CHAPTER THREE SURFACE WATER QUALITY ASSESSMENT

WATER QUALITY IN ASSESSED SURFACE WATERS

Methodology

Information about surface water quality throughout New Mexico is largely based on the results of the New Mexico Environment Department's (NMED) intensive surveys, project-by-project monitoring of selected nonpoint source control efforts, preliminary results of a statewide ultra-clean study to determine low-level mercury contamination in stream waters and sediments, and the development of Total Maximum Daily Loads (TMDL's). Water quality information is also obtained from data collected by NMED staff during inspections of wastewater treatment facilities, review of Discharge Monitoring Reports submitted by individual wastewater dischargers, the State's voluntary monitoring project "Watching Our Waters," and a review of physical, chemical and biological data entered by all agencies into STORET, the United States Environmental Protection Agency's computerized database. Additional water quality information was included from results of historical water quality surveys, investigations resulting from information provided by concerned citizens, and fisheries data where available .

Assessment Strategy: Assessed waters are those waterbodies for which the State can determine levels of support for designated uses established in the State's assessment protocol as well as for the goals of the federal Clean Water Act (CWA). Designations are established by the New Mexico Water Quality Control Commission (WQCC) for most perennial surface waters in New Mexico. These include fisheries, recreational and domestic uses, municipal and industrial water supplies, irrigation and livestock watering and wildlife habitat. Numeric and narrative water quality standards are established by the WQCC to protect designated, existing and attainable uses. These standards are consistent with the CWA goals which provide for the protection and propagation of fish, shellfish and wildlife, as well as providing for recreation in and on the waters.

The categories of assessment are 'monitored' and 'evaluated':

- 'Monitored waters' are those waterbodies for which current (1993-1997), site-specific physical/chemical water quality data are sufficient to make a use support decision. These data are compared to numeric and narrative criteria in the State's water quality standards. Where available, biological data are also used to determine whether designated uses are supported;
- 'Evaluated waters' are those waterbodies where insufficient current data exist to consider the waterbody 'monitored,' but where other information permits an evaluation of the use support status. New Mexico's evaluated assessments are based on data older than five years, data not fully meeting Quality Assurance/ Quality Control standards, citizens' monitoring or reports of impairment, or on professional evaluations by NMED or water resource professionals from other state or federal agencies.

Levels of support for designated uses are determined for individual waterbodies as follows:

- Fully supporting: all uses are fully supported;
- Fully supporting, impacts observed: all uses are fully supported; however, it is reasonably expected to exceed water quality criteria before the next two-year list submission deadline;
- Partially supporting: one or more uses are adversely affected, but not precluded, by pollution and the remaining uses are fully supported; and
- Not supporting: one or more uses are at least temporarily precluded by man-made or man-induced pollution.

The State's assessment protocol of monitored waters depends primarily on ambient physical/chemical, biological, and other types of available data. It also uses fish tissue data from a study begun in 1991. Data from biological surveys and biomonitoring tests are becoming available and are incorporated into the State's assessment protocol where available.

Criteria used for determining designated and overall use support are summarized in Table 2. These criteria are largely comparable to those recommended by EPA in guidelines **(2)** for this document but have been modified to meet the special needs and circumstances of New Mexico.

For this report, New Mexico has chosen to designate uses as 'partially supported' when waters show exceedances of chronic criteria for toxicants unless exceedances of other criteria indicate that impairment is serious enough to warrant the designation of 'not supported.' In waters where more than one toxicant exceeds acute criteria at significant levels, we have stated that a use is 'not supported.'

Water quality criteria necessary to protect aquatic biota from toxic pollutants which have been adopted in New Mexico's water quality standards are listed in Table 3. As part of the 1991 triennial review of stream standards, New Mexico adopted these chronic and acute numeric water quality standards. In addition, numeric criteria for toxicants for the uses of irrigation, domestic water supply, livestock watering and wildlife habitat were developed. The majority of these standards are for the dissolved fraction of the metals, and are largely based on criteria in EPA's Quality Criteria for Water 1986 **(3)** or on updates to this document.

New Mexico's chronic standards are applied to the arithmetic mean of four samples collected on four consecutive days. Significant data do not yet exist to evaluate chronic toxicity based on the four-day average of total or dissolved

Table 2. Criteria for Determination of Designated and Aquatic Life Use Support.

Assessment Basis	Assessment Description	Support of Designated Uses[a]: Fully Supporting	Fully Supporting, Impacts Observed	Partially Supporting	Not Supporting
Evaluated	Available data more than 5 but less than 10 years old OR if no site specific data, assessment based on land use, location of sources and on-site professional evaluation.	Available historical data indicate criteria are met AND no point or nonpoint sources are known to be present which could interfere with the uses.		Available historical data indicate criteria are violated OR sources are present which affect uses OR no known sources exist but water quality complaints are on record OR evaluation by professional indicates use impairments.	Available historical data indicate criteria often or significantly violated OR the multitude or magnitude of sources indicate uses are not supported. Documented non-compliance of narrative surface water standards. Waters with fishing, swimming or drinking water advisories in effect.
Monitored (Biological)	Available data no more than 5 years old. Site visited by qualified biologist. Recognized bioassessment protocols used. Benthic macroinvertebrate taxonomic identifications made to at least the family level using protocol comparable to EPA's "*Rapid Bioassessment Protocols for Use in Streams and Rivers*."	No evidence of modification to indigenous or established community. Comparable to best situation expected within ecosystem (watershed reference site). Balanced trophic structure. Optimum community structure (composition & dominance) for stream size and habitat quality.	Community structure less than expected. Composition (species richness) lower than expected due to loss of some intolerant forms. Percent contribution of tolerant forms increases.	Some modification of community noted OR biomonitoring demonstrates behavioral modification or decreased fecundity. Fewer species due to loss of most intolerant forms. Reduction in EPT index[b].	Use clearly not supported, definite modification of community noted. Biomonitoring demonstrates significant lethality. Few species noted. If high densities of organisms, then dominated by one or two taxa.
Monitored (Chemical /Physical)	Available data no more than 5 years old. Fixed-station sampling, intensive surveys, or rigorous reconnaissance surveys. Chemical analysis of water, sediment or biota.	For chemical/physical parameters[c], criteria exceeded in $\leq$ 7% of measurements within a 5-year period. If criteria are exceeded in 7 to 15% of the measurements within a 5-year period, the water body is listed as *Fully Supporting, Impacts Observed.*	For chemical/physical parameters[c], criteria exceeded in $\geq$ 7% but $\leq$ 15% of the measurements within a 5-year period.	Within a 5-year period, criterion for any parameter[c] is exceeded in a 15-25% range of measurements OR one toxic pollutant exceeds EPA acute criteria by $\geq$ 1.5 times but $\leq$ 2 times the acute standard.	Criteria for the grouped parameters[c] exceeded in $\geq$ 25% of measurements within a 5-year period. Criteria for any two or more toxic pollutants exceed ($\geq$ 2 times) the EPA's acute water quality standard.
Monitored (CWA § 307(a)[d] Toxics including ammonia and cholorine)	Available data no more than 5 years old. Fixed-station sampling, intensive surveys, or reconnaissance surveys. Only acute values currently used for toxicology determinations.	No measured toxic pollutants[d] exceed EPA acute criteria. For any toxic parameter, one exceedance $\geq$ 1.5 times thechronicstandard within a 5-year period constitutes listing the waterbody as *Fully Supporting ,Impacts Observed.*	For any one parameter[d], one exceedance of the acute or chronic criteria or chronic screening level within a 5-year period.	For any one parameter[d], more than one exceedence of the acute or chronic criteria or chronic screening level within a 5-year period and in < 25% of samples.	For any one parameter[d], more than one exceedence greater than the acute or chronic criteria within a 5-year or 3-year period respectively and in $\geq$ 25% of the samples.
Monitored (Using Stream Morphology[e])	Available data no more than 5 years old. Recognized stream morphology protocols used.	Data indicate only slight modification of stream morphology using a quantifiable tool. Stream is stable.	Data shows moderate alterations which are localized and do not show impacts outside of a reasonable recovery area.	Modification to stream morphology significant and with broad scale. Quantifiable assessments of stream morphology show vertical and/or horizontal instability.	Stream morphology severely altered. Severe bank failure and/or hydrological changes. Accelerated upland erosion.

a *Fully Supporting* = All designated uses fully supported; *Fully Supported, Impacts Observed* = All designated uses fully supported but is reasonably expected to exceed criteria for at least one designated use in the next two-year reporting period; *Partially Supporting* = One or more designated uses partially supported and all other designated uses fully supported; and *Not Supported* = One or more designated uses not supported.

b EPT index is the total number of distinct taxa within the orders *Ephemeroptera , Plecoptera,* and *Trichoptera.* This value summarizes taxa richness within the insect orders that are generally considered to be sensitive to pollution.

c Conventional pollutants to be grouped for the determination of aquatic life use support are temperature, turbidity, pH, dissolved oxygen and total phosphorus.

d Refers to priority pollutants identified in CWA § 307(a). Toxicants include metals, pesticides, organics, ammonia, cyanide and chlorine (See Table 3, page). Currently, insufficient data are collected to use chronic toxicity values to determine use support decisions based on New Mexico Water Quality Standards.

e These assessments will be made using assessment tools currently being developed by the Nonpoint Source Pollution Section of the Surface Water Quality Bureau in the New Mexico Environment Department. Further modifications to this table will be necessary as the tool is modified and tested.

Table 3. New Mexico Fishery Use Protection Numeric Water Quality Standards For Toxicants

Chronic Criteria [a]		
Dissolved aluminum	87.0	ug/l
Dissolved beryllium	5.3	ug/l
Total mercury	0.012	ug/l
Total recoverable selenium	2.0	ug/l
Cyanide, amenable to chlorination	5.2	ug/l
Total chlordane	0.0043	ug/l
Dissolved cadmium[c]	e(0.7852[ln(hardness)]-3.49)	ug/l
Dissolved chromium[d]	e(0.819[ln(hardness)]+1.561)	ug/l
Dissolved copper	e(0.8545[ln(hardness)]-1.465)	ug/l
Dissolved lead	e(1.273[ln(hardness)]-4.705)	ug/l
Dissolved nickel	e(0.846[ln(hardness)]+1.1645)	ug/l
Dissolved zinc	e(0.8473[ln(hardness)]+0.7614)	ug/l
Total chlorine residual	11	ug/l
Acute Criteria [b]		
Dissolved aluminum	750	ug/l
Dissolved beryllium	130	ug/l
Total mercury	2.4	ug/l
Total recoverable selenium	20.0	ug/l
Dissolved silver	e(1.72[ln(hardness)]-6.52)	ug/l
Cyanide, amenable to chlorination	22.0	ug/l
Total chlordane	2.4	ug/l
Dissolved cadmium [c]	e(1.128[ln(hardness)]-3.828)	ug/l
Dissolved chromium [d]	e(0.819[ln(hardness)]+3.688)	ug/l
Dissolved copper	e(0.9422[ln(hardness)]-1.464)	ug/l
Dissolved lead	e(1.273[ln(hardness)]-1.46)	ug/l
Dissolved nickel	e(0.8460[ln(hardness)] +3.3612)	ug/l
Dissolved zinc	e(0.8473[ln(hardness)]+0.8604)	ug/l
Total chlorine residual	19	ug/l

[a] The chronic criteria shall be applied to the arithmetic mean of four samples collected on each of four consecutive days. Chronic criteria shall not be exceeded more than once every three years.

[b] The acute criteria shall be applied to any single grab sample. Acute criteria shall not be exceeded.

[c] For numeric standards dependent on hardness, hardness (as mg $CaCO_3$/L) shall be determined as needed from available verifiable data sources including, but not limited to, the United States Environmental Protection Agency's STORET water quality database. The hardness-dependant formulæ for metals are only valid for hardness values of 0-400 mg/L. For for values above 400 mg/L, 400 will be used.

[d] The criteria for chromium shall be applied to an analysis which measures both the trivalent and hexavalent ions.

metals. Therefore, many of New Mexico's evaluations were based on grab samples for total or dissolved metals. Grab samples are single water samples taken on a single day, therefore these results are appropriately compared with acute water quality standards. As data are collected during new surveys, samples will be collected for metals on four consecutive days. All future changes to the listings for chronic standards violations should be based on four-day averages. Until adequate data exists for evaluating use support based on four-day averages, the number of miles of impairment due to chronic violations should be assumed to be artificially high. Significant data for such studies is currently being collected.

It should be noted that many of New Mexico's streams and lakes have not been sampled by any agency within the last five water years (October 1993 - September 1998). Data limitations reported in the State's last reports to the United States Congress still exist **(4, 5, 6)**.

During the current Clean Water Act §305(b) reporting cycle, 11 special 3-season intensive water quality surveys were completed. These special surveys are listed in Table 14, Chapter 8 on page 132.

Also during the current biennial reporting period (1996-1998), geographic and water quality assessment data for the majority of New Mexico's perennial rivers and streams have been entered into the latest application (version WBS98) of EPA's Water Body System (WBS) database. The WBS allows for more detailed reporting of the overall health of a waterbody, the number of miles affected by various pollutants, and the extent of designated use support. The information in the database was used to provide many of the tabulations in this report. Because of more detailed tracking, the miles of streams with impaired uses may vary from previous reports.

Stream Water Quality

Table 16 of Appendix B summarizes, on a segment-by-segment basis, those rivers and streams with designated uses which are either fully supported-impacts observed, only partially supported or which are not supported due to man-made or man-induced point or nonpoint source pollution. In the case of several waters not currently assigned designated uses in the State's water quality standards, attainable uses which are impaired are identified. Table 16 of Appendix B also identifies the impaired reach of the stream or river and the probable causes and sources of use nonattainment. Table 18 of Appendix B identifies the codes for sources of nonsupport.

Approximately 2,936 assessed river miles have impaired designated or attainable uses and 496 miles out of a total of 5,948 State-recognized perennial river miles are threatened with impairment. Many of the identified reaches have more than a single threatened or impaired use. Use impairment is frequently due to several causal agents from several sources. One hundred and eighty streams and 164 impaired reaches of these streams are distributed among 43 of the 56 segments described in the State's water quality standards. Stream reaches with impaired uses have been identified in all of New Mexico's water quality basins. This compares with the 3,573.15 impaired river miles in 154 rivers or streams composed of 195 reaches in the last report to Congress.

Aquatic Life Use Support in the State's Streams

Table 4 summarizes the aquatic life level of use support in those streams which have been assessed. Almost 1,567 stream miles were found to have been adversely affected to the extent that designated or attainable uses were only partially supported. Twenty-four streams with approximately 867.9 stream miles were found to be affected to the extent that designated uses were not supported.

Almost 951 miles of New Mexico's waters have been assessed and determined to fully support all designated uses. The majority of these waters are in wilderness areas or in watersheds protected from anthropogenic impacts. As evaluation of water quality continues, additional waters may be identified which fully support designated uses; these will be tabulated in future reports.

Individual Use Support in the State's Streams

Table 5 is a summary of individual designated use support. The Clean Water Act goal of "fishable" is now reported under the fish consumption and aquatic life support uses, and the "swimmable" goal is reported under the swimmable and secondary contact uses. EPA developed this method through a consensus approach to reduce inconsistencies in states' reports. Table 5 was generated by using the WBS database.

Overall, 12 of the State's 15 designated uses have been impaired by point or nonpoint sources of pollutants. All subcategories of both the coldwater and warmwater fishery uses, as well as the irrigation and irrigation storage, primary and secondary contact , domestic water supply, fish culture, and livestock watering and wildlife habitat uses have been impaired.

The majority of assessed river miles at least partially meet the fish consumption and aquatic life support goal of the Clean Water Act; a little over 93 miles only partially meet the fishable goal.

Approximately 951.4 miles of stream reaches were removed from impaired status to *fully supporting* designated uses. In addition, approximately 230 miles of stream reaches were changed from *partially supporting* designated uses to *fully supporting, impacts observed* status. The changes in status were largely the

Table 4. Aquatic Life Use Support in Assessed Streams (Size unit in miles)

	Assessment Basis		
Degree of Use Support	**Evaluated**	**Monitored**	**Total Assessed**
Fully Supporting	670.6	280.8	951.4
Fully Supporting, Impacts Observed	228.0	268.0	496.0
Partially Supporting	867.0	700.05	1,567.05
Not Supporting	405.8	462.1	867.9
Not Attainable	0.0	0.0	0.0
Total Size Assessed	**2,171.4**	**1,710.95**	**3,882.35**

Table 5. Individual Use Support Summary for New Mexico Streams

(Size unit in miles)

Use	Fully Supporting	Fully Supporting Impacts Observed	Partially Supporting	Not Supporting	Not Attainable	Not Assessed
OVERALL USE SUPPORT	951.4	496.0	1,567.05	867.9	0.0	1,518.6
FISH CONSUMPTION	0.0	0.0	93.4	0.0	0.0	0.0
AQUATIC LIFE SUPPORT	751.5	376.9	1,304.0	1,562.8	0.0	1,018.3
SWIMMABLE	4,087.6	15.3	16.0	15.0	0.0	1,501.1
High Quality Cold Fishery	268.9	225.4	557.35	428.9	0.0	1,033.8
Coldwater Fishery	59.3	46.0	331.9	162.6	0.0	146.5
Marginal Coldwater Fishery	7.7	49.7	313.0	245.6	0.0	131.5
Warmwater Fishery	42.9	18.6	340.0	185.7	0.0	200.6
Limited Warmwater Fishery	10.0	190.6	284.2	38.6	0.0	207.0
Primary Contact	294.1	0.0	4.7	53.6	0.0	93.4
Secondary Contact	3,612.9	0.0	42.3	5.7	0.0	1,406.0
Domestic Water Supply	1,370.1	0.0	4.6	26.4	0.0	1,017.0
Fish Culture	1,128.0	0.0	4.6	0.0	0.0	752.4
Irrigation	3,379.6	87.2	123.7	129.5	0.0	1,811.8
Livestock Watering	4,822.0	26.9	30.5	60.4	0.0	1,016.0
Wildlife Habitat	111.3	0.0	4.6	0.0	0.0	54.8

result of best management practices that led to water quality improvement. These management practices primarily consisted of improvements to recreational areas, road closures, or road obliterations at timber harvest sites, grazing management changes, and drainage improvements or paving of forest roads.

Lake Water Quality

The State has identified 170 publicly owned, freshwater lakes totaling 135,410 acres. These waterbodies consist of large mainstem reservoirs, mountain cirque lakes and small fishing impoundments ranging in size from less than one acre to a 40,000-acre reservoir (Elephant Butte at maximum storage pool). Regardless of size, all lakes are used extensively in water-scarce New Mexico. Even the smaller lakes provide drinking water for livestock watering and habitat for wildlife, are used by migratory waterfowl or provide important recreational opportunities for boating, swimming, fishing and aesthetic pleasure in municipal, rural, and wilderness settings (Appendix B, Table 22).

Although all publicly owned waterbodies are considered important, NMED has prioritized lakes and reservoirs over twenty acres as 'significant,' due to their many uses. In addition, publicly owned high mountain cirque lakes, regardless of size, are also considered 'significant' since they serve as sensitive indicators of potential acidic precipitation as well as nonpoint sources of pollution.

Attainment of Designated Uses and Clean Water Act Goals

Assessed lakes, playas and reservoirs cover approximately 124,255 acres, or about 92%, of the estimated 135,410 publicly-owned lake acres. The State water quality standards apply to lakes and reservoirs as well as to streams. During 1996-1998, NMED conducted lake monitoring to collect and update data for fifteen playas. Where available, data collected during the past five years (1993-1998), were used to determine use attainment in lakes and reservoirs determined to be 'significant' in New Mexico; this number includes a few additional lakes smaller than twenty acres where fish kills or pollutants have threatened designated use attainment. The remainder of the 'significant' lakes were evaluated based on historical data or best professional judgement. Monitoring data were used to assess 47,241 lake acres (thirty percent of assessed lake acres) while 107,545 acres (seventy percent) were evaluated.

Table 20 of Appendix B summarizes the State's assessment of the 'significant' lakes with less than full support for designated or attainable uses. The table also identifies lakes whose status of support is unknown due to paucity or age of data. This table identifies:

- thirty-five lakes and playas which currently fully support designated uses but whose uses are threatened if current trends continue;
- thirty-one lakes and playas which partially support designated uses;
- nine lakes and playas where use support is unknown due to the paucity of recent monitoring data or other information which would permit an updated evaluation; and
- seven lakes and playas in which at least one designated use is not supported.

A total of 124,140 lake and playa acres do not fully support designated uses; this is a slight decrease in the number of lake acres identified as impaired in 1994 **(5)**.

Table 6 summarizes the overall level of use support in assessed lakes. Almost all impaired lake acreage falls under the categories of partially supported or fully supported/impacts observed . Based on recent water quality data and/or observation of persistent conditions, 1,960 lake and playas acres are assessed as not supporting one or more designated use. Causes of nonsupport include nutrients, siltation, reduction of riparian vegetation, and bank destabilization resulting primarily from agriculture and recreation.

Table 7 summarizes the status of support for designated uses and for the so-called fishable/swimmable goals of the federal Clean Water Act. The uses listed in this table are a combination of uses which EPA has requested the states use to report CWA goal attainment and the state's designated uses identified in its water quality standards.

The fishable goal of the CWA is defined as protection and propagation of fish, shellfish, and wildlife. Support for this use is reported under the fish consumption and aquatic life support uses in Table 7. Lake acreage where fish tissue sampling has been conducted was used to assess the degree of support for fish consumption. Most of the assessed lake acres only partially support the fish consumption use due to the levels of mercury in fish tissue; this issue is discussed below under ***Public Health/Aquatic Life Impacts***. The aquatic life use assessment is based on the fishery uses assessment contained in Table 20 of Appendix B. Since all classified lakes, playas and reservoirs in the State are designated for one or more fishery uses, the total lake acres in the Aquatic Life/Fish Consumption category are equal to the total classified lake acreage. All classified lake and playa acreages are also designated for wildlife habitat and livestock watering uses. Because lake data have not yet been included in the WBS98 database, total lake acres for the other uses listed in Table 7 cannot be identified at this time.

The swimmable goal is defined as providing for recreation in and on the water. Support for this goal is reported under the primary and secondary contact uses. Support for the swimmable use is based on swimming area closures. No closures have been issued at the state level and NMED does not have records of any local closures.

Support assessment for all of the

Table 6. Aquatic Life Use Support in Assessed Lakes (Size units in acres)

Degree of Use Support	Assessment Basis: Evaluated		Assessment Basis: Monitored		Total Assessed
Size fully supporting	85	(2%)	4,573	(98%)	4,658
Size fully supporting, impacts observed	11,666	(45%)	14,086	(55%)	25,752
Size partially supporting	95,593	(78%)	26,587	(22%)	122,180
Size not supporting	5	(<1%)	1,955	(>99%)	1,960
Unknown	196	(83%)	40	(17%)	236
TOTAL	**107,545**	**(70%)**	**47,241**	**(30%)**	**154,786**

Table 7. Individual Use Support in New Mexico Lakes

(Size units in acres)

Use	Assessed						Nonassessed
	Supporting	Supporting But Threatened	Partially Supporting	Not Supporting	Not Attainable	Unknown	Unknown
Clean Water Act Goals							
Fish Consumption	-	410	109,499	-	-	-	-
Aquatic Life Support	674	13,019	111,116	18	0	142	7,366
Swimming	-	-	-	-	-	-	-
Secondary Contact Recreation	-	201	127	13	0	0	-
Drinking Water Supply	-	-	-	-	-	-	-
Agriculture	-	0	0	0	0	0	-
New Mexico Designated Uses							
High quality coldwater fishery	-	4,568	6,064	5	-	40	-
Coldwater fishery	-	7,535	19,970	13	0	0	-
Marginal coldwater fishery	-	740	0	0	0	20	-
Warmwater fishery	-	8,150	101,332	0	0	196	-
Limited warmwater fishery	-	0	0	0	0	0	-
Primary contact recreation	-	0	0	0	0	0	-
Secondary contact recreation	-	301	137	13	0	0	-
Domestic water supply	-	0	0	0	0	0	-
Fish culture	-	0	0	0	0	0	-
Livestock watering	-	12,863	12,110	1,942	0	0	-
Wildlife Habitat	-	12,863	12,110	1,942	0	0	-
Irrigation	-	130	0	0	0	0	-

State's designated uses are based on Table 20 of Appendix B. Impaired lake acreage is due solely to nonpoint sources of pollution. Table 7 shows that six designated uses in New Mexico's lakes have been adversely affected by these sources. All three subcategories of coldwater fisheries and one of the two subcategories of warmwater fisheries are partially impaired or threatened. Rooted macrophytes, algal growth and turbidity have adversely affected secondary contact recreation, and irrigation storage has been impaired by siltation.

Trophic Status

Trophic state is established as part of lake water quality monitoring efforts. Although trophic state is not used in New Mexico in use attainment determination, it is an important tool which helps relate the relative condition of a lake to its designated use support, and also leads to a better understanding of what probable cause or causes may be contributing to water quality problems within a lake.

Trophic states were evaluated using the Carlson trophic state indices (TSIs). The lakes were categorized using a continuum from oligotrophy to eutrophy. The univariate Carlson index used to assess trophic state is based on Secchi disk depth, chlorophyll *a* and total phosphorus concentrations. It is an absolute index whereby a ten-unit increase on a scale of zero to 100 corresponds to a doubling in epilimnetic algal biomass. Thus, small differences in data values result in a larger change in TSI for lake trophic evaluation. Each of the Carlson TSI values for a given lake has been separately evaluated with preferential consideration given to chlorophyll concentrations. Trophic state boundaries are consistent with the EPA index: i.e., trophic state values exceeding 47 indicate a eutrophic lake and values less than 42 indicate oligotrophic lakes **(6, 7)**. These trophic state indices were evaluated for their applicability in comparisons between the various playa lakes under investigation throughout New Mexico. The investigators concluded that these indices have little to no applicability or usefulness in comparisons between hypersaline lakes. Furthermore, since these trophic state indices were developed using data from temperate freshwater lakes, their applicability in most playa lake environments may be limited.

Classification systems simplify the dynamic concept of trophic state. Among the assumptions of the classification indices are that algae are the most important primary producers and nutrient loading is responsible for the productivity within the lake **(7, 8)**. The Carlson index is of limited applicability for lakes with significant non-algal turbidity or nitrogen limitation, where aquatic macrophytes are the dominant primary producers, or where zooplankton grazing controls algal abundance. The biological data and total nitrogen/total phosphorus ratios for each lake are also used to help evaluate the utility of the trophic index for classifying lakes in New Mexico.

The total number of evaluated lakes in each trophic class is:

Eutrophic	33
Oligomesotrophic	8
Mesoeutrophic	7
Oligotrophic	0
Mesotrophic	12
Dystrophic	1

Trophic state for evaluated lakes and general morphometric data for most of the publicly owned lakes in New Mexico are summarized in Table 20, Appendix B.

Lake Acidification

No lakes in New Mexico are known to consistently have pH values less than 5.0 standard units; therefore, there is no current need to develop methods to neutralize or restore buffering capacity. Lakes most likely to be susceptible to acid precipitation are characterized by alkalinities less than 100-200 eq/L (less than 5-10 mg $CaCO_3$/L), have small watersheds, and are located on granitic bedrock at high elevations. Data from 14 such publicly-owned lakes were collected by Lynch *et al*. **(9)**. Results of this study indicated that, based on the characteristics listed above, the Truchas Lakes and Santa Fe Lake are potentially the most susceptible of those reviewed to acidification due to low buffering capacity. Further data for these and other alpine lakes are needed to establish acidification trends in any high-elevation lake in New Mexico.

The high-elevation cirque lakes in New Mexico are all contained within National Forests boundaries. The United States Forest Service (USFS) has developed a monitoring plan to perform tracer studies to identify the sources of possible acid precipitation falling in the State's major high-mountain areas.

Control Methods

Programs and measures to control potential pollution sources to New Mexico's lakes include the federal National Pollutant Discharge Elimination System (NPDES) program for point source discharges and the State certification process for permits issued under this program; State certification of federal dredge-and-fill permits; discharge plans required under the State ground water regulations; State review of federal actions under the consistency provisions of the federal Clean Water Act; and agreements between NMED and other State and federal agencies to implement nonpoint source pollution control measures.

CAUSES AND SOURCES OF WATER QUALITY IMPAIRMENT

Streams

Table 8 presents an analysis of those causal agents which have seriously affected the State's streams. A cause was judged to make a major impact if it was the predominant reason for use impairment. A moderate/minor impact is one where multiple causes are responsible for impairment but none predominate. Heavy metal contamination, stream bottom deposits, temperature, total phosphorus and turbidity are the major causes of impairment of designated or attainable uses.

Point source discharges now play a quantitatively minor role in the impairment of the State's streams (Figure 4). Over 91% of all water quality impairment identified in New Mexico's streams is due to nonpoint sources of water pollution.

While poorly operated or maintained treatment plants may have severe adverse localized effects on water quality, the available data indicate the State, working with EPA and permitees, has been largely successful in reducing point source impacts on the State's surface waters.

Approximately 288 stream miles are impaired largely due to discharges from wastewater treatment plants (Table 9). The majority of the remaining stream miles are impaired by nonpoint sources of pollution. Figure 5 identifies the major nonpoint sources of impairment in the State's streams. The chart shows that water quality impairment due to agriculture and range land grazing affects about 27% of the State's streams. Although no 'hard' data exists, wildlife grazing may also contribute to localized water quality problems.

Hydromodification impairments affecting over 43% of New Mexico streams occur from dam reconstruction activities, stream channelization, or flow diversion for irrigation.

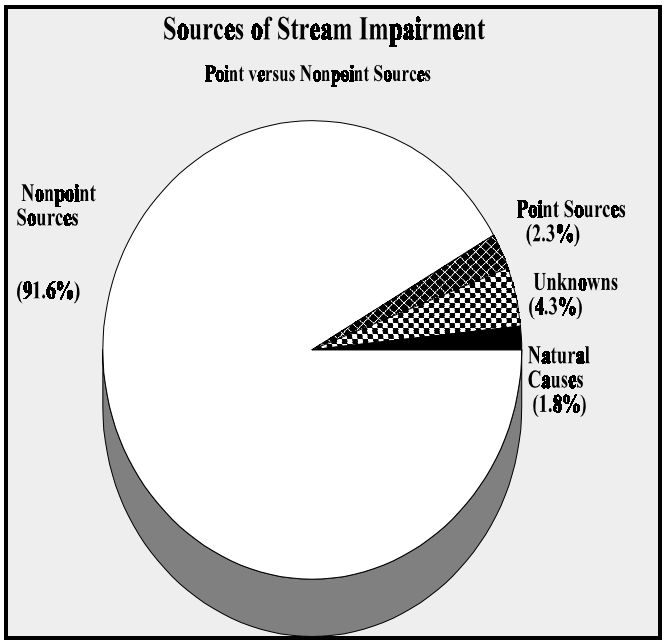

Figure 4. Sources of Impairment to New Mexico's Streams.

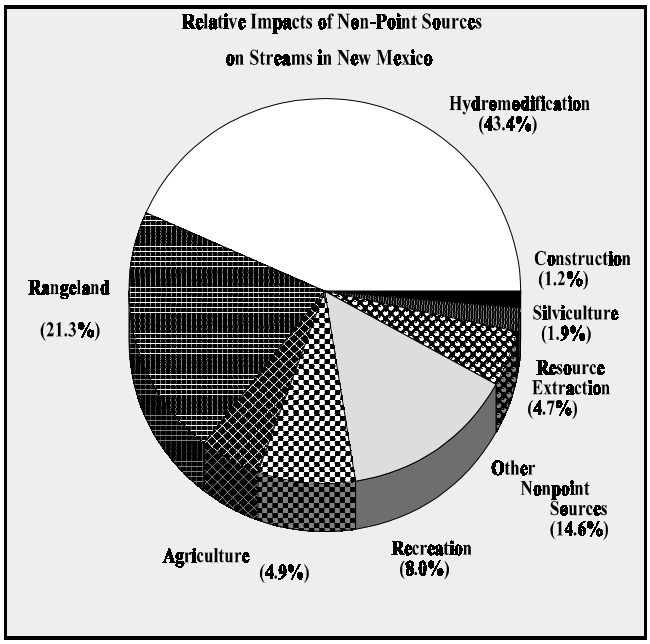

Figure 5. Major Nonpoint Sources of Pollution in New Mexico's Streams.

Lakes

Table 10 presents an analysis of the causal agents adversely affecting the State's lakes. Heavy metals, siltation, nutrients and habitat destruction are the major casual agents of use impairment. Agriculture and recreation are the predominant sources of lake water quality impairment (Table 11). Point sources are not a factor in attainment of designated uses in the State's lakes.

PUBLIC HEALTH/AQUATIC LIFE IMPACTS

Measures evaluated in determining the public health and aquatic life impacts of waterborne toxic and non-toxic contamination include:

- fishing guidelines in effect;
- fishing bans in effect;
- pollution-related fish abnormalities observed;
- pollution-caused fish kills observed;
- surface drinking water supplies closed;
- bathing areas closed; and
- waterborne disease incidents.

In January 1991, the United States Fish and Wildlife Service (USFWS) presented NMED with information which indicated that at least two species of fish in Santa Rosa Reservoir were contaminated with mercury at levels which could affect human health. The United States Army Corps of Engineers also provided NMED with copies of data which also indicated that there could be significant mercury contamination of fish in the State.

The discovery of elevated levels of mercury in some reservoir fish prompted NMED, in cooperation with the New Mexico Department of Health and the New Mexico Department of Game and Fish, to issue *Fish Consumption Guidelines Due to Mercury Contamination*, which are periodically updated as new information is received. The latest guidelines are contained in Appendix C.

Table 8. Total Stream Miles Not Fully Supporting Designated or Attainable Uses [a]

~ By Cause Category ~

Causal Category	Major Impact (miles [b])	Moderate/Minor (miles [b])
Biological impairment	0.0	7.9
Biological criteria	30.8	0.0
Cause unknown	0.0	172.7
Unknown toxicity	0.0	62
Pesticides	0.0	2.8
Metals	220.3	506.9
Total ammonia	152.6	129.1
Un-ionized ammonia	0.0	12.1
Chlorine	6.1	93.7
Chlordane	0.0	58.3
Other inorganics	3.3	0.0
Nutrients	0.0	28.2
pH	148.5	90.3
Turbidity	409.1	367.8
Siltation	0.0	48.1
Dissolved oxygen deficiencies	11.6	27.4
Salinity/TDS/chlorides	71.9	0.0
Temperature	237.8	397.3
Stream bottom deposits	262.5	1,584.65
Fecal coliform	26.0	506.9
Radiation (Gross alpha)	6.1	3.3
Total phosphorus	223.4	356.2
Total organic carbon	0.0	14.8
Conductivity	50.1	63.9
Plant Nutrients	13.6	280.4

a This information was generated using the USEPA's *WaterBodies System 98* database software.

b In most instances, more than one causal agent contributed to water quality impairment. Where waterbodies have more than one cause of impairment, the appropriate waterbody length was entered in each category.

Table 9. Total Stream Miles Not Fully Supporting Designated or Attainable Uses [a]

~ By Source Category ~

Causal Category	Major Impact (miles [b])	Moderate/Minor Impact (miles [b])
Point Sources		
Municipal (0200)	80.7	166.3
Domestic (0201)	13.6	27.2
Nonpoint Sources		
Agriculture (total)	1,049.9	2,129.05
Irrigated crop production (1200)	155.7	266.1
Irrigated return flows (1201)	68.7	64.4
Pastureland (1400)	7.0	0.0
Rangeland (1500)	811.5	1,779.55
Riparian grazing (1510)	0.0	12.0
Aquaculture (1700)	0.0	7.0
Animal holding/management areas (1800)	7.0	0.0
Silviculture (total)	77.6	151.0
Harvesting, restoration, residue mgt. (2100)	24.2	50.9
Forest management (2200)	4.3	44.3
Road construction maintenance (2300)	49.1	55.8
Construction (total)	42.2	109.9
Highway/road/bridge (3100)	4.8	29.8
Land development (3200)	37.4	80.1
Urban runoff\storm sewers (4000)	26.0	71.1
Resource extraction (total)	173.3	395.3
Surface mining (5100)	8.1	95.5
Subsurface mining (5200)	8.0	6.8
Placer mining (5300)	0.0	15.4
Dredge mining (5400)	11.6	0.0
Petroleum activities (5500)	37.1	117.5
Mill tailings (5600)	36.1	10.4
Mine tailings (5700)	39.6	29.0
Road construction/maintenance (5800)	0.0	19.6
Spills (5900)	32.8	101.1
Land disposal (total)	26.4	81.9
Landfills (6300)	0.0	2.8
Onsite wastewater system (6500)	26.4	68.7
Hazardous waste (6600)	0.0	10.4
Hydromodification (total)	1,905.1	3,373.0
Hydromodification (7000)	0.0	5.5
Channelization (7100)	119.1	106.3
Dredging (7200)	40.7	3.8
Flow regulation/modification (7400)	109.1	213.9
Bridge construction (7500)	0.0	12.0
Removal of riparian vegetation (7600)	700.4	1,508.95
Streambank modification/destabilization (7700)	540.5	1,522.55
Other nonpoint source pollution (total)	448.4	1,562.85
Highway maintenance/runoff (8300)	150.3	413.4
Spills (8400)	62.0	34.7
Natural (8600)	114.4	106.9
Recreational activities (8700)	40.5	568.45
Road/parking lot runoff (8701)	34.5	167.4
Off-road vehicles (8702)	0.0	38.7
Refuse disposal/littering (8703)	26.4	76.4
Ski slope runoff (8705)	17.4	4.3
Upstream impoundment (8800)	2.9	51.5
Unknown	201.8	328.0

[a] This information is generated using the USEPA's *WaterBodies System 98* database software.

[b] In most instances, more than a single source contributed to water quality impairment. Where waterbodies have more than one source of impairment, the appropriate waterbody length is entered in each category.

Table 10. Total Lake and Playa Acres Not Fully Supporting Designated or Attainable Uses

~ By Cause Category ~

Causal Category	**Major Impact** (acres [a])	**Moderate/Minor Impact** (acres [a])
Unknown	0	0
Unknown toxicity	0	0
Priority organics	0	0
Nonpriority organics	0	0
Pesticides	0	1,240
Metals	0	63,200
Un-ionized ammonia	0	0
Chlorine	0	0
Other inorganics	0	0
Nutrients	23,098	11,953
Total phosphorus	27	0
pH	0	107
Turbidity	0	34
Siltation	73,594	9,777
Dissolved oxygen deficiencies	32	84
Salinity/TDS/Chlorides	6,177	0
Thermal modification	0	0
Flow alteration	0	0
Other habitat alterations		
Reduction of riparian habitat	18,195	14,242
Bank destabilization	17,060	15,365
Pathogens	0	0
Radiation	0	2,880
Oil and grease	10	4
Mine waste	600	0
Noxious aquatic plants/nuisance algae	300	9,404
Filling and draining	0	0
Fish tissue mercury	0	109,499

[a] In most instances, more than one causal agent contributed to water quality impairment. All agents contributing to the impairment are identified in the table.

Table 11. Total Lake and Playa Acres Not Fully Supporting Designated or Attainable Uses

~ By Source Category ~

Source Category	Major Impact (acres [a])	Moderate/Minor Impact (acre [a])
Point Sources		
Industrial	0	0
Municipal	0	0
Domestic	0	0
Combined sewer overflow	0	0
Nonpoint Sources		
Agriculture	90, 509	2,325
Silviculture	0	215
Construction	0	0
Urban runoff	14	0
Resource extraction	1,342	0
Land disposal	327	13
Hydro/habitat modification	0	35
Recreation	63	85,746
Road maintenance/runoff	0	60
Road/parking lot runoff	0	25
Dredging	0	0
Salt storage	350	0
Storm Sewers	0	4
Mine and mill tailing	950	0
Natural	10,907	450
Unknown	0	109,011

[a] In most instances, more than one causal agent contributed to water quality impairment. All agents contributing to the impairment are identified in the table.

Table 12. Fish Kills in New Mexico, 1996-1998

Waterbody of Concern	Pollutant	Source of Pollutant	Size Affected	Comments
Cabresto Lake	Unknown	Unknown	15 acres	50+ Brook Trout died of apparent spawning mortality
Laguna Larga	High pH, T°, Dissolved oxygen deficiency	Typical summer eutrophic conditions	15 acres	800 10½" rainbow trout stocked in June. August kill of unknow size. Three dead fish witnessed by reporting officer.
Green Meadow Lake	Low water levels/ High water temperatures Dissolved oxygen deficiency		Unknown	70 small white crappie observed dead. Water pump was found in a reversed-flow condition, thus lowering the lake.

Until the current CWA § 305(b) reporting cycle, water and sediment samples collected from lakes, reservoirs and streams did not yield detectable levels of mercury. In September 1994 a new effort was initiated to sample the stream waters and sediments in the State using experimental ultra-clean sampling and analytical methods. The ultra-clean sampling protocol was developed in conjunction with the Cincinnati EPA National Exposure Research Laboratory, which conducted the low-level mercury analyses gratis in order to fully develop the sampling and analytical methods using "real-world" samples. The Laboratory is able to reproducibly analyze levels to 0.7 ng/L (parts per trillion). The ongoing study is revealing that low-levels of mercury in surface waters are common throughout New Mexico and that higher levels are found in isolated locations and in some stream sediments. The elevated levels that have been found in fish are due to a process called biomagnification. This process starts with the methylation of the elemental mercury by microorganisms present in the organic layers found at the bottom of large bodies of water. These low concentrations of the organic methylated form of mercury are then passed through the trophic web progressively from smaller to larger and larger fish until the result is elevated levels in the larger fish. These elevated mercury levels are especially evident in the top predatory fish such as walleye, bass and perch, as well as some of the bottomfeeders such as catfish. Because of the low concentrations of mercury in waters, all other designated or attainable uses including primary and/or secondary recreation, livestock watering and wildlife habitat, and irrigation are not currently affected by this pollutant.

To date, only one fishing ban has been issued in New Mexico. The single instance of a fishing ban issued in 1989 and still in effect, was initially due to the suspected presence of polychlorinated biphenyls (PCBs) in trout in the Rito Cañon de Frijoles located wholly within Bandelier National Monument. Additional surveys conducted by the National Park Service and NMED did not confirm the high levels of PCBs in fish or sediment but did identify relatively high concentrations of DDT (1,1,1-trichlor-2,2-bis-(p-chloro-phenyl) ethane) and its decomposition products. The National Park Service has conducted an intensive survey of the area to try to identify and pinpoint the sources of the contamination, and is currently preparing preliminary remediation efforts.

Table 12 summarizes the incidence in New Mexico that have resulted in fish kills during 1996-1998 (**10**, **11**). Causes included improper stocking techniques, human error, low oxygen concentrations, low water conditions and unknown reasons, among others.

No surface drinking water supplies were closed due to public health concerns during 1996-1998. There were, however, reported cases of giardiasis in the State. There have been no "bathing" closures issued in New Mexico during the 1996-1998 reporting cycle.

OTHER WATER QUALITY ASSESSMENT MEASURES FOR STREAMS AND LAKES

NMED also uses the following measures to assess the water quality status of New Mexico's streams and lakes and to direct programmatic activity:

Water Quality Limited Segments

Section 303(d) of the federal Clean Water Act requires states to designate 'water quality limited' stream segments where applicable water quality standards are not being met, or are not expected to be met even after the application of technology-based effluent limitations. Identification of a segment as 'water quality limited' requires the state to:

- Calculate a total maximum daily load (TMDL), which considers seasonal variations and margins of safety, for the segment. The TMDL is the water segment's capacity to accept point and nonpoint pollution loadings, as well as natural background levels, while maintaining parameter levels which assure protection and propagation of indigenous populations of fish, shellfish, and other wildlife, while maintaining the State's water quality standards;
- Develop more stringent effluent limitations, if necessary, for point sources; and
- Develop best management practices, where appropriate, to mitigate nonpoint source pollution.

New Mexico has previously identified

three stream reaches as water quality-limited, and has developed waste load allocations for the Town of Red River on the Red River, Twining Ski Valley on the Rio Hondo, and the City of Grants on the Rio San Jose. The current State list for streams requiring TMDL work is analogous with Table 16 in Appendix B.

Water Quality Trends

No water quality trend information based on ambient data has been developed for New Mexico. The United States Geological Survey is the only source in the State of longterm water quality data at fixed stations. Overall, it is difficult to compare the use assessment discussed above to earlier use assessments due to lack of historic data, increase in the number of stream reaches and lakes assessed, changes in the use attainment protocol, and the adoption of standards for additional contaminants or changes in standards, as the need for these are identified. It should be noted, that most of the statistical techniques designed to evaluate trends have significant data requirements and greater mathematical assumptions.

STATUS OF NEW MEXICO WETLANDS

The USFWS has mapped wetlands in New Mexico using the Cowardin system. The USFWS estimates that there are approximately 481,900 remnant acres of wetlands in New Mexico. The USFWS further estimates that there were 720,000 acres of wetlands in New Mexico in the 1780's based on the existing distribution of hydric soils. Hence, there has been a 33% reduction in the State's wetlands in historical times.

Individual wetlands have not yet been classified in the State water quality standards, thus do not have designated uses, but do have at least the attainable use of livestock watering and wildlife habitat. Wetlands, however, were defined in the State's water quality standards as "waters of the State" during the 1990-1991 triennial standards review. As waters of the State, wetlands are protected under the general standards, the antidegradation policy, and any attainable use under §3101 of the State water quality standards. The overall status of wetlands in New Mexico with respect to attainment of CWA objectives is not known, but due to historical trends, point and nonpoint source discharges and drainage practices, all wetlands are considered threatened in New Mexico.

Future Direction

Wetlands and riparian areas, threatened in New Mexico, are of great importance for maintaining water quality and quantity, stabilizing stream banks, providing flood control, as well as providing habitat for fish and other wildlife. NMED in conjunction with EPA has entered into a five year project with the University of New Mexico, New Mexico Heritage Program to develop a basic description of the diversity of riparian vegetation types in relation to soils and the hydrology and other environments in which they occur, their successional relationships, and management strategies. This work is especially important in light of the New Mexico definition of wetlands, "*which are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico*", (Section 3100.VV. of the "New Mexico Standards for Interstate and Intrastate Streams in New Mexico").

This project will provide an essential component of the New Mexico Wetlands Conservation Plan, which is currently in the process of being developed, by identifying important riparian/wetland areas in New Mexico and their particular management opportunities. Information produced by this project will enable the State to more precisely identify goals for the protection, enhancement and restoration of riparian/wetland areas throughout New Mexico. The products of this study will include a preliminary hierarchical classification system describing the general physiographic, edaphic and floristic features for riparian/wetland community types as well as dichotomous keys, descriptions and management information.

A 5-year study has been completed on the Pecos, Upper and Lower Rio Grande, Gila, San Francisco, San Juan, Little Colorado and Mimbres Watersheds. The 5th- year's study included performing a classification study of the Arkansas-White-Red Rivers Watersheds and testing the Wetlands Assessment Manual in preparation for the production and printing of the Statewide Wetlands/ Riparian Assessment classification system.

Middle Rio Grande Ecosystem: Bosque Biological Management Plan

The Bosque Biological Management Plan was created to mitigate the stress in the Middle Rio Grande Valley from Cochiti Dam to San Marcial and to develop a new approach to sustain and enhance the biological quality and ecosystem integrity of the middle Rio Grande bosque, together with the river and floodplain that it integrates. The plan was proposed by the Rio Grande Bosque Task Force, a citizen's group formed by United States Senator Pete Domenici to examine the bosque's problems, to solicit public involvement and to recommend the means for its protection and the continuation of its benefits to human society. An interagency team of biologists from the USFWS, the United States Army Corps of Engineers, the United States Bureau of Reclamation and the University of New Mexico was appointed to develop the plan in consultation with scientists, historians and other experts on the Middle Rio Grande Valley.

The plan's goals are as follows: (1)

Synthesize past and present available information about the ecosystem; (2) identify key species, communities and ecological processes essential to sustaining the ecosystem's biological quality and integrity; (3) recommend procedures for monitoring, conducting research and managing the ecosystem; and (5) identify procedures for incorporating new information and recommendations into the management plan.

CONCLUSION

New Mexico's use assessment protocol is based primarily on ambient physical/chemical and biological water quality data. NMED recognizes the value of other relevant data produced through the growing emphasis on biological and toxicological testing and is incorporating these types of data into the special water quality surveys being conducted.

Use attainment methodology will be in a state of flux over the next ten years as it adapts to meet the changing face of surface water concerns, such as the development of standards for lakes and reservoirs, playa lakes and wetlands, and as strategies are developed to protect them.

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