, IFM, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, IST, ITT, IUD, MHM, MMF, MSC, MSP	Central nervous system, liver, kidney damage

Synthetic Organic Chemicals (SOC's)

Pesticides

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Alachlor	0.002	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CCE, CCG, CGC, CHW, CRL, CRY, CUS, ICL, ICP, IHD, ILS, IPP, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHM, MHR, MMF, MPR, MSC, MSD, MSP	Eye, skin irritation; liver, kidney, spleen, nose, eye damage; Increased risk of cancer
Aldicarb	0.003	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAW, CGC, CHW, CRL, CUS, ICL, ICP, IHD, ILS, IPP, IRG, ISD, ISF, ITS, ITT, IUD, MPR, MPW, MSC, MSP	Gastrointestinal, central nervous system, eye problems
Aldicarb Sulfone	0.003	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAW, CGC, CHW, CRL, CUS, ICL, ICP, IHD, ILS, IPP, IRG, ISD, ISF, ITS, ITT, IUD, MPR, MPW, MSC, MSP	Gastrointestinal, central nervous system, eye problems
Aldicarb Sulfoxide	0.003	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAW, CGC, CHW, CRL, CUS, ICL, ICP, IHD, ILS, IPP, IRG, ISD, ISF, ITS, ITT, IUD, MPR, MPW, MSC, MSP	Gastrointestinal, central nervous system, eye problems
Atrazine	0.003	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CAI, CAW, CCG, CCE, CFC, CGC, CHW, CRL, CRY, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHD, MHM, MLF, MMF, MPR, MPW, MSC, MSD, MSP, RMS	Cardiovascular system, kidney, adrenal gland damage; Increased risk of cancer
Carbofuran	0.04	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAI, CAW, CCE, CCG, CGC, CHW, CPL, CRL, CST, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHR, MLF, MMF, MPR, MSC, MSD,MSP, RMS	Central nervous system, reproductive system damage
Chlordane	0.002	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAI, CAW, CBY, CCY, CRL, CST, CUS, ICP, ICL, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUR, MHM, MLF, MMF, MPR, MRF, MSC, MSD, MSP, RMS	Central nervous system, blood disorders; Liver, kidney, heart, lung, spleen , adrenal gland damage; Increased risk of cancer
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.07	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CAI, CAW, CCE, CCG, CCY, CGC, CHW, CRL, CRY, CST, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUR, MHM, MHR, MLF, MMF, MPR, MPW, MSC, MSD, MSP	Nervous system, kidney, liver damage

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Dalapon	0.2	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CAI, CAW, CCE, CCG, CCY, CGC, CHW, CRL, CRY, CSY, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHD, MHM, MHR, MLF, MMF, MPR, MPW, MSC, MSD, MSP, RMS	Kidney changes
Dibromochloropropane	0.0002	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAI, CAW, CCE, CGC, CHW, CRL, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUR, MHM, MMF, MSC, MSD, MSP	Kidney, liver, reproductive system damage; Increased risk of cancer
Dinoseb	0.007	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CHW, CRL, ICL, ICP, IHD, IRG, ISD, ISF, ITT, IUD	Reproductive system problems
Diquat	0.02	ACS, ADC, AFI, AFN, AHC, AHF, ARL, ASC, ASG, ASP, CAW, CGC, CRL, CUS, ICL, ICP, IHD, ILS, IPP, IPU, ISD, ISF, ITS, ITT, IUD, IUR, MHM, MMF, MPW, MSD, MSP	Cataracts
Endothall	0.1	ACS, ADC, AFI, AFN, AHC, AHF, ARL, ASC, ASG, ASP, CAI, CAW, CBY, CCE, CCG, CCY, CGC, CHW, CPL, CRL, CRY, CST, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUR, MHM, MHR, MLF, MMF, MPR, MPW, MSC, MSD, MSP	Stomach, intestinal problems
Endrin	0.002	ACS, ADC, AFI, AFN, AHC, AHF, ARL, ASC, ASG, ASP, CAW, CRL, CRV, CRY, CST, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUR, MHM, MMF	Central nervous system problems; Liver damage
Ethylene Dibromide (EDB)	0.00005	ACS, ADC, AHC, APP, ASC, ASG, ASP, CAI, CAW, CFR, CHW, CPP, CPR, CPS, CRL, CUS, ICL, ICP, IFM, IHD, ILS, IPL, IPP, IRG, ISD, ISF, ITS, ITT, IUD, MMF, MSP	Liver, stomach, adrenal gland, reproductive system, respiratory, nervous system, heart, kidney damage; Increased risk of cancer
Glyphosate	0.7	ACS, ADC, AFI, AFN, AHC, AHF, AHF, ARL, ASC, ASP, CAI, CAW, CCE, CCG, CCY, CGC, CHW, CPL, CRL, CRY, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, IUD, IUI, IUR, MHM, MHR, MLF, MMF, MPR, MPW, MSC, MSD, MSP, RMS	Respiratory problems; Kidney, reproductive system damage
Heptachlor	0.0004	CAI, CCY, CGC, CPL, CRL, CRV, CRY, ICE, ICL, ICP, IHD, IPP, IPU, ISF, ITT, IUD, IUR, MHM, MMF, MSC	Central nervous system, liver damage; Increased risk of cancer
Heptachlor Epoxide	0.0002	CAI, CCY, CGC, CPL, CRL, CRV, CRY, ICE, ICL, ICP, IHD, IPP, IPU, ISF, ITT, IUD, IUR, MHM, MMF, MSC	Central nervous system, liver damage; Increased risk of cancer
Hexachlorobenzene	0.001	ACS, ADC, ASC, ASG, ASP, CPP, CPR, CRL, CUS, ICL, ICP, IHD, ILS, IMW, IPL, IPP, IRG, ISF, ITS, ITT, IUD, MMF	Skin lesions; Nerve, liver, kidney damage; Reproductive system problems; Endocrine Gland Tumors; Increased risk of cancer
Hexachlorocylopentadiene	0.05	CRL, CUS, ICL, ICP, IHD, ILS, IPL, IPP, IRG, ISF, ITS, ITT, IUD	Gastrointestinal problems; Liver, kidney, heart damage

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Lindane	0.0002	ACS, ADC, ADF, AFI, AFL, AFN, AHC, ARL, ASC, ASP, CCY, CHW, CPP, CPR, CRL, CVS, ICL, ICP, IHD, IPM, IPP, IRG, ISF, ISM, ITS, ITT, IUD, MHM, MMF, MSC, MSP	Liver, kidney damage; Pulmonary problems
Methoxychlor	0.04	ACS, ADC, ADF, AFI, AFL, AFN, AHC, AHF, ASC, ASG, ASH, ASP, ASW, CBY, CCG, CGC, CHW, CRL, CUS, ICL, ICP, IHD, ILS, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUR, MHD, MHR, MMF, MPR, MSC, MSD	Central nervous system, gastrointestinal tract problems; Liver, kidney, heart damage
Oxamyl (Vydate)	0.2	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CAW, CCE, CGC, CHW, CRL, ICL, ICP, IHD, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHM, MLF, MMF, MSC, MSP	Central nervous system problems
Pentachlorophenol	0.001	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CBY, CCY, CFR, CHW, CRL, CRY, ICL, ICP, IFM, IHD, IPM, IPP, IPU, IRG, ISF, ISM, ITT, IUD, MHM, MLF, MMF	Central nervous system damage, liver, kidney, reproductive system damage; Increased risk of cancer
Picloram	0.5	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CAI, CAW, CCE, CCG, CCY, CGC, CHW, CPL, CRL, CRY, ICL, ICP, IHD, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHD, MHM, MHR, MLF, MMF, MPR, MSC, MSD, MSP, RMS	Central nervous system, liver damage
Simazine	0.004	ACS, ADC, AFI, AFN, AHC, ARL, ASC, ASP, CAI, CAW, CBY, CCG, CCE, CCY, CGC, CHW, CPL, CRL, CRY, CSY, ICL, ICP, IHD, IPP, IPU, IRG, ISD, ISF, ITS, ITT, IUD, IUI, IUR, MHD, MHM, MHR, MLF, MMF, MPR, MPW, MSC, MSD, MSP	Reproductive system, blood, kidney, liver, thyroid damage; gene mutation; Increased risk of cancer
2,3,7,8-TCDD (Dioxin)	3x10-8	CAI, CRL, ICL, ICP, IEE, IHD, IPP, IPU, ISF, IUD, IUR, MIN, MMF, MSW	Reproductive system problems; Birth defects; Increased risk of cancer
Toxaphene	0.003	ACS, ADC, AFI, AFL, AFN, APF, ARL, ASC, ASP, CRL, ICL, ICP, IHD, IPP, ISF, IUD	Central nervous system, thyroid problems; liver, kidney degeneration; Increased risk of cancer
2,4,5-TP (Silvex)	0.05	ACS, ADC, ARL, ASC, ASP, CBY, CCE, CGC, CRL, CRY, ICL, ICP, IHD, IPP, IPU, ISF, ITT, IUD, IUR, MHM, MLF, MMF	Liver, kidney damage; Central nervous system problems

Non-Pesticides

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Benzo(a)pyrene	0.0002	AFM, CAI, CAR, CBS, CCY, CFC, CRL, CRY, IAS, ICC, ICL, ICP, IFW, IHD, IMI, IMP, IPL, IPP, IPU, IRG, ISF, IST, ITT, MFS, MHM, MIN, MLF, MMF, MMP, MSC	Anemia; Immune system depression; Reproductive, developmental problems; Increased risk of cancer

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Di(2-ethylhexyl)adipate	0.4	AAP, CAI, CAR, CBY, CCY, CHW, CPS, CRL, CST, ICL, ICP, IHD, IMI, IMP, IMW, IPL, IPP, IPU, IRG, ISF, ITS, ITT, IUD, MIN, MLF, MMF, MMP, MSL, MSP, MSS, MST	Liver, reproductive system damage; Increased risk of cancer
Di(2-ethylhexyl)phthalate	0.006	AAP, APP, CHM, CHW, CPP, CPR, CRL, CSY, ICE, ICL, ICP, IEE, IHD, IMP, IMW, IPL, IPP, IRG, ISF, IST, ITT, IUD, MHM, MIN, MLF, MMF, MRF, MSW	Liver, reproductive system damage; Increased risk of cancer
Polychlorinated Biphenyls (PCB's)	0.0005	ACS, ASC, CAI, CCY, CHM, CRL, CRY, CST, CSY, ICL, ICP, IEE, IHD, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, ISM, ITS, IUD, IUR, MHM, MIN, MLF, MMF, MSS, MST, MSW	Skin problems, thymus gland, reproductive system, immune system problems; Liver function changes; Increased risk of cancer

Inorganic Chemicals (IOC's)

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Antimony	0.006	CRL, CSY, ICL, ICP, IEE, IFW, IHD, IMI, IMP, IPL, IPP, IRG, ISF, IST, IUD, MIN, MLF, MSW	Blood changes; Increased risk of cancer
Arsenic	0.05	AAP, ACS, ADC, AFI, AFN, AHC, APP, ASC, ASP, CAI, CAR, CBS, CCE, CCY, CFC, CGC, CHM, CHN, CPP, CPR, CRL, CRV, CSY, CVS, ICL, ICP, IEE, IHD, IMI, IMP, IMW, IPM, IPP, IRG, ISF, ISM, IUD, IPU, MLF, MMF, MSC, MSW	Skin damage; Circulatory problems; Increased risk of cancer
Asbestos	7 MLF (Million Fibers per Liter)	CAI, CAR, CBS, CBY, CCY, CHM, CHN, CHW, CRL, CRV, CRY, CSY, ICC, ICL, ICP, IHD, IHM, IMI, IMO, IMW, IPU, IRG, ISF, IST, ITT, IUD, MHD, MHM, MIN, MLF, MMF, MMP, MSC, MSW, MWP	Lung disease, Increased risk of cancer
Barium	2	CAI, CAR, CAW, CBS, CCY, CFR, CHM, CHN, CHW, CPP, CPR, CRL, CRV, CRY, CSY, CVS, ICC, ICL, ICP, IEE, IFW, IFM, IGO, IHD, IHM, IMI, IPL, IPM, IPP, IPU, IRG, ISF, ISM, IST, ITT, IUD, IUI, IUR, MHM, MIN, MLF, MMF, MMP, MSC, MSW	Gastrointestinal problems; High blood pressure
Beryllium	0.004	CRL, CSY, ICL, ICP, IEE, IFW, IHD, IHM, IMI, IMO, IMP, IMW, IPP, IPU, IRG, IRW, ISF, IST, IUD, MIN, MLF, MMF, MSW	Lung, bone damage; Increased risk of cancer
Cadmium	0.005	AAP, APP, CAI, CAR, CBS, CBY, CCY, CHG, CHM, CHW, CPP, CPR, CPS, CRL, CRY, CSS, CSY, ICC, ICE, ICL, ICP, IEE, IFW, IHD, IHM, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, ISM, IST, ITT, IUD, IUR, MHM, MIN, MLF, MMF, MMP, MSC, MSP, MSS, MST, MSW, MWP	Gastrointestinal problems; Kidney, liver, bone, blood damage
Chromium	0.1	CPP, CPR, CRL, CSY, ICC, ICL, ICP, IEE, IFW, IHD, IHM, IMI, IMO, IMP, IMW, IPP, IPU, IRG, ISF, IST, ITS, ITT, IUD, MIN, MLF, MMF, MPW, MSC, MSP, MSS, MST	Skin problems; Liver, kidney, circulatory, nerve damage.

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Copper	1.3 TT Treatment Technique Action Level	AAP, ACS, ADC, AHC, APF, APP, ASC, ASP, CAR, CBS, CCY, CHM, CHN, CHW, CPP, CPR, CRL, CRY, CST, CSY, CVS, ICL, ICP, IEE, IFM, IFW, IHD, IHM, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, ISM, IST, ITS, ITT, IUD, MIN, MLF, MMF, MSP, MSS, MST, MSW	Gastrointestinal problems; Liver, kidney damage; Anemia
Cyanide	0.2	ACS, ADC, AFI, AFN, AHC, ASC, ASP, CCY, CHN, CHW, CPP, CPR, CPS, CRL, CST, CUS, CVS, ICL, ICP, IEE, IFW, IHD, ILS, IMI, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISD, ISF, ISM, IST, ITS, ITT, IUD, MHM, MLF, MMF, MPW, MSC, MSS, MST	Thyroid problems; Nerve damage
Fluoride	4	ACS, ADC, ASC, ASF, CCY, ICC, ICL, ICP, IFW, IHM, IMI, IMO, IMP, IST, IUD, MWP	Tooth mottling; Bone disease
Lead	0.015 TT	CAI, CAR, CBS, CBY, CCY, CFR, CHG, CHM, CHN, CHW, CPP, CPR, CPS, CRL, CRY, CSY, ICC, ICL, ICP, IEE, IFM, IFW, IHD, IHM, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, ISM, IST, ITS, ITT, IUD, IUR, MHD, MHM, MIN, MLF, MMF, MMP, MRF, MSC, MSP, MSS, MST, MSW, MWP, RMS	Blood, Neurological development problems; Kidney disease; Stroke; Increased risk of cancer
Mercury	0.002	AAP, ACS, ADC, AFI, AFN, AHC, APP, ASC, ASP, CAI, CAR, CBS, CBY, CCY, CFR, CHM, CHN, CHW, CPP, CPR, CRL, CRV, CRY, CST, CSY, CUS, CVS, ICE, ICL, ICP, IEE, IFM, IFW, IHD, IHM, ILS, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, ISM, IST, ITS, ITT, IUD, IUR, MHM, MIN, MLF, MMF, MPW, MRF, MSC, MSP, MSS, MST, MSW	Kidney damage
Nickel	0.1	CAI, CAR, CBS, CBY, CCY, CPP, CPR, CRL, CST, CSY, CUS, ICE, ICL, ICP, IEE, IFW, IHD, IHM, ILS, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, IST, ITS, ITT, IUD, MHM, MIN, MLF, MMF, MMP, MPW, MRF, MSC, MSP, MSS, MST,MSW	Gastrointestinal irritation; Nerve, liver , kidney, reproductive system damage
Nitrate	10	AAP, ACS, ADC, ADF, AFI, AFL, AFN, AHC, AMA, AMS, AOA, APF, APP, ARL, ASC, ASF, ASH, ASW, CAI, CAW, CBB, CBY, CCE, CCG, CCW, CCY, CFC, CGC, CHG, CHN, CPL, CPP, CPR, CRL, CST, CVS, ICL, ICP, IHD, IHM, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, ISD, ISF, ISM, ITS, ITT, IUD, IUR, MHD, MHM, MLF, MMF, MPR, MPS, MPW, MSC, MSD, MSL, MSP, MSS, MST, MSW, MWP, RMS	Methemoglobinemia; Spleen damage

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Nitrite	1	AAP, ACS, ADC, ADF, AFI, AFL, AFN, AHC, AMA, AMS, AOA, APF, APP, ARL, ASC, ASF, ASH, ASW, CAI, CAW, CBB, CBY, CCG, CCE, CCW, CCY, CFC, CGC, CHG, CHN, CPL, CPP, CPR, CRL, CST, CVS, ICL, ICP, IHD, IHM, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, ISD, ISF, ISM, ITS, ITT, IUD, IUR, MHD, MHM, MLF, MMF, MPR, MPS, MPW, MSC, MSD, MSL, MSP, MSS, MST, MSW, MWP, RMS	Methemoglobinemia; Spleen damage
Selenium	0.05	ADC, AFI, AFN, ARL, CPP, CPR, CRL, ICC, ICL, ICP, IEE, IFW, IHD, IHM, IMI, IMO, IMP, IMW, IPL, IPM, IPP, IPU, IRG, ISF, IST, IUD, MHM, MIN, MLF, MMF, MPW, MSC, MSS, MST, MSW	Peripheral nervous system, kidney, liver, circulatory system damage
Thallium	0.002	CHN, CPP, CRL, ICC, ICE, ICL, ICP, IEE, IFW, IHD, IHM, IMI, IMO, IMP, IPL, IPP, IPU, IRG, ISF, IUD, IUR, MIN, MLF, MMF, MSS, MST, MSW	Blood chemistry changes; Nerve, liver, kidney, intestinal, reporductive system damage

Radionuclides

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Beta Particles and Photon Emitters	4 Millirems per Year	CAW, CHN, CRL, IGO, IHM, IMO, IRG, IRW, ISF, MMF, MWP	Increased risk of cancer
Gross Alpha Particle Activity	15 Picocuries per Liter	CAW, CHN, CRL, IGO, IHM, IMO, IRG, IRW, ISF, MMF, MWP	Increased risk of cancer
Radium 226 and Radium 228 (Combined)	5 Picocuries per Year	CAW, CHN, CRL, IGO, IHM, IMO, IRG, IRW, ISF, MMF, MWP	Increased risk of cancer

Microbiologicals

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Crytosporidium parvum		AAP, ADC, ADF, AFL, AMA, AMS, AOA, APF, APP, ARL, ASH, ASW, CAW, CBY, CCG, CFC, CHN, CPL, CRV, CSS, CST, CVS, ISD, ITS, IUI, IUR, MHD, MHR, MMF, MPR, MPS, MPW, MSC, MSD, MSL, MSP, MSS, MST, MWP, RMS	Cryptosporidiosis, a gastroenteric disease
Giardia lambia	TT**	AAP, ADC, ADF, AFL, AMA, AMS, AOA, APF, APP, ARL, ASH, ASW, CAW, CBY, CCG, CFC, CHN, CPL, CRV, CSS, CST, CVS, ISD, ITS, IUI, IUR, MHD, MHR, MMF, MPR, MPS, MPW, MSC, MSD, MSL, MSP, MSS, MST, MWP, RMS	Giardiasis, a gastroenteric disease

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Name of Contaminant	MCL *	Potential Contaminant Source (by Contaminant Code)***	Health Effects
Legionella sp.	TT**	ADC, CBY, ITS, MPW, MSD, MSP, MWP	Legionnaire's Disease; pneumonia
Total Coliforms (Including Fecal Coliform & E. coli)	5 Percent (See NOTE 1)	AAP, ADC, ADF, AFL, AMA, AMS, AOA, APF, APP, ARL, ASH, ASW, CAW, CBY, CCG, CFC, CHN, CPL, CRV, CSS, CST, CVS, ISD, ITS, IUI, IUR, MHD, MHR, MMF, MPR, MPS, MPW, MSC, MSD, MSL, MSP, MSS, MST, MWP, RMS	Used as an indicator that other potentially harful bacteria may be present (See NOTE 2)
Turbidity	TT**	ADC, CBY, CCG, CCW, CCY, CGC,CPL, CRV, CRY, ICC, IHD, IHM, IMO, IPM, IUD, IUR, MHD, MHM, MHR, MIN, MLF, MMF, MPR, MPW, MRF, MSC, MSD, MSL, MSP, MSS, MST, MSW, RMS	Turbidity has no health effects but can interfere with disinfection and provide a medium for bacterial growth. It may indicate the presence of microbes
Viruses (Enteric)	TT**	AAP, ADC, ADF, AFL, AMA, AMS, AOA, APF, APP, ARL, ASH, ASW, CAW, CBY, CCG, CFC, CHN, CPL, CRV, CSS, CST, CVS, ISD, ITS, IUI, IUR, MHD, MHR, MMF, MPR, MPS, MPW, MSC, MSD, MSL, MSP, MSS, MST, MWP, RMS	Gastroenteric disease

TT** : The Surface Water Treatment Rule requires systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water to meet criteria to avoid filtration so that the following contaminants are controlled at the following levels: Giardia lambia-99.9% killed/inactivated; Viruses-99.99% killed/inactivated; Legionella-No limit, but EPA believes that if Giardia and viruses are inactivated, Legionella will also be controlled; Turbidity-At no time can Turbidity (cloudiness of water) go above 5 nephelometric turbidity units (NTU) [Systems that filter must ensure that the turbidity is no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples for any month]; HPC-No more than 500 bacterial colonies per milliliter.

NOTE 1 : No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive). Every sample that has total coliforms must be analyzed for fecal coliforms. No fecal coliforms are allowed.
NOTE 2 : Fecal coliform and E. coli are bacteria whose presence indicates that the water may be contaminated with human/animal wastes. Microbes in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. They pose a special health risk for infants, young children, and people with severely compromised immune systems.

* Maximum Contaminant Level in milligrams per liter (mg/l) unless otherwise noted.
*** Refer to Appendix C. for Contaminant Code explanation.

Appendix C

Potential Sources of Contamination

APPENDIX C.
POTENTIAL SOURCE OF CONTAMINATION (PSOC)

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
	AGRICULTURAL		
AAP	Animal Processing Plant	Operations/Waste Storage/Disposal	Nitrates, Pathogens, Organic/Inorganic Chemicals
ACS	Agricultural Chemical Storage	Farm/Ranch Storage Sites	Pesticides, Fertilizers
ADC	Agricultural Drainage Canals	Acequias, Ditches, Canals	Pesticides, Fertilizers, Nitrate,Pathogens
ADF	Agricultural Dairy Farming	Livestock Sewage Wastes	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
AFI	Agricultural Farming	Irrigated Crop Areas	Runoff and Infiltration: Fertilizers, Pesticides
AFL	Animal Feedlot (CAFO)	Livestock Sewage Wastes	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
AFM	Agricultural Farm Machinery	Farm Machinery Maintenance Areas	Automotive Wastes, Welding Wastes
AFN	Agricultural Farming	Non-Irrigated Crop Areas	Runoff and Infiltration: Pesticides, Fertilizers
AHC	Horticultural/Gardens/Nurseries/Greenhouses	Operations/Storage	Pesticides, Fertilizers
AHF	Agricultural Storage Hay/Feed	Storage Site	Fungicides, Pesticides, Nitrates
AMA	Animal Manure Application Areas	Land Application of Manure	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
AMS	Animal Manure Storage	Lined and Unlined Manure Storage Facilities	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
AOA	Agricultural Other Animal Farming	Livestock Sewage Wastes	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
APF	Agricultural Poultry Farming	Poultry Sewage Wastes	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
APP	Agricultural Processing Plant	Operations, Waste Storage and Disposal	Organic/Inorganic Chemicals, Pathogens
ARL	Animal Rangeland	Rangeland Areas	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
ASC	Agricultural Storage-Petroleum/Chemicals	Storage-500 gallons or more	Petroleum/Inorganic/Organic Chemicals
ASF	Agricultural Storage-Bulk Fertilizers	Feed Mill, Agricultural Co-op	Fertilizers
ASG	Agricultural Storage-Grain	Grain Storage Site	Fungicides
ASH	Agricultural Sheep Farming	Livestock Sewage Wastes	Nitrate, Phosphate,Chloride, Pesticides, Pathogens
ASP	Agricultural Storage-Pesticides	Feed Mill, Agricultural Co-op	Pesticides
ASW	Agricultural Swine Farming	Livestock Sewage Wastes	Nitrate, Phosphate,Chloride, Pesticides, Pathogens

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
	COMMERCIAL		
CAI	Airport (Active/Inactive)	Operations/Maintenance/Construction	Aircraft Fuels, Deicers, Batteries, Diesel Fuel, Chlorinated Solvents,Automobile Wastes, Heating Oil, Building Wastes, Sewage, Septage, Pathogens, Pesticides, Fertizers
CAR	Auto Repair Shop	Operations/Maintenance/Storage	Solvents, Metals, Automotive Waste, Oils, Gasoline
CAW	Abandoned/Improperly Closed Wells	Storage/Disposal	Organic/Inorganic Chemicals, Brines, Waste Oil, Treated Sewage Effluent, Storm Water Runoff, Process Waste Water, Metals, Pathogens, Nitrate
CBB	Beauty/Barber Shops	Operations/Maintenance	Dyes, Organic Chemicals, Pathogens
CBS	Auto Body Shop	Operations/Maintenance	Paints, Solvents
CBY	Boat Yards/Marinas	Operations/Maintenance	Gasoline, Diesel Fuels, Septage, Wood Treatment Chemicals, Paints, Varnishes,Automotive Wastes, Solvents, Building Wastes
CCG	Camp Grounds	Operations/Maintenance	Septage, Gasoline, Pesticides, Organic/Inorganic Chemicals
CCE	Cemetary	Operations/Maintenance	Leachate, Arsenic, Pesticides, Fertilizers
CCW	Car Wash	Unsewered, Without Total Recycling System	Soaps, Detergents, Waxes, Organic/Inorganic Chemicals
CCY	Construction/Demolition Yard/Staging Areas	Storage/Maintenance	Gasoline, Diesel Fuels, Wood Treatment Chemicals, Paints, Varnishes,Automotive Wastes, Solvents, Building Wastes, Explosives, Oil
CDC	Dry Cleaners	Operations/Maintenance	Chlorinated Solvents, Organic/Inorganic Chemicals
CFA	Fuel Storage Tank-Above Ground	Non-Service Station Tanks	Gasoline,Diesel Fuel, Organic/Inorganic Chemicals
CFB	Fuel Storage Tank-Below Ground	Non-Service Station Tanks	Gasoline, Diesel Fuel, Organic/Inorganic Chemicals
CFC	Funeral Homes/Cremetories	Operations	Biohazard Waste, Organic/Inorganic Chemicals, Septage
CFR	Furniture Repair/Refinishing	Operations	Paints, Solvents, Organic Chemicals
CGC	Golf Courses	Operations/Maintenance	Fertilizers, Pesticides, Gasoline, Automotive Wastes, Batteries, Septage
CHG	Historic Gasoline Service Stations	Above/Below Ground Storage Tanks/Operations	Gasoline, Oils, Solvents, Automotive Wastes, Septage

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
CHM	Home Manufacturing	Operations/Maintenance/Storage	Paints, Solvents,Organic/Inorganic Chemicals
CHN	Hospitals/Nursing Homes	Operations/Maintenance	Biohazard Waste, Organic/Inorganic Chemicals, Septage, Radiological Waste
CHW	Hardware/Lumber/Parts Stores	Operations/Storage	Pesticides, Fertilizers, Organic/Inorganic Chemicals
CLD	Laundromat	Operations	Detergents, Soaps, Septage
CPL	Parking Lots/Malls	Operations	Runoff: Pesticides, Fertilizer, Pathogens, Nitrate, Phosphate, Oil, Gasoline, Diesel Fuel
CPP	Photo Processing Labs.	Operations/Storage	Organic/Inorganic Chemicals
CPR	Printing Shops	Operations/Storage	Solvents, Inks, Dyes, Organic/Inorganic Chemicals
CPS	Paint Stores	Storage	Paint, Solvents
CRL	Research Laboratories	Operations/Maintenance/Storage	Biohazard Waste, Radiological Materials and Waste, Metals, Organic/Inorganic Chemicals
CRV	RV/Mini Storage	Storage	Gasoline, Diesel Fuels, Pesticides, Fertilizers, Oil, Automotive Wastes, Organic/Inorganic Chemicals, Acids, Bases, Batteries, Household Chemicals
CRY	Railroad Yard and Tracks	Operations/Maintenance/Storage	Diesel Fuel, Pesticides, Organic/Inrganic Chemicals
CSS	Gasoline Service Stations	Above/Below Ground Storage Tanks/Operations	Gasoline, Oils, Solvents, Automotive Wastes, Septage
CST	Commercial Septic Tanks/Leachfields/Leachpits/Cesspools	Storage/Disposal	Septage, Septic Effluent, Pathogens, Nitrate, Ammonia, Chloride
CSY	Scrap/Junkyard	Storage	Oils, Gasoline, Batteries, PCB's, Antifreeze
CUS	Underground Storage Tanks	Storage/Disposal	Gasoline, Oils, Solvents, Diesel Fuel, Organic/Inorganic Chemicals, Process Wastewater, Acids, Bases
CVS	Veterinary Services	Operations/Maintenance	Biohazard Waste, Organic/Inorganic Chemicals, Septage, Radiological Waste

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
	INDUSTRIAL		
IAS	Asphalt Plant	Production/Storage	Petroleum Derivatives
ICC	Cement/Concrete Plants	Operations/Maintenance/Storage	Organic/Inorganic Chemicals, Oils, Natural Gas, Propane,
ICE	Communications Equipment Manufacturers	Production/Maintenance/Storage	Solvents, Organic/Inorganic Chemicals, Oils, Waste Oils, Metals
ICL	Chemical Landfills	Storage/Disposal	Leachate of Organic/Inorganic Chemicals, Acids, Bases, Metals, Solvents, Gasoline, Diesel Fuel, Pesticides, PCB's
ICP	Chemical Production Plant	Production/Maintenance/Storage	Organic/Inorganic Chemicals, Solvents, Oils, Metals
IEE	Electronic/Electrical Equipment Manufacturers	Production/Maintenance/Storage	Solvents, Organic/Inorganic Chemicals, Oils, Waste Oils, Metals, Acids, Bases
IFM	Furniture and Fixture Manufacturers	Production/Maintenance/Storage	Paints, Solvents, Organic/Inorganic Chemicals
IFW	Foundry/Smelting Plant	Production/Maintenance/Storage	Organic/Inorganic Chemicals, Metals, Solvents, Acids, Bases, Oils
IGO	Gas/Oil Wells-Active/Abandoned/Test	Production	Oil, Natural Gas, Organic/Inorganic Chemicals, Acids, Bases, Drilling Wastes
IHD	Historic Dump/Landfill	Storage/Disposal	Leachate of Organic/Inorganic Chemicals, Acids, Bases, Metals, Solvents, Gasoline, Diesel Fuel, Pesticides, PCB's, Automotive Wastes
IHM	Historic Mining Operation	Production Waste/Storage	Metals, Inorganic Chemicals, Acids, Bases, Radiological Materials
ILS	Leaking Underground Storage Tank (LUST)	Storage/Disposal	Gasoline, Diesel Fuels, Organic/Inorganic Chemicals, Acids, Bases, Solvents, Oils
IMI	Primary Metal Industries	Steel/Metal Works, Rolling/Wire Mills	Metals, Inorganic Chemicals, Acids, Bases
IMO	Mining Operations (Surface And Subsurface)	Production Waste/Storage	Metals, Inorganic Chemicals, Acids, Bases, Radiological Materials
IMP	Metal Plating/Processing	Operations/Maintenance/Storage	Organic/Inorganic Chemicals, Acids, Bases, Metals
IMW	Machine/Metal Working Shop	Operations/Maintenance/Storage	Cutting Oils, Metals, Solvents, Organic/Inorganic Chemicals, Detergents
IOG	Oil/Gas Pipeline	Transport	Oils, Gasoline, Volatile Organic Chemicals, Natural Gas, Propane
IPL	Plastics Manufacturer/Molder	Operations/Maintenance/Storage	Solvents,Oils, Organic/Inorganic Chemicals,Acids, Bases

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
IPM	Paper Mill	Operations/Maintenance/Storage	Acids, Metals, Organic/Inorganic Chemicals
IPP	Petroleum Production/Refining/Storage	Operations/Maintenance/Storage	Oils, Gasoline, Diesel Fuels, Organic Chemicals, Oil Drilling/Refining Wastes
IPU	Public Utilities	Power Generating Stations	PCB's, Solvents, Diesel Fuel, Propane, Natural Gas, Oil, Acids, Bases, Organic/Inorganic Chemicals, Metals
IRG	RCRA Waste Generator	Storage/Disposal	Organic/Inorganic Chemicals, Solvents, Metals, PCB's, Acids, Bases, Radiological Materials
IRW	Radioactive Waste Disposal Sites	Storage/Disposal	High and Low Level Radiological Wastes
ISD	Sumps/Dry Wells	Storage/Disposal	Storm Water Runoff, Organic/Inorganic Chemicals, Solvents, Process Wastewater, Pesticides, Oils
ISF	Superfund Site	Storage/Disposal	Organic/Inorganic Chemicals, Solvents, Metals, PCB's, Acids, Bases, Radiological Materials
ISM	Primary Wood Industries	Saw Mills, Planers, Wood Treatment	Organic/Inorganic Chemicals, Metals, Solvents
IST	Stone, Tile, Glass Manufacturers	Operations/Maintenance/Storage	Solvents, Oils, Metals, Organic/Inorganic Chemicals
ITS	Treatment/Storage/Disposal Ponds/Lagoons	Treatment/Storage	Organic/Inorganic Chemicals, Metals, Acids, Bases, Sewage
ITT	Transport/Transfer Stations, Warehouses	Operations/Maintenance/Storage	Gasoline, Diesel Fuels, Automotive Wastes, Metals, Organic/Inorganic Chemicals, Acids, Bases
IUD	Unregulated Dumps/Excavated Sites	Storage/Collection/Disposal	Organic/Inorganic Chemicals, Automotive Wastes, Oil, Gasoline, Runoff from Adjacent Sites
IUI	Underground Injection (UIC) Wells	Storage/Disposal	Organic/Inorganic Chemicals, Brines, Waste Oil,, Treated Sewage Effluent, Storm Water Runoff, Process Wastewater, Metals, Pathogens, Nitrate
IUR	Utility/Transportation Right of Ways	Power Lines, Gas/Oil Pipelines, Highways, Roads, Airports, Railroads	Pesticides, Gasoline, Diesel Fuels, Automotive Wastes, Organic/Inorganic Chemicals, PCB's, Sewage, Metals, Stormwater Runoff, Pathogens

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
	MUNICIPAL/RESIDENTIAL		
MFS	Fire Station/Training Facility	Operations/Maintenance/Storage	Gasoline, Diesel Fuels, Pesticides, Automotive Wastes, Oil
MHD	High Density Housing	Operations/Maintenance/Storage	Gasoline, Household Chemicals, Pesticides, Stormwater Runoff: Pathogens, Nitrate, Phosphate
MHM	Highway/Road Maintenance Yards	Operations/Maintenance/Storage	Gasoline, Diesel Fuels, Solvents, Road Salt, Asphalt, Pesticides, Automotive Wastes,
MHR	Highway Rest Areas	Operations/Maintenance/Storage/Disposal	Automotive Wastes, Septage, Gasoline, Diesel Fuels, Pesticides
MIN	Incinerator	Operations/Disposal	Metals, Organic/Inorganic Chemicals
MLF	Municipal Waste Landfill	Storage/Disposal	Leachate,Organic/Inorganic Chemicals, Pesticides, Metals, Oils
MMF	Military Facilities	Operations/Maintenance/Storage/Disposal	Gasoline, Aircraft Fuels, Diesel Fuels, Automotive Wastes, Metals, Organic/Inorganic Chemicals, Explosives, Radiological Materials, Pesticides, Sewage/Septage, Oils, Solvents, Fertilizers, Batteries, Deicers
MMP	Motor Pools	Operations/Maintenance/Storage/Disposal	Gasoline, Diesel Fuel, Oils, Waste Oils, Automotive Waste, Batteries, Metals
MPR	Parks/Recreation Facilities/Campgrounds	Operations/Maintenance/Storage/Disposal	Pesticides, Organic/Inorganic Chemicals, Septage, Gasoline, Diesel Fuel, Automotive Wastes, Stormwater Runoff: Pathogens, Nitrate, Phosphate
MPS	Sewage Pump Station	Operations/Storage	Sewage, Pathogens, Nitrate, Metals, Organic/Inorganic Chemicals
MPW	Polluted Surface Water Source	Naturally Occurring/Anthropogenic	Sewage, Pathogens, Nitrate, Metals, Acids, Bases, Organic/Inorganic Chemicals
MRF	Recycling Facility	Operations/Storage/Disposal	Metals, Organic/Inorganic Chemicals, Pesticides, Automotive Wastes, Oils
MSC	Schools/Government Offices/Office Buildings	Operations/Storage/Disposal	Gasoline, Diesel Fuels, Pesticides, Fertilizers, Oil, Automotive Wastes, Sewage/Septage, Organic/Inorganic Chemicals, Acids, Bases
MSD	Storm Drainage Collection Areas and Outlets	Storage/Disposal	Runoff, Pesticides, Fertilizer, Pathogens, Nitrate, Phosphate, Oil
MSL	Sewer Lines	Transport	Sewage, Pathogens, Nitrate, Metals, Organic/Inorganic Chemicals

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Contaminant Code	Contaminant Source	Description	Contaminants of Concern*
MSP	Wastewater Seepage/Retention Pond (Unlined/Lined)	Storage/Disposal	Sewage Effluent, Nitrate, Ammonia, Pathogens, Organic/Inorganic Chemicals, Pesticides
MSS	Sewage Effluent/Sludge Land Application Areas	Storage/Disposal	Sewage/Sewage Sludge, Nitrate, Pathogens, Organic/Inorganic Chemicals, Metals
MST	Sewage Treatment Plant	Operations/Maintenance/Storage/Disposal	Sewage, Sewage Sludge, Metals, Pathogens, Organic/Inorganic Chemicals
MSW	Solid Waste Transfer Station	Storage/Disposal	Metals, Organic/Inorganic Chemicals, Pesticides, Automotive Wastes, Oils
MWP	Water Treatment Plant	Operations/Maintenance/Storage/Disposal	Organic/Inorganic Chemicals, Chlorine
RMS	Residential/Municipal Septic Tanks/Leachfield/Leachpit/Cesspools	Disposal	Septage, Septic Effluent, Pathogens, Nitrate, Ammonia, Chloride

* Contaminants of Concern include substances that are commonly, although not always, associated with the Contaminant Sources listed.

Appendix D

DRASTIC Index

Appendix D.
DRASTIC Index

DRASTIC is a methodology that will allow the pollution potential of any hydrogeologic setting to be systematically evaluated anywhere in the United States. The system was developed by the National Water Well Association (now the National Ground Water Association) under contract to the U.S. Environmental Protection Agency in 1987. This article is written in two parts. The first installment describes the DRASTIC System in general. The second part deals specifically with numerical values to use in calculating the DRASTIC Index.

The system has two major parts: the designation of mappable units, termed hydrogeologic settings, and the superposition of relative rating system called DRASTIC.

Hydrologic Settings

Hydrogeologic settings form the basis of the system and incorporate the major hydrogeologic factors which affect and control ground water movement including depth to water (D), net recharge (R), aquifer media (A), soil media (S), topography (T), impact of the vadose zone media (I), and the hydraulic conductivity (permeability) of the aquifer (C).

Hydrogeologic settings are combined with these factors to create units which can be graphically displayed on a map. The system optimizes the use of existing data to rank areas with respect to pollution potential.

The DRASTIC method was developed to assist planners, managers, and administrators in the task of evaluating the relative vulnerability of areas to ground water contamination from various sources of pollution. Ideally, the DRASTIC analysis is completed at an early stage in the planning process so resources and land-use activities can be directed properly and effectively.

The DRASTIC method has the advantage that it assumes that the user of the method has only a very basic knowledge of hydro-geology and the processes which govern ground water movement and contamination. However, the greater the hydrogeologic experience of the user, the more useful the DRASTIC analysis will become because the numerical estimates required by the method can be more accurately determined. It is important to note that the DRASTIC method is not intended to substitute for onsite inspections or to site a specific facility or institute a specific practice. It is a general method which, if properly applied, will alert the user to potential problems. It is intended to provide a basis for comparative evaluation of areas with respect to potential for ground water pollution.

The DRASTIC parameters are set forth again here:

- D Depth to water in feet;
- R (Net) Recharge;
- A Aquifer Media;
- S Soil Media;
- T Topography
- I Impact of Vadose Zone Media;
- C Conductivity (Hydraulic) of the Aquifer.

The Drastic factors represent measurable parameters for which data are generally available from a variety of sources without detailed reconnaissance. Sources for this information include:

Depth to Water	U.S. Geological Survey State Engineer's Office Local Well Drillers
Net Recharge	U.S. Geological Survey State Engineer's Office
Aquifer Media	U.S. Geological Survey State Engineer's Office Local Well Drillers
Soil Media	U.S. Soil Conservation Service Bureau of Land Management
Topography	U.S. Geological Survey Topographic Maps
Impacts of Vadose Zone	U.S. Geological Survey State Engineer's Office
Hydraulic Conductivity of the Aquifer	U.S. Geological Survey State Engineer's Office

The equation for determining the DRASTIC Index for any hydrogeologic setting is:
DRASTIC Index = $D_RD_W + R_RR_W + A_RA_W + S_RS_W + T_RT_W + I_RI_W + C_RC_W$

where: $_R$ = Rating Factor, and $_W$ = Weight Factor.

The higher the DRASTIC Index, the higher the ground water pollution potential. The rating and weight factors are attached on the Table Sheet. *If the user is concerned over the possible impact of pesticides, the pesticide factors should be used.* The Rating Factors are unchanged. ***Professional judgments are commonly applied to refine the DRASTIC Index.***

DRASTIC Mapping

In conducting a Wellhead Protection Survey, or Vulnerability analysis prior to selecting a well site, it is helpful to prepare a DRASTIC map of the area in which possible water supplies might be developed. In conducting such a survey, the hydro-geology of the area is generalized to the greatest extent possible. This commonly requires some professional judgment. For each hydro-geologically distinct area, a DRASTIC Index is developed. Areas of similar DRASTIC Index are outlined (or contoured) on a map.
In the recent ground water protection plan developed for Bernalillo County, a DRASTIC Index of 100 was used to classify areas which were susceptible to ground water contamination.

On the attached sheet Tables 1 through 9 contain weighting factors and ratings for the parameters in the DRASTIC equation.

Example 1
For the first example, consider the area of eastern Bernalillo County and western Torrance County.

Throughout most of this area, the depth to ground water is more than 100 feet. From Table 1, the Weight is 5 and from Table 3, the Rating is 1.

Recharge given in a report entitled The Geology and Hydrology of Eastern Bernalillo and Southern Santa Fe Counties, New Mexico in the University of New Mexico Library indicates the average recharge is about 21% of area rainfall. Rainfall in the area is about 15 inches. Therefore, recharge is about 3.2 inches. From Table 4, the Weight is 4 and the Rating is 3.

The Aquifer ranges from a fractured bedded limestone and shale sequence to a massive limestone called the Madera formation. It is a prolific aquifer and where caverns have developed in it, its production capacity is only limited by the size of the pump in the well. The Weight factor is 3, and the Rating is about 6 from Table 5.

Examination of the aquifer material in roadcuts reveals a thin or absent soil horizon. Table 6 gives a Weight of 2 and a Rating of 10 for this condition.

The land surface dips gently to the east at about 3 percent. Table 7 gives a Weight of 1, and a Rating of 9, for this parameter.

The Vadose Zone is the zone between the land surface and the water table. In the area under analysis, the rock in the vadose zone is the same limestone which contains the ground water. Table 8 indicates a Weight of 5, and a Rating of between 2 and 7. Because the limestone is well fractured, choose a Rating of 7.

The same report cited above gives the average aquifer transmissivity as 29,078 gallons per day per foot width of aquifer. If the aquifer is 100 feet thick, the hydraulic conductivity is about 290 gallons per day per square foot. Table 9 indicates a Weight of 3, and a Rating of 2.

The DRASTIC Index can now be calculated from the DRASTIC equation.

DRASTIC Index = $D_R D_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$

DRASTIC Index = 5*1 + 4*3 + 3*6 + 2*10 + 1*9 + 5*7 + 3*2 = 105.

Conclusion
Based upon the criteria that a DRASTIC Index above 100 suggests that wells may be vulnerable to contamination, we would want to conduct a more thorough study of surface use to rule out possible sources of contamination. Or, if we were siting a well, we would be aware that there is a potential for ground water contamination and we would not want to site a well where surface use could threaten the well. In either case, we would want to examine methods of limiting the surface use of land within the vicinity of any well.

Example 2

The second example was submitted to the New Mexico Environment Department by Mr. William J. Berry, General Manager of Butterfield Park Mutual Domestic Water Association.

The depth to water in the Butterfield Park wells exceeds 580 feet. From Table 3, the Weight is 5 and the Rating is 1.

Net local recharge to the aquifer according to the State Engineer Office is zero (0) inches. From Table 4, the Weight is 4 and the Rating is 1.

Again from information obtained from the State Engineer Office the aquifer media is sand and gravel. From Table 5, the Weight is 3 and the Rating is 8.

The soil media is a mixture of sandy loam and clay loam. This information was obtained from State Engineer Report 43, Water Resources of the Rincon and Mesilla Valleys and adjacent areas, New Mexico, and A Soil Survey of Dona Ana County Area, New Mexico, by the United States Department of Agriculture, Soil Conservation Service. From Table 6, the Rating for Sandy Loam is 6 and the Rating for Clay Loam is 3. Use a Rating of 5. The Weight is 2.

Topography of the land is a 3% slope as depicted on topographic sheets of the area. From Table 7, the Rating is 9 and the Weight is 1.

The Vadose Zone is described by the State Engineer Office as a confining layer. From Table 8, the Rating is 1 and the Weight is 5.

The Transmissivity is rated by the State Engineer Office at approximately 10,000 gallons per day per foot and the aquifer is estimated to be 700 feet thick in the area. The Hydraulic Conductivity is therefore 10,000/700 or approximately 14 gallons per day per square foot. From Table 9, the Rating is 1 and the Weight is 4.

By incorporating the Ratings and Weights presented above into USEPA's DRASTIC Index formula, Butterfield Park's Index would compute as follows:

DRASTIC Index = $D_R D_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$

DRASTIC Index = 1*5 + 1*4 + 8*3 + 5*2 + 9*1 + 1*5 + 1*4 = 61.

A DRASTIC Index of 100 or more indicates that wells may be vulnerable to contamination. The Butterfield Park DRASTIC Index of 61 would suggest that these wells are not vulnerable.

DRASTIC Tables:

Table 1
Assigned Weights for non-Pesticides

Feature	Weight
Depth to Water	5
Net Recharge	4
Aquifer Media	3
Soil Media	2
Topography	1
Impact of Vadose Zone Media	5
Hydraulic Conductivity (Aquifer)	5

Table 2
Assigned Weights for Pesticides

Feature	Weight
Depth to Water	5
Net Recharge	4
Aquifer Media	3
Soil Media	5
Topography	3
Impact of Vadose Zone Media	4
Hydraulic Conductivity (Aquifer)	2

Table 3
Ranges and Ratings for Depth to Water

DEPTH TO WATER (FEET)	
Range	**Rating**
0 - 5	10
5 - 15	9
15 - 30	7
30 - 50	5
50 - 100	3
100 +	1
General Weight: 5	Pesticide Weight: 5

Table 4
Ranges & Ratings for Net Recharge

NET RECHARGE (INCHES)	
Range	**Rating**
0 - 2	1
2 - 4	3
4 - 7	6
7 - 10	8
10 +	9
General Weight: 4	Pesticide Weight: 4

Table 5
Ranges and Ratings for Aquifer Media

AQUIFER MEDIA		Typical
Range	**Rating**	**Rating**
Massive Shale	1 - 3	2
Metamorphic/Igneous	2 - 5	3
Weathered Metamorphic/Igneous	3 - 5	4
Glacial Till	4 - 6	5
Bedded Sandstone, Limestone and Shale Sequences	5 - 9	6
Massive Sandstone	4 - 9	6
Massive Limestone	4 - 9	6
Sand and Gravel	4 - 9	8
Basalt	2 - 10	8
Karst Limestone	9 - 10	10
General Weight: 3 Pesticide Weight: 3		

Table 6
Ranges and Ratings for Soil Media

Soil Media	
Range	**Rating**
Thin or Absent	10
Gravel	10
Sand	9
Peat	8
Shrinking and/or Aggregate Clay	7
Sandy Loam	6
Loam	5
Silty Loam	4
Clay Loam	3
Muck	2
Non shrinking and Non aggregated Clay	1
General Weight: 2 Pesticide Weight: 5	

Table 7

Ranges and Ratings for Topography (Percent Slope)

Range	Rating
0% - 2%	10
2% - 6%	8
6% - 12%	6
12% - 18%	3
18% +	1

General Weight: 1 Pesticide Weight: 3

Table 8

Ranges and Ratings for Vadose Zone Impact

VADOSE ZONE IMPACT		Typical
Range	**Rating**	**Rating**
Confining Layer	1	1
Silt - Clay	2 - 6	3
Shale	2 - 5	3
Limestone	2 - 7	6
Sandstone	4 - 8	6
Bedded Sandstone, Limestone, and Shale	4 - 8	6
Sand & Gravel with significant Silt and Clay	4 - 8	6
Metamorphic/Igneous	2 - 8	4
Sand and Gravel	6 - 9	8
Basalt	2 - 10	9
Karst Limestone	8 - 10	10

General Weight: 5 Pesticide Weight: 4

Table 9

Ranges and Ratings for Hydraulic Conductivity

Range	Rating
1 - 100 (GPD/Ft)	1
100 - 300 (GPD/Ft)	2
300 - 700 (GPD/Ft)	4
700 - 1,000 (GPD/Ft)	6
1,000 - 2,000 (GPD/Ft)	8
2,000 (GPD/Ft) +	10

General Weight: 5 Pesticide Weight: 2

DRASTIC Program Input Parameter Worksheet

DATE:_____

PARAMETER	BASE VALUE / DESCRIPTION	DRASTIC RATING	SOURCE(S)
Public Water System Name		**N/A**	Field Office - NMED
Public Water System ID Number (WSS#)		**N/A**	Field Office - NMED
Depth to Water Units = Feet			U.S. Geological Survey State Engineer's Office Local Well Drillers
Net Recharge Units = Inches			U.S. Geological Survey State Engineer's Office
Aquifer Media			U.S. Geological Survey State Engineer's Office Local Well Drillers
Soil Media			U.S. Soil Conservation Service - Bureau of Land Management
Topography			U.S. Geological Survey Topographic Maps
Impacts of Vadose Zone			U.S. Geological Survey State Engineer's Office
Hydraulic Conductivity of the Aquifer Units = Gals/Day/Ft^2			U.S. Geological Survey State Engineer's Office

Appendix E

WRASTIC Index

Appendix E
WRASTIC Index

WATERSHED VULNERABILITY ESTIMATION USING WRASTIC

By David Gallegos, P.E., Jerry Lowance, P.E., & Charles Thomas,
Adapted from the Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

Introduction

WRASTIC is a methodology that will allow the pollution potential of any watershed to be systematically evaluated anywhere in the United States. The system was developed by adapting Appendix J - Watershed Control Program, of the Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources developed for EPA in 1991 by the American Water Works Association.

Watershed Settings

Watershed settings form the basis of the system and incorporate the major characteristics and usage factors which will affect the potential for contamination including presence of wastewater (W), recreational activities (R), agricultural activities (A), size of the watershed (S), transportation avenues (T), industrial activities (I), and the amount of vegetative ground cover (C).

These characteristics are combined to indicate the overall vulnerability of the watershed to contamination, which can be graphically displayed on a map.

The WRASTIC method was developed when it was realized that a ranking system for surface water systems was needed which would accomplished essentially the same goals as the DRASTIC method does for groundwater systems. The WRASTIC method was developed to assist planners, managers, and administrators in the task of evaluating the relative vulnerability of areas to surface contamination from various sources of pollution. Ideally, the WRASTIC analysis is completed at an early stage in the planning process so resources and land-use activities can be directed properly and effectively.

The WRASTIC method has the advantage that it is based upon easily identifiable properties of the watershed area. No in-depth calculations or gathering of detailed scientific data is required. It is important to note that the WRASTIC method is not intended to substitute for onsite inspections or to site a specific facility or institute a specific practice. It is a general method which, if properly applied, will alert the user to potential problems. It is intended to provide a basis for comparative evaluation of areas with respect to potential for surface water pollution.

The WRASTIC parameters are set forth again here:

W	Wastewater presence
R	Recreational impact
A	Agricultural impact
S	Size of the watershed
T	Transportation avenues
I	Industrial impact
C	vegetative ground Cover

The equation for determining the WRASTIC Index for any watershed is:

$$\textbf{WRASTIC Index} = W_R W_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$$

where: R = Rating Factor, and W = Weight Factor.

The higher the WRASTIC Index, the higher the surface water pollution potential. The rating and weight factors are attached on the Table Sheet. ***Professional judgments are commonly applied to refine the WRASTIC Index.***

WRASTIC Mapping

In conducting a Watershed Protection Survey, or Vulnerability analysis it is helpful to prepare a WRASTIC map of the area in question. The recommended first source of information for developing a WRASTIC map are 7.5 minute USGS quadrangle maps. These maps generally have great enough detail to indicate all buildings within the area which might be possible contamination sources. Determination of the size of the watershed, if unknown, can be accomplished by obtaining the 7.5 minute quadrangle maps associated with the watershed and counting the section squares, which are approximately 1 square mile each, which are contained within the watershed area.

Example 1

For the first example, consider the City of Santa Fe's drinking water reservoir.

For the watershed area associated with the reservoir, no wastewater discharge is allowed. From Table 1, the Weight is 3, and from Table 2, the Rating 1.

No Recreational activity is allowed, and all public access is restricted. From Table 1, the Weight is 2, and from Table 3, the Rating 1.

Since all access is restricted, the only agricultural impact listed on Table 4a is that due to wildlife in the area, and pesticide distribution by the Forest Service. Therefore two activities is present. From Table 1, the Weight is 2, and from Table 4, the Rating 2.

The watershed area of the City of Santa Fe is relatively small, approximately 20 square miles. From Table 1, the Weight is 1, and from Table 5, the Rating 1.

Due to the restricted access, there are no transportation avenues through the watershed area. From Table 1, the Weight is 1, and from Table 6, the Rating 1.

Again, due to the restricted access, there is no industrial presence within the watershed area. From Table 1, the Weight is 3, and from Table 4, the Rating 1.

Finally, within the watershed area, which is dominated by Pinon and Pine trees, the ground cover is between 35-50% due to the kill zone created by pine needles. From Table 1, the Weight is 1, and from Table 8, the Rating 2.

The WRASTIC Index can now be calculated from the WRASTIC equation.

WRASTIC Index = $W_R W_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$

WRASTIC Index = 3*1 + 2*1 + 2*1 + 2*2 + 1*1 + 3*1 + 1*2 = 17

Conclusion
Based upon the criteria that a WRASTIC Index below 25 allows up to a nine year waiver, the watershed associated with the City of Santa Fe would appear to be relatively non-vulnerable to contamination due to the restrictions on the watershed area.

Example 2
The second example is the City of Bloomfield, which obtains their water from Navajo Reservoir.

The Navajo Reservoir watershed contains numerous public wastewater treatment plants and private septic systems. From Table 1, the Weight is 3, and from Table 2, the Rating 5.

The Navajo Reservoir allows motorized boating upon the lake. From Table 1, the Weight is 2, and from Table 3, the Rating 5.

Due to the extent of the watershed area, all six activities listed in Table 4a can be found within the watershed area. From Table 1, the Weight is 2, and from Table 4, the Rating 5.

The watershed area includes the San Juan River Basin. This results in a watershed area greater than 750 square miles. From Table 1, the Weight is 1, and from Table 5, the Rating 5.

There are several railways through the watershed area. From Table 1, the Weight is 1, and from Table 2, the Rating 5.

The industry associated with the watershed area has a combined effect of a very large discharge and a very heavy impact on the surroundings. From Table 1, the Weight is 3, and from Table 7, the Rating 5.

Although several portions of the watershed area contain greater than 50% ground cover, the average ground cover is probably closer to between 35-50%. From Table 1, the Weight is 1, and from Table 8, the Rating 2.

The WRASTIC Index can now be calculated from the WRASTIC equation.

$$\text{WRASTIC Index} = W_R W_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$$

$$\text{WRASTIC Index} = 3*5 + 2*5 + 2*5 + 1*5 + 1*5 + 3*5 + 1*2 = 62$$

Conclusion

Based upon the criteria that a WRASTIC Index above 41 allows a maximum of a three year waiver, the watershed area for the City of Bloomfield would appear to be vulnerable to contamination based upon its large size and lack of restricted access.

WRASTIC Tables

Table 1
Assigned Weights for Contaminants

Feature	Weight
Wastewater Presence	3
Recreational Activity	2
Agricultural Impact	2
Size of Watershed	1
Transportation Avenues	1
Industrial Impact	4
Vegetative Cover	1

Table 2
Ranges and Ratings for Wastewater Presence

Range	Rating
Public WWTP effluent introduced into watershed area **and** private septic systems present	5
Public WWTP effluent introduced into watershed area	4
> 50 Private Septic systems present	3
< 50 Private Septic systems present	2
No Wastewater discharges present	1

Table 3 Ranges & Ratings for Recreational Impact	
Recreational Impact	
Range	**Rating**
Motorized activity allowed on water	5
Non-motorized activity allowed on water	4
Vehicle Access	3
No Vehicle Access	2
No Recreational Access	1

Table 4 Ranges and Ratings for Agricultural Impact	
Agricultural Impact	
Range	**Rating**
5 or more activities present	5
4 activities present	4
3 activities present	3
2 activities present	2
1 activity present	1

Table 4a Activities Used with Table 4
Pesticide Application
Presence of Feedlots/Barnyards/Cattlelots
Presence of Heavy Grazing Activities
Presence of Minimal Grazing Activities
Presence of Farming
Presence of Wildlife

Table 5 Ranges and Ratings for Size of Watershed	
Size (Sq. Miles)	
Range	**Rating**
> 750 sq. miles	5
150 - 750 sq. miles	4
60 - 150 sq. miles	3
15 - 60 sq. miles	2
< 15 sq. miles	1

Table 6 Ranges and Ratings for Transportation Avenues	
Range	**Rating**
Railway or U.S. Interstate avenue through watershed area	5
U.S. highway avenues through watershed area	4
State highway or other paved avenues through watershed area	3
Unimproved avenues (dirt roads) through watershed area	2
No transportation avenues through watershed area	1

Table 7

Ranges and Ratings for Industrial Impact

Industrial Impact	
Range	**Rating**
Industry has a very large discharge or very heavy impact on surroundings	8
Industry has a large discharge or heavy impact on surroundings	6
Industry has a moderate discharge or moderate impact on surroundings	4
Industry has minimal discharge and minimal impact on surroundings	2
No Industry in watershed	1

Table 8

Ranges and Ratings for Vegetative Cover

Range	Rating
0 - 5 % Ground Cover	5
6 - 19 % Ground Cover	4
20 - 34 % Ground Cover	3
35 - 50 % Ground Cover	2
> 50 % Ground Cover	1

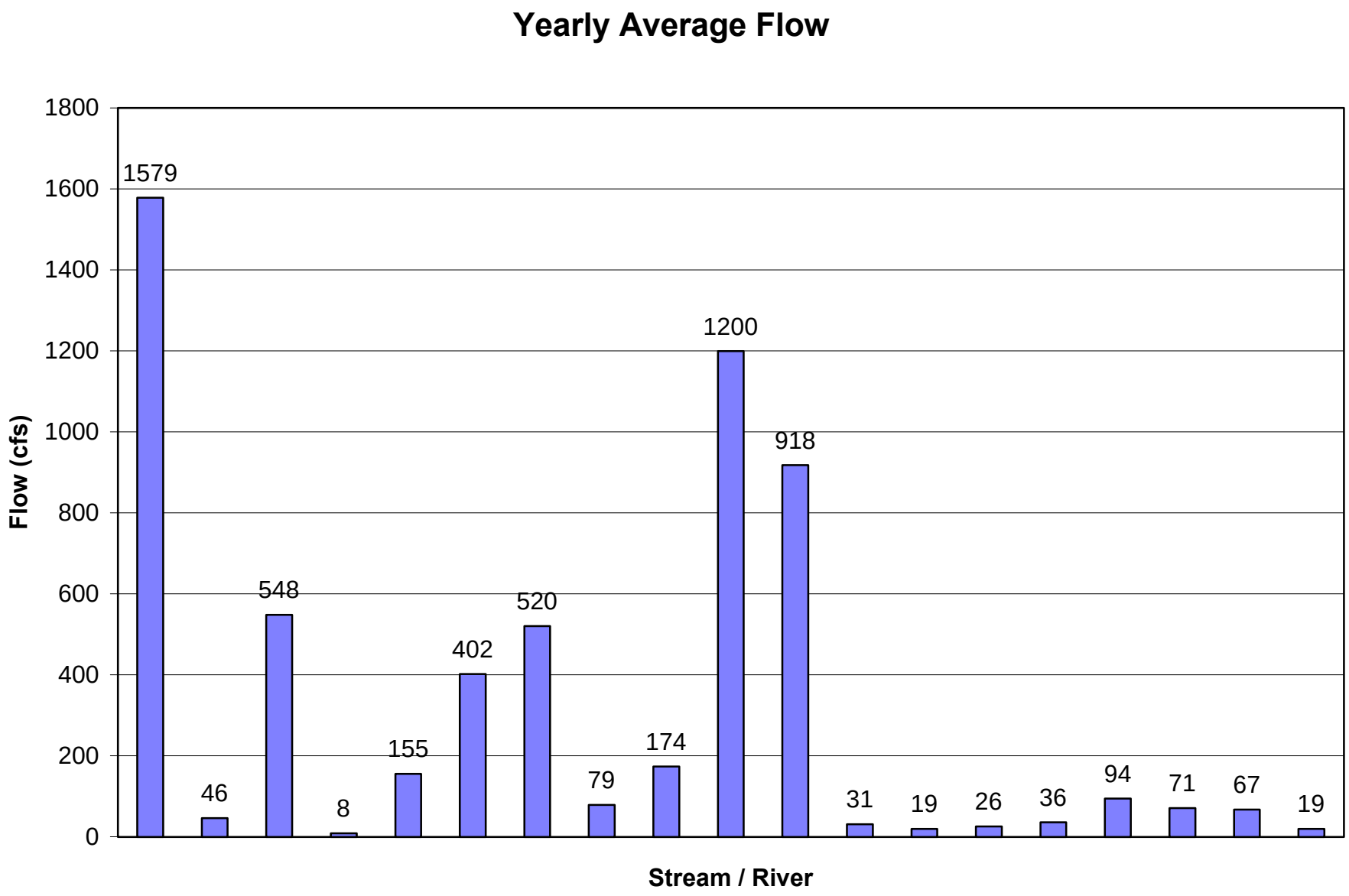
WRASTIC Program Input Parameter Worksheet

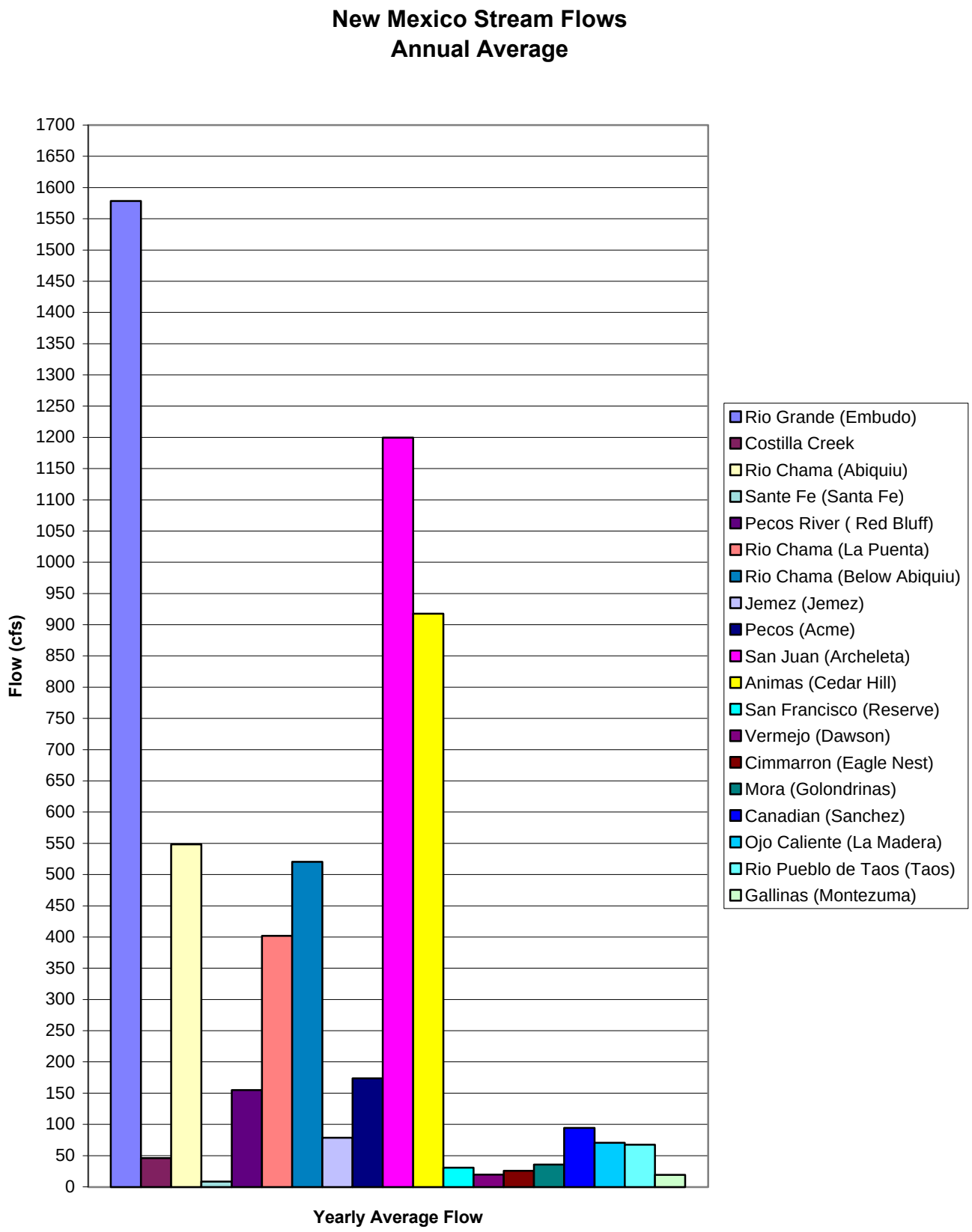
DATE:_____

PARAMETER	BASE VALUE / DESCRIPTION	WRASTIC RATING	SOURCE(S)
Public Water System Name		**N/A**	Field Office - NMED
Public Water System ID Number (WSS#)		**N/A**	Field Office - NMED
Wastewater Presence			NMED - Surface Water Quality Bureau, Ground Water Protection & Remediation Bureau, U.S. Geological Survey Topographic Maps
Recreational Impact			U.S. Forest & Park Services
Agricultural Impact			U.S. Forest & Park Services, Visual Survey
Size of Watershed Units = miles^2			U.S. Soil Conservation Service - Bureau of Land Management
Transportation Avenues			New Mexico Highway Dept.
Industrial Impact			Visual Survey
Vegetative Ground Cover Units = %			U.S. Forest & Park Services, Visual Survey

Appendix F

New Mexico Lake and River Size Determination


Yearly Average Flow
Flow (cfs)
1800
1600
1400
1200
1000
800
600
400
200
0
1579
46
548
8
155
402
520
79
174
1200
918
31
19
26
36
94
71
67
19
Stream / River


New Mexico Stream Flows
Annual Average
Flow (cfs)
1700
1650
1600
1550
1500
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Yearly Average Flow
Rio Grande (Embudo)
Costilla Creek
Rio Chama (Abiquiu)
Sante Fe (Santa Fe)
Pecos River (Red Bluff)
Rio Chama (La Puenta)
Rio Chama (Below Abiquiu)
Jemez (Jemez)
Pecos (Acme)
San Juan (Archeleta)
Animas (Cedar Hill)
San Francisco (Reserve)
Vermejo (Dawson)
Cimmarron (Eagle Nest)
Mora (Golondrinas)
Canadian (Sanchez)
Ojo Caliente (La Madera)
Rio Pueblo de Taos (Taos)
Gallinas (Montezuma)

Average Monthly Flows (cfs) for New Mexico Streams and Rivers

Stream / River	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Yearly Average
Rio Grande (Embudo)	782	1016	971	825	957	1427	2400	3774	3382	1620	943	845	1579
Costilla Creek	16	12	9	8	9	18	51	121	118	85	69	34	46
Rio Chama (Abiquiu)	287	319	327	195	256	438	920	1206	1100	657	469	406	548
Sante Fe (Santa Fe)	5	3	3	2	3	5	13	24	18	9	8	7	8
Pecos River (Red Bluff)	277	149	126	114	98	70	58	223	184	114	159	289	155
Rio Chama (La Puenta)	93	85	60	55	70	184	852	1832	785	136	352	320	402
Rio Chama (Below Abiquiu)	202	194	310	166	197	356	969	1820	959	406	368	297	520
Jemez (Jemez)	36	38	29	28	36	88	271	241	69	33	42	34	79
Pecos (Acme)	149	54	26	26	29	164	212	286	313	320	201	303	174
San Juan (Archeleta)	886	924	1048	1100	1104	1181	1453	1730	1784	1288	974	923	1200
Animas (Cedar Hill)	464	340	267	244	260	423	1085	2515	3018	1263	612	520	918
San Francisco (Reserve)	21	24	31	35	39	27	20	16	17	47	66	26	31
Vermejo (Dawson)	8	7	6	5	6	7	21	50	36	30	40	17	19
Cimmarron (Eagle Nest)	23	6	2	1	1	6	28	74	43	69	41	13	26
Mora (Golondrinas)	22	15	12	12	11	13	45	93	76	40	56	35	36
Canadian (Sanchez)	91	84	75	75	66	38	25	53	24	220	224	157	94
Ojo Caliente (La Madera)	14	17	17	18	23	59	287	325	53	10	14	10	71
Rio Pueblo de Taos (Taos)	27	33	34	33	39	49	117	257	140	31	25	23	67
Gallinas (Montezuma)	12	9	6	5	5	12	35	54	22	17	31	21	19

Reference USGS Water
Historical Data NM

Appendix G

SWAPP Timeline

NEW MEXICO SOURCE WATER ASSESSMENT & PROTECTION TIMELINE

	1999				2000				2001				2002				2003			
TASK	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Develop Policies and Train staff	>>>>>>>	>>>>>>>	>>>>>>>	>>>>>>>	>>>>>>>															
Public Participation/ Advisory committee	>>>>>>>	>>>>>>>	>>>>>>>	>>>>>>>				Nov-00				Nov-01				Nov-02				Nov-03
Submittal of SWAPP	Feb-99																			
Implementation of SWAPP/SWP Internet Site						May-00														
SWAPP Progress Report, WHP Biannial Report			Oct-99								Oct-01								Oct-03	
Epa Approval of SWAPP				Nov-99																
Internal Progress Reports			Jul-99		Jan-00		Jul-00		Jan-01		Jul-01		Jan-02		Jul-02		Jan-03		Jul-03	
Completion of SWA's on all community PWS												Dec-01								
SWAPP Progress Report, WHP bianniel Report												Oct-01								
Completion of SWAs on all PWs in NM																		May-03		
Final Assessment Report to EPA																			Sep-03	

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