Espanola Basin Sole Source Aquifer System (EBSSAS)

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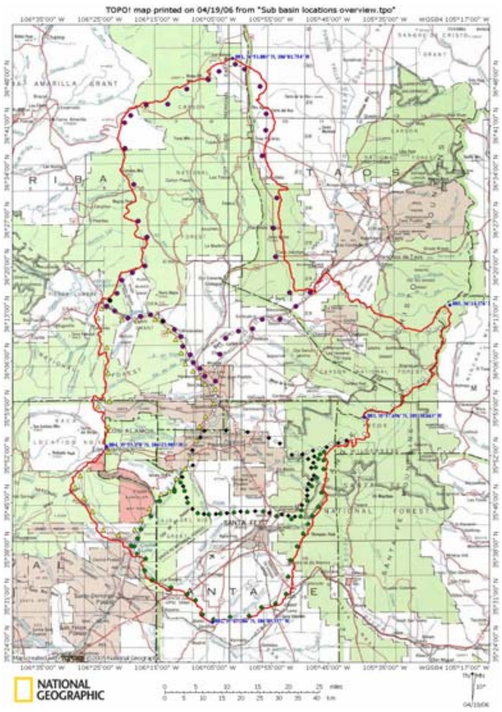

Espanola Basin Sole Source Aquifer System (EBSSAS)

By Zane Spiegel and Elaine Cimino
May 2006

Santa Fe, Los Alamos, Rio Arriba, and Taos Counties

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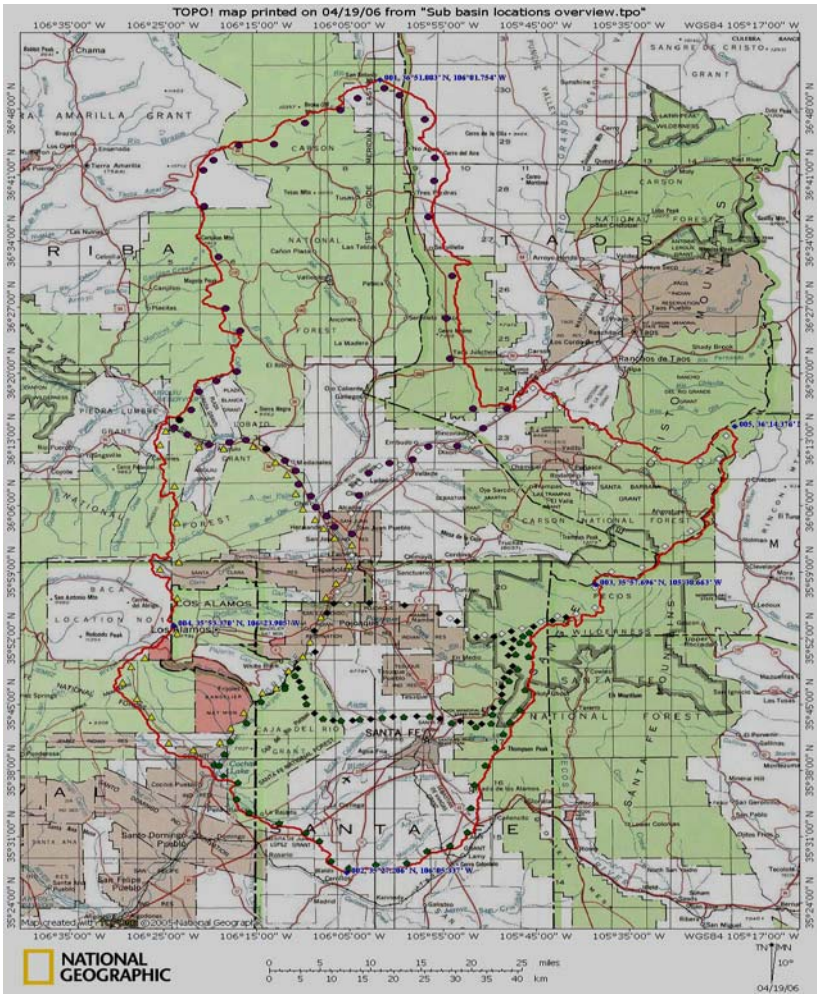
Exhibit 3-1



Espanola Basin System Sole Source Aquifer System

<u>Lower Santa Fe River basin,</u> ◀ ◀ ◀ (Green hexagons)

<u>Canada Ancha/Rio Pojoaque sub-basin</u>♦♦♦♦ (Black diamonds)

<u>Picuris Mountains/Truchas Range sub-basin</u> ◊ ◊ ◊ ◊ (White diamonds)

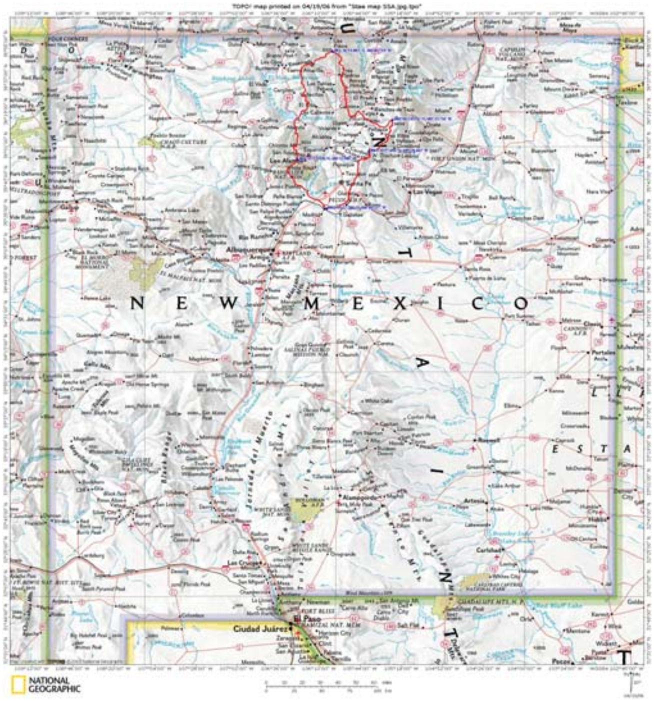
<u>Pajarito Plateau sub-basin</u> ▲ ▲ ▲ ▲ (Yellow triangles)

<u>Lower Rio Chama and NE tributary valleys/</u>
<u>Abiquiu Dam to Rio Grande</u> ● ● ● ● (Purple dots)

3.3.1 PETITIONER IDENTIFYING INFORMATION

AQUIFER **ESPANOLA BASIN SOLE SOURCE AQUIFER SYSTEM: (EBSSAS)**

Exhibit 3-6



LOCATION North Central Rio Grande area of New Mexico
Santa Fe, Los Alamos, Rio Arriba, and Taos Counties

PETITIONER (La Cienega Valley) Citizens for Environmental Safeguards (CES)

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Espanola Basin System Sole Source Aquifer System
(EBSSAS)

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Santa Fe, Los Alamos, Rio Arriba, and Taos Counties

3.3.2. Narrative

(1) General location of the Sole Source Aquifer (system) (SSA(S).

New Mexico, north-central Santa Fe Santa Fe, Los Alamos, Rio Arriba, Taos and Mora Counties mostly in Townships referenced to NM Baseline (NMBL) and NM Principal Meridian (NMPM) - Global Positioning System (GPS) Waypoints included in Appendix X which outlines the outer boundaries of the Espanola Basin System Sole Source Aquifer System EBSSAS.

The “aquifer” is not a single unit (element) but an assemblage of eight principal aquifer elements and several older elements; all hydraulically connected, thus forming a single aquifer system, termed herein the **EBSSAS. (**See Spiegel, 1962, for aquifer-system terminology used herein.)

2) Ground Water Dependency

The Espanola Basin Sole Source Aquifer System (EBSSAS) has the following principal aquifer elements, from oldest to youngest: the Tesuque and Ancha formations of the Santa Fe group (late Tertiary and Pleistocene age, respectively; (Baldwin, 1963, p. 86-89), and in some arroyo channels and fringe areas, Quaternary sediments. Former locally perched or semi-perched waters (Spiegel, 1963, p. 106, 120) have probably been drained by wells, test holes, and construction activities in the past 3 to 5 decades, and the waters evaporated or transferred to underlying aquifer elements. (An initially misrepresented well system, at Eldorado, in the southeastern portion of the Lower Santa Fe River Basin, was temporarily bolstered by two wells in alluvium of Galisteo River, outside the SSA(S) area.)

(3) No Realistic Long-term Alternative Drinking Water Supplies (+ Sec. 3.3.3 (4a)).

Locally only, and in generally small and easily exhaustible quantities, springs or wells yield water from rocks older than (either under or adjacent to) the principal aquifer elements of the EBSSAS, in (a) rocks of Precambrian, late Paleozoic, Cretaceous, and early Tertiary age, primarily at, the eastern and southeastern, edges of the surface-water drainage basin, and (b) also of limited extent, in the inner valleys of some arroyos in the immediate vicinity of La Cienega and La Cieneguilla villages, the Galisteo Formation (primarily red clay and poorly sorted sandstone), and the Espinaso Formation (primarily lavas and tuffs), both of early Tertiary age; and overlying basaltic rocks of mid-Tertiary age.

These minor aquifer elements are hydraulically connected to adjacent or overlying Santa Fe group aquifer elements, and contribute (d) to the natural discharges of ground water in some sub-valleys of the EBSSAS area, or its southern extension, San Marcos Arroyo. Such contributions typically occur along the fault or overlap margins of the Santa Fe Group on the older rocks, or in tributaries such as at Canada de Los Alamos Village (S.E. of El Gaucho); Rio Quemado, S.W. of Truchas; and the east draining canyons, west of LANL).

Therefore these older and less transmissive aquifers do not really represent “additional supplies”, but are merely alternative points or areas of diversion from aquifer elements connected with the regional aquifer system.

Details of the connections of these peripheral minor aquifers to the main aquifer elements are given by Spiegel, (1963, 1975, var. see compilations by Borton, var.) most of which are in files of the NM Office of State Engineer (NMOSE).

Annotated references to about 80 reports, prior to about 1978, many not in the NMOSE compilations, are given by Spiegel (1978, open-file report). Many of the reports contain serious conceptual errors and over-estimated long-term well yields (see Spiegel, 1963 for specific types of over-estimates and reasons for short lives of wells, pumps, and aquifers).

South of the EBSSAS, the Galisteo Valley has been eroded into a thick sequence of rocks of Mesozoic and uppermost Paleozoic age, mostly claystone, siltstone, and fine-grained sandstone with very low transmissivity and well yields, plus two units of gypsum beds which contribute high-sulfate waters (unsuitable for potable water systems) to other rocks.

The Galisteo River has a narrow inner valley with a spring east of Lamy, originally developed by the Santa Fe Railway for their station and adjacent community of Lamy. Farther downstream the inner valley has Quaternary alluvium slightly more than 100 feet thick, which locally supplies small to moderate quantities of well water, suitable for drinking, from Lamy to Galisteo. Eldorado acquired two wells in the alluvium for supplemental use, but these wells failed during a recent drought. The entire inner valley of Galisteo River and adjacent drainage areas therefore has no surplus waters, and in fact only marginal supplies for internal use, with none available for long-term export.

To the north and northeast of the in the lower Santa Fe sub-basin area, the adjacent City of Santa Fe has historically obtained municipal water from a high-altitude mountain surface-water source (Santa Fe River), but a combination of growing population, drought, and inadequate planning in the period 1948-51 created severe water shortages in several years (Spiegel, 1963).

Wells drilled during and after this drought period, first in the city, then later in the Buckman area to the northwest, supplemented the surface supply. Poor natural water quality in at least one of the Buckman wells (Water Task Force,1973); and severe over pumping of the others, plus anthropogenic nitrate (Spiegel, 1999-2000) and hydrocarbons in some of the wells in the city field, requiring their closing, moved an “adequate water future” back to the usual recurring-shortage era.

Continuing uncontrolled population growth, poor planning (compounded by poor design, construction, and pump-capacity selection -“over-design”-for the wells/well-fields; see Spiegel, 2000x for specific examples in the adjacent Espanola area) prevented the achievement of an adequate long-term city water supply, and discouraged serious consideration of the extension of city water to LCV, even if it were affordable.

In the past few years, a long-debated “salvation” again appeared to be becoming a reality--water rights acquired by Santa Fe from sources upstream of the Buckman wells; right-of-way agreement with San Ildefonso Pueblo for construction of infiltration gallery-wells along the east side of the Rio Grande inner valley; and pipeline right-of-way to the existing Buckman line.

However, marginal performance of the hoped-for “salvation” appears to confirm previous doubts by Spiegel in 1973 (Spiegel, 200, per comm.) on the success of gallery-wells at the Rio

Grande (as sub-consultant to W.F. Turney & Associates, prior to the decision by their client PNM, Santa Fe's water franchisee at the time to drill Buckman well field). Before proven results had been obtained at San Ildefonso, Santa Fe, Santa Fe County, the State of New Mexico, Santa Fe Community College, and adjacent land owners to the south entered into agreements or negotiations for the distribution of the San Ildefonso "cyber-water", including distribution of some of it to the La Cienega Valley area to compensate senior water-right holders there for the water diverted from their sole-source aquifer system by junior wells previously--and still being--allowed by Santa County on the basis of fallacious assumptions of "safe yield" (Bredehoeft, 1997; Spiegel, 1978).

The exceptionally dry and windy spring of 2000, plus human errors, has dealt a "final blow" to the unrealistic water scenario for city-county coalition, particularly consideration of "imported water" lines to the Lower Santa Fe sub-basin. Huge fires in the Jemez Mountains, with resulting erosion and transport of toxic wastes and sediments to the Rio Grande from Los Alamos area canyon dumps to the Rio Grande may rule out hope of that source for water supply, and fires to the east in Pecos River and Santa Fe River canyons mark the reality that Santa Fe may not have an assured water supply for itself, with none for its neighboring SSAS sub-basins.

(1) <u>NEED FOR SSA DESIGNATION</u>

(1a) Raising public consciousness re protecting ground water through SSA designation.

(1b) Existing, ongoing, and proposed new Federal projects (AGENCIES), which individually and collectively, contaminate SSA, without any regional EIS since beginning of NEPA (1969).

REGIONAL:

(A) (DOJ, DOD) Sewage lagoons at State Penitentiary and National Guard, etc.

(B) (FHA etc.)Thousands of dispersed septic systems draining into SSA.

(C) (FHWA+) Urban runoff from Santa Fe conveyed from Santa Fe River drainage basin to Arroyo de Los Chamisos (sic) across heart of recharge area and in the lower Santa Fe sub-basin area, by existing city streets and storm drains, with multiple new storm drainage projects proposed which will greatly increase volumes of storm runoff bearing multiple contaminants (nitrates, waste petroleum products) from a highway system that is federally funded for road improvement projects involving untreated storm water runoff.

(D) (DOD) Unplugged or improperly plugged uranium test holes (200+)

(E) (FHA, HUD, etc.) Vast areas of existing residential and small commercial subdivisions (many subsidized by Federal agencies), most with individual septic systems, domestic animals, and untreated storm runoff.

(F) (DOD, DOE, NNSA) oversight past dumping and leaking underground storage of nuclear and bio chemical weapons waste from Los Alamos National Laboratories.

(G) (EPA) groundwater monitoring systems from Los Alamos and drinking water pumping from the ground water east and west of the Rio Grande in the vicinity of Los Alamos National Laboratory affecting established and proposed domestic wells, community and municipal drinking water systems. GROUNDWATER CONTAMINATION IN THE REGIONAL AQUIFER BENEATHTHE LOS ALAMOS NATIONAL LABORATORY (ABSTRACT) by Robert H. Gilkeson, Registered Geologist (See the CES Website)

(H) (EPA) Mine tailings and mining operations that are under federal contract leach/contaminants into the aquifer and affect domestic groundwater and surface drinking water.

(2) AQUIFER VULNERABILITY TO CONTAMINATION

Surficial soils are sandy, developed on the Ancha Formation, piedmont fans derived from granitic rocks, and arroyo terraces; some areas dominated by re-vegetated dunes created by early 20th century homestead agriculture (promoted by Federal policy!), and closely-spaced arroyos with sandy channels, rapidly absorb infiltration of storm runoff and septic system drainage from over-developed suburban residential subdivisions promoted by all the counties since at least 1969, plus Santa Fe Water Treatment Plant effluent to Santa Fe River and above La Cieneguilla.

Known cases: A Hydrogeochemical Study along the valley of the Santa Fe River, Santa Fe and Sandoval Counties, New Mexico (Longmire, Patrick, 1985) Ground Water Surveillance Section, Ground water and Hazardous Waste Bureau Environmental Improvement Division, Health and Environment Department, P.O. Box 968 - Crown Building -Santa Fe, New Mexico 87504-0968, July 1985.

(3) QUALITY OF GROUND WATER IN SSA AREA

(a) Chemical quality of ground water under pre-development conditions, prior to post-WWII population surge and resulting first regional study, based on field data collected beginning in 1951 (Spiegel, 1963), was generally good. However, even in 1951-2 there were local spring and well samples with high nitrate, probably due to Santa Fe-area and LCVA agricultural activities since the 17th century, and to more recent ranch and domestic contamination sources. A nitrate mound rose rapidly after Santa Fe's 1948 Siler Road WWTP, which distributed poorly, treated effluent to feed crops along the SW approach to Santa Fe, a municipal golf course, and surplus effluent to Santa Fe River channel. (See Spiegel, 1999a, 1999b, 2000, 2000a, etc.) [from FOIA list attached]; also an earlier ZS/OSE report (1969?), Don Akin/OSE compilation of USGS monitoring data, and a NMED report done as a result of Zane Spiegel's notice of the problem.

(b) The southern sub basin is composed mostly of residents who belong to a Mutual Domestic Water Consumers Association (MDWCA), the principal purveyor of water supply in the western part of the aquifer service area, formed under the rules and funding of NMED and its predecessor agencies, with Federal fund contributions. In the southeastern part of the area, the AMREP Corporation operates the Eldorado community water system (is currently under adjudication with the OSE), supplied precariously throughout its history (since about 1971; see file of reports and correspondence provided to U.S. Dept of Justice, S. NY Distr. Office", 1972, and to Gershon Siegel of "Eldorado Sun", Spiegel, 1996). Other smaller purveyors of water supply are now included on the OSE iWATERS data base under Domestic (SEE TABLE A for Domestic use wells within the designated area in Township and Range) and Non-Domestic Use:

(A) Valle Vista Subdivision
(B) New Mexico State Penitentiary
(C) National Guard Armory

See the New Mexico Office of the State Engineer website @ <http://www.ose.state.nm:7001 /iWATERS/> Click on Non-Domestic wells, then click on Well Data Report Submit button.

3.3.3 SOLE OR PRINCIPAL SOURCE DATA.

3.3.3 (1) Introduction.

Recent events (see Sec. 3.3.2(3) above) may soon bring public realization that the “develop to the max” policy of Santa Fe County and the City of Santa Fe, promoted largely by self-serving land owners and developers who deliberately ignored common sense and the modern theory of ground water/surface water interaction, known for at least 60 years (Theis, 1940) and formally practiced locally by the NMOSE since 1958 (Spiegel per. comm.), was a deliberate lie.

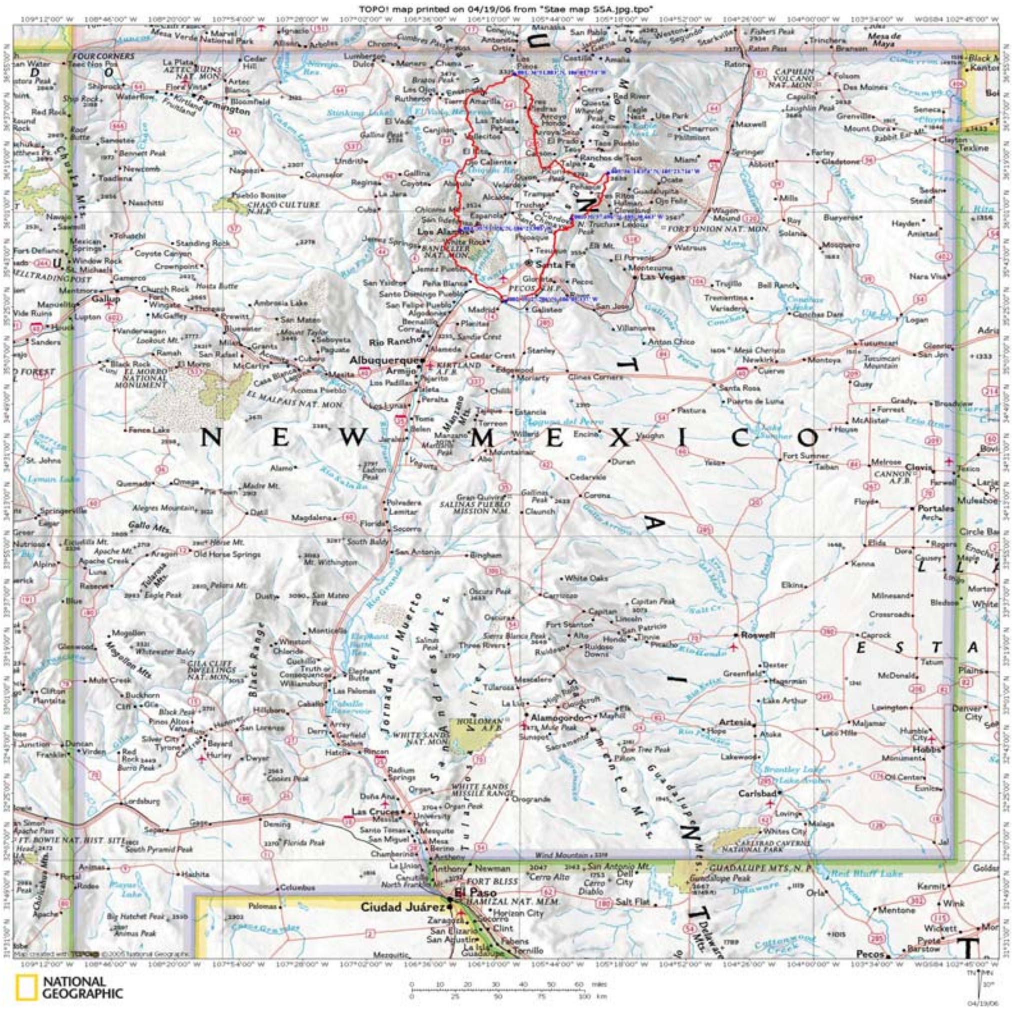
Nearly 100 percent of the water available (under realistic scenarios) to the petitioned SSA is from existing or permitted wells in the petitioned SSA. These existing and permitted wells in the SSA already have a total consumptive use of the aquifer that exceeds the senior rights to the natural discharge in the Galisteo River, San Marcos Arroyo-Cerrillos, La Cienega, and La Cieneguilla areas.

This is due in part to “grandfather” rights by the City of Santa Fe and a few other users, but principally because of a giant “loophole” created by special-interest legislation in 1933--NM Statute 75-xx-xx, the “Stock and Domestic Use Law” (S&D Law) which requires the State Engineer to issue permits of up to three acre-feet of water per year (nearly a million gallons per year each) without requiring compensation to or transfers of rights from senior right-holders. The State Engineer Office has attempted to reduce the per-right diversion under the S&D Law, but a small quantity of water-per-right multiplied by a virtually unlimited number of S&D rights permitted by County subdivision regulations amounts to an enormous volume of pumped water, which is already depleting the limited local saturated thicknesses (aquifer storage volumes) in many areas (most obviously in the Eldorado area) before the drawdown cones fully affect the discharge boundaries to the southwest and west. Effects of pumping on well water levels may be masked somewhat by improved interconnection of the Ancha and Tesuque aquifer elements by many dual-completion wells, and possibly increased recharge by urban storm-water runoff to sandy arroyos. There is a great difference between NMOSE water rights and the ability to appurttendent wells to produce the amount of the right in perpetuity.

The State Engineer Office is able to protect the aquifer and senior rights to natural discharge in non-S&D permits for new appropriations by requiring transfers of appropriate quantities of senior rights on a time schedule, coordinated with a metered pumping schedule, and calculated return flow schedule, intended to prevent impairment of the senior rights to the natural aquifer-system discharge. As the State Engineer is appointed--and can be removed by-- the Governor, there are strong political reasons why the S&D statute has not been changed by the Legislature. As of past year NM law and OSE policy is being changed as of July 2006, to limit all new permitted wells to 1 acre ft. per year (afy), which since 1930 has been 3 afy per domestic well.

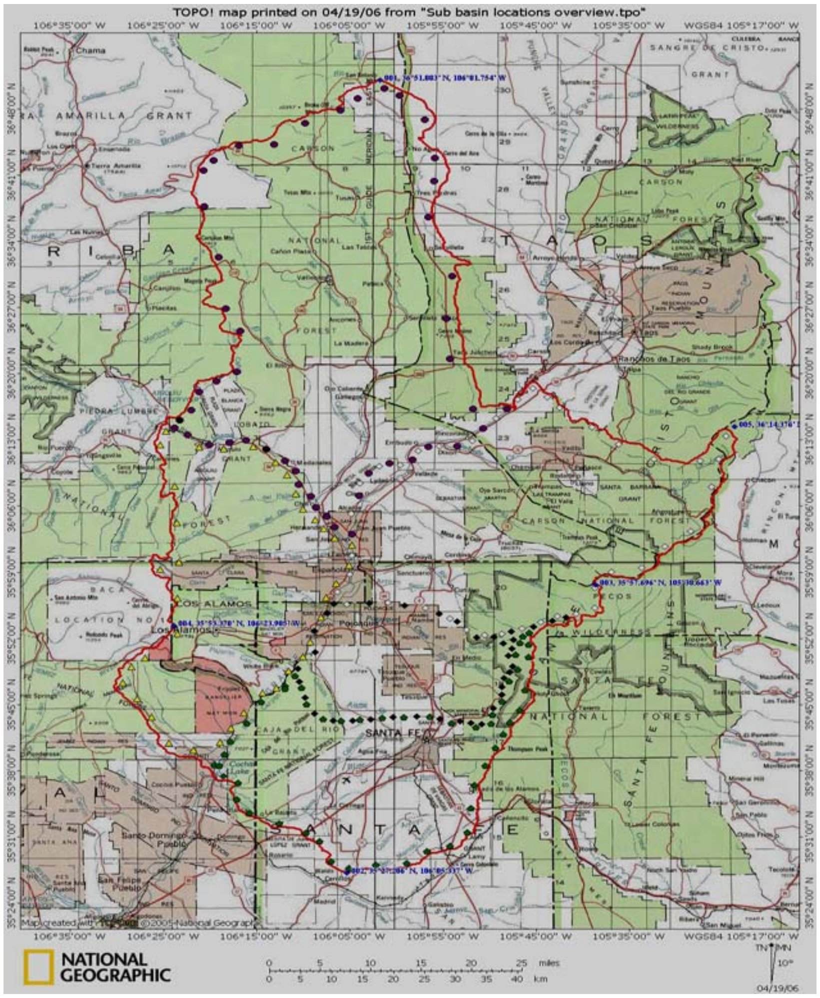
Although a possible solution for the conflict of interest between SSA and its senior rights-holders might be an “enlightenment of the crisis” in the current and future droughts, due to more effective conservation by all users, and widespread civil lawsuits (priority calls and claims for compensation) by senior users, the timely establishment of an SSA is likely to be more effective because of the slowness and great expense of the in direct legal approach through the court system, i.e. Aamodt decision.

3.3.3 (2) AQUIFER SERVICE AREA



Area within the State of New Mexico

Exhibit 3-1



Espanola Basin System Sole Source Aquifer System

Lower Santa Fe River basin, ◀◀◀ (Green hexagons)

Canada Ancha/Rio Pojoaque sub-basin♦♦♦♦ (Black diamonds)

Picuris Mountains/Truchas Range sub-basin ◊◊◊◊ (White diamonds)

Pajarito Plateau sub-basin ▲ ▲ ▲ ▲ (Yellow triangles)

Lower Rio Chama and NE tributary valleys/
Abiquiu Dam to Rio Grande ● ● ● ● (Purple dots)

3.3.3 (1) POPULATION

Since the original petition the 2000 Census took place and other water planning documents have been released that shows the 2000 census information and projected population within the EBSSAS. One such report was the Jemez y Sangre (JyS) Water plan (March, 2003) Prepared for the Jemez y Sangre Water Planning Council the Population/Demand Subcommittee contracted UNM Bureau of Business and Economic Research (BBER) to show current and projected population trend in the Jemez y Sangre drawn political boundaries which do not match our hydrological boundaries. Never-the-less, the outer boundaries are similar enough that we are able to cite this specific aspect of the planning document related to population. The below table 3 show the year 2000 census figures and the projected 60-year figures. Please note that the small area of Taos counties and Mora counties are not included in the BBER Population Report. The 2000 Census shows that 10, 435 live in the Taos County area of the EBSSAS.

Santa Fe Convention and Visitors Bureau estimates that the City has one to two million visitors annually, and that approximately 30% of those visitors are attendees at meetings who stay for 3-4 days, and 70% of the visitors are tourist ("transient population") who stay 4-5 days. Taking the middle values for all these estimates leads to the following:

1.5 million visitors x .3 x 3.5 = 1.575 million day 365- 4,315 visitors' years
+
1.5 million visitors x .7 x 4.5 = 4.725 million day 365= 12,945 visitors years
Total = 17,260 visitors years

Based on the Population Consumption of Water in the EBSSAS
(a) *Residents living within EBSSAS 214,364. J y S Population Projections*
Transient visitors 17,260
231,624 X **.10767** drinking water consumption = **24,938.956 afy**
24938.956 afy x 325,851 gallons in afy = 8126383777.62408 ÷ 365 = **22,264,065.144 mgd**

(b) *Residents living in the EBSSAS 210,505 2000-2005 estimate US Census (Appendix D)*
Transient visitors 17,260
227,765 X .10767 drinking water consumption =24523.457 afy
24523.457 afy x 325,851 gall in afy = 7,990,993,166.125 ÷ 365 = **21,893,131.961 mgd**

Note: The population living within the EBSSAS and transient populations are all served by domestic wells and in the municipal groundwater systems. Only with the exception of the City of Santa Fe that has an alternative surface water diversion from the McClure reservoir and exchange rights from the San Juan Chama.

According to Somos Unidios that is non-profit group in Santa Fe there are over 20,000 nationalized and/or undocumented workers in the Santa Fe Area that are not included in the census. This was not included in the 2000 census. Many of these families live in the Santa Fe County just out side the City of Santa Fe water Service area and are on domestic wells. BBER did include the Galisteo basin and populations which the EBSSAS does not. However, adding the undocumented families the numbers are very close to the same as what is on the table below.

In the original petition the following was stated:

> *According to the Census of 1990 the City of Santa Fe population was 55,859 the county central area was 26,275 which totals 82,134 the population within the aquifer service area that is actually served by the proposed sole source aquifer is 82,134 according to the last census. The present population before this next census which will be available in 2002 is estimated as 114,000. The numbers of the entire population and the population served are the same.*
>
> *This information was supplied by the Santa Fe County Land Use Department, December 1996 in a report titled "Analysis of Development Patterns in Santa Fe County".*
>
> *"The Santa Fe County Population and Housing Study" Prepared by John Prior Associates, August 1994, the 1998 Central Regional reports on updated information indicates this region now has a population of 114,000. The 2000 Census will be out wit in the next year which should substantiate this figure or go beyond it. – LCVSSA Sec. 3.3.3 Population*

Table 3

Revised Most Likely Regional and County Population Series

July 1, 2000 - July 1, 2060

As of Jul 1...	Re ion Los Alamos	Rio Arriba	Santa Fe	Tri-County Region Total
2000	19,234	41 ,307	128,429	188,969
2005	19,573	43,132	141,660	204,364
2010	19,913	45,058	156,279	221,250
2015	20,342	46,953	172,164	239,459
2020	20,722	48,630	189,258	258,610
2025	21,067	49975	207,908	278,950
2030	21 ,289	50,996	225,934	298,219
2035	21 ,490	51,806	245,029	318,325
2040	21,627	52,500	265,606	339,733
2045	21,704	53,109	287,889	362,702
2050	21,761	53,666	310,945	386,372
2055	21,811	54,172	335,652	411,635
2060	21,854	54,645	36,117	438,615

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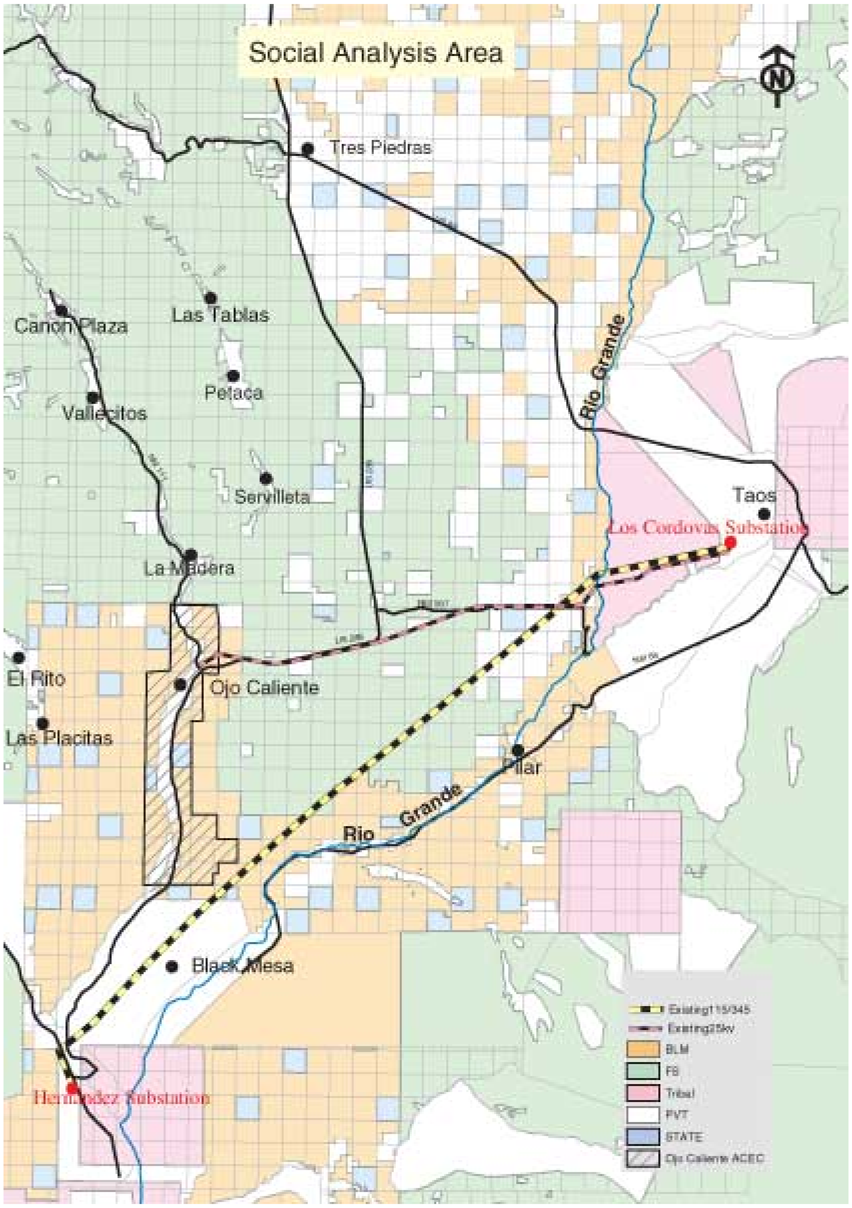
The Table 3 figures are substantiated with the projected figures that Prior Associates projected in 1994. Therefore, we will go with the figures in the 2005 year on projected populations in the EBSSAS.

Percentage of the population by race within the zip code tabulation area’s for the service area (Census Bureau 2000). CES used a figure of 10,000 people within the area shown on the map. Many people in this area live off the grid.

The populations of Taos and Rio Arriba Counties have increased since the existing 25 kV distribution line was constructed in the late 1940s. The population was basically static for about the first 20 to 30 years after line construction. The population of Taos County has nearly doubled in the last 30 years (17,516 in 1970 to 29,979 in 2000). A similar change is shown in Rio Arriba data (25,170 in 1970 to 41,190 in 2000). Although the population increase may not be uniform across a county, these changes indicate an increase in demand for electrical power through increase in population. The Carson, Ojo Caliente and the Vallecitos general areas have all seen increases in population as evidenced by home construction.



This is Figure 33. Kit Carson Cooperative service area for Ojo Caliente region.

3.3.3 (2) Sources of current drinking water/public water supply systems (identified in sec. 3.2.3, Step 1.)

EXHIBIT 3-2
CURRENT DRINKING WATER SOURCES FOR THE AQUIFER AREA

Espanola Basin Sole Source Aquifer System (EBSSAS) Principal Aquifer	**Drinking water sources**	**Water rights Allocated Acre Ft/yr Aquifer**	**Drinking Water (million gallons per day (mgd))**	**Drinking Water Consumption Total**
	Municipal GW in SSA Area From Table A (2005 figures) Wet year	**30216.80** afy total permitted/licensed diversion **9772.786** afy* actual use (2005)	**9772.786** afy = **8,724,581.070** mgd	
	(2004 figures) Dry year	**12,056.161 afy**	**11,452,945.77**	
	Averaged 2 year amounts	**21829.021 Afy**	**10,088,763.42 mgd**	
	Permitted Domestic Wells in the SSA System Well registration since 1968	16973 wells @ 3 afy = **50919** afy	50919 afy = **45,457,553.62** mgd	Muni Well + Dom. Wells = **54,898,462.318** mgd of permitted use
	Consumptive Use based on Population Total	Per person Consumptive Use Based on (USGS calculation) **	**(a) 22,264,065.144 Mgd** **(b) 21,893,131.961 mgd**	

- * Mutual domestic community wells were counted in this figure as 1 well when the total number of households served is 25,104 within the EBSSAS.
- ** These numbers do not reflect the number of undocumented citizens living in the EBSSAS.

The chart above gives the totals of domestic and municipal ground drinking water with both variables of right of permitted groundwater use and the population consumptive use model based on the USGS calculation. There should be no doubt in anyone’s mind, who knows anything about New Mexico, that there is a major reliance on groundwater which provides most of the drinking water throughout the state of New Mexico. There are heroic attempts by the City and County of Santa Fe and the City of Espanola to curb the reliance on groundwater for drinking water and they are working toward surface water diversion in exchange of San Juan Chama Water Right. What this document will show is that despite every effort to buy, transfer and use surface water rights there will be more reliance on the aquifer, especially as the population grows. The municipalities will not be able to meet the water demand through surface water alone. There will always be aquifer reliance on this finite resource. For all intended purposes the sole source aquifer designation may be a tool to protect the water quality of the aquifer and let our future generations know we cared enough to preserve our water quality in the State of New Mexico.

Table A. Annual Production of Major Well Fields Municipal Groundwater

Table A. Annual Major Municipal Ground water wells*							
MUNI GW RIGHT	**Santa Fe St Michael Well GW/SW**	**Santa Fe Basin Osage = NW Well**	**Buckman Wells**	**Los Alamos County**	**Espanola**	**Eldorado**	**Total AFY**
2005 pumpage afy Wet year	445.86 afy = 14,583,926.86 mgy = 398,038 mgd	1114.336	3784.331	2930.284 Historical Use High 5100 afy	1002.375 afy	38.8 afy = 12,638,184 mg/mo 12 x 38.8= 465.60	9772.786 afy GW pumpage 2005 8,724,581.070 mgd
2004 pumpage afy Dry year	319.54 afy = 285,266.96 tgd	1443.264	5746.50	2859.971	1104.926 afy	189,840,288 mgd 582.59 afy (2003) Offline 2004	12056.161 afy GW Pumpage 2004 11,452,945.777 mgd
Total Diversion	1600 afy **	4865 afy	10,000 afy	5541.30	5560.50 afy	Under OSE adjudication	21828.947 2 year Total

- * Based Pumpage Reports from the City of Santa Fe and the OSE
- ** Tied to the 5040 surface water right –(minus) the groundwater pumpage as shown above

Purchases from City Buckman Water	**Santa Fe County City Purchase + Valle Vista**	**Las Campanas City Purchase**	**Total**
2005 (Wet Year)	340 afy est.	462.39 afy	802.39 afy
2004 (Dry year)	340 afy	529.07 afy	869.7 afy
Already included in Buckman pumpage	650 afy	1800 afy	Capacity At the Buckman Diversion

However, based on the Actual Consumption per capita figures of drinking water, use by the EPA Region 6, Dallas, Texas, May 2002, Support Document, at 256 per capita drinking water consumption gpd per person was still considered high. Instead, the figures used were based on the USGS (1990) “the average consumption is 0.10767 acre-ft/year or about 96.1 gpd. This value is consistent with the generalized estimates of water use in New Mexico, which are given by the USGS (1990) as 80 gpd for self-supplied sources, and 135 gpd for public water supplies."

16,973 wells in the EBSSAS @ 3 afy permitted diversion = 50919 afy permitted/licensed GW diversion per year. These wells were permitted by the OSE beginning in 1968 to present. The number of domestic wells before 1968 is unknown, but it is estimated to have been at least 5,000 wells in the EBSSAS sub-basin. These estimated totals prior to 1968 are not included in the figures above. Based on the information provided by the OSE on municipal ground water pumpage for the year 2005, which was a wet year.

It is important to note that "other factors" affecting domestic wells occur, for instance a single well may have connections to multiple dwellings, up to 4 homes. The numbers from the Office of the State Engineer (OSE) data base is from domestic wells, no irrigation wells are counted in this data. However, 121 Mutual domestic wells are included in the number domestic well count of 16,973 domestic wells. 121 Mutual domestic wells serve a population of 25,104. (See Appendix D list of water systems in four county areas highlighted included in the EBSSAS.) The data base references is from OSE web site, and follows the map coordinates aquifer quadrants. OSE updates the data site every 5years. (See Table B in Appendix A.)

Note: The Upper Canyon Watershed native stream flow source water stored at the reservoirs is a "declared" water right by the City of Santa Fe through a purchase from Public Service Company of New Mexico (PNM). This adjudication has been held in the courts for over 20 years in a case called ANAYA vs. PNM and the City of Santa Fe. Several of the litigants are downstream water rights holders that had water rights previous to 1907.

EXHIBIT 3-3.A ALTERNATIVE DRINKING WATER SOURCES	**YEAR 2005**	**YEAR 2004**	**YEAR 2003**
(A) Santa Fe Water Treatment Plant * **Reservoirs:** **McClure 2961 af & Nichols 600 af** **Subject to Compact Call** Total storage capacity 3940	4591.76 afy 4,098,580. 66 mgd SW permit 5040 afy = 4,499,422 mgd	2855.12 afy 2,548,886.86 mgd	2151.96 1,921,146.07mgd
Total Permitted Surface Water Diversion afy *Million gallons per day (mgd)*	5040.62 4,098,580.66 mgd	2,548,886.86 mgd	TOTAL Alternate Source Surface Water

*Pumpage meter readings and Water Rights Information from Public Records Request City of Santa Fe and supplied by the Office of the State Engineer (OSE).

Exhibit 3.3.b ***(B) Other* Alternate sources– *Pending***	Surface Water diversion (SWD) afy	SWD MGD	
(C) Scheduled for 2010 pending *C7 EIS Completion* Buckman Surface Diversion *Surface Water Diversion –* San Juan Chama right (below) will be used for Buckman Diversion Project County and Las Campanas will transfer water rights to surface water diversion	City of Santa Fe 5230 afy County Water 1700 afy Las Campanas 1800 afy Total Diversion 8730 afy	7,793,641.72 mgd	
San Juan Chama Surface Diversion Permit See Table D *For City and County*	5605 afy Difference offset depletions and other adverse effects	5,004,714 mgd	

<table>
<tr><th colspan="3">Rio Grande Compact Water Compliance Offsets</th></tr>
<tr><td>Year</td><td>Releases from Heron Reservoir</td><td>Stored City water Owed to Texas</td></tr>
<tr><td>2005</td><td>931**</td><td>912</td></tr>
<tr><td>2004</td><td>934**</td><td>915</td></tr>
<tr><td>2003*</td><td>394* **</td><td>381*</td></tr>
<tr><td colspan="3">* Relinquishment Year - Extra water in Elephant Butte was released to Texas. The compliance offset was lowered to stakeholders in the Middle and lower Rio Grande.
** Conveyance Loss – 2%
Information Provided by the City of Santa Fe and the Interstate Stream Commission</td></tr>
</table>

<table>
<tr><th colspan="2">San Juan-Chama Water Right</th></tr>
<tr><td>Offsets – on the GW pumping impairments of the Buckman Well Field Groundwater Diversion effects Surface water - the Rio Grande, Pojoaque, Tesuque and the springs at La Cienega. SJC water rights are to make the river whole.</td><td>800-1000 afy **
Retired Water Rights Portfolio is used to offset impairments – County is adding water rights to this portfolio. The entire WR Portfolio for the City and County is < less than 1000 afy</td></tr>
<tr><td>Exchanges –
Compact Compliance</td><td>5230 + 375 = 5605
City + County = San Juan Chama Water</td></tr>
<tr><td colspan="2">Potential Pending Surface Water -- 50 year lease from the Jicarilla Apache</td></tr>
<tr><td>5,000 afy to start in the year 2008/after the Buckman Surface Water Diversion is on-line</td><td>Agreement stipulates to meet ONLY the Rio Grande Compliance Compact</td></tr>
<tr><td colspan="2">Currently and until the Buckman diversion comes online
<i>NO SAN JUAN-CHAMA SURFACE WATER IS USED FOR DRINKING WATER</i>
<i>Information provided by the City of Santa Fe</i></td></tr>
</table>

In order to meet the Rio Grande Compact the City of Santa Fe first uses the retired water rights portfolio and then uses San Juan-Chama water rights in order to meet compact compliance.

The conjunctive use water management policy – Substitutes surface water for GW water and intends to use groundwater as a backup. However, this will fall short at this time because demand outweighs the water right and ability and capacity to take surface water.

Meanwhile, the County is using hydrologic modeling to find new ground water production wells to drill to wheel through the County system. Within the next two years they will be making an application to the OSE for drilling more groundwater production wells in Santa Fe (See Santa Fe County website).

(3-a.) San Juan-Chama Diversion and the Rio Grande Compact

In this Sole Source Aquifer petition there is another boundary that runs from the Otowi gage along the southern boundary of the Pojoaque/Nambe sub-basin. Everything south of this line is considered to be in the Middle Rio Grande Conservancy District. Under the Rio Grande Compact, New Mexico is only supposed to use the same water amount that it used in 1929. The area south of this boundary is also subject to a “call for water” to meet downstream apportionment. This means that all cities south of the boundary, including Santa Fe, are subject to call and must reserve rights/water to meet the demand. Contrary to popular belief, Santa Fe does not release water down the Santa Fe River, instead the City of Santa Fe “exchanges” the San Juan-Chama (SJC) water rights to release water, in Heron Reservoir, to meet the down stream flow at Otowi and delivery completion at Elephant Butte Reservoir. For the purposes of this EBSSAS designation the calculations are administered by the State and executed by the City at their will. Offsets of SJC water are also used at the Buckman Wellfield impairments on stream flow sources in the Pojoaque Tesuque sub-basin and to the down stream springs at La Cienega. NO SAN JUAN-CHAMA WATER is used for drinking water at this time.

The calculation differs each year depending on precipitation, and how the conjunctive use water management plan is implemented. The City of Santa Fe has more paper water rights than it has actual water. It cannot pump from the aquifer or take surface water without impairing or having adverse effects on surrounding wells or stream-flow sources (See table D). There may not be enough water to meet the future demand for municipal use past 2015. On one hand the municipalities are looking to wean themselves off of the finite aquifer water source by using surface water, while on the other they are planning, applying for permits and in NMOSE hearings for more groundwater production wells to meet the demand due to population and irresponsible growth.

(3-b) County of Santa Fe Water Rights and System

The potential capacity of water right at Buckman Diversion Project (BDP) is 1700 afy a year but the county does not expect to reach that capacity until 2020.

According to hydrologist Steve Wust, most water in the County Water System is being wheeled from the Buckman Ground Water Wells via a purchase agreement, which is 340 afy. There is a small amount of water from the Valle Vista Subdivision, which is from a mutual domestic well and serving a population of 1250 with 261 afy water right. The remainder demand amount would be purchased from the City included in the count on Table B. According to City water director Claudia Borchert, the County purchases all water from the City at this time.

The County will have the right to 500 afy in perpetuity from the City of Santa Fe on the BDP. Along with the current 375 afy a year + 500 afy from City GW at Buckman the Potential capacity in 2010 on the BDP is 875 afy. (Under the City and County of Santa Fe Joint Powers Agreement.) The County is currently looking into 3-4 areas in the Lower Santa Fe sub-basin in order to drill large production wells to meet future water needs. (See County of Santa Fe Website www.co.**santa-fe**.nm.us for PDF download of current modeling report.)

The OSE has ruled that there will not be any transfer of groundwater to surface water for the Buckman Diversion Project. (Cimino, per. comm. 2006)

TABLE C

SANTA FE COUNTY WATER ALLOCATIONS AND RIGHTS			
Buckman Capacity	Purchase Allocation from the City Now	Allocation Future @ Buckman	Total Potential in 2010 @ Buckman
1700 afy	340 afy out of 375 afy * available	500 afy	650 afy
The County can pump 261 afy from the Valle Vista Mutual domestic with the remainder wheeled from the city. However, the city has been supplying the entire purchase of 340 afy.			

The Long Range Water Plans from the City of Santa Fe can be found on the City of Santa Fe Website. http://santafenm.gov under Water Division. Included in the long range plan, if the City acquires an additional 5000 afy at 4.4 mgd in surface water right, it still does not come close to the amount of groundwater dependency on the finite aquifer source. A sole source aquifer designation is needed because more than 50% of drinking water for this area comes from groundwater and for which there are no reasonable available alternative sources should the aquifer become contaminated.

EXHIBIT 3-5

ALTERNATIVE DRINKING WATER SOURCE	
PETITONED AQUIFER A PRINCIPAL SOURCE	
(A) PETITIONED AQUIFER SUPPLY	
SOURCE	*ESTIMATED DAILY SUPPLY*
(B) 1.) Municipal GW (2005) 2. a.) Domestic Wells (16,973 @ 3afy) b.) Consumptive Use (USGS model)	**8,724,581.070** mgd **45,457,553.62** mgd **(a) 22,264,065.144 mgd** **(b) 21,893,131.961 mgd**
	Total *54,182,134.69 mgd* / 22,264,065.144 mgd
(C) ALTERNATIVE – Surface water from City Treatment Plant	**4,098,580. 66** mgd
(D) Pending – Buckman Diversion 2010 At maximum capacity of other stakeholders	**7,793,641.72** mgd
Or 5000 afy future purchase (unlikely) because of the Supplemental GW wells use in Long Range Water Plan	**5,004,714.** mgd Total 16,896,936.38 mgd
Result: *Petitioned aquifer would be a principal source, because the alternative sources can supply less than the volume of drinking water supplied by the petitioned aquifer.*	

(4) SOURCES OF DRINKING WATER/PUBLIC SUPPLY SYSTEMS (Narrative)

4a) Total number of domestic wells within the aquifer quadrants (by Townships and Range identified in Table B) 16,973 domestic wells in the OSE data base since 1968 reporting became mandatory. It is estimated there are 5,000 additional wells, about 1/3 more wells, in the entire EBSSA prior to 1968. This would bring the total number of groundwater wells to estimated 22,000 wells in the EBSSAS. Even in the long range plans of the City of Santa Fe use 110-120 gallons per capita which is still on the high end (see above USGS equation) since we used the medium range average of 96.1 to figure consumptive use as in the original petition and use herein. The only surface water diversion within the EBSSAS is the City of Santa Fe.

4b) Data Source for figures is from the OSE and the City of Santa Fe (See Appendix Table B)

4c) Summer diversions higher & c.u. (June – October) due to irrigation; smaller % return flow.

4d) “Potential capacity (environmentally) is zero because non-sole source aquifers originally contributed to recharge of SSA, which was already fully (or over-) appropriated; actual supply and use by “traditional communities” of La Cienega and La Cieneguilla areas probably underestimated by Spiegel, 1963, p. 188 because 1951-2 data base was during a drought period, and some effects on wells outside the traditional areas may already have occurred, in part compensated by Santa Fe Sewage effluent return flow surface (La Cieneguilla) and subsurface (La Cienega).

3.3.3 (5) <u>Potential Water Sources</u> –

(5a) Introduction. See narrative for Sec. 3.3.2 above (alternative aquifers are either part of the SSA(S) or are already fully appropriated, contaminated, or in limbo because of physical, legal, or financial political factors.).

(5b) Narrative description. See preceding Section.

· GROUND WATER IN PRE-TESUQUE AQUIFER ELEMENTS.
· SURFACE WATERS IN ADJACENT AREAS TO EAST AND SOUTH
· Santa Fe River ABOVE SANTA FE in the Upper Canyon watershed.
· CITY OF SANTA FE WASTEWATER EFFLUENT
· GROUND WATER NORTH OF SANTA FE RIVER TO POJOAQUE-NAMBE RIVERS
· RIO GRANDE (below and above Otowi gage)
· RIO GRANDE VALLEY GROUND WATER, UPSTREAM OF OTOWI GAGE
· SAN JUAN-CHAMA DELIVERY OF COLORADO RIVER BASIN WATER

(5c) Why alternative sources are not used presently?

(A) Rio Grande below Otowi gage--not used because of high cost (acquisition of rights [($10,000 afy), silt removal, distance, high lift)] and legal and institutional obstacles.

(B) Rio Grande above Otowi--not previously available because of location on Indian lands; currently and in foreseeable future, sources are in limbo (see preceding and following sections). Water quality may be a problem requiring high additional cost for treatment.

(C) Distant sources are far too expensive for SSA users to develop and deliver, without working through city and/or county of Santa Fe (negotiations are under way, but infirm at this time, as noted elsewhere in narrative, particularly the next section). Federal funds as a major source are denied at this time.

(5d) Legal and institutional constraints.

(A) Rio Grande below Otowi gage--All water allocated under US-Mexico International Compact and Rio Grande Compact (CO, NM, TX); fully (over!) appropriated by senior users, including MRGCD and cities of Albuquerque and Santa Fe; transfers limited by MRGCD and competitive environment (cost, time delay for applications and legal resolution of probable protests). Santa Fe's Buckman well field diverts part of its long-term supply from the Rio Grande mainstem below Otowi gage, and some from the mainstem and tributaries above Otowi gage (see (B) below).

Sources too distant and expensive for SSA users to utilize except in cooperation with Santa Fe City and county, whose current efforts are slow and possibly ineffective.

Probable contamination from 2000 Cerro Grande fire and subsequent erosion of Los Alamos 1,400 dump sites, as well as past and continuing site leakage from Los Alamos since early 1940's, and leakage and spills from Red River area molybdenum mine tailings and chemicals (since 1960's) and other mining, industrial, agricultural, and municipal sources.. San Juan-Chama water: see (B-3) below.

(B) Rio Grande above Otowi gage--

(1) Native waters originating in NM--SURFACE AND GROUND WATERS fully appropriated--transfers difficult, costly, and delayed. Export of Community Acequia rights strongly opposed by traditional communities; much of supply, and most in critical months, is from ground-water discharge.

(2) Ground waters: Current and possible future additional amounts diverted to Santa Fe from Buckman well field, which have some adverse effects on the Rio Grande above Otowi gage. (See Spiegel 2002 CES Website: Zane Spiegel's Draft Comments on the Los Alamos National Laboratory Report "Analysis of Capture Zones of the Buckman Wellfield and a Proposed Horizontal Collector Well North of the Otowi Bridge").

Santa Fe County project for diversion of Rio Grande surface water through caisson-gallery system in progress under agreement with San Ildefonso Pueblo--progress slow and questionable for reasons not made public by participants in project. Test results from first site not sufficient in quantity and additional sites may be limited by San Ildefonso Pueblo due to sacred lands (Spiegel, pers. comm. based on Pueblo lease proposal.) Water quality may be degraded by passage through post-glacial and recent Rio Grande channel deposits (Spiegel, 1961, 1964; also see (A) above for sources of channel sediment and pore-water dissolved contaminants).

(3) San Juan-Chama diversion: Waters have long been allocated to early claimants (Albuquerque, Santa Fe, Espanola, Taos, etc…). Negotiations under way for participation with Santa Fe City and County, but with problems noted above.

(4) Santa Fe City wastewater effluent: Some water privately contracted, for non-potable use only because of poor chemical quality and historical poor performance of WWTP. Future supplies for irrigation at Cieneguilla under negotiation with Santa Fe. Potable use in SSA area will require expensive storage and treatment facilities, as noted above ground water in areas near the Santa Fe Wastewater Treatment contaminated by sub-standard effluent releases from 1948 to present (Spiegel, pers. comm.)

(5e) See page

(5f) See page

(5g) Needs for transfer to alternative sources:

(List by source--see 3.3.3 (5b) above.

· GROUND WATER IN PRE-TESUQUE AQUIFER ELEMENTS of LCVASSAS (NA--already part of SSA, inad. Q)

· SURFACE WATERS IN ADACENT AREAS TO EAST AND SOUTH (over appropriated--(SEO))

· SANTA FE RIVER ABOVE SANTA FE (over approp.--SEO)

· CITY OF SANTA FE WASTEWATER EFFLUENT (denitrification, availability not assured)

· GROUND WATER NORTH OF SANTA FE RIVER. TO POJOAQUE-NAMBE RIVERS (NA—over approp. (SEO))

· RIO GRANDE (below and above Otowi gage) (filtration & micro-filtr., pipeline, lift stations, ROW over Indian land)

· RIO GRANDE VALLEY GROUND WATER, ABOVE OTOWI GAGE (NA--well yields low+ Espanola & Indian land) with many sacred sites not accessible for wells.

· SAN JUAN-CHAMA DELIVERY OF COLORADO RIVER BASIN WATER (availability/cost; see RG above) Potential contamination by mining, wastes, regional fallout, irrigation return, etc.

(5h) Explained above.

(5i) Not applicable. See table.

THE ESPANOLA BASIN AQUIFER SYSTEM

3.3.4 (1) a. Narrative description of locale of the Espanola Basin SSA System

(1)(a-1) ***Topography***: The principal aquifer elements underlie a gentle southwesterly sloping plain south of the shallow valley of Santa Fe River, and west of the rugged foothills of the southernmost Sangre de Cristo Range. Both types of terrain contribute direct recharge (by infiltration of surface runoff into sandy runoff channels) to portions of the principal aquifer elements. Rocks in the foothills and mountains, West, and North to the east of the principal aquifer elements contribute additional recharge by direct lateral inflow or more commonly, by natural discharge to small springs into arroyo alluvium, thence by channel infiltration into underlying aquifer elements downstream.

The south edge of the aquifer system is formed by a thinning of the principal aquifer elements on a northwesterly-sloping base of older, low-transmissivity aquifer elements which has been truncated by down faulting of large blocks and subsequent erosion by Galisteo River. The west side of the aquifer system, south of the Chama River and west of the Rio Grande is connected by a highland of volcanic rocks. The Rio Grande and its tributaries have been superimposed on this volcanic terrain. The principal aquifer and associated lavas are exposed in most of the area NE of the Chama River and west of the Rio Grande.

(1)(a-2) ***Climate****:* The regional climate of the aquifer system, temperate semi-arid monsoon, is dominated by (1) its location where global movements of frigid, dry air masses from the north and cool to cold moist air masses from the northwest, alternate or interact with warmer, very moist air masses from the Gulf of Mexico and Pacific Ocean offshore of southern California and northwest Mexico, and (2) its high altitude (about 6,000 feet to more than 10,000 feet above sea level) in an area bordered by even higher lands to the north and west.

"Normal" weather is clear with low humidity (about 80 percent of the time), with some clouds over higher lands, caused by cooling of updrafts created by transfer of solar heat from land to the air, uplift of local air currents against the highlands, and at night, radiation cooling of the highlands, which cools adjacent air. The cold heavy air flows down the slope by gravity at night and accumulates in tributary valleys and the inner valley and adjacent terrains of the Rio Grande. These processes are accentuated when moist air masses from the southeast, southwest, or northwest have entered the area, at which times local thunderstorms commonly occur, mostly in summer, but occasionally even in winter. The cloudiness reduces day temperatures, but also reduces night-time temperature inversions.

Major widespread precipitation occurs primarily when moist, warm maritime air masses move into the area at the same time that cold, denser air is moving southward from higher latitudes, causing substantially greater uplift of the moist air, and more rapid cooling and condensation of the water vapor in the maritime air, resulting in the winter monsoon pattern, most commonly from November to March. Fall and the early spring months are normally drier, but the very warm and moist summer air masses that break out of the Gulf of Mexico, due to intense solar heating of the sea and overlying air, periodically cause summer monsoons which provide most (on average, half, in the months July to September) of the annual direct precipitation to the La Cienega Valley proper and bordering plain to the east. Average annual precipitation is about 13 inches, more on higher lands. (See Spiegel and Baldwin, 1963).

(1) (a-3) ***Geology:*** The principal aquifer elements of the EBASSA are simple in stratigraphy and structure--a generally westerly dipping sequence of interfingering beds of clay, siltstone, and sandstone, called the Tesuque formation (Miocene to Pliocene age), overlain unconformably south of the Santa Fe River by the thick sheet-like layer (Ancha Formation, of Pleistocene age) of poorly cemented, pebbly and bouldery piedmont deposit, with an irregular base deposited on an erosional surface with several well-defined buried valleys that had been cut into the tilted sequence of the underlying Tesuque Formation. North of the Santa Fe River discontinuous sheets of terrace gravels and arroyo alluvium cover much of the Tesuque Formation and equivalents and facilitates recharge.

The first detailed mapping of the area in 1951-52, by Baldwin, Kottlowski and Bundy of the NM Bureau of Mines (Baldwin, 1963), had relatively few reliable well logs to define the interface between the Tesuque Formation and the Ancha formation and associated alluvium, particularly in the area south of the Santa Fe River valley, so the presence of deep buried valleys northeast of La Cienega, roughly parallel to the courses of present-day Arroyo Hondo and Arroyo de los Chamisos - was not detected until 1975, when more data had become available from uranium exploration test holes, and the State Engineer office had collected logs of all new wells, including thousands of private domestic wells, pursuant to the declaration and extension of the Rio Grande Underground Water Basin (RGUWB) in 1957 and 1968, respectively. A report on the hydrology of the vicinity of the Santa Fe Downs (Spiegel, 1975) was the first to recognize the importance of the Ancha-filled buried valleys. Fleming (1994), with many more records of private wells available, prepared a more detailed map of the basal configuration and thickness of saturation of the Ancha Formation.

However, pre-Tesuque rocks in the eastern part of the aquifer system also contribute some lateral inflow to ground water of the three principal aquifer elements; are a source of much surface runoff, which contributes to the recharge of the principal aquifer elements, and locally are a source of water for some individual residential wells and community supplies. (See Section3.3.4)

Therefore, a brief description of the geologic history of the area follows (see Spiegel and Baldwin, 1963, and annual presentations at EBTAG (2002-2006, conferences1-5) for more details and maps). The Sangre de Cristo Range, from the vicinity of Glorieta Baldy on the south to the Truchas Peaks area on the north are formed primarily of crystalline rocks of Precambrian age--quartzite and schist (metamorphosed sandstone and shale, respectively), dark green and black amphibolite (iron- and magnesium-rich minerals) masses and dikes, and gray and pink granite with related quartz dikes. These erosion-resistant rocks were source areas for lower Paleozoic rocks (Cambrian age) that were deposited in southern NM and in Colorado, but remained a “positive area” (rising source area) as later sedimentary marine rocks (Silurian, Devonian, and Mississippian-Pennsylvanian age) in Northern New Mexico lapped up onto gradually diminishing areas of outcrop of Precambrian rocks. Several areas of folds developed, with corresponding large local changes in thicknesses. These rocks were principally shale, sandstone (with significant interbeds of coarse conglomerate), and limestone, locally with distinctive fragments of pink potassium-feldspar from nearby outcrops of Precambrian granite.

Toward the end of Pennsylvanian time, the positive area broadened, marine waters became shallower, with more arid source areas, and a sequence of fine-grained red sediments with local gypsum and salt beds (Permian age) was deposited, thinning rapidly toward the range crest, thickening east and south. After Permian time ended, the positive area rose more rapidly, and coarse red basal conglomerates and sandstone of Triassic age overlapped and removed the gently upturned edges of Paleozoic rocks. Deposition of sandstones, shale, and more gypsum layers continued in Triassic to Cretaceous time.

In early Tertiary time, deep basins formed south and east of the positive areas, filled with red clay and sandstone (Galisteo Formation) in the south and equivalents in the north, probably derived from the predominantly red sediments previously deposited on the flanks of the positive area, followed by intrusions and associated extrusions of lavas and tuffs of intermediate composition (Espinaso Formation), apparently also mostly southwest of the present Sangre de Cristo Range. During mapping of the Santa Fe area in 1951-2 (Baldwin, 1963), and in later work by Spiegel (pers. comm.), a few outcrops of presumed Galisteo Formation were discovered below the lower part of the Santa Fe Group in several localities at the west edge of the foothills. At these and other outcrops, the basal Tesuque Formation contained weathered debris from intermediate intrusive/volcanic rocks similar to the Espinaso Formation to the south and the Picuris Tuff to the north. Near Bishop's Lodge in Tesuque, and at other sites to the north, deeply weathered basalt flows were found, leading to the naming of this part of the Tesuque Formation the Bishop's Lodge Member (Baldwin, 1963). No evidence of closer sources of volcanic rocks was found (the nearest being on the west side of Interstate Highway I-25 on La Bajada, a steep hill southwest of the LCVASSAS), despite continuing search by Spiegel (pers. comm.). However, in spring 2000 the long-sought-for intra-mountain source of similar volcanic rocks was found by a NMBM geologist at Rosario Hill, between Cowles and Pecos, NM. directly east of the Santa Fe River area.

Some time after the deposition of the Espinaso Formation and probable equivalents in and north of the Santa Fe area, the positive area to the east rose again, and most of the probably once-extensive outcrops of the Espinaso Formation and underlying Galisteo Formation were eroded away from the flanks of the ancestral Sangre de Cristo Mountains, to be deposited (in inverted order) as the Bishop's Lodge member of the Tesuque Formation and the main unit of the Tesuque Formation. At about this time, and continuing through Ancha time, numerous volcanic centers and associated dikes erupted along north-trending faults west of La Cienega, La Cieneguilla, and Pojoaque Valley.

There might have been some faulting and folding (associated with the earlier periodic rises) along the margins of the positive area. However, most of the many nearly vertical faults and narrow fault blocks that locally preserved pre-Tesuque rocks (evident in some early well records, at Eldorado and in outcrops in the drainage ways that cross the foothills in the Santa Fe area) probably occurred after the deposition of the Tesuque Formation, but before the deposition of the Ancha Formation. In addition to the less well exposed foothill faults, some very large late faults caused the steep escarpment --the south boundary of the EBASSAS--that overlooks the lower Galisteo River valley.

The result of the foregoing geologic history is the present day plateau surface underlain by the principal aquifer elements of the southern EBSSAS and associated older rocks that form minor aquifers, bounded by the high ridges of crystalline Precambrian rocks to the east, and isolated by large blocks of much less transmissive rocks to the south and west. Although the Tesuque Formation continues northward beyond the Santa Fe River, Most area lack the thick section of better-sorted and poorly-cemented sandstones found along the present Santa Fe River and Canada Ancha.

The city's early presence (since 1609) and preemption--indeed over-development--of all available surface water and ground water, accentuated by the construction of McClure Dam in 1946-47 and deep municipal wells, beginning in 1946. Therefore the city (and recently the Santa Fe County) effectively blocked access to any possible alternative water supplies to the north. Ownership of much of the lands and most senior water rights by several Native American Pueblos north of Santa Fe has recently required cooperation between indigenous and later cultures, However, considerable natural and anthropocentric recharge, with attendant urban contamination to the southern EBSSAS, still occurs along the channel of the Santa Fe River, Pojoaque, Santa Cruz, Rio Grande and Rio Chama, as well as by infiltration of storm-water runoff from densely developed terrace and alluvial fan lands along the rivers. Until recently, north tributaries of Santa Fe River, north of the municipal airport, provide some relatively uncontaminated surface water and recharge to the Cieneguilla area.

Indeed, the recent spurt of large-scale development along and north of the Santa Fe River and in the southern part of Santa Fe and adjacent County lands, without adequate provisions for protection of the water quality or senior rights of the EBSSAS, or adequate consideration of many other environmental problems, has been the principal impetus for the petition for SSA status of the area.

(1)(a-4) **Ground-water use and occurrence**

The earliest human uses of the ground waters of the EBSSAS were by small pre-Hispanic groups that settled along natural discharge sites for the aquifer system in the eastern areas of pre-Tesuque Formation aquifer elements described above, at least during hunting and trade expeditions. The settlements were probably located at low-lying lands adjacent to natural perennial wetlands for convenience in growing their traditional crops, thus avoiding the considerable extra labor required to develop larger, but more variable, supplies available seasonally along the river (Spiegel, 1963, p. 91-

2) and other streams to the north. The Santa Fe sites had been abandoned at the time of the Spanish settlement of Santa Fe in 1609 but numerous favorable spring –fed sites to the north had been occupied for centuries. Walk-in wells are known to have been used at Santo Domingo and other pre-hispanic sites in northern New Mexico, but the first known wells to the north were dug by Spanish settlers.

Spanish colonization on a larger scale began in the early 17th century, with agricultural settlements based on acequias dug in the principal natural discharge areas of the aquifer system--at springs and associated natural wetlands (which were appropriated according to Spanish law, according to seniority) at La Cienega and Cieneguilla. Pojoaque and other valleys to the north,, and these early settlements, like early Santa Fe and Agua Fria, developed in traditional form, continuing to use their spring flows, with expanded wetlands (vegas) created by leakage from acequias and by deep seepage under irrigated fields.

As the populations grew, family lands were subdivided among heirs, and although wells supplanted the use of acequias for domestic uses, the crowding together of individual wells and waste systems caused contamination as bad as or worse than in the days when acequias were the principal water supplies. Increasing awareness of public health problems, in addition to greater convenience, made deeper drilled wells a more desirable source of domestic water than the traditional acequias and shallow dug wells. As many of the springs emerged from the aquifers, in large part because of the thinning of the aquifer at its western edge, most wells, even the newer drilled wells were not very deep, and were susceptible to contamination by livestock and privies or septic systems. Therefore community organizations (Mutual Domestic Water Consumers Associations, MDWCA) were formed to qualify for state and federal construction funds and professional design of water systems, consisting of wells, storage tanks, and distribution lines, at La Cienega and other communities.

During the later stages of the above community history, beginning in the late 18th and early 19th centuries, trade of Santa Fe with communities to the north increased, and accelerated rapidly after the opening of the Santa Fe Trail. This trail came south along the eastern edge of the Sangre de Cristo Range, across the relatively low Glorieta Pass, down headwater tributaries of Galisteo River, and northward along the western foothills of the mountains, probably following logical paths used by previous Native American travelers, which passed through or near perennial water supplies

(ground water discharges from peripheral aquifer elements of EBASSAS in Canada de los Alamos and Arroyo Hondo and coming from the eastern edge of the Sangre de Christo Range.
Most of the plains east of what is now called the Caja del Rio area were large cattle ranches during the late 19th and early 20th centuries, including some lands that were homesteaded during part of this time, and had left distinctive small-scale dune topography where the land had been farmed or over-grazed. The old dunes became re-vegetated by grass, but with some remaining "pioneer" vegetation (yucca and cholla cactus). Some of the homesteads remained in family ownership, with some limited sub-division for "ranchettes" and isolated home sites.

Numerous small mines and accompanying communities existed at various times in the Cerrillos ("small hills") area, as well as a large coal mine and community at Madrid, a few miles south of the SSA boundary. The mine and community were served by a branch line of the Santa Fe Railway from a junction at Waldo, a few miles west of the village of Cerrillos, beginning about 1881. A large tank at the Waldo station received water by a railway-built pipeline from former springs in San Marcos Arroyo, one of the original natural discharges of ground water from aquifer elements of the southern EBSSAS. This pipeline also has supplied (and still does) the Cerrillos station and adjoining community. In addition to supplying water for the railway's steam engines, water was hauled from the former Waldo tank to Madrid by railway tank cars until about 1950. After that time Madrid has been supplied with water of marginal chemical quality (high sulfates) by local wells. Another railway supply was provided at Lamy station, from a spring in Galisteo valley upstream of the village, outside of the EBSSAS. To the north in the narrow gorge "Chili Line" used springs and wells for stations.

Most wells in the principal aquifer elements were for stock water and limited ranch home use, and were pumped by windmills until recent decades. Some state facilities have been supplied by local wells and waste disposal systems (e.g., Prison and National Guard) and residential subdivisions, on large and small scales, have been created, mostly after WW II. Most of the facilities have been served by individual wells and septic systems, which are the principal sources of contamination of the EBSSAS. Community well systems are listed above, in Sec. 3.3.3(4).

Prior to the creation of the Rio Grande Underground Water Basin (RGUWB, 1956) and its extension into more part of the EBSSA area in 1968, wells were drilled without necessity for state permits or well records, or any provision for compensation to owners of senior water rights in the fringes of the SSA. After the RGUWB rules took effect, commercial or community well systems required transfer of pre-existing water rights, but many subdivisions were allowed to be created using individual wells drilled (by the thousands) under the "S&D" statute (NMSA 75-11-1, now 72-12-1), for a very small fee to the OSE. The owners of these wells do not have to account for their depletion of natural discharges nor compensate the senior water-right holders. Although there may be legal remedies, to be initiated by the impaired parties, the proceedings are undoubtedly expensive and protracted, and possibly with great delay in effectiveness.

In addition to the depletion of local ground-water storage and eventual diversion of the natural discharge used by the traditional and other old communities noted in Sec. 3.3.4(1)(d-1) and (d-2), most of the wells drilled were used for purposes which generated effluent to the EBSSAS which contain dissolved nitrogen compounds and other contaminants.

3.3.4 (A) BOUNDARY INFORMATION

DESCRIPTIONS OF AQUIFER-SYSTEM UNITS

INTRODUCTION

The concept of a set of ground-water sub-basins connected by a major river was probably originated by Kirk Bryan, a native of Albuquerque, while a student and professor of geomorphology at UNM. Later, as professor at Harvard University, he and several graduate students did geological studies of the Rio Grande rift valley and some of its sub-basins. Bryan (1938) summarized these works. Related hydrologic aspects of the Rio Grande rift were summarized by Theis (1938), especially concerning contributions of aquifers to the surface flow of the Rio Grande. Theis (1940, 1941) and Spiegel (1961) published important concepts of quantitative hydrology of the Rio Grande. The latter study indicated that one reach of the Rio Grande (near and upstream of the Jemez River) had natural ground-water levels lower than the river and its drains, due to extremely high transmissivity of an underlying stratigraphic unit of "axial river gravels", not known in the Santa Fe area (Baldwin, 1963). The lower natural ground-water levels in this reach allowed the Rio Grande to contribute natural recharge to the aquifer, which under natural conditions would have contributed to river flow in the next reach downstream or reduced the artificial lowering of ground-water levels by local wells there.

General analytic mathematical quasi-3D models of the inter-relations of pairs or multiples of successive strata in rectangular- or circular–plan regions were conceived and named *“stream-connected aquifer systems”* by Spiegel (1962), developed concurrently with the Jemez River study (Spiegel, 1961, op. cit.), following several years of field study of various aquifers in other portions of the Rio Grande rift. Some of these field studies were done as follows: 1949-51, part of Socorro County (published 1954); 1949, in the Pajarito Plateau and adjacent Jemez Mountains and Valles Caldera; and 1951-53, in the Santa Fe and Tesuque-Pojoaque areas (published 1963); 1956 (with R. L. Borton), reconnaissance of rift aquifers and spring-fed streams from Colorado to Mesilla Valley; and 1960-62, compilation of available field data, reports, and analogous *Boundary Value Problems (BVP).* Several examples of sets of *mutually-leaky aquifer elements* (expanding the new mathematical work by Hantush (1948; various later works) on radial 3-D drawdowns by wells in leaky aquifers connected to one or more streams or lakes were generalized under the new concepts and appurtenant terminology. One of these aquifer-system models was posed and solved for the case of natural circulation of water in the overlying river channel in an upstream reach to underlying and adjacent aquifer elements, with return to ground water and the river farther downstream—like the case of the Jemez River area field study (Spiegel, 1961. op. cit.). Other similar situations probably exist, for example, in the Lower Rio Chama area. Contamination of the Rio Grande or tributaries and related aquifers (from regional atmospheric fallout, LANL, other industrial and municipal effluents, and mine drainage/tailings leachates) has already occurred at various sites in the proposed expanded area of LCVASSA and upstream.

Some aspects of our original petition for the LCVSSA, now the Santa Fe River sub-basin, were opposed by representatives of Santa Fe City and County, and one state agency (New Mexico Environment Department, NMED), primarily on the basis of one or both of two objections. The first objection alleged that ground-water sources for the proposed SSA did not meet the EPA minimum of 50 percent of the total drinking-water supply for the area. Although both our original estimate and those of the objectors were considered by the respective parties to be accurate, all were based in part on unprovable assumptions. Our estimate, if augmented by new considerations available in 2001, would have enabled us to meet the 50 percent requirement with little doubt. These additional sources are (a) ground-water components of tributary surface-water basins; (b) natural recharge of tributary surface waters directly to the proposed aquifer system; (c) incidental artificial recharge of surface waters and imported Buckman Well Field waters distributed to water users within the original SSA area; (d) new tabulations of private wells and small public water-system well fields not yet released at the time of our first petition; and (e) the 2000 Census of population in non-city areas of Santa Fe County and a private estimate (by a local Hispanic organization) of a very large number of undocumented immigrants in our area, also not available earlier.

The second objection was that the area of the original petition omitted similar areas contiguous to the petitioned area. As EPA had accepted other partial-aquifer areas as sole-source aquifers, this objection was rejected. However, new geological investigations of the Espanola Basin and other parts of the northern Rio Grande Rift (USGS, 2004) and related interagency studies--Espanola Basin Technical Advisory Group (EBTAG, var.)--have produced maps which facilitate expansion of the original SSA Petition area. In addition, increasing evidence of widespread contamination of aquifers by many private and public waste-water disposal systems in these adjacent areas provided a reasonable basis for several of these agencies to request our expansion of the area of our original SSA Petition. We have made the necessary adjustments in geographic coverage and description and renamed the original LCVASSA as “Espanola Basin Sole Source Aquifer System” (EBSSAS).

(B) PROPOSED ADDITIONAL EBSSAS SUB-BASINS (from south to north)

We have expanded the area of the original petition by adding one small area (all the lower Santa Fe River drainage basin from the junction of Cienega Creek west of the La Cienega Valley down to Cochiti Dam) and several large sub-basins north and northwest of the original area, both east and west of the Rio Grande. These are listed and described below, beginning with the lower portion of the Santa Fe River basin, followed by several sub-basins of the adjacent main portion of the Espanola structural basin and their contributing areas of surface and ground waters. Valleys of the Rio Grande and Rio Chama and their respective tributaries deliver large quantities of surface water (including respective base flows from various local aquifers therein), plus variable quantities of diverted San Juan River water, to the Espanola structural basin. Some of these surface waters might now or in the future be diverted from the river channels to wells in the proposed expansion of SSA, or for direct municipal use, after extensive (and expensive) treatment. Funding and construction will take many years to complete, and current hopes may need to be revised. Like areas described previously (Spiegel, 1962, 1963; CES, 2000), all sub-basins are hydraulically interconnected. The proposed new sub-basins are listed and described below, and illustrated on a separate set of maps outlined by us in brown on USBLM 30x60 min, quadrangle maps(the original maps will be sent to EPA for review) and digitized by CES on TOPO! Tele Atlas and USGS software program.

In each new sub-basin, lines separating the principal regional aquifer from adjoining aquifer elements with lower transmissivities were transferred by NMOSE to our augmented SSA map from USGS Open-File Report 2004-1040 and/or related new geologic maps. The Rio Grande or other streams and surface-water drainage boundaries that "bound" proposed new sub-basins are not to be construed as hydraulic barriers, but only as types of boundaries long used in common mathematical models, such as BVP and their digital equivalents. The primary reason for this is that real streams usually do not fully penetrate aquifer elements, which they overlie or adjoin. The assumption of surface drainage boundaries or river full-penetration boundaries herein or in analytic ground-water models is made to simplify the models and their analytical solutions. Such approximations are usually neither needed nor useful in digital models, and if used, give untruthful results. No model results should be believed until all explicit and implicit assumptions are fully listed and evaluated.

ADDITIONAL SUB-BASINS EAST OF RIO GRANDE

Lower Santa Fe River sub-basin, La Cienega Valley to Cochiti Dam Canada

Ancha/Rio Pojoaque sub-basin

Picuris Mountains/Truchas Range sub-basin

ADDITIONAL SUB-BASINS WEST OF RIO GRANDE

Pajarito Plateau sub-basin

Lower Rio Chama and NE tributary valleys, Abiquiu Dam to Rio Grande

(C) DESCRIPTIONS OF ADDITIONAL SUB-BASINS EAST OF RIO GRANDE

(1) Lower Santa Fe River sub-basin, La Cienega Valley to Cochiti Dam

This sub-basin encompasses most of the lower portion of the Santa Fe River and adjoining Caja Del Rio Plateau. The plateau has persisted due to erosional resistance of its extensive basaltic flows that erupted along feeder dikes and volcanic centers. These sources trend northerly from the vicinity of La Bajada village to the Buckman area and San Ildefonso's Black Mesa. Arsenic and uranium in some Buckman well waters (Spiegel, 2000, var.) probably originate from basaltic dikes similar to those related to hydrothermal mineralization and related hazardous metals at a small mining area near La Bajada.

The western boundary of this sub-basin commences at the top of a small cinder cone (1980 meters) NE of the I-25 Waldo Interchange and trends westerly across the basalt cap of Mesita de Juana Lopez, thence WNW off the Mesita to La Majada Mesa to Cochiti Dam along a wing dam and artificial cut that (at high lake stages) connect the Santa Fe River arm of Cochiti Reservoir to the main reservoir. The western boundary continues northerly on the center lines of Cochiti Reservoir, its Rio Grande estuary, and/or the Rio Grande to a point on the Rio Grande that is southeast of White Rock center, then up the steep east slope of White Rock Canyon, along an old trail to Sagebrush Flats.

The east sub-basin boundary, common with the southwestern boundaries of the proposed Canada Ancha/Rio Pojoaque sub-basin and original Santa Fe River sub-basin, trends southerly across the eastern part of the Caja Del Rio Plateau, to Ortiz Mountain, Twin Hills, hills "2144 m" and "2059 m", and Las Tetillitas to a point on Santa Fe River just below its junction with Cienega Arroyo, where it completes the boundary loop by joining the western boundary described in the first sentence of the preceding paragraph.

(2) Canada Ancha/Rio Pojoaque sub-basin

Most of this sub-basin is underlain by generally west-dipping Tesuque Formation of the Santa Fe Group, or equivalent (contemporaneous, but locally with different source areas, hence slightly different lithologies). Locally these beds are overlain by basaltic tuff and lava, and cut by flow-source dikes. To the east, the thick Tesuque Formation laps up on or is faulted against Paleozoic and Precambrian-age rocks of the Sangre de Cristo Mountains. These older rocks contribute both surface and ground water to the principal aquifer elements farther west. The mountain drainage areas include weathered and fractured rocks, locally overlain by moraines, talus, slopewash, and terrace and channel deposits which contain thin to thick zones of saturation which sustain perennial or intermittent streams *(base flow).*

The Tesuque Formation in the western part of this basin (particularly in or near Canada Ancha valley) contains some westerly-dipping higher-transmissivity strata. This was predicted in 1973 (Spiegel, 2004, pers. comm.), on the basis of locally wide spacing in water-level contours (see Plate 7 and related text of Spiegel and Baldwin (1963)). Spiegel's prediction has been confirmed in the past few years by test drilling of five exploratory wells in the Tesuque Formation for the City of Santa Fe. These wells were drilled in strata equivalent to the most productive strata of the Tesuque Formation in Santa Fe's original well field along Santa Fe River in the 1950's. The "Northwest Well" is the first of the five recent wells, and is in the Santa Fe River drainage basin. The other four are along Canada Ancha, the route of the water pipeline from the Buckman Well Field to Santa Fe (see USBLM, 2003: Spiegel, 2003 a.), just outside the area of our original petition.

In the La Cieneguilla area, and farther south (as noted in Spiegel and Baldwin, 1963; Spiegel, 1975, 2000), the westerly-dipping strata of the Tesuque Formation preserved in the subsurface are less permeable (possibly because of some structural deformation). However, post-Tesuque erosion and deposition created a system of buried valleys filled by thinner, but more permeable sediments of the Ancha Formation, which probably are connected hydraulically to the belt of sandy Tesuque Formation strata to the north.

The five recent wells drilled between Santa Fe River and Buckman have been approved for temporary and emergency supplies for the City of Santa Fe, but might be used regularly in the future, either as replacements for some of the original Buckman wells or (if new water rights are acquired) as supplements to the original Buckman wells. These early wells were closely spaced and too close to basalt dikes and associated sources of mineralized water. Regional anisotropy, caused by the combination of the Tesuque Formation's well-sorted, sandy strata that have westerly dip/northerly strike in this area, and the line of five new wells, hydraulically link the Buckman Well Field with nearby springs and well-fields.

These areas are: (1) springs and wells to the north (northerly from Buckman Well Field on both sides of the Rio Grande (some on San Ildefonso lands), and other springs and wells on San Ildefonso and non-pueblo lands along the lower Rio Pojoaque); (2) springs to the south, (at La Cieneguilla, now submerged by Santa Fe's sewage effluent); and (3) numerous private wells and Santa Fe's first well field—along Santa Fe River. The natural springs at La Cieneguilla (prior to submergence by Santa

Fe waste-water effluent) discharged from saturated Ancha Formation sediments that unconformably overlie the Tesuque Formation in a system of buried valleys cited above (Spiegel and Baldwin, 1963; Spiegel, 1975, 2002).

Long-continued production of new and future large-capacity wells in this area will undoubtedly have adverse effects on separate springs that discharge through overlying Ancha Formation sediments filling buried valleys eroded into the Tesuque formation near La Cieneguilla and La Cienega, and on existing wells in the Santa Fe River drainages to the southeast, as well as in other directions, particularly down-dip and along the strike of permeable strata of the Tesuque Formation.

The thick buried-valley sediments of the Ancha Formation in the La Cieneguilla area have long been contaminated by dissolved nitrates and other nitrogen species having their origin in domestic waste effluents from private and public sources (Spiegel, 1963; 1999-2002, var.; NMED, var.; USGS/NMOSE monitoring program). Long-term effects of the aforementioned new large-capacity wells would likely induce or increase inflow from the well-documented nitrate-contamination plume in the Ancha Formation into the adjacent or underlying Tesuque Formation by augmenting substantial combined regional drawdowns by thousands of other wells. Similar effects have occurred in many areas of the new sub-basins proposed herein and have caused numerous public-health problems. The principal aquifer elements in this sub-basin are stratigraphically continuous with those to the southwest and west, but locally westerly flows of ground water in them are diverted laterally by central and dike conduits and eventually reach the Rio Grande. The Puye Formation under the Los Alamos National Laboratory (LANL) area, which contains semiperched ground water locally contaminated by LANL wastes, is not recognized east of the Rio Grande, but may be a time-equivalent of some of the Ancha Formation.

The west boundary of this sub-basin coincides with the eastern border of the Lower Santa Fe River sub-basin on the Caja Del Rio Plateau, and farther north, with the Rio Grande.

The northern boundary of this sub-basin follows east-west trending ridges between San Ildefonso Pueblo’s Black Mesa, in Santa Fe County, and peak “3766 m.” (Two miles north of Santa Fe Baldy). These ridges divide tributaries of the Rio Nambe on the south from those of the Rio Santa Cruz on the north.

The east boundary trends southerly from “peak 3766 m.” along a ridge rising to Santa Fe Baldy, then descending to the southeast, around the head of Rio Nambe, across Puerto Nambe saddle to Penitente Peak at the head of Santa Fe River Canyon, the north limit of the original SSA petition. This portion of the east boundary of the sub-basin is also the divide between Rio Grande and Pecos River tributaries.

The southeast boundary of this sub-basin trends west from Penitente Peak to Lake Peak, where it becomes the south boundary, in common with the north boundary of the original petitioned area of the LCVASSA. This original petitioned area is now considered to be a sub-basin of an expanded SSA (EBSSAS). This larger area is essentially the area that has long been called the Espanola Structural Basin, and is an area that is being studied by the Espanola Basin Technical Assistance Group (EBTAG) by the U. S. Geological Survey and numerous New Mexico agencies and institutions. The common boundary continues south-southwesterly along the heads of Tesuque and Little Tesuque creeks for a little more than six miles, then continues westward along the north limits of arroyos draining to Santa Fe River, ending at the southern peak of Twin Hills, along the east boundary of the first new sub-basin described herein ("Lower Santa Fe River basin….").

(3) Picuris Mountains/Truchas Range sub-basin

This sub-basin contains northward continuations of the Tesuque Formation, the principal aquifer element of the Canada Ancha/Rio Pojoaque drainage basin. As in the Canada Ancha/Rio Pojoaque sub-basin to the south, the principal aquifer element (Tesuque Formation and equivalents) appears to overlap older rocks to the east, but is locally in fault contact with them. The Santa Fe Group equivalents in the central/western portions of the area are generally finer-grained and less transmissive than those of the type areas to the south, probably because most of the source rocks of the aquifers, except for some local lavas and tuffs, are fine-grained sediments of Mesozoic and uppermost Paleozoic age rather than the much more erosion-resistant rocks of Precambrian age to the east and southeast, which locally provide coarse sand and pebbles to the Tesuque Formation. However, the climate during the time of the deposition of the Tesuque Formation must have been warm and humid, and the rate of uplift of bordering source rocks very slow to account for the thick section of silt and clay beds prevalent in the eastern and central portions of the sub-basin.

The west boundary of this sub-basin is the Rio Grande, beginning at a point west of Black Mesa (Santa Fe County) and ending near the USGS river gaging station three miles below the Rio Pueblo de Taos. However, as explained above (in the short section following the end of our Introduction), the Rio Grande is not a geohydrological barrier to effects of well withdrawals from alluvium or from the deep and more transmissive beds of the regional aquifer, nor to movement of dissolved contaminants in deep ground water.

The north boundary of this sub-basin extends southeasterly from the Rio Grande in the vicinity of a USGS gaging station about 3 miles downstream from the mouth of the Rio del Pueblo de Taos, along ridges, mostly of crystalline rocks of probable low transmissivity, that descend both east and west from Picuris Peak. In the vicinity of a pass ("U. S. Hill") crossed by NM 518 (formerly NM 3), between Taos and Penasco, the sub-basin boundary follows lower ridges on rocks of Paleozoic age easterly to Cerro del Oso, thence northeasterly to Cerro Olla and Cerro Vista, at the Taos/Mora county line. The north boundary follows surface-water divides between Rio Embudo and its tributaries to the south and Arroyo Hondo, Arroyo del Alamo, and Rio Grande del Rancho to the north.

The east boundary in its low northern portion is formed by a drainage divide near the east edge of part of an old structural reentrant in which Paleozoic rocks (shale, sandstone, and limestone) have been preserved. This portion of the eastern boundary runs southerly along the Taos/Mora county line, which is also the drainage divide between Rio Grande and Mora River tributaries, as far as the eastern tip of Rio Arriba County. All of this part of the east boundary is in shale and sandstone of Paleozoic age. The east boundary then rises southward to the three peaks of the Truchas Range (on Rio Arriba/Mora County line). The Truchas Range has the most conspicuous peaks and evidence of past glaciation (including boulder trains downstream of terminal moraines and associated alluvial fans) in all of New Mexico, in large part due to the highly resistant quartzite strata in the range. The east boundary continues southward along a high ridge with west-facing cliffs (the Trail Riders' Wall) and rises to the top of East Pecos Baldy, jogs westward to Pecos Baldy, and four miles beyond, to the indefinite boundary between Mora County and Santa Fe County, then southerly to "peak 3766 m.", which is the eastern terminus of the south boundary of this sub-basin (in common with the north boundary of the Canada Ancha/Rio Pojoaque sub-basin).

(D) DESCRIPTIONS OF ADDITIONAL SUB-BASINS WEST OF RIO GRANDE

(1) Pajarito Plateau sub-basin

The principal aquifer element in most of this sub-basin is at great depths, but is continuous stratigraphically and hydrologically with the Tesuque Formation of the Santa Fe Group and its thousands of wells east of the Rio Grande. It supplies all drinking water for Los Alamos County, LANL, and most public supplies east of the river. Early spring and stream supplies were augmented or replaced by well fields in lower Los Alamos Canyon and a tributary, Guaje Canyon. Two additional well fields were added in recent decades (see our review, Spiegel, 2003, at <www.environmentalsafeguards.com> ; 2004). The Puye Formation above the regional aquifer contains a locally contaminated, semi-perched zone under much of the Pajarito Plateau. Water recharged on the mesa surfaces and canyons drains down to the “regional aquifer” and some springs in the southeastern part of the Pajarito Plateau.

The natural recharge on the Pajarito Plateau mesas and adjacent lowlands has been falsely assumed by LANL to be zero, on flimsy short-term and indirect evidence, mostly during the current drought (neglecting or denying, first by silence, then by refusing to release information on their reasons for rejecting our written evidence for significant long-term recharge, requested by letter under the Freedom of Information Act (FOIA)). Our evidence consisted in long-term monthly records of precipitation elsewhere in New Mexico, in amounts similar to those on Pajarito Plateau mesa tops, correlated with ground-water levels since the 1920’s, compiled by USGS and NMOSE engineers. Data and explanations of pertinent processes are in Spiegel (1963a, a report prepared under a Federal grant to NMOSE, a copy of which can be read free or copied at cost at Forest Guardians in Santa Fe). Pertinent pages of this report were supplied by Spiegel to LANL staff (at meetings of two citizen advisory groups, Santa Fe’s “Water Quality Task Force”; LANL’s “Focus Group MDA-H”, convened to advise on potential problems with hazardous wastes stored in deep, unlined, cylindrical pits on a mesa in the northern LANL reservation). However, no LANL staff member has indicated any reason why these data from their Focus Group has been ignored.

Most of the two-thousand-plus LANL waste sites are on mesa tops. Therefore LANL’S continuing insistence on their unfounded assumption of zero recharge on the mesa tops and continuing failure to address specific written and oral contrary evidence provided to LANL at meetings of the Santa Fe Water Quality Task Force and LANL’S own Focus Group MDA-H from 2000 to 2003 might best be explained as deliberate attempts to avoid responsible and effective action to protect the underlying aquifers from contamination by infiltration of meteoric waters concentrated in mesa-top swales and arroyos by rainfall and snowmelt in wet years prior to the recent drought, and in future wet years when recharge is most likely.

The southwestern boundary of this sub-basin trends northerly from the right abutment of Cochiti Dam along the adjoining reservoir shore and westerly along the south drainage divide of the southerly of three small tributaries of Cochiti Reservoir through BM 1687 to the crest of the Tent Rocks area onto Cone Ridge and northwesterly along the southwest ridge of Bland Canyon, around the heads of tributaries Reid and Frazier canyons, thence north along Woodard Ridge to the rim of Valles Caldera, near Paso del Norte. The boundary continues northeasterly through the pass to Rabbit Mountain, Cerro Grande, and Pajarito Mountain, thence northerly along the surface-water divide of the Valles Caldera with Pajarito Plateau drainages, through Cerro Toledo, and into Abiquiu Quadrangle (30 x 60 min) and encircles the head of Santa Clara Canyon. The natural ground-water divide in this area is in dense pre-caldera volcanic rocks underlying the rim of the younger Jemez Caldera, which also forms the surface-water divide between direct Rio Grande drainage and Rio Jemez drainage. The western boundary of this sub-basin continues northerly through Polvadera Peak, Cerro Pelon, and the western side of Canones Mesa to Abiquiu Dam. The Pajarito Plateau sub-basin's northeast boundary is the Chama River southeasterly from Abiquiu Dam along the river to its confluence with the Rio Grande, thence south to Cochiti Dam.

All waters infiltrating west and south of the eastern caldera divide and southwest of the head of Santa Clara Canyon flow to tributaries of the Jemez River. Several large-capacity flowing wells in Valle Grande and Valle Toledo (see USBLM 30 x 60 Min. Topographic Map, Santa Fe sheet) constructed in 1948-9 for a planned - but aborted - new water supply for Los Alamos. Aquifer-system theory (Spiegel, 1962) was confirmed by field tests made in 1949 by Conover, Reeder, and Spiegel of USGS. Most of the Jemez River waters have been claimed by Jemez and/or other pueblos downstream along Jemez River (Spiegel, pers. comm., 2006). Due to low transmissivity of the intrusive and extrusive rocks of the Jemez Caldera rim, effects of pumping from the regional aquifer to the east are not likely to significantly affect natural ground–water levels in the semi-confined highly transmissive ancient caldera fill.

If it could be shown that the caldera rim rocks indeed have significant transmissivity, then existing and/or future LANL wells on the Pajarito Plateau would not only lower ground-water levels in the Caldera, but would also deplete the springs flowing to the Jemez River tributaries (in fact, are the Jemez River in much of most years). Our Federal government has already (about 1950) discovered that Jemez Pueblo is not likely to part with any of the Jemez River waters that they claim. Ironically, one of the best ways to determine the magnitude of the transmissivity of the pre-caldera rim rocks might have been to have proceeded with their pre-1949 proposal to construct a tunnel through the rim rock to deliver the water from the numerous flowing wells that they drilled in 1948-49.

(2) Lower Rio Chama and NE tributary valleys, Abiquiu Dam to Rio Grande

Equivalents of the Tesuque Formation and the "regional aquifer" of the Pajarito sub-basin form the principal aquifer of this sub-basin. Along lower reaches of the Chama River and some tributary channels the principal aquifer element is overlain directly by shallow alluvial aquifer elements. The upper part of the principal aquifer element is largely derived from fine-grained sandstone beds of Mesozoic age to the west, with some contamination by clastic particles and ground-water inflows from evaporite beds. Lower beds of the regional aquifer probably have contributions from volcanic rocks of the Jemez Mountains. The stream alluvium contains various mixtures of reworked sediments of the Santa Fe Group, direct deposition of eroded rocks of Mesozoic age, volcanic rocks from nearby mesas (mostly basaltic), and intermediate volcanic rocks from tributary drainages from the west and north.

In some areas poor quality of ground water is probably due to the presence of the evaporite beds in the source rocks and/or in reworked sediments derived from them. Lava and tuff of early to middle Cenozoic age are at or near the surface in parts of the north and east portions, and are the probable sources of weathered volcanic debris in the low-transmissivity lower part of the Santa Fe Group elsewhere. Younger basaltic lava and source volcanoes, such as those of Black Mesa (Rio Arriba County) cap large areas of the Santa Fe Group on the east side of the sub-basin.

Santa Fe Group equivalents provide water to springs and wells in the principal community areas. Many individual well supplies are contaminated by livestock in nearby corrals and small pastures or by nearby domestic wastewater disposal systems. El Rito's first community water supply well may have become contaminated by livestock that were not excluded from the vicinity of the well early in the history of its use (Spiegel, pers. comm.). Such violations of common sense and principles of ground-water hydrology have been common historically, and have contributed to community water-quality problems throughout the proposed SSA area (now EBSSAS).

The eastern edge and adjacent areas of this sub-basin are underlain principally by extinct volcanoes and associated sheets of tuff and lava, locally interbedded with or overlying clastic aquifer elements of the main aquifer (the Santa Fe Group or its northern equivalents). The main aquifer is present mostly at great depths under the extensive plateau in the latitude of Taos and discharges directly or by upward leakage of its (locally thermal) waters to the Rio Grande and some tributaries.

Locally thin shallow zones of perched or semi-perched ground water are present; some of these zones are marked conspicuously by springs on the eastern slopes of Black Mesa (Rio Arriba County)

Rio Chama below Abiquiu Dam forms the SW boundary of this sub-basin. The NW and W boundaries of this sub-basin follow the western drainage divide of El Rito valley, thence easterly around the headwaters of El Rito and Rio Ojo Caliente to the top of San Antonio Mountain and easterly across US 285. The boundary continues southerly and southeasterly, following Comanche Rim to a point about one mile west of Taos Junction, thence along the east side of Canada Embudo and the “Chile Line”(railway trace) to the junction of sections 22/23/26/27 (T. 24 N., R. 10. E.), thence easterly to the Rio Grande near Pilar (opposite the mouth of Agua Caliente Canyon), and downstream to Rio Chama mouth.

(E) CONCLUSION

This proposed expansion of the LCVASSA petition includes closely coupled extensions of the principal aquifer elements in the Espanola Basin. These extensions include present or proposed sites of withdrawals of both ground- and surface-water supplies, and returns of some of these diversions to ground waters or surface waters for several of the most important population centers in north-central New Mexico (Santa Fe, Los Alamos, Espanola and nearby Santa Cruz Valley, and Pojoaque-Tesuque Valleys) where water quality problems or expectations have existed for decades). See GPS 1-69 waypoints for outer boundary in appendix, which has been illustrated in Exhibit 3-1.

The proposed expansion also includes areas providing tributary inflows which now, or in the past or future, contribute (or are likely to contribute) substances harmful to the health and survival of humans and other biota. The areas included also contribute undesirable dissolved or suspended solids in runoff waters (both surface and underground) to the Rio Grande, a proposed source of supplemental water for Albuquerque (nearly half of New Mexico’s population and potable-water use).

Areas upstream (e.g., the Taos area and headwaters of the Rio Grande and Rio Chama, plus the headwaters of the San Juan River) of the proposed new sub-basins provide generally high-quality waters to downstream areas, but all have local sources of contamination. Such areas need to be monitored, and if deemed necessary in the future, protected by more detailed monitoring, evaluation and remediation than they are now receiving.

Ironically, in 1973, our consultant (Zane Spiegel, pers. comm., 2006, based on information documented in USGS WSP 1525) advised W. F. Turney, Consulting Engineer to the then-owner (PNM) of the Santa Fe water system, to drill wells along the proposed pipeline route, beginning near the western end of the Santa Fe River Well Field, instead of following alternate proposals to explore for a horizontal collector well in Rio Grande alluvium, or drilling a cluster of wells near Buckman site. Unfortunately his logical suggestion was rejected at that time, but has been vindicated by several test wells in Rio Grande alluvium and several deep wells drilled along the pipeline route, or nearby, in recent years (Spiegel, var.).

Sec. 3.3.4 (C)

(1) Wells

The early histories of the drilling of wells in the EBSSAS have been given above, as an essential accessory to discussion of the history of use and abuse of the aquifer system and its recharge and natural discharges, particularly in regard to the introduction of contaminants to the aquifer system by disregard of the fact that almost all new "developments", rather than increasing revenues, create new costs to the public that exceed the benefits, but are not budgeted or warned about, yet have to be paid for by the current residents as well as the new, especially the costs of contamination of the public water supplies caused primarily by growth--and these payments are in the form of increased property taxes allocated to bond issues for infrastructure, such as new wells and pipelines, sewers, waste treatment plants, land acquisition. etc.), local increases in gross revenue tax rates, inflated costs of rental housing, and increases in local fees for services and utility costs (including replacements of over-pumped wells, utility line extensions (many hidden in rate structures), subsidy of public transportation and parking facilities, etc.--and increases in personal transportation time, miles, and parking fees!

In addition, contributions of state and federal funds to local infrastructure are not "free", but are paid for by local residents' contributions to state and federal taxes, not only for utilities noted above, but for improved and extended highways, storm runoff structures required to protect public health and safety--in part due not only to the excess runoff generated by the highways themselves, but in large part due to the runoff generated by the vastly increased areas of retail and wholesale businesses, both free-standing and in malls. Then there are vastly increased energy costs (and their water infrastructure and adverse water quality impact) required for highway and mall lighting.

Tabulations of the community drinking, irrigation, and industrial/commercial water supplies, and individual residential water diversions, almost all supplied by wells drawing from the EBSSAS have been listed above (Sec3.3.3 (6). Table A) Almost all the water withdrawn is in part returned to the EBSSAS with contaminating substances added, as noted in previous Section 3.3.3(4).

Considering the total net depletions of the EBSSAS and since we will not participate in the long history of Santa Fe County’s deceit of the public by comparing the depletions to the “recharge”, it suffices to note that since the old and traditional communities of Santa Fe had already appropriated (prior to 1951) all the natural recharge (by putting to beneficial use all of the equivalent natural discharge) then all the net depletion's are “overdraft”, and all future net diversions from the EBSSAS will be increased overdraft, unless and until sufficient water is imported to replace all existing and future diversions.

Sec. 3.3.4 (C)

(2) <u>Maps showing water-level contours, springs, and surface-water pathways.</u>

Water-level contours in the southern part of principal aquifer elements of the EBSSAS for approximately “initial” or natural conditions in 1951-52, are shown in Spiegel (1963, Pl. 7), reproduced in the plates of the original petition on file or on the CES web site <http://www.environmentalsafeguards.org>. These contours are a type of geophysical representation of the aquifer system, as the spacing between contours is inversely proportional to the aquifer transmissivity at any given location, abrupt decreases in spacing suggest fault zones, and mounds or ridges suggest sources of relatively greater recharge, such as along Santa Fe River west of Santa Fe. Water-level contours for later years are also shown in the LCVSSA, the original petition. These maps reflect the aggregate drawdowns of many large-yield municipal, commercial, and irrigation wells, and thousands of individual wells, mostly not monitored for production or regional drawdown, including the municipal wells east of Los Alamos, and Santa Fe’s Buckman well field, just across the Rio Grande from the Los Alamos wells. Their aggregate drawdown has undoubtedly extended southward to add to the aggregate drawdown cones of the Santa Fe municipal well field and other large yield wells in the Southern part of the EBSSAS.

Sec. 3.3.4 (B) RECHARGE AREAS.

Espanola Basin System Sole Source Aquifer System

Lower Santa Fe River basin, ◀◀◀ (Green hexagons)
Canada Ancha/Rio Pojoaque sub-basin♦♦♦♦ (Black diamonds)
Picuris Mountains/Truchas Range sub-basin ◊◊◊◊ (White diamonds)
Pajarito Plateau sub-basin ▲ ▲ ▲ ▲ (Yellow triangles)
Lower Rio Chama and NE tributary valleys/
Abiquiu Dam to Rio Grande ● ● ● ● (Purple dots)

1 (a) ***Introduction.***

The entire surface of the EBSSAS is the recharge area for the sole source aquifer system, between the eastern boundary watershed divides with the Pecos River valley and the east rim of the Jemez caldera and the northern ridges leading from Abiquiu Dam thence north to San Antonio Mtn. and SE to Pilar; and on the south, north of the feather edge of the Ancha Formation and underlying minor aquifer elements on the north rim of the Galisteo River drainage basin. Even the immediate environs of the springs at Cieneguilla, Cienega Valley Pojoaque drainage and most streams to the north are in part recharge areas, as most of the springs have long been diverted by acequias which collect and spread the spring waters over the areas adjacent to them and to the irrigated lands.

Therefore not only have the spring waters been put to beneficial use by constructed works, as was long required by New Mexico water law to initiate and maintain valid water rights, but substantial areas of lands near the acequias and irrigated plots have been converted into wetlands and local aquifers by the same works of man and the deep return flow from them, as well as the direct acequia leakage and deep infiltration from irrigated lands. Locally drinking water is supplied by wells. In these wetlands and the accompanying base flows also provide habitat for varied wetland and aquatic plant and animal life downstream to the Rio Grande (and associated Cochiti Lake).

The enlarged from Fig. 31 in (Spiegel (1963) shown in the original aquifer petition, shows at a glance the delineation of recharge areas to the main aquifer elements on the southern plains of the

EBSSAS, divided into three sub areas on the basis of the respective areas to which the aquifers discharge naturally (from north to south, the Santa Fe River area, the Cienega unit plains, and the southern unit. The eastern part of each of these three units has a "Mountains" area (cross-hatched and identified with the number of square miles in each of the three "Mountain" areas). As noted previously (Sec 3.3.3 (2)) the "Mountain" units not only contribute direct surface runoff to recharge the plains areas, but are themselves recharged, and their minor aquifer elements have historically contributed to perennial or intermittent base flows within their areas and onto adjacent plains, where some of their water becomes recharge to the principal aquifer elements. In some areas especially south of Santa Fe, domestic wells (both individually and community) have dried up former springs which contributed recharge to the plains to the west.

(b) ***Delineation of recharge areas on topographic maps.***

The information described in the previous paragraph and diagrammed herein has been transferred to the topographic base map assembled from parts of several larger-scale sheets are given in a supplement to this petition. Other information on the Recharge areas can be found in the original petition. This can be also found on the CES Web site; <http://www.environmentalsafeguards.org>

(c) ***Description of methods used to determine recharge areas.***

Considerable effort was made in the investigation reported by Spiegel and Baldwin (1963) to relate the complex natural discharge areas of the Santa Fe Group area to the areas which provided those discharges. The principal method was, insofar as possible, to reconstruct the original "steady-state" pattern of water level contours from the somewhat modified system encountered in 1951-52.

(d) ***Assessment of topographic, geologic, and hydrogeologic maps.***

In the Southern part of what is now the EBSSA, Spiegel (1963) obtained measured depths to well water levels onsite, plus elevations of well measuring points or spring levels (from 1:24,000 scale topographic maps with 20-foot land contour intervals), so that accurate water levels above sea level could be ascertained at as many points as possible. In many cases, if necessary, with owners' permission, holes were drilled in well casings or their cover plates to permit the insertion of chalked steel tapes to measure the depths to water. Reported initial depths to water in wells, from oral or written driller's records, confirmed where possible by independent information from well or land owners, were then compared to later reported or measured water levels and adjusted as needed. The reconstructed initial water levels were then plotted on 1:24,000 topographic maps and contours of water levels were drawn, to produce a hydrogeologic map based on the most direct geophysical indicator of local and regional aquifer characteristics--the hydraulic transmission property of the aquifer. Due to paucity of well data in some areas, geophysical information from Winkler (1963, op. cit) was also taken into account in preparing the water-level contour map.

2 (a) Review and assessment of regional/sub-regional ground-water flow system data.

"Dividing streamlines" (Spiegel, 1963, p. 151-2; Spiegel, 1967) were drawn eastward on the water-level contour maps, beginning at the upper and lower ends of the La Cienega Valley, to delineate the northern and southern boundaries of the region which contributes ground water to the Cienega unit of the plains. The eastern limit of this plains area was determined from outcrops of the Ancha and Tesuque formations and older rocks, well logs, and geophysical interpretations by Winkler (1963).

Hagerman (1975) and Akin (1975) each made assessments of the rate of decline of water levels in the aquifer in and near the city wells, with differing conclusions, the former very pessimistic, the latter less so. Neither study adequately assessed the impact of wells on senior spring rights, particularly the thousands of "S & D" wells that had been drilled by that time, or the thousands more that were to be drilled later.

A number of reports were done by the USGS on the Los Alamos well field, which although it is west of the Rio Grande, is not far from Santa Fe's Buckman well field, and in the same aquifer (Tesuque Formation), and is discussed here because previous studies for the Los Alamos and Buckman well fields did not adequately evaluate the effect of one upon the other, or their combined effect on area streams and prior rights. One of the most important considerations is that, although the Tesuque Formation is hydraulically connected to the Rio Grande, (1) the connection is by generalized cross-bed or fault-zone leakage, and (2) the Rio Grande only partially penetrates the thick Tesuque beds, and does not penetrate at all into the principal water-bearing beds, therefore is not a "hydraulic boundary" for wells on either side of the river.

(2) (b) Data from an observation-well network initiated by Spiegel in 1951.

This network was continued by NMSEO and USGS, monitored by Akin of NMOSE, and compiled and summarized by Mourant (1980). (Some samples for nitrate collected by observers and NMED;

no isotope or tracer studies made).

Despite the growing availability of reported or monitoring-system data from wells drilled or observed later, in the region of the growing plume and mound of sewage-contaminated ground water near the Santa Fe airport (Spiegel, 1962 (?); 1999), water levels rose but did not significantly move the bounding streamline on the north margin of the Cienega unit. Farther east, the network density and reliability did not warrant significant revision of the original boundary of the unit, even though the growth of drawdown cones originating northeast of La Cienega and the aggregate drawdown of thousands of new wells near and within the Cienega unit probably moved the north-bounding dividing streamline to the south in that area.

However, interpretation of new well-log data by Spiegel (1975), updated by Fleming (1994) did permit more detailed mapping of the basal contact of the Ancha Formation and its saturated thickness., which revealed the presence of two buried Ancha-filled valleys not previously detected (see also Sec. 3.3..4 (a) (1)). The effect of these channels is primarily local (e.g., the effects of a well drilled in one of them would have a more rapid effect on a spring discharging from that channel's Ancha fill than on a spring discharging from another channel fill or the Tesuque Formation).

(2) (c) Conceptual, analytical and numerical flow simulation (regional aquifer systems).

Numerical simulations of regional ground-water flow have long been used--and abused--by hydrologists, recently because of the rapid proliferation of models and software, much of which has been developed primarily to give high visual impact (colors, 3-D views, zoom, rotations, etc.), and by the use of well-advertised software and models by computer-oriented technicians who do not have sufficient fundamental understanding of field geology and hydrology or three-dimensional flow concepts pertaining to real aquifer systems to make an intelligent choice of models.

Alternatively, there are many simple "conceptual models" that can be visualized by human computers (brains), to arrive at almost instant qualitative evaluation of almost any aquifer system if (1) the brain is trained to comprehend the field information--formation outcrops and geometry, faults and fault zones, relation of surface topography to the water table and other potentiometric surfaces, "outcrops" (wetlands, springs, perennial reaches of streams) of the saturated zone where these features intersect, semiconfining and semiperching beds, etc. (Spiegel, 1962), and

(2) the brain has sufficient knowledge of analytical models of a large number of possible geometric arrangements of aquifer elements, semi-confining beds, and lateral boundary conditions, not only

from hydrologic literature, but also from analogous fields of physics, such as heat conduction in solids, diffusion in porous media, R-C electrical fields or discretized networks, etc.

Some typical field examples and their analytical approximations in the Rio Grande Basin of New Mexico and Colorado, one set of which originated as approximations of the two-aquifer, mutually leaky, rectangular-plan conceptual model of the main EBSSAS, are also described by Spiegel (1963, op. cit.). Several Appendices in that work classify geometric and hydrologic arrangements of aquifer elements and boundary conditions and equivalent terminology and parameters in three fields of physics that are mathematically isomorphous (“same form”) to the equations of ground-water flow. These appendices facilitate acquisition of the necessary conceptual skills. Another Appendix in the same work lists fifty examples from readily-available literature of boundary-value problems (BVP) that are applicable to equivalent aquifer systems, and another hundred examples were compiled in unpublished loose-leaf notebook form in Spiegel, (1962a), some of which have been used in administrative decisions by the NMOSE staff, either directly or by conversion to numerical models.

Numerical simulation models are merely discretized analytical models--representing differentials by difference notation at sets of nodes distributed in a plane (2D models) or in a volume (3D models). The author of a well-known text on diffusion in porous media, long employed by Imperial Chemicals Ltd., London, in research on industrial applications of his theory, once began a lecture to an audience of Imperial College engineering students in various fields by saying that numerical methods were the future of their fields. However, the balance of his lecture was illustrated exclusively by the use of analytical mathematical models!

There are two main issues concerning the EBSSAS that really don’t need any more than a simple conceptual model, and no numerical models, to arrive at valid general conclusions:

(1) New appropriations of water available to the principal aquifer elements under “natural” conditions that existed before about 1941, when few large-capacity wells existed in the area. ANSWER: NONE, because all the inflow (recharge) was already being used by the ancient appropriations of the natural discharge (springs) in several natural discharge areas. However, since 1956 (locally since 1968) the NMSEO has had an orderly process for transfer of rights from old spring sources to wells, either in the general vicinity of old rights or to more distant locations. This process did need some numerical calculations or discrete modeling results to give transferees the

benefit of temporary withdrawals of water from aquifer storage, yet protect the remaining ancient rights from depletion of their share of the remaining springflow.

However, as noted previously, Santa Fe County has allowed extensive use of the special “Stock and Domestic” category of wells permitted by NMSA 75-11-1 (now 72-12-1), and all the consumptive use by these wells represents “overdraft”, without any requirement for public notice, hearing, formal transfer of rights, or monetary compensation to senior right-holders for diverted (i.e., stolen) water.

(2) (d) Description and location of natural and man-induced aquifer recharge.

(d-1) Natural Precipitation (rain and snow) and Resulting Recharge: The average annual precipitation at Santa Fe in the 48 years beginning in 1952 was slightly greater than for the previous period of record (see Spiegel, 1963, p. 146-150, Table 10, and Fig. 33). Therefore the continuing pattern of periodic water shortages for the city after 1946 was due to failure of the city water system managers to take appropriate steps to either (a) reduce demand or (b) increase the water supply during years with sub-average precipitation.

Previous section 3.3.4 (A)(a)(4) cites the history of Santa Fe’s growth and the adverse effects of increased diversion of the flow of Santa Fe River on the water available to irrigated lands along the river in and west of the city. The substantial reduction of (in large part) man-induced aquifer recharge along the Santa Fe River valley by diversion of most of the surface water after 1946 was accentuated by the lowering of ground-water levels by substantial pumpage from wells near the river from 1946-1952, during subsequent droughts, and as uncontrolled (indeed, encouraged) growth continued, in most years.

(d-2) Unlined Surface Impoundments and Other Irrigation Facilities, Privies, and Septic Fields.

All sources of recharge to the EBSSAS, noted in the foregoing sub-title paragraph, had been effective in raising the water table and sustaining springs in downtown Santa Fe and downstream and along the streams to the north, for centuries. The springs in Santa Fe proper that had not already been dried up by local drainage projects (e. g., Federal Place and Cienega Street) were eliminated by river diversions above Two-mile Dam after 1946, but most of the “incidental” recharge facilities (privies and septic fields) were greatly reduced, replaced by partially treated effluent downstream in and after 1948, leaving behind (or underneath) the contamination by nitrogen species and other “rural residues” that continued to migrate westward with the ground water.

(d-3) Land Disposal of Sewage Effluent. At the completion of a new sewage treatment plant on Siler Road in 1948, treated effluent was distributed to forage irrigation plots and the Santa Fe Country Club Golf Course along Cerrillos Road and Airport Road, and to the Santa Fe River channel north of the airport, which in effect transferred a large part of the man-made component of aquifer recharge from the city area to areas southwest of the city (see Spiegel, 1963, p. 172-176; Fig. 40, reproduced in the Original Aquifer petition).

(d-4) Injection Wells and Unintended Fluid Injections.

At this time none of these features are known in the EBSSAS, but a large number of uranium test holes were drilled in 1970-72 (Borton, op.cit.) that were abandoned with unknown completion practice, which may have been just leaving them full of drilling fluid and formation cuttings, including uranium ore, if any. One or more of these test holes is located at the north end of the present “Downs at Santa Fe”; covered with horse manure and other fill, and may be a source of some local contamination. However, in the future the County of Santa Fe intended to work on direct injection for aquifer storage. The concern here is the injection plume stirring the aquifer and dispersing contaminants throughout a wide area.

Sec. 3.3.4 (C) *STREAMFLOW SOURCES*

(C) (1) Santa Fe River, Arroyo Hondo, Canada de Los Alamos and the Pojoaque drainage system all have had reaches that were perennial in the mountain and foothill areas east of the plains, but the latter three have become intermittent due to drought and diversions by wells. As described in section 3.3.4 (1)(a-4), most of the mountain sources of Santa Fe River flow have been captured by city reservoirs and water distribution systems. The reach of Santa Fe River downstream of Sandoval Street is a losing section when there is flow from upstream, or for storm flows and local snowmelt. Tributary arroyos in this area, when flowing, also are losing drainages. Over the past five decades, increasing development of the city has resulted in greatly increased storm flows, only a small portion of which is recharged, due to constriction of the channel and erosion of former channel fill within the city area where the city wellfield is located.

(C) (1-a) Delineation of streamflow source area.

Reliable data on the ephemeral storm and snowmelt flows in the Santa Fe River west of the city center are not available. Any new recharge created by increased storm runoff merely offsets and moves to the west a part of that lost by upstream diversions from the old irrigation system of the city area. Most of the present recharge in the river channel is sewage effluent, far to the west of the original irrigation-related recharge. Such recharge that does occur in the river channel occurs where shown by a dashed line.

(C) (1-b) *Explanation of methods used in determining streamflow contributions.*

All contributions from surface runoff are more than offset by pumping from the city well field, resulting in net depletions of ground-water storage, especially in the northern part of EBSSAS. SFWWTP effluent continues to recharge the area just above Cieneguilla, and possibly some passes under the airport-Country Club area to La Cienega valley; the Los Alamos County WWTP continues to recharge Los Alamos Canyon to the Rio Grande; the Espanola WWTP return flow to the Rio Grande.

3.3.4. (C) (2) (A) STREAMFLOWS

(1) EAST AND WEST OF THE UPPER RIO GRANDE

This sub basin, like the proposed Upper Rio Chama sub-basin, straddles the principal river of the sub-basin. The Rio Grande and it tributaries (stream sourceflows) in this area have incised deep canyons into sequence of basalt flows, volcano sources and interbedded sediments of Cenozoic age. These incisions have exposed some aquifer sub-elements which discharge to springs along the Rio Grande and some tributaries, of which Red River, Arroyo Hondo, and Rio Pueblo de Taos are the most important. The most productive portions of the aquifer elements in this sub-basin are sediments overlying and/or interbedded with lava east of the Rio Grande, in Sunshine and Questa valleys and the Taos Area. In these areas the sediment resembles and is probably correlative to the Tesque Formation of the Santa Fe Range.

The south boundary of the sub- basin coincides with the north boundary of the Truchas/Picuris sub-basin. The east boundary is the drainage divide with the Canadian, Guadalupita, and Mora Rivers, which is nearly coincident with the east limit of Taos County. The north boundary is NM/CO state line (but the san Luis Valley and NMED of the Taos and Questa areas, respectively, are providing updates of older studies for NMOSE by Spiegel (var.), Winograd, and others. The Taos area study includes a preliminary digital model of the ground water and associated springs and streams.

This sub-basin adds to stream-flow through the EBSSAS and recharge to the downstream aquifer systems along the Rio Grande. However most of the recharge zones in the principal aquifer systems come from the river systems and tributaries of the east and west of the Rio.

(2) ADDITIONAL SUB-BASINS EAST OF RIO GRANDE

(a) Lower Santa Fe River sub-basin, La Cienega Valley to Cochiti Dam

Santa Fe River, Arroyo Hondo, and Canada de Los Alamos all have had reaches that were perennial in the mountain and foothill areas east of the plains, but the latter two have become intermittent due to drought and diversions by wells. As described in section 3.3.4 (1)(a-4), most of the mountain sources of Santa Fe River flow have been captured by city reservoirs and water distribution system. The reach of Santa Fe River downstream of Sandoval Street is a losing section when there is flow from upstream, or for storm flows and local snowmelt. Tributary arroyos in this area, when flowing, also are losing drainages. Over the past five decades, increasing development of the city has resulted in greatly increased storm flows, only a small portion of which is recharged, due to constriction of the channel and erosion of former channel fill within the city area where the city wellfield is located. Included in this recharge area of stream flows are the La Cienega Creek, Bonanza Creek, Alamos Creek, Canada de Los Alamos, Arroyo Hondo and the Arroyo Chamisas.

(b) Canada Ancha/Rio Pojoaque sub-basin

In the Canada Ancha/Rio Pojoaque sub-basin area stream flows include Tesque Creek, Rio Chupedero, Rio en Medio, Canada Ancha, Rio Pojoaque, Rio Tesuque, Rio Nambe Rio Capulin, which flow from the Sangre de Christo Mountains to the Rio Grande. These areas have acequia systems used for irrigation—agriculture use. The traditional acequia systems adds recharge to wells both domestic and municipal. The Pojoaque River Valley from Nambe (Sangre de Christo Mtns) to San Ildefonso Pueblo’s (at the Rio Grande) area has severely contaminated water wells both domestic and mutual domestic systems from nitrogen and high arsenic levels. (See Section 3.3.5)

(c) Picuris Mountains/Truchas Range sub-basin

The Rio Frijoles, Rio Molino, Rio Medio, Canada los Tanos, Rio de los Trampas, Rio de los Truchas, Rio Quemado, River Santa Cruz, Rio Embudo, Canada Ojo Sarco, Rio Santa Barbara, Rio Chiquito, Rio Pueblo and their tributaries contributes to recharge of the basin

(3) ADDITIONAL SUB-BASINS WEST OF RIO GRANDE

(a) Pajarito Plateau sub-basin/

Lower Rio Chama and NE tributary valleys, Abiquiu Dam to Rio Grande

The principle aquifer element in most of these sub basins is at a great depth, but it is continuous stratigraphically and hydrologically with the Tesque Formation of the Santa Fe group east of the Grande. It supplies all drinking water for Los Alamos County and the Los Alamos national Laboratory (LANL). And to some of the public –supply wills for Espanola and Santa Clara Pueblo. In the early 1930's and the early years of the atomic research, springs were used for all resident and laboratory needs, but were replaced by well fields in lower Los Alamos Canyon and the a tributary, Guaje Canyon.

Two additional well fields were added in recent decades (See our highly comprehensive review of the highly defective report by LANL Vesselinov and Keating, 2002- in the CES web site: www.environmentalsafeguards.com). The Puye Formation, A possible time equivalent of the Ancha Formation in the Santa Fe Group, contains a saturated semi-perched zone under much of the Pajarito Plateau, which transmits water recharge in the mesa surface and dissecting canyons to the underlying "regional aquifer". Contaminants from LANL operations have accumulated in the Puye Formation, and are in transit in the regional EBSSAS. (See Section 3.3.5)

A water divide in dense volcanic rocks underlying the rim of the younger Jemez Caldera forms the western boundary of this sub-basin, encircles the head of the Santa Clara Canyon, and continues northerly to Abiquiu Dam. All water west of this divide and southwest of the head of the Santa Clara Canyon flows to tributaries of the Jemez River, Most of which has been claimed by the Jemez and other Pueblos downstream along, Jemez River (Spiegel Per Comm., based on studies made in 1949 by Theis, Conover, et al . of the USGS, following completion of several large capacity flowing wells in Valle Grande and Valle Toledo(see USBLM 30 X 60 Min Topographic map, Santa Fe Sheet) by los Alamos for a planned—but aborted—new water supply for Los Alamos). Sue to low transmissity of the intrusive and extrusive rocks of the Jemez Caldera Rim, effects of pumping from the regional aquifer system.

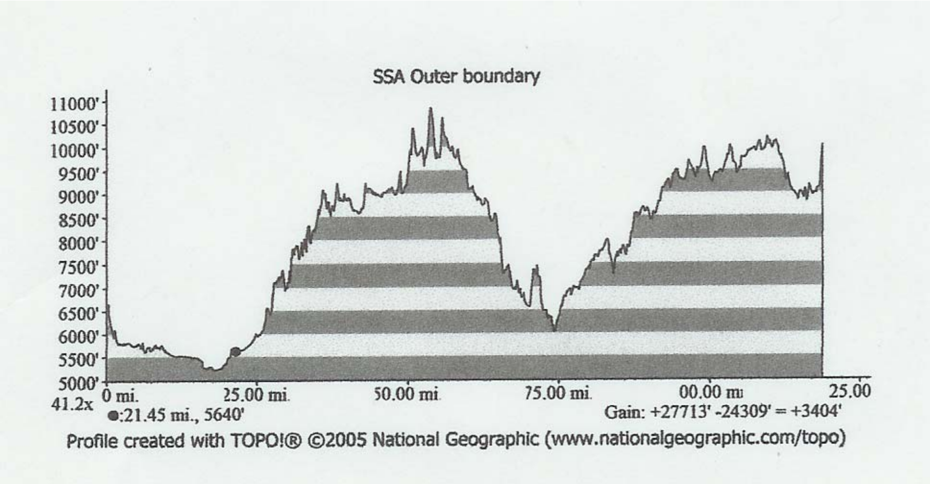
Drainage area of El Riot and Ojo Caliente valleys (except of the upper portion are mostly underlain by Santa Fe Group equivalents, and provide water to springs and wills in the principal community areas. El Rito’s first community water supply well may have become contaminated by livestock that were not excluded form the vicinity of the well early in the history of it use.

Stream flows in this sub basin includes: Arroyo do la Aquaje la Petaca, Canada los Comanches, Canada de Embudo, Rio Tusas, Ojo Caliente Rio, Rio El Rito, Rio Vallecitos and their tributaries are mostly from spring flows and snow runoff.

South of the Lower Rio Chama stream flows from the Parajito Plateau include: the Lower Rio Chama below the Abiquiu Dam, Abiquiu Creek, Rio de Oso, Vallecitos Creek, Santa Clara Canyon, Guaje Canyon, Los Alamos Canyon, Pajarito Canyon, Water Canyon, Canyon de los Frijoles, Alamo Canyon, Cochiti Canyon, Bland Canyon, and the Rio Chiquito and all the tributaries and smaller canyons that are associated with the mainstem canyons described above.

(D) DESIGNATED AREA.

This map was made on the TOPO National Geographic USGS and Tele Atlas “Back Road Explorer Software program. All of the area within this designation is a recharge zone. Elevation Chart as Follows: This elevation chart shows the boundary elevation line

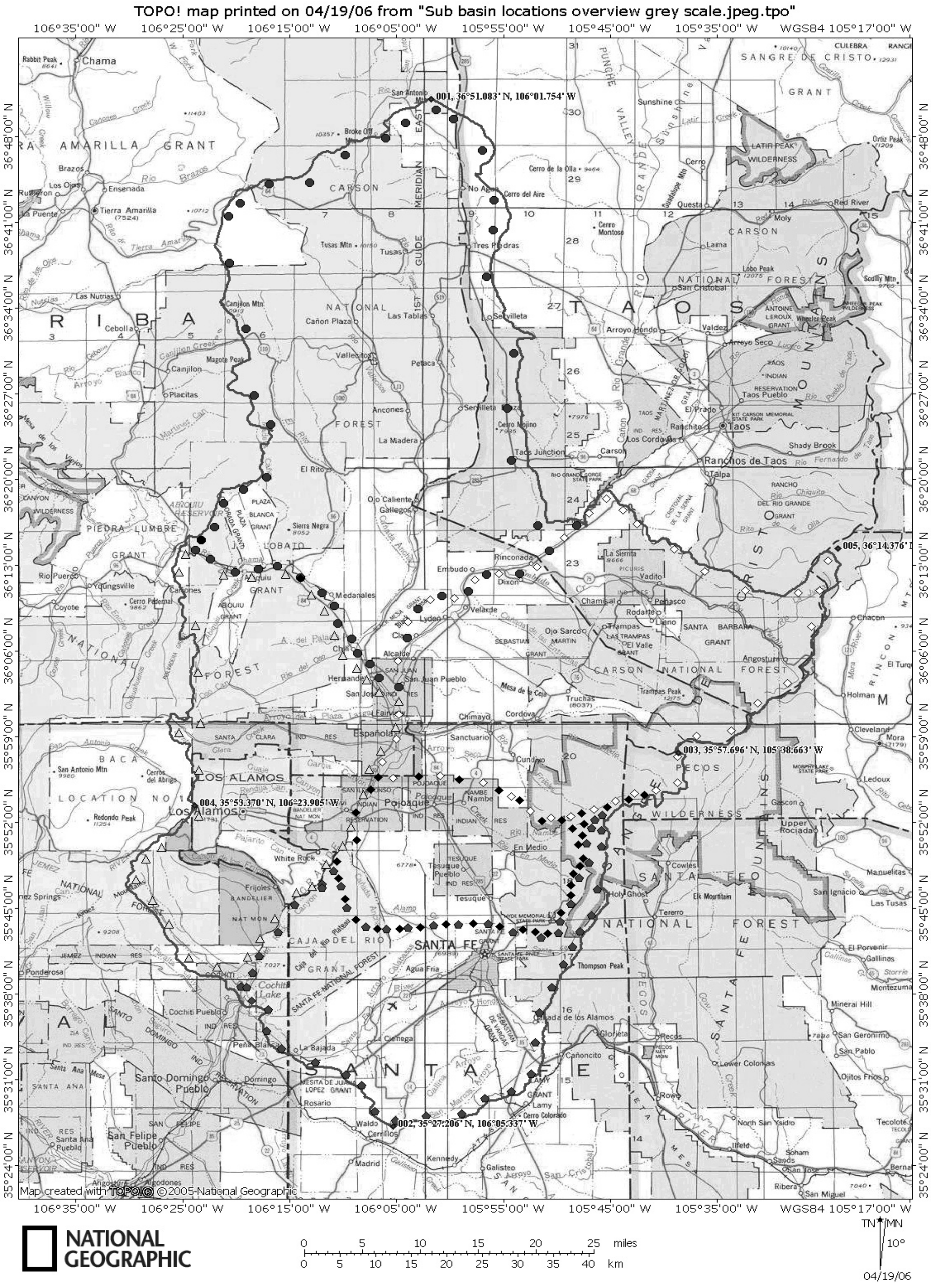


From Pilar at the Rio Grande and the north and west boundary of the Picuris, Pojoaque and Santa Fe Sub basins

(1) DESIGNATED AREA - EBSSAS - *on the next page*

(2) THE PROJECT REVIEW AREA

Hydrological maps provided to the EPA Region 6 office.



Recharge map

3.3.5. Information Related to Significant Public Health Hazard

(A) Threats to the water quality in the aquifer system.

Nearly all uses of water, and most uses of the land, above the aquifer system result in the addition of undesirable or dangerous substances into aquifer water, even for legally transferred water rights. In most cases ("point sources") the polluted water introduced, for example from a standard septic system, descends to the zone of saturation, where it forms a plume of contamination that drifts down-gradient with very little dilution. Standard engineering "conceptual models" assume that the pollution is immediately greatly diluted by normal aquifer water, but this is rarely the case, except in cavernous limestone or lava. If the plume approaches a well or spring, it will enter that discharge area and be diluted to some extent by water entering the well or spring from other directions or levels. If the plume enters a stream, it contaminates the stream, the degree depending on relative flows and concentrations.

Even if a well were used only for slightly-degrading purposes, (if the dissolved solids content of the water from such a well is raised only slightly), return of the used water to the aquifer will raise the dissolved solids content of the water, and if the disposal point is near the producing well, or some other well, there will be continuing buildup of dissolved solids in the aquifer water with continued recycling. Such recycling can usually occur even if the disposal point is down gradient form the source well, due to reversal and natural gradients due to the well's drawn-down cone.

Several numerical models have been created and tested to simulate or predict aquifer response to changes of input or output in the Santa Fe area, including the EBSSAS, and some have been used routinely by the NMOSE to manage water rights transfers from surface waters (ground-water discharge or baseflow) from a specific irrigated tract in the Cienega area, or from the Rio Grande, Rio Pojoaque, or Rio Tesuque to a well elsewhere in the aquifer system. The first ("Akin") model properly took into account the aquifer boundaries, insofar as they were known prior to 1975, but was inadequate for most nearby "transferred to" locations. The other models did not have proper boundary conditions in the various spring areas that constitute the natural discharge of the aquifer system, so they are of little value for prediction of future regional drawdown patterns or future water-level contours, particularly near the western and southern boundaries of the aquifers, and they ignore the pre-Tesuque aquifer elements.

Most groundwater in the EBSSAS is of good to very good drinking water quality except in areas of plumes of contaminants or occurring problems. (See map NMED on last page of this section for Santa Fe County.) The plumes of contaminants are usually nitrates from leaking septic tanks and leach fields, radon, radionuclides, uranium (naturally occurring), perchlorates, PCB's, Dioxins, hormones, underground storage tanks, chemical spills (see list at the end of this section) and/or from mining activities. In this section there is an overview of each of the sub-basins giving some of the problems occurring in each of the different areas. By no means is this a comprehensive list of all challenges faced in the aquifer system. Although CES has compiled a list of permitted discharges in the aquifer system by county, the work still remains to compile more comprehensive data.

Lower Santa Fe sub-basin

(A) As described herein this petition there are several areas that are documented problem areas that require Critical Aquifer Protection. (See previous Sections 3.3.2. Narrative and various references.)

(B) The City of Santa Fe Water system high Arsenic sampling results are equal to or greater than the 10ppb MCL. Currently the City of Santa Fe is designing a new water treatment plant which will have to address the potential problems of downstream surface water diversion at the Buckman Diversion Project. The Eldorado Utilities has high Arsenic sampling results equal to or greater than the 10ppb MCL. The El Vadito de los Cerrillos Water Association has high Arsenic sampling results equal to or greater than the 10ppb MCL, according to the NMED Drinking Water Bureau website. There are high Nitrates in the La Cieneguilla and La Cienega Area.

Pajarito sub-basin:

Most of the contamination that comes from Los Alamos National Laboratory (LANL) resulted from more than 1,400 legacy hazardous waste sites that have released contaminants into the earth environs via air, groundwater, LANL employee's dumping nuclear waste over the edge of canyons and into arroyos and through surface water. From 1943 to 1963 the LANL discharged untreated and treated radioactive wastewaters into Acid and DP Canyons, part of the Los Alamos Canyon watershed. Those contaminants were subsequently distributed and stored in bank and channel sediments throughout the watershed and into the Rio Grande. The contaminants, including approximately 3 Curries of Plutonium$^{239/240}$ as well as other radioactive and industrial wastes were disbursed through effluent discharge and storm water events. These sediments continue to mobilize during storm events when banks are destabilized causing the canyon floors to be scoured and contaminants transported by streams flows into alluvium recharge zones. Additional sources of contaminants were made available after the Cerro Grande Fire. The ash created by the fire contained radioactive contaminants greater than soil background reference levels. The contaminant sources include global fallout as well as potential LANL operations. Contaminant transport increased after the Cerro Grande Fire as magnitude and frequency of storm water floods began to change the stream channel morphology. The storm waters have accelerated the rates of normal channel adjustment such degradation, aggradation and subsequent sediment mixing. At a monitoring station in lower Pueblo Canyon, NMED estimated 87 mCi of PU-$^{239/240}$, contained in 22,000 tons of suspended sediments were transported by storm water beyond the Laboratory boundaries during 2000 to 2002. (See Englert, Ford- Schmid and Bransford, "Post Cerro Grande Fire Channel morphology in the Lower Pueblo canyon, Reach P-4 West: and Storm Water Transport of Plutonium 239/240 in Suspended Sediments"). The contaminants were transported through the lower Los Alamos watershed into the Rio Grande. Stormwater erosion caused incisions within the canyons alluvium beds that transported sediments throughout the Acid, Pueblo, Los Alamos, Sandia, Pajarito and Mortendad Canyons. Previous studies (Graf, 1993) identified LANL contaminant transport into the Rio Grande. NMED is currently describing contaminant distribution in Rio Grande sediments. Historical storm events transported contaminants off-site and were redistributed downstream in fine sand and clay beds and in the channel of the Rio Grande at Canada de Ancha at the Buckman Wellfield and the site of the proposed Buckman Diversion. Plutonium $^{239/240}$ was measured in sediment cores at Canada Ancha up to 0.06 pCi/g, over 6 times higher than that of atmospheric fallout conditions. The NMED/DOE Oversight Bureau has also identified up to 99% of the contaminants in some Rio Grande sediments that originated from LANL by using thermal ionization mass spectroscopy methods. “The shallowest reservoir bottom sediments in Cochiti Reservoir are predominantly fallout derived, with more than 90% of the plutonium activity from fallout, with the remaining 6% from LANL. The deepest sediments collected in a core taken near the dam appear to have greater proportion of LANL Plutonium $^{239/240}$, however. On a depth weighted basis, approximately 40% of the plutonium activity in the core segments near the dam is LANL-derived.” “*Plutonium and Uranium from Los Alamos National Laboratory in Sediments of the Northern Rio Grande Valley*,” Bruce M Gallaher, Deward E. Efurd, August 2002. The LANL plutonium content in Cochiti reservoir sediments is as much as 40%. This is a depth weighted average in cores and content ranged greater in different areas and depth horizons. The remaining plutonium source is from atmospheric fallout.

(A) DOE Oversight/LANL scientists have identified 40% of plutonium $^{239/240}$ activity in Cochiti Lake sediments originated from the LANL. Because the fire fallout is a major concern in Pueblo and Sandia Canyons, they have tested for insoluble materials such as PU, there are several other soluble constituents that stick to the fine sand and clay beds such as PCB’s, Perchlorates and other agents used in nuclear and biological weapons manufacturing. However, Dioxins and other contaminants have not been tested. These canyons empty before the Canada Ancha where the Buckman Diversion Project is slated. The contaminants found in the flora/forest materials are concentrated on the forest floor when the forest were reduced to ash in the fire. There has not been enough funding given to local authorities, such as NMED, to monitor this and other problematic contamination in the aquifer system, or to the City of Santa Fe to assure against negative perceptions of unsafe drinking water, especially in the coming years. (Elaine Cimino and Magdalena Avila, Environmental Justice Survey on the Perceptions of Contaminants from Los Alamos National Laboratory on the Surrounding Communities, Aug, 2005). Even risk assessments done by the EPA (RCRA) start with the assumption that both the soluble and insoluble constituents are so diluted that there is no significant threat because of time and distance from the release site. If this were true then the reaches in the Rio Grande south of Los Alamos Canyon to Cochiti Dam would show a lesser amount of soluble and insoluble contaminant levels in sediments, the further away from the upper reaches of the polluted Pajarito Plateau canyons. Instead, samples from sediments taken along the Rio Grande at several springs downstream from Los Alamos Canyon and at the mouth of Pajarito Canyon verify greater contaminant levels directly related to LANL and atmospheric fallout. The contaminant levels of Plutonium, $PU^{239/240}$, at Cochiti Dam is attributed to storm events during the pre/post-Cochiti Dam years. The legacy nuclear waste was moving through these recharge zones in the canyons and river during wet precipitation years, and when the Dam was built, in the early 1970's, the water back up caused suspended sediments to rest higher levels on the banks and canyons walls. There is a clear correlation between the recent CG Fire event and stormwater scouring of canyons causing downstream suspended sediment deposit of soluble and insoluble contaminants in springs and clay sediment beds along the Rio Grande. The highest measurement found has been 170 pCi/g up in Pueblo Canyon. According to Greg Mello of the Los Alamos Study Group historical measurement estimates was a reading of 20 pCi/g in the Los Alamos Canyon near the findings of Plutonium $^{239/240}$ of 170 pCi/g. Over the years it has been demonstrated that the intensity of storm events are higher especially after a cycle of drought years. This area is in such a cycle now. As global warming weather starts to affect the Western states weather patterns, there will be less snow melt, affecting the amount of surface water available; there will be more severe storm events (when it does rain) affecting water quality because the soils will be less likely to hold moisture from drought conditions, which will affect recharge and reliance on the aquifer drinking water. <u>The Solution to Pollution IS NOT Dilution</u>, it is establishing safeguards to protect the public health. Several reports have been written concerning these legacy waste practices by the Lab leaching contaminants into the earth in recharge zones and streams flow sources, it is reasonably likely that these contaminants will find their way into the City of Santa Fe water system.

(B) In the upper reaches of Pajarito sub-basin canyons adjacent to several of the technical areas in Mortendad, Sandia and Pajarito canyons and from the effluent output from the Bayo Waste-Water Plant in Pueblo Canyon there are hot/contaminated reaches that have been wattled and stopped by earthen dams, allowing water to seep and percolate into the aquifer.

NMED recently proposed limits on LANL's wastewater and discharge permit. (See References Cited and article copy in Appendix D, Brian Shields, Op-ed, <u>"LANL Contamination must be addressed"</u> Santa Fe New Mexican, May 21, 2006.) LANL's intentions are to override the Governor and the state's authority by appealing the proposed terms of the permit and other numerous requests to keep LANL from discharging into the streamflow sources, recharge zones and waterways that threaten drinking water and the EBSSAS water supply.

(C) The seepage is also a problem in various waste sites at LANL causing groundwater contamination. The reports by Zane Spiegel (See CES Website herein Cited References), Robert H. Gilkeson, [("GROUNDWATER CONTAMINATION IN THE REGIONAL AQUIFER BENEATH THE LOS ALAMOS NATIONAL LABORATORY" Version of July 13, 2004 on the CES Website) and various non-profit groups and individuals i.e. Greg Mello of the Los Alamos Study Group]. The increase in nuclear and biological weapons manufacturing has been supported with the help of political maneuvering on all levels in the name of economic growth for the region, national security and foreign policy, and at the same time being in Noncompliance with the Treaty on Nonproliferation of Nuclear Weapons.

(D) To summarize, most if not all reports released by LANL cover-up poorly constructed and manipulated reports in regards to groundwater flows and contaminant migration to the Buckman surface diversion area and well field for Santa Fe, NM, sources of water for the County of Santa Fe, to the various Pueblos and traditional historic Hispano agricultural communities downstream and downwind in the EBSSAS. Spiegel's report demonstrates that the contaminants leaching into the aquifer is widespread and not only in specific areas designated in the LANL reports; not only migrating through fractures in geological formations but also through alluvium flows through the various canyons entering into the Rio Grande at and before Los Alamos Canyon. (See Map D from **www.lasg.org**) Spiegel states that the travel times for these contaminants are within 20 to 40 years versus a report stating that it would take 10,000 years for contaminants to migrate into areas that would cause a significant public health hazard. Also, Spiegel suggests that because 60 years of legacy dumping has already occurred, and with the findings of fact showing that low levels of contaminants already have reached the Rio and Buckman area, unhealthy exposures are within the next 10 years. (See Spiegel "Analysis of Capture Zones of the Buckman Wellfield and a Proposed Horizontal Collector Well North of the Otowi Bridge", "Minority Report: Santa Fe Water Task Force", "Realities of Evasion", Appendix A, Appendix B; "2000

Presidential Address:..." by Mary Lou Zoback, all of these references are on the CES Website).

(E) After reviewing the Gilkeson report, a CES summary was released to NMCAB, the EPA, NMED and various legislators both at federal and state levels revealing the following:

> *The Gilkeson report released by the NM CAB merits further investigation as to what RCRA laws were violated regarding the installation, development, and sampling of the groundwater monitoring well system and groundwater characterization at LANL. In order to meet compliance under RCRA, LANL authored and started to implement the Hydrogeologic Workplan 1998. Its mission is to characterize the aquifer contamination with over 32 monitoring wells on an estimated budget of 30.8 million dollars. The goal of the project was to monitor the geochemistry, permeability flows of probable contaminant pathways within the EPA RCRA guidance. LANL has spent well over 100 million dollars and many of the wells must be abandoned, plugged, re-drilled and developed correctly in spots that would show the most likely areas that would be contaminated. The higher costs are 2-5 times over the estimated budget and LANL falls short in gathering data that they projected in the work plan … (See CES Website, Summary of Gilkeson report)*

…because of faulty intelligence, engineering and poor execution installing the wells and screens.

It would be important to note here that the potential hazardous problem within the region would qualify the EBSSAS for Critical Aquifer Protection status (Under 40 CFR Ch 1; Part 149…) Establishing the EBSSAS as a Critical Aquifer Protection area would be crucial because the contamination of the sole and/or principal aquifer is reasonably likely to occur. There are indications by the current administration that there will be an increase in production of nuclear and biological weapons at LANL, especially now that Rocky Flats operations have moved there. Evidently, certain aspects of enforcement and grant programs have not been properly funded in the past, therefore making it harder to enforce this potential public hazard. Not only have there been ignored reports from respected geo-hydrologists but also from the USGS staff and NMED as well. The CDC has been involved in gathering data on LANL's off-site hazardous releases exposures on civilian populations, in an under-funded project called, "Los Alamos Historical Document Retrieval and Assessment Project (LAHDRA)" (See http://www.shonka.com/ReConstructionZone/default.htm.) This project has been usurped by severely limiting access to LAHDRA personnel who have a higher security clearance than personnel in custody of the records at LANL. Many records were reclassified after 9-11 in the name of "National Security," in most cases to allow LANL to operate under a continuing cloak of secrecy, but also to stop the release of information to the public and to the Center for Disease Control that would prove a likely and reasonable significant public health hazard, as well as remaining unaccountable for past and current practices. Nearly 90% of current files that are now classified, were not classified pre-911 and during the Cold War (Cimino, pers. comm. 2004). In a project briefing LAHDRA released findings on autopsies that proved that people living off-site, within 5-10 miles of the lab, never working at LANL, had high levels of radionuclides in the liver and other body organs. These findings were enough to continue to push for further data and funding of the project.

The preceding examples of closed records, over-spending millions on poorly executed installation of monitoring wells, LANL's manipulation of hydrologic modeling, shunning accountability of off-site nuclear releases, ignoring public calls for intensive cleanup of waste sites and public exposure only supports the perceptions of further mistrust for government, its ability to protect water quality in the region and protect the health and welfare of the people.

(F) The Los Alamos Municipal Water Systems has been tested for Arsenic sampling and the results are equal to or Greater than the 10ppbMCL, according to the NMED Drinking Water Bureau website.

(G) PCB levels have been found at levels thousands of times higher than what is considered to be safe for human health, resulting in the first ever 'Do Not Eat' fish advisory for the Rio Grande from Los Alamos Canyon discharge point to the Cochiti Dam.

Pojoaque/Nambe Sub-basin

(A) Most water in this area, especially though the Pojoaque river valley, has high levels of Arsenic, Radon and Nitrates. Most people in the area are downwind from LANL. This area had the most brutal exposures during the Cerro Grande Fire (2000). There were several areas around the Lab that burned and were known to be contaminated by the historical dumping into canyons and arroyos and included the building that housed the manufacturing of the bombs of Hiroshima and Nagasaki.

(B) The Nambe Headstart has high Arsenic sampling results equal to or greater than the 10ppb MCL, according to the NMED Drinking Water Bureau website.

Picuris and Truchas sub-basin

(A) In the City of Espanola there is a contaminated plume of Dry cleaning solvents in the aquifer that is waiting for federal Superfund cleanup moneys. Already there are 4 known deaths from cancer on this plume.

(B) Most people in the area are downwind from LANL. This area had the most brutal exposures during the Cerro Grande Fire (2000). There were several areas around LANL that burned and were known to be contaminated by the historical dumping into canyons and arroyos, and included the building that housed the manufacturing of the bombs of Hiroshima and Nagasaki.

(C) The Alcalde MSWCA has high Arsenic sampling results Equal to or greater than the 10ppb MCL the Espanola Water System has high Arsenic sampling results equal to or greater than the 10ppb MCL, according to the NMED Drinking Water Bureau website.

(D) EPA Brownfields clean-up grant has been approved to the Picuris Pueblo to clean mine scarred land at the US Hill Mica Mine site that is within the EBSSAS. The site contains several hazards, including a waste rock dump, an over burden dump, open pits and processed mica fine waste. The site contributes to siltation and erosion from uncontrolled storm-water runoff.

Lower Chama Rio to Mtn. San Antonio to Embudo sub-basin

(A) Here in this petition, mentioned in previous section the El Rito’s Mutual Domestic system, which was one of the First areas to have contaminated wells due to high Nitrate and Nitrogen problems.

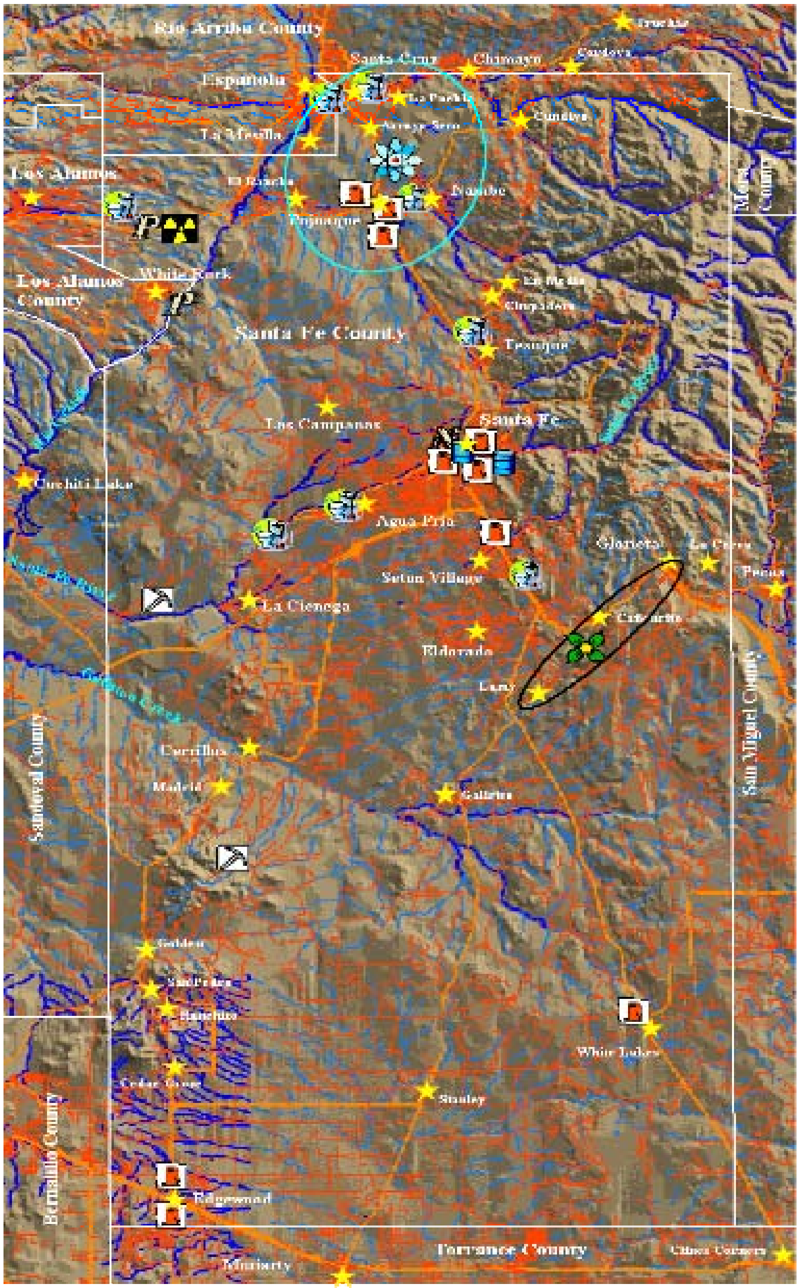
(B) The San Antonio MSWCA has high Arsenic sampling results equal to or greater than the 10ppb MCL, according to the NMED Drinking Water Bureau website. (See the last page of this section for web site information.)

(B) Potential Aquifer Contamination (NMED website information)

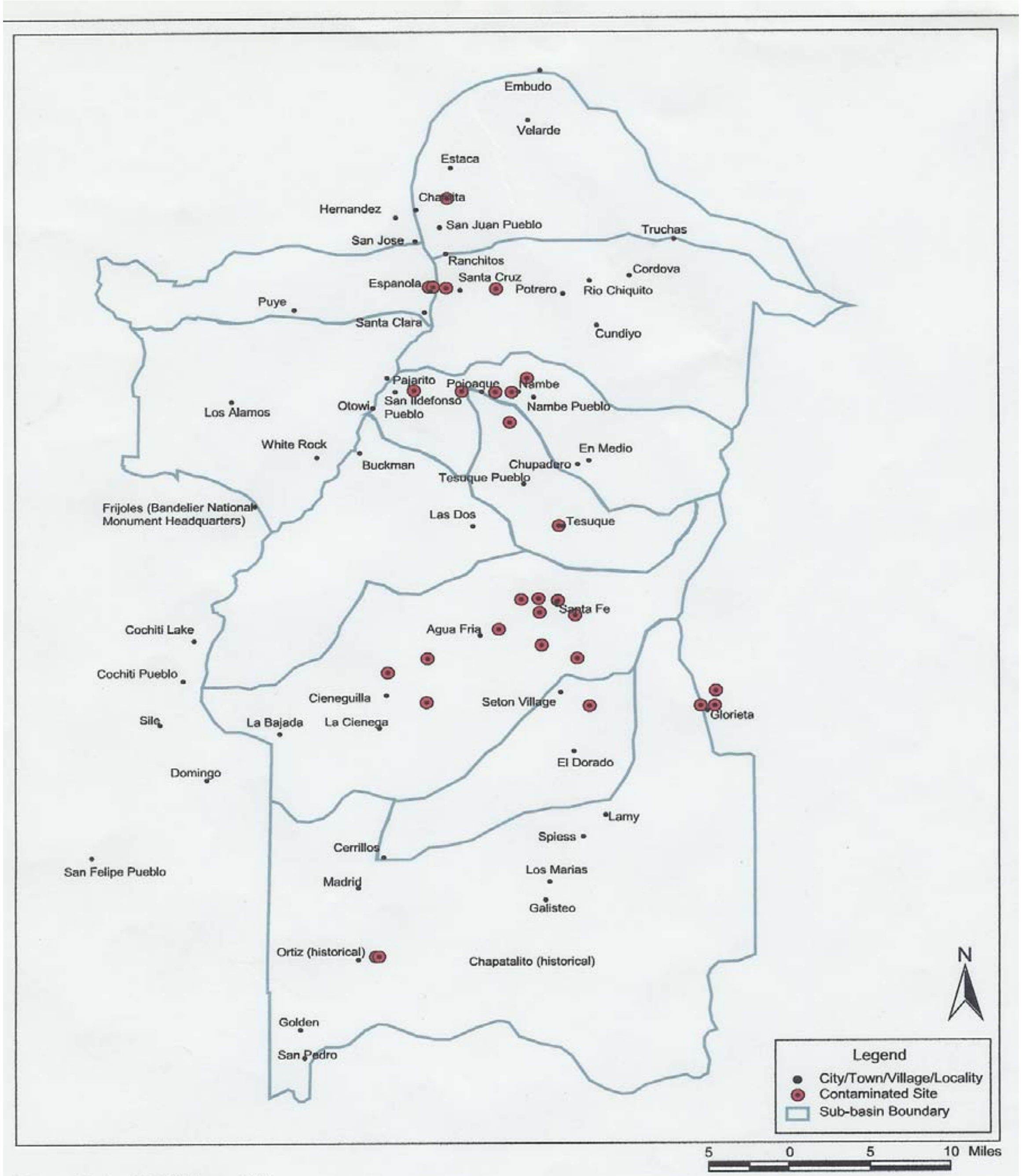
In any aquifer there are potential sources of contamination, the New Mexico Environment Department Drinking Water Bureau has the following listed on the website:

Some potential sources of contamination include:
Septic Tanks & Leachfields
Hazardous Waste Sites
Mining Activities
Industrial Areas
Commercial Areas
Stormwater Runoff
Pesticides & Fertilizers
Animal and Human Waste Disposal
Underground Storage Tanks
Agrichemical Application
Chemical Spills
Household Waste
Landfills & Illegal Dumps

In the Jemez y Sangre/Duke report there were maps published by Duke engineering that took some of the same area and illustrated Map A. Contamination sites (See JyS Report) Map B. Nitrates contamination, (See JyS Report) Map C.
Locations of major municipal well fields, which all coincide with the geohydrological boundaries of the EBSSAS (See JyS Report).
http://www.nmenv.state.nm.us/gwb/GWQ%20Atlas/Santa_Fe_County.html



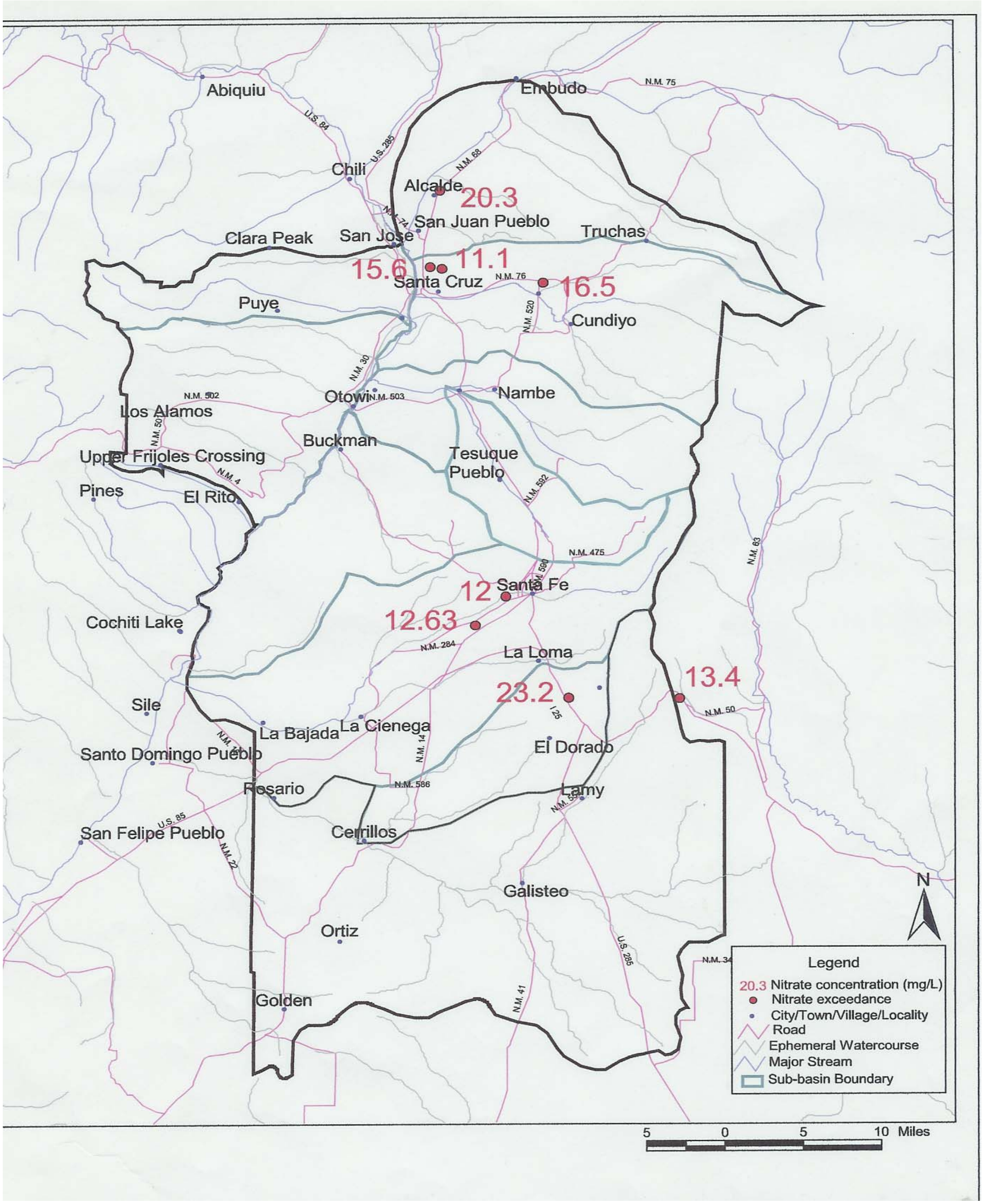
Web site map from the NMED Ground Water Atlas Santa Fe County



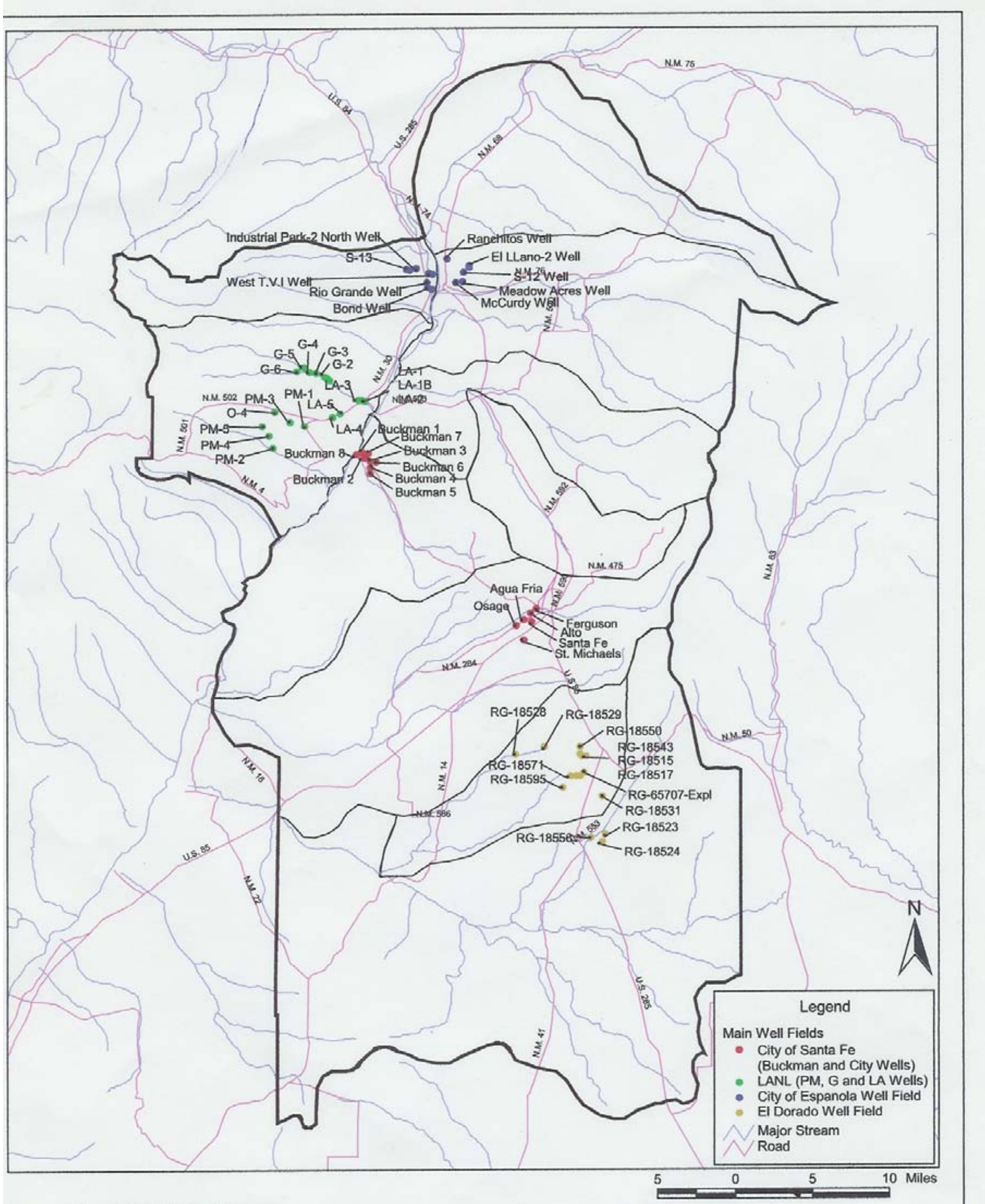
Source: Duke, 2001 (Figure 6-9)

Map A: Contamination Sites

(Note: Duke Engineering: Did not map any contamination sites on or off the federal reservation of LANL.)

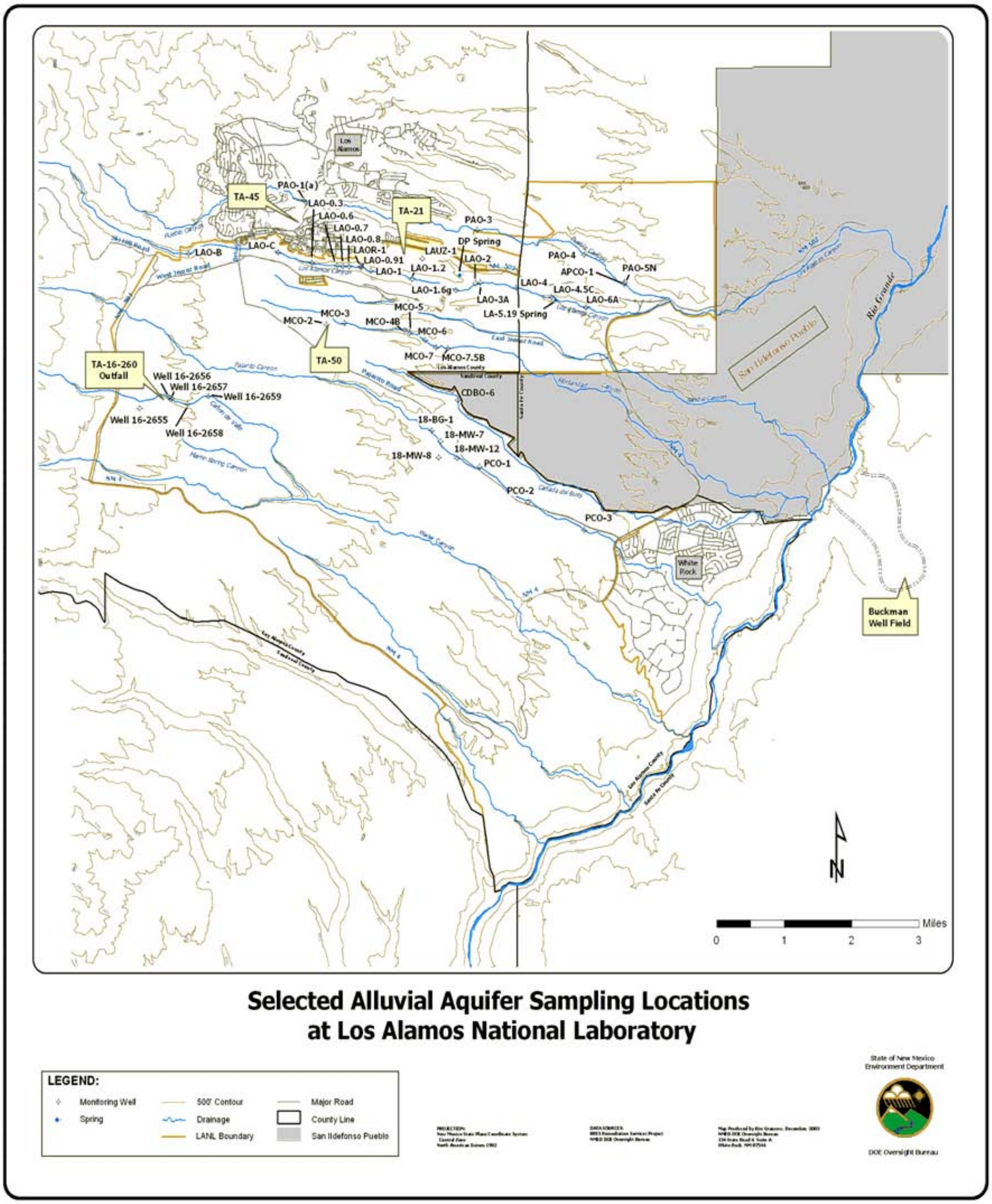


Map B: Nitrate concentrations
Note: CES did not include the Subbasin of Galisteo.
Instead, Spiegel followed the correct Geo-hydrological boundaries.

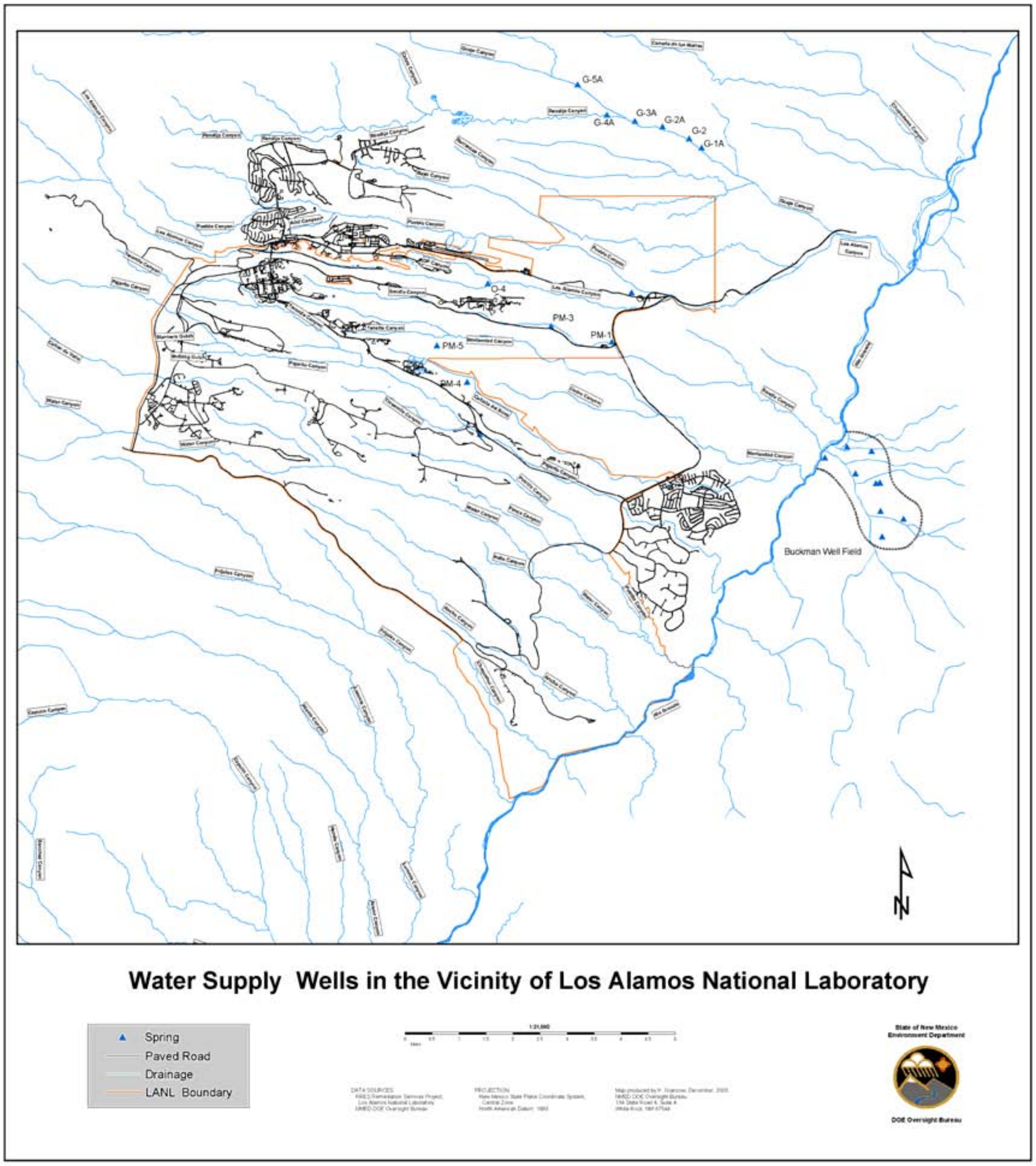


Source: Duke, 2001 (Figure 5-3)

Map C: Major Municipal Well Fields

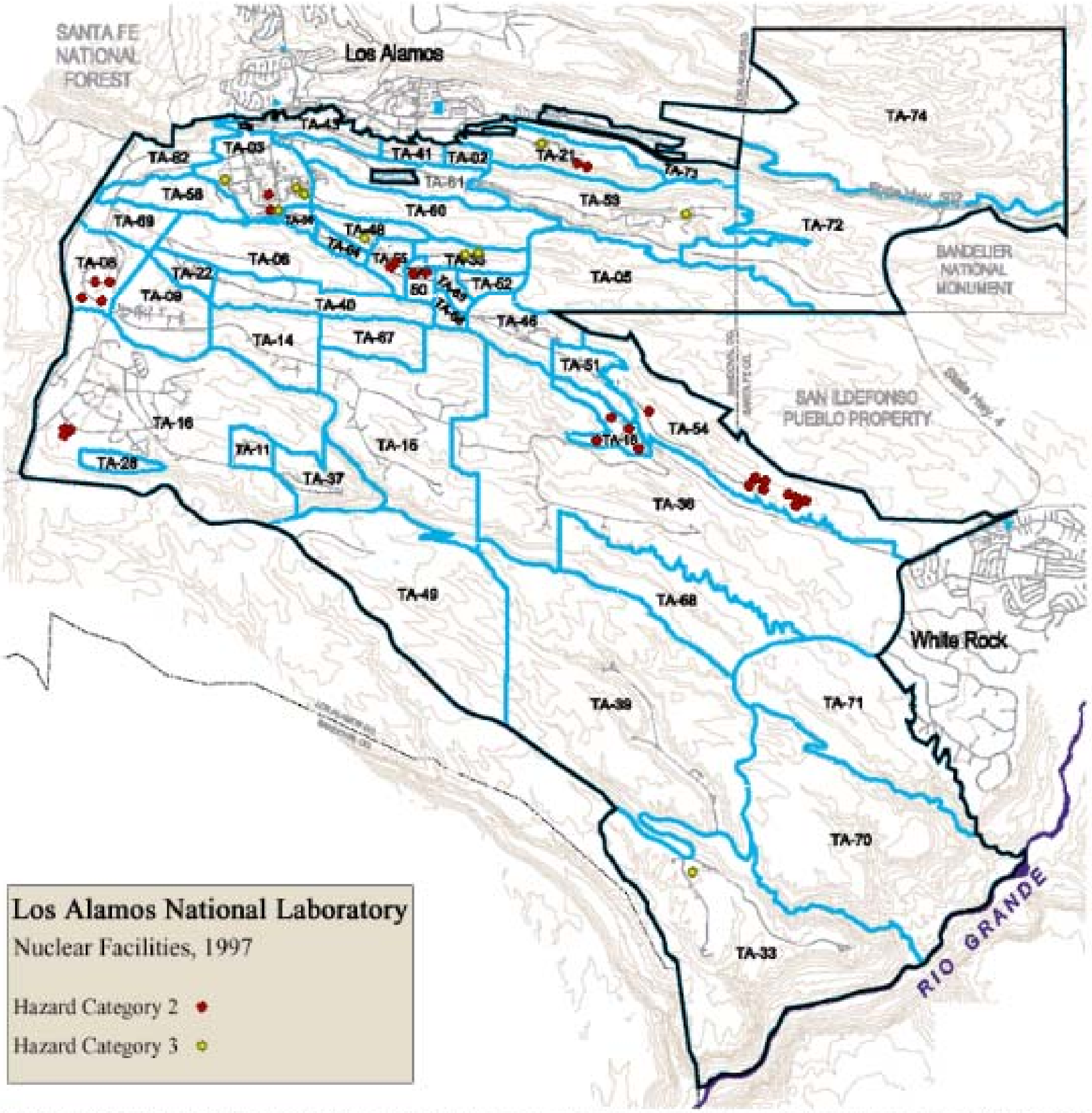


Map D
See the Los Alamos Study Group Website www.lasg.org for more information on waste sites and drinking water.



Water Supply Wells in the Vicinity of Los Alamos National Laboratory

Map E



Source: Site-Wide Environmental Impact Statement Project Office, *Description of Technical Areas and Facilities at Los Alamos*, LA-UR-97-4275.

Map F

More information on waste sites and hazards from LANL www.lasg.org See Technical areas and maps.

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