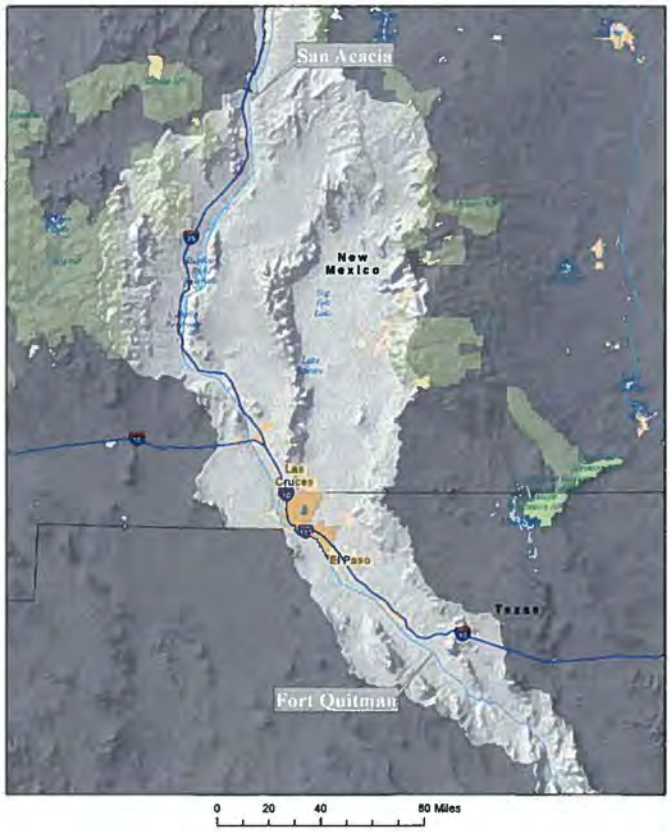
Evaluation Summary Submitted to:
Army Corps of Engineers – Albuquerque District

Evaluation of the NMISC Lower Rio Grande Hydrologic Data Compendium as a Preliminary Source of Salinity-Related data



United States Geological Survey
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Introduction

The New Mexico Interstate Stream Commission (NMISC) Lower Rio Grande Hydrologic Data Compendium includes a geodatabase of groundwater sites and associated data, a geodatabase of surface water sites and associated data, original source documents that include digital tabular data and scanned hard-copy reports, and metadata files organized by document source. This evaluation summary discusses the structure and contents of the groundwater and surface water geodatabases, summarizes the Compendium's contents by document source, examines the contents for salinity-related data, and suggests a Lower Rio Grande Salinity Geodatabase Preliminary work plan. A separate geodatabase accompanies this report and includes source summaries, a spatial footprint of each project study area, and summary statistics for salinity-related data.

Compendium Structure and Contents

Surface Water Geodatabase

- The surface water geodatabase is comprised of one point feature class (Stations) and one main data table (ParameterSeries) with several ancillary look-up tables that regulate field values within geodatabase.
- The Station feature class stores site information that includes spatial location, site id, name, station type and use, and source data.
- The ParameterSeries data table stores sample information that includes site, date, time, parameter, measured value, method, matrix sampled, data qualifier, and source information.
- The number of values and the number of sites from the ParameterSeries table are listed by source agency are listed in Table 1.

Groundwater Geodatabase

- The groundwater geodatabase is comprised of one point feature class (Stations) and one main data table (ParameterSeries) with several ancillary look-up tables that regulate field values within geodatabase.
- The Station feature class stores site information that includes spatial location, site id, name, well construction, and source data.
- The ParameterSeries data table stores sample information that includes site, date, time, parameter, measured value, method, matrix sampled, data qualifier, and source information.
- The number of values and the number of sites from the ParameterSeries are listed by source agency are listed in Table 2.

Table 1. Summary of all data in the NMISC Surface Water Geodatabase summarized using the DocumentSource field in the ParameterSeries data table.

Document Source	Data Type	First Record	Last Record	Number of Records	Number of Sites
Boyle-Parsons Compilation	Discharge or Stage	1/15/1939	5/15/1994	488	2
Boyle-Parsons Compilation	Water Quality	1/15/1938	12/15/1995	11432	29
EBID Staff Provided File Or Information	Discharge or Stage	1/1/1930	12/31/2005	294110	74
EPA Legacy STORET Database	Discharge or Stage	5/1/1970	9/15/1994	370	9
EPA Legacy STORET Database	Water Quality	10/1/1964	9/14/1999	89319	147
EPA Modernized STORET Database	Water Quality	5/27/1977	12/14/2004	10228	20
IBWC Website	Discharge or Stage	1/1/1889	12/31/2007	175498	6
Jerry Williams Salt Thesis	Discharge or Stage	1/15/1934	12/15/1963	648	2
Jerry Williams Salt Thesis	Water Quality	1/15/1934	12/15/1963	31777	9
NMSU King-Tillery Data Compilation	Discharge or Stage	1/1/1908	9/30/2003	443961	88
Suzanne Mills, Daniel B. Stephens Water Quality Database	Water Quality	1/2/1900	1/27/2005	13798	55
US Bureau Of Reclamation Staff	Discharge or Stage	10/21/1995	12/31/2005	6195	16
USGS NWIS Database Website	Discharge or Stage	1/1/1899	12/31/2007	221768	26
USGS NWIS Database Website	Water Quality	6/10/1958	5/30/2007	72846	82
Version 2 Lower Rio Grande Data Compendium	Discharge or Stage	1/31/1889	9/30/2005	41084	115

Table 2. Summary of all data in the NMISC Groundwater Geodatabase summarized using the DocumentSource field in the ParameterSeries data table.

Document Source	Data Type	First Record	Last Record	Number of Records	Number of Sites
EBID Staff Provided File Or Information	Discharge or Water Level	1/15/1946	6/15/2003	15498	55
EBID Water Resources Information System	Discharge or Water Level	1/24/2001	3/31/2008	96870	70
EPA Legacy STORET Database	Water Quality	12/8/1981	5/9/1996	20820	168
New Mexico Office Of The State Engineer Staff	Discharge or Water Level	5/6/1947	3/7/1985	4700	408
New Mexico Water Resources Research Institute	Water Quality	9/11/1935	4/10/1997	75049	844
SSPA Staff	Discharge or Water Level	3/10/1972	2/17/1978	85	9
SSPA Staff	Water Quality	1/1/1901	11/11/1984	805	269
Texas Water Development Board Website	Discharge or Water Level	11/30/1909	4/5/2003	60207	1744
Texas Water Development Board Website	Water Quality	3/19/1953	8/4/1987	48	17
United States Geological Survey Staff	Water Quality	3/20/1926	10/4/2001	50483	842
US Bureau Of Reclamation Staff	Discharge or Water Level	1/15/1946	12/15/1997	48502	50
USGS NWIS Database Website	Discharge or Water Level	8/8/1931	12/23/2005	32696	609

Original Source Documents

The NMISC Lower Rio Grande Hydrologic Data Compendium contains original source documents that include digital tabular data and scanned hard-copy reports, and metadata files organized by document source. The majority of the numerical data are in MS Excel spreadsheets and MS Access databases that have been incorporated into the Groundwater and Surface Water geodatabases by the NMISC.

Several original reports that are pertinent for the study area are included as pdf files. Data for the Williams, 2001 report are included in the Surface Water geodatabase. The reports included in the Documentation folder of the Groundwater section are not referenced in the DocumentSource field of the Groundwater geodatabase. The groundwater reports contain substantial information about wells, well construction, and statistics summarizing the state of wells in the study areas—information difficult to represent within a database. Bibliographic information for the reports is listed below.

- Original Surface Water Report
  - Williams, J.H., 2001, Salt Balance in the Rio Grande Project from San Marcial, New Mexico to Fort Quitman, Texas: New Mexico State University master's thesis, 92 p.
- Original Groundwater Reports
  - Tetra Tech EM Inc, 2003, Final Report for Well Installation Activities within the Mesilla Valley Lower Rio Grande Basin prepared for New Mexico Interstate Stream Commission.
  - Wilson, C. A., White, R.R., Orr, B.R., Roybal, R.G., 1981, Water Resources of the Rincon and Mesilla valleys and Adjacent Areas, New Mexico: Office of the State Engineer Technical Report #43, New Mexico, 514 p.
  - Alvarez, H.J. and Buckner, A.W., 1980, Ground-water Development in the El Paso Region, Texas with emphasis on the resources of the Lower El Paso Valley: Texas Department of Water Resources Report #246, 322 p.
  - Frenzel, P.F., Kaehler, C.A., and Anderholm, S.K., 1988, Geohydrology and Simulation of Ground-Water Flow in the Mesilla Basin, Doña Ana County, New Mexico and El Paso County, Texas: U.S. Geological Survey Open-File Report 88-305, 194 p. (Note: This report has been superseded by a more recent publication: USGS Report: PP-1407-C, http://pubs.er.usgs.gov/usgspubs/pp/pp1407C)
  - Nickerson, E.L., 1986, Selected Geohydrologic Data for the Mesilla Basin, Doña Ana County, New Mexico, and El Paso County, Texas: U.S. Geological Survey Open-File Report 86-75, 86 p.

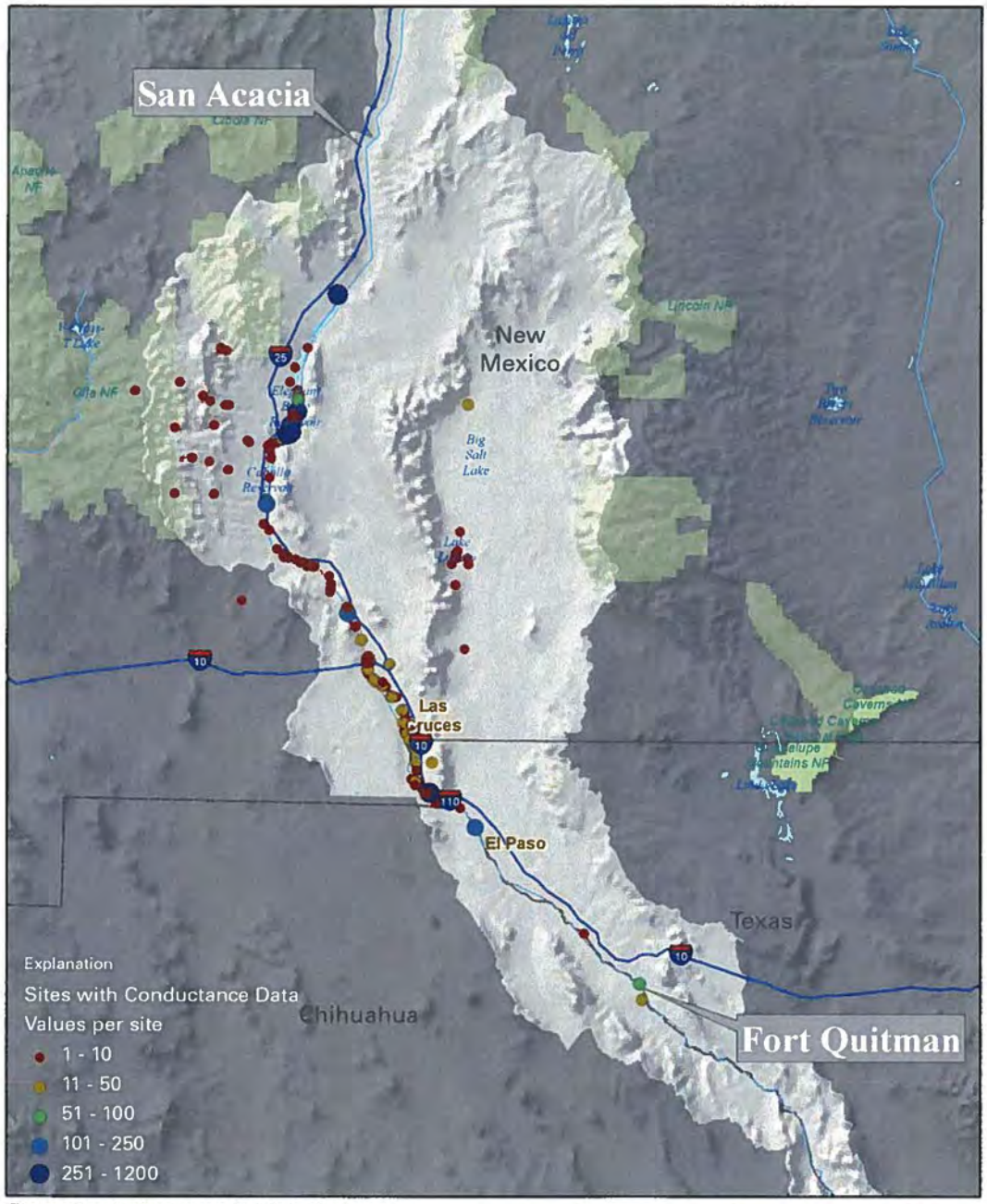
Salinity-Related Data

Salinity can be estimated and analyzed using a variety of parameters. Total dissolved solids, specific conductance, and major ions are commonly used to estimate salinity concentrations in surface water. If a statistically significant relation is established between specific conductance, dissolved solids, and discharge, then dissolved solids concentrations and loads may be predicted from specific conductance and discharge values, resulting in reasonably accurate and complete estimates of salinity for a particular stream location. (Lieberman and others,1986, p. 2). Based on this information, the NMISC Surface Water database was examined to serve as a starting point for a compilation effort of salinity-related data along the Lower Rio Grande.

Surface Water Geodatabase

- About 61 of 1995 parameters reported in the database were considered to be salinity-related parameters.
- 272 of 424 sites had at least one sample with a salinity-related parameter for the entire period of record of the database.
- 203 sites have specific conductance data; 58 of those sites have over 10 values (fig. 1)
- 179 sites have total dissolved solids or residue on evaporation data; 75 sites have over 10 values (fig. 2)
- 165 sites have discharge data; 131 sites have over 100 values (fig. 3)
- Of the 272 sites with at least one sample with a salinity-related parameter, 68 sites also had discharge data (fig. 5).
- 6 source agencies had sites with salinity-related data (table 3)
- The largest number of salinity-related records are from about 1975 to 1993 (fig. 5).

Sites with Conductance Data in the NMISC Surface Water Geodatabase

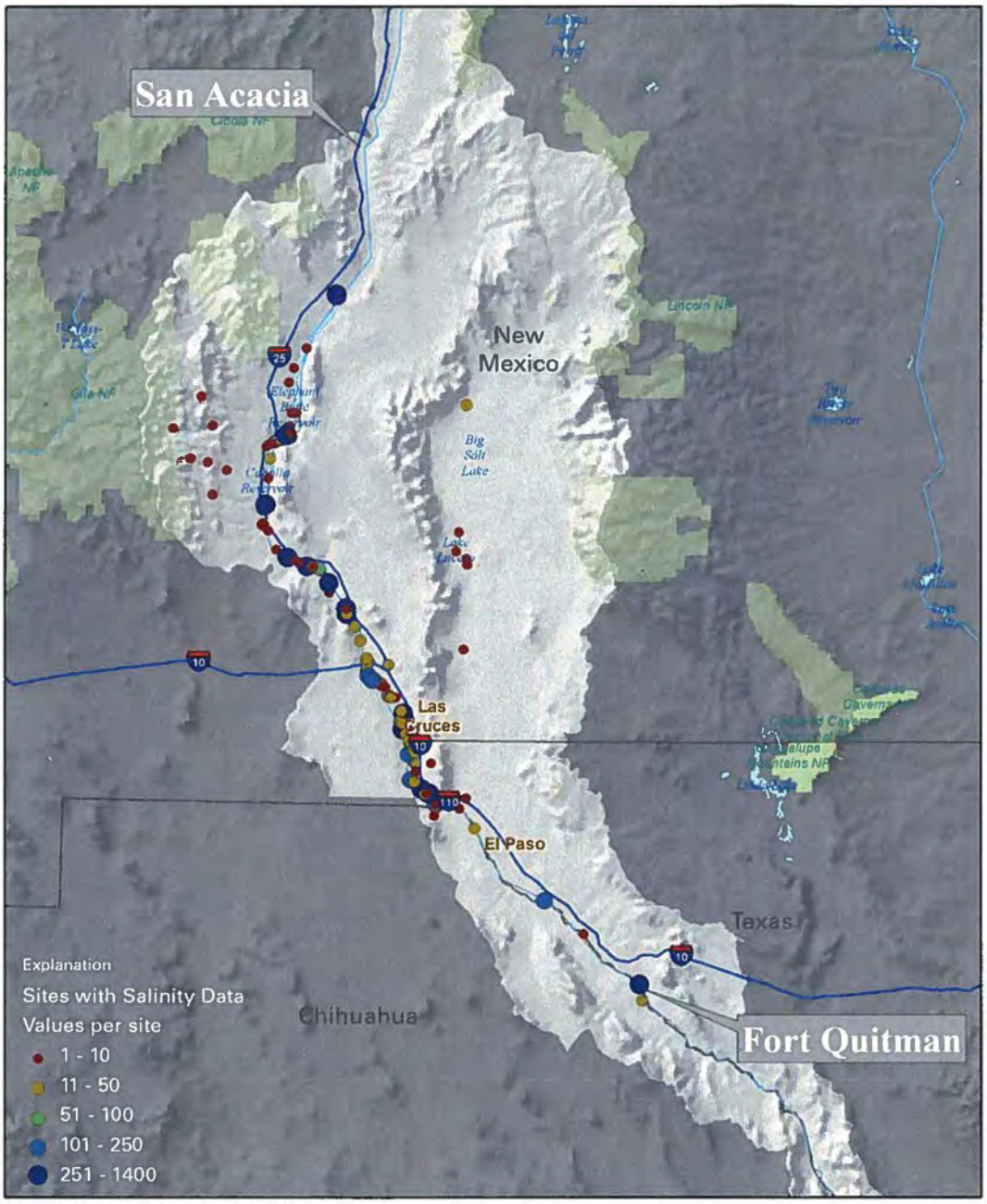


The number of values were calculated using the NMISC Surface Water geodatabase. Values were limited to parameters associated with conductance.

0 20 40 80 Miles

Figure 1. Map showing sites in the NMISC Surface Water geodatabase that have conductance data.

Sites with Salinity, Residue on evaporation and/or dissolved solids data in the NMISC Surface Water Geodatabase

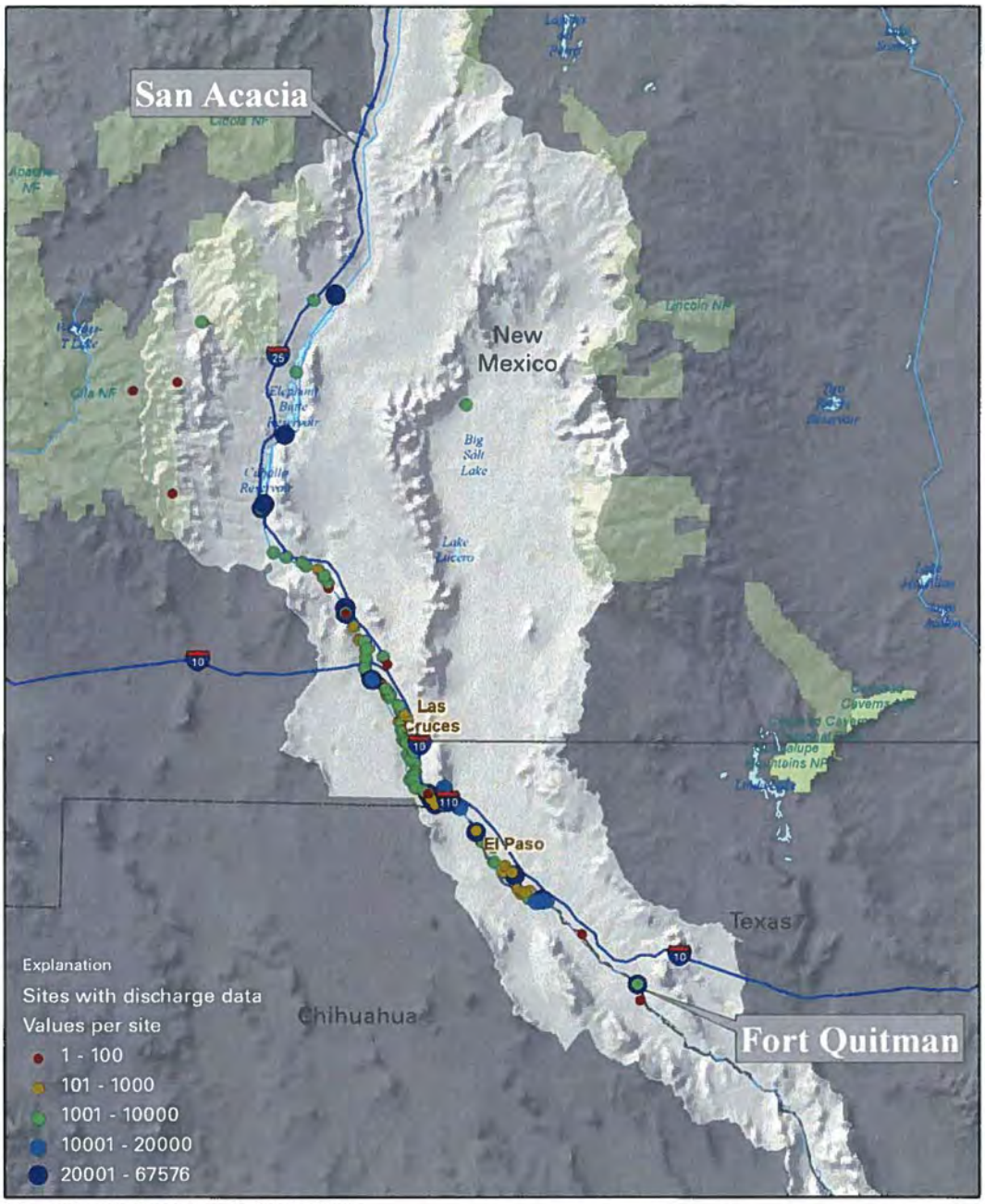


The number of values were calculated using the NMISC Surface Water geodatabase. Values were limited to parameters associated with salinity, residue on evaporation and/or dissolved solids data.

0 20 40 80 Miles

Figure 2. Map showing sites in the NMISC Surface Water geodatabase that have salinity, residue on evaporation and dissolved solids data.

Sites with Discharge data in the NMISC Surface Water Geodatabase

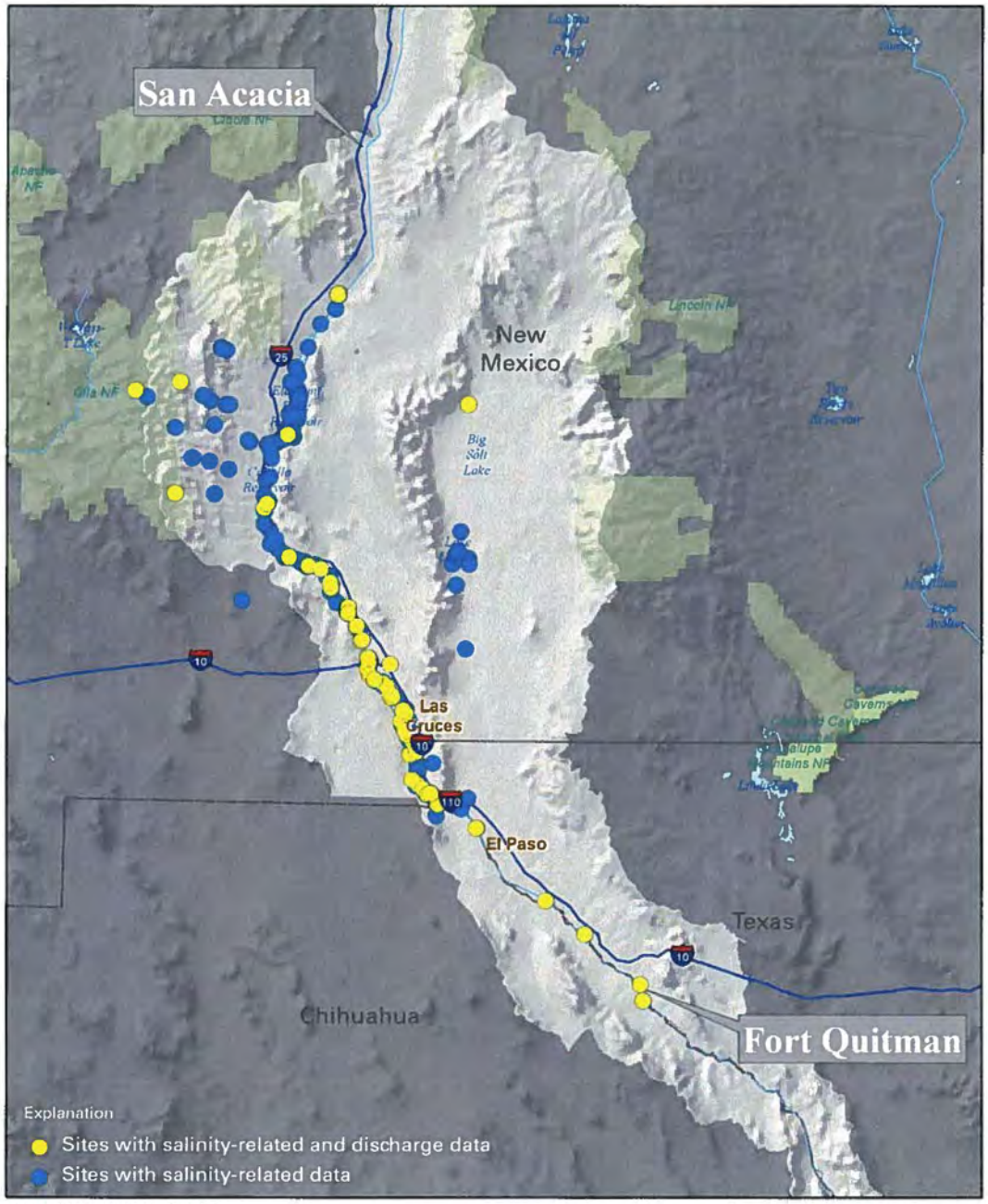


The number of values were calculated using the NMISC Surface Water geodatabase.

0 20 40 80 Miles

Figure 3. Map showing sites in the NMISC Surface Water geodatabase that have discharge data.

Sites with Salinity-Related and Discharge data in the NMISC Surface Water Geodatabase



Sites documented using the NMISC Surface Water geodatabase.

0 20 40 80 Miles

Figure 4. Map showing sites in the NMISC Surface Water geodatabase that have salinity-related data and discharge data.

Table 3. Summary of sites with salinity-related data in the NMISC Surface Water Geodatabase summarized using the DocumentSource field in the ParameterSeries data table. 11 sites are cited by multiple sources.

Document Source	First Record	Last Record	Number of Records	Number of Sites
Boyle-Parsons Compilation	1/15/1938	12/15/1995	11432	29
EPA Legacy STORET Database	10/1/1964	9/14/1999	9284	97
EPA Modernized STORET Database	5/27/1977	12/14/2004	934	20
Jerry Williams Salt Thesis	1/15/1934	12/15/1963	15901	9
Suzanne Mills, Daniel B. Stephens Water Quality Database	1/2/1900	1/27/2005	6928	55
USGS NWIS Database Website	6/10/1958	5/30/2007	12813	79

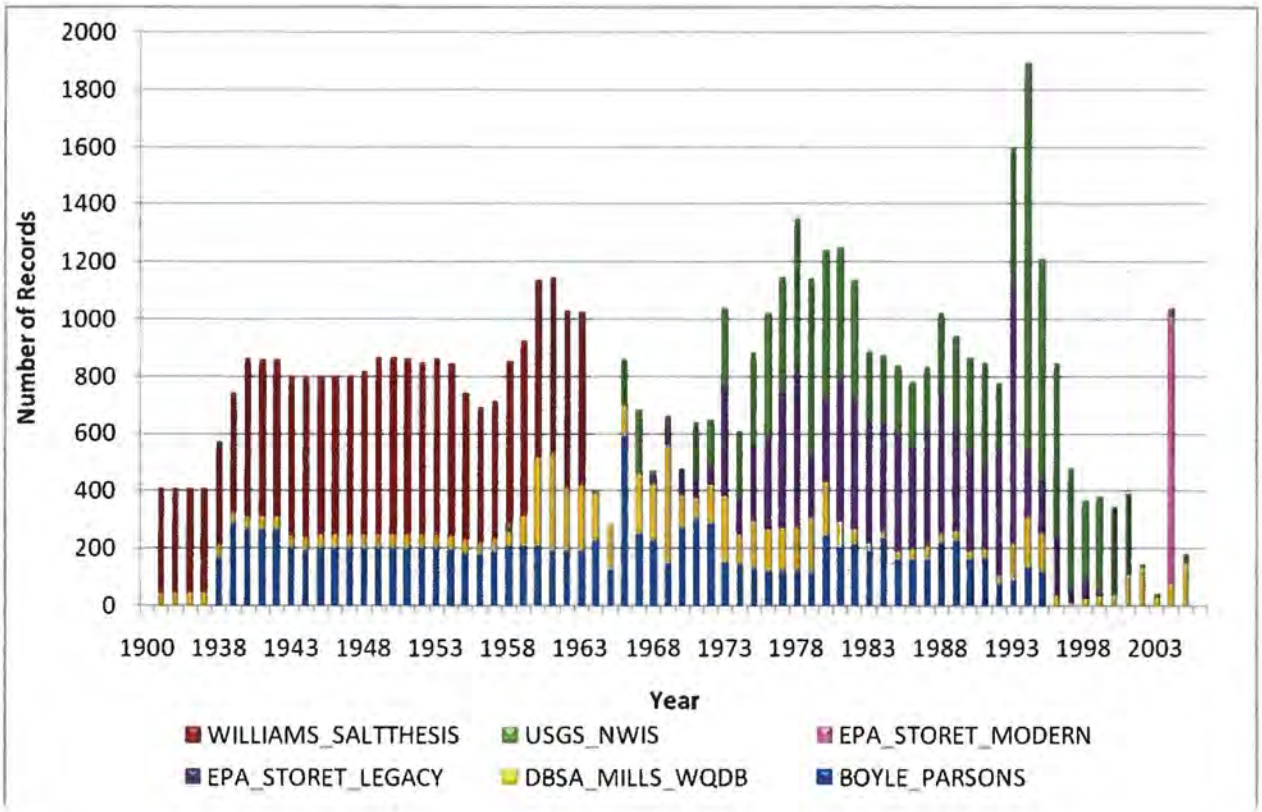


Figure 5. Number of salinity-related records in the NMISC Surface Water geodatabase by year for each document source.

Geospatial Bibliography of NMISC Compendium

The USGS has produced an ESRI ArcGIS 9.2 geodatabase containing three feature datasets (Groundwater, Surfacewater, and Salinity). FGDC-compliant metadata is provided at the feature dataset level. The Groundwater and Surfacewater feature datasets contain summary information for sites and data stored in the NMISC Surface and Groundwater Geodatabases. The Salinity feature dataset contains summary information and extents for sites with salinity-related data.

The Groundwater (gw) and Surfacewater (sw) feature datasets contain:

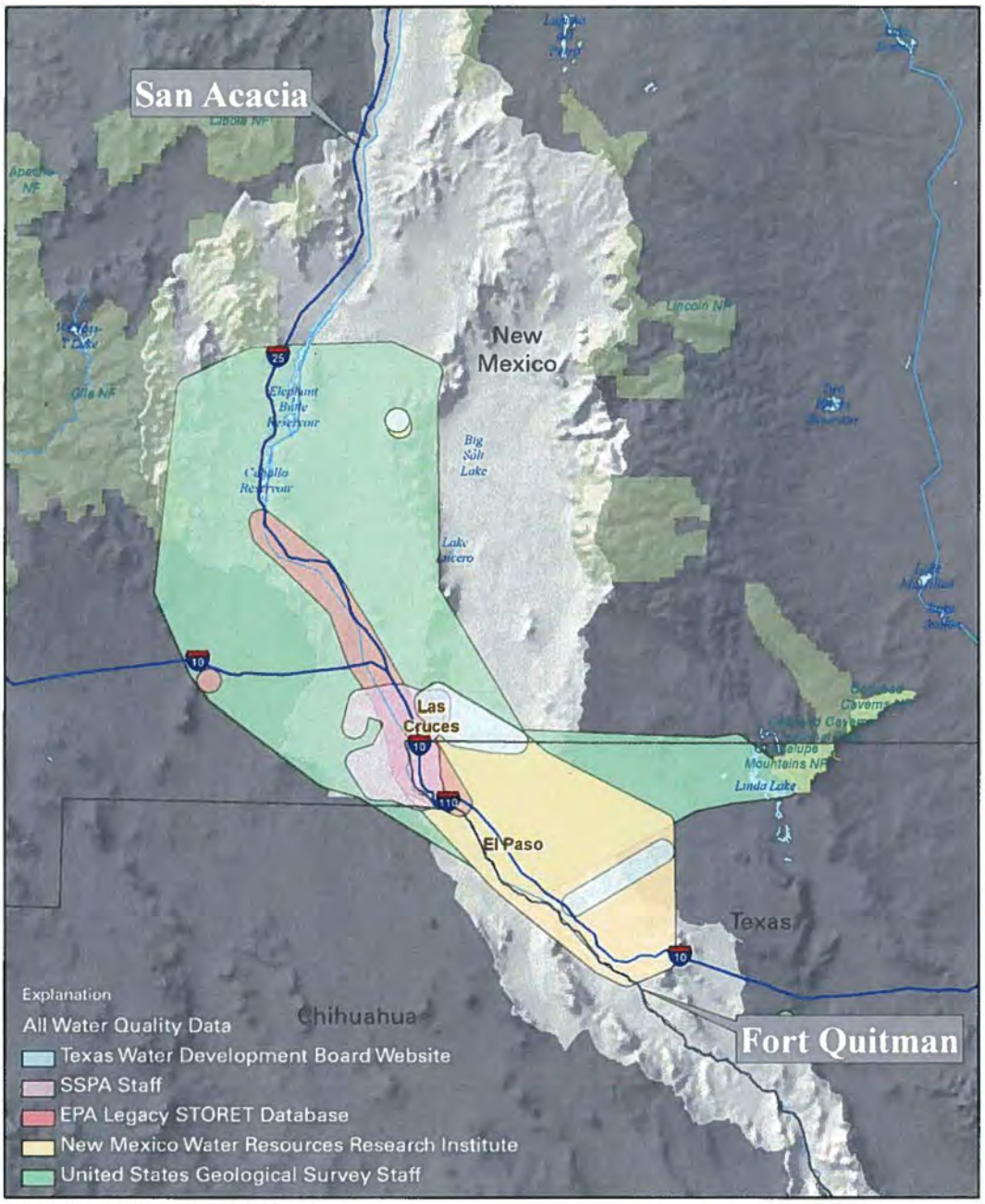
- All sites attributed with start and end dates, number of values, and document source are stored in a point feature class in the respective feature dataset (gw_all_sites, sw_all_sites).
- All spatial footprints (extents) for each study/document source attributed with start and end dates, number of values, and document source are stored in a polygon feature class in the respective feature dataset (gw_all_sites [fig. 6-7], sw_all_sites [fig 8-9]).
- Sites for each study are arranged by study/document source and summarize data for each site. They are stored in the remaining point feature classes in the respective feature dataset.
- Spatial footprints (extents) for each study/document source are also stored individually in the remaining polygon feature classes. They contain the single extent polygon for the DocumentSource they represent. These extents are also available collectively in the all_extents feature class in each feature dataset, respectively.

The Salinity (sal) feature dataset contains:

- All spatial footprints (extents) for each study/document source that contains salinity-related data in the current New Mexico Interstate Commission data collection are stored in a polygon feature class attributed with start and end dates, number of values, and document source (sal_all_extents [fig. 10]).
- Spatial footprints (extents) for each study/document source are also stored individually in the remaining polygon feature classes attributed with start and end dates, number of values, and document source. They contain the single extent polygon for the study/document source they represent. These extents are also available collectively in the sal_all_extents feature class.

In addition, the USGS has exported the datasets stored in the ESRI ArcGIS 9.2 geodatabase as three kmz files that correspond to the three feature datasets described above to allow them to be viewed in Google Earth. Using a computer with Google Earth installed (can be downloaded for free at http://earth.google.com/), double-click on the kmz and it will open the files in the My Places section of the Google Earth viewer.

Extents for Sites with Water Quality data in the NMISC Groundwater Geodatabase

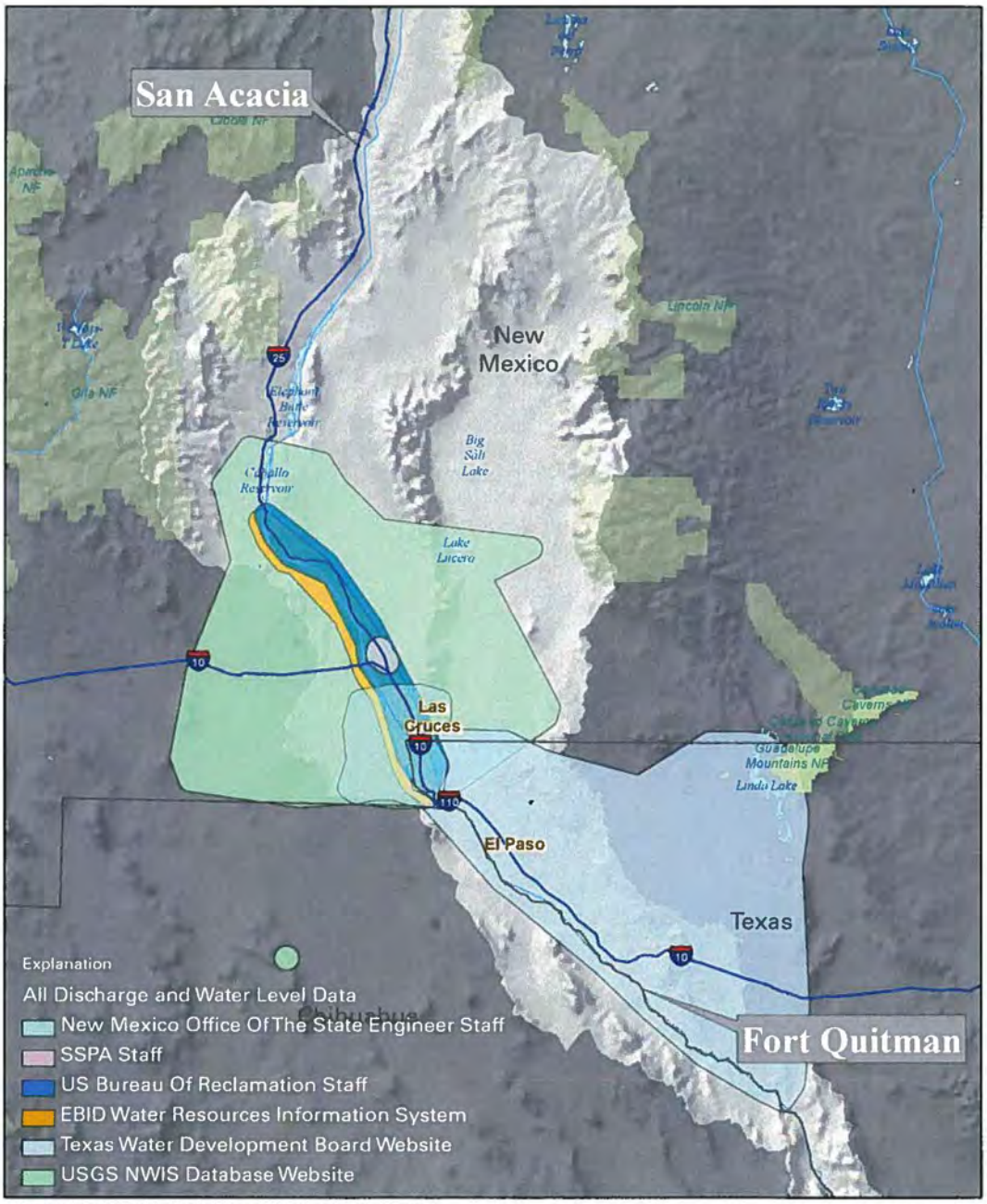


Extents for sites with water quality data by DocumentSource in the NMISC Groundwater geodatabase.

0 20 40 80 Miles

Figure 6. Map showing extents for sites with water quality data by DocumentSource in the NMISC Groundwater geodatabase.

Extents for Sites with Discharge and/or Water Level data in the NMISC Groundwater Geodatabase

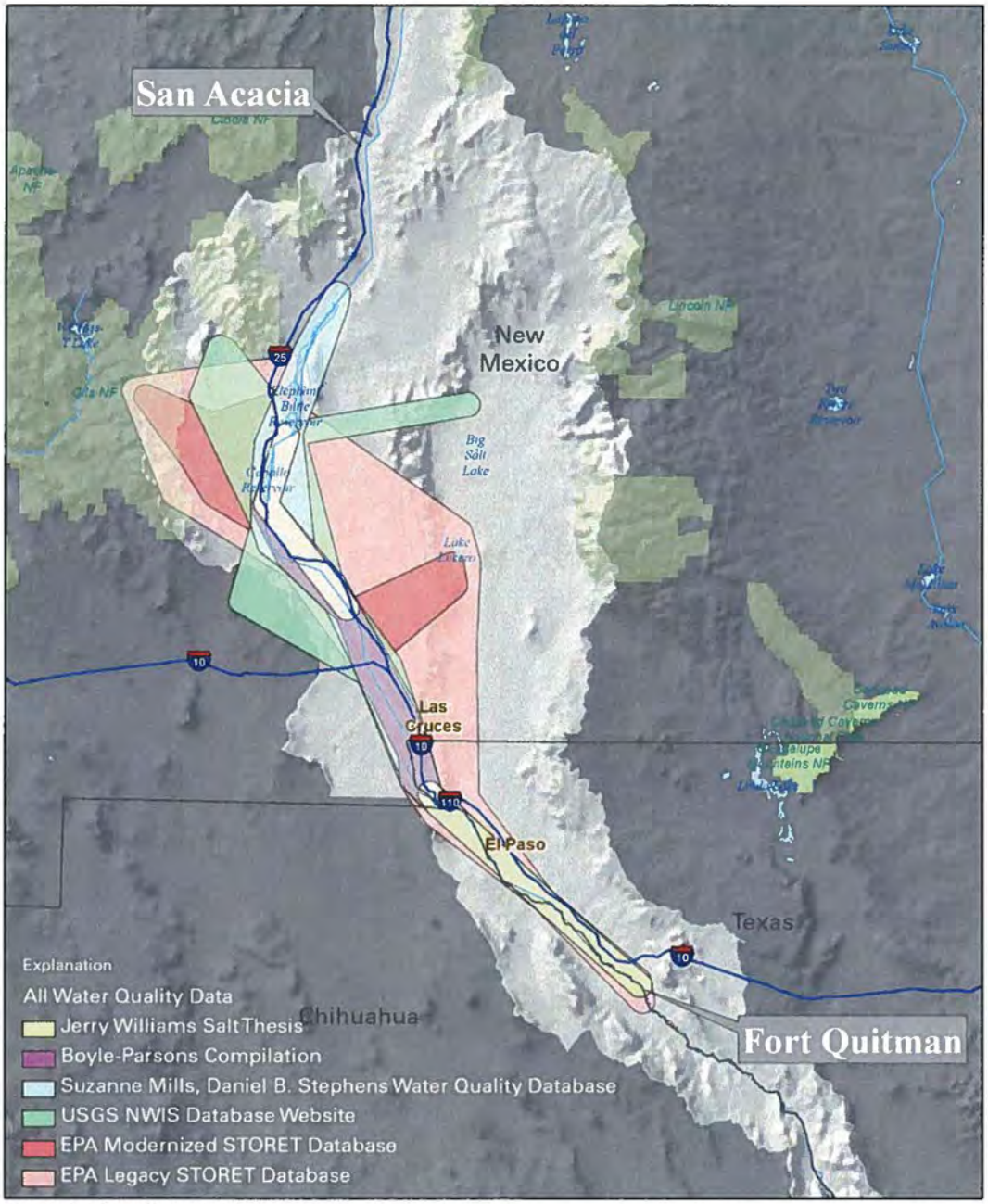


Extents for sites with discharge and/or water level data by DocumentSource in the NMISC Groundwater geodatabase. The US Bureau of Reclamation Staff extent was offset slightly to the northeast to allow the EBID Water Resources Information extent to be visible.

0 20 40 80 Miles

Figure 7. Map showing extents for sites with discharge and/or water level data by DocumentSource in the NMISC Groundwater geodatabase.

Extents for Sites with Water Quality data in the NMISC Surface Water Geodatabase

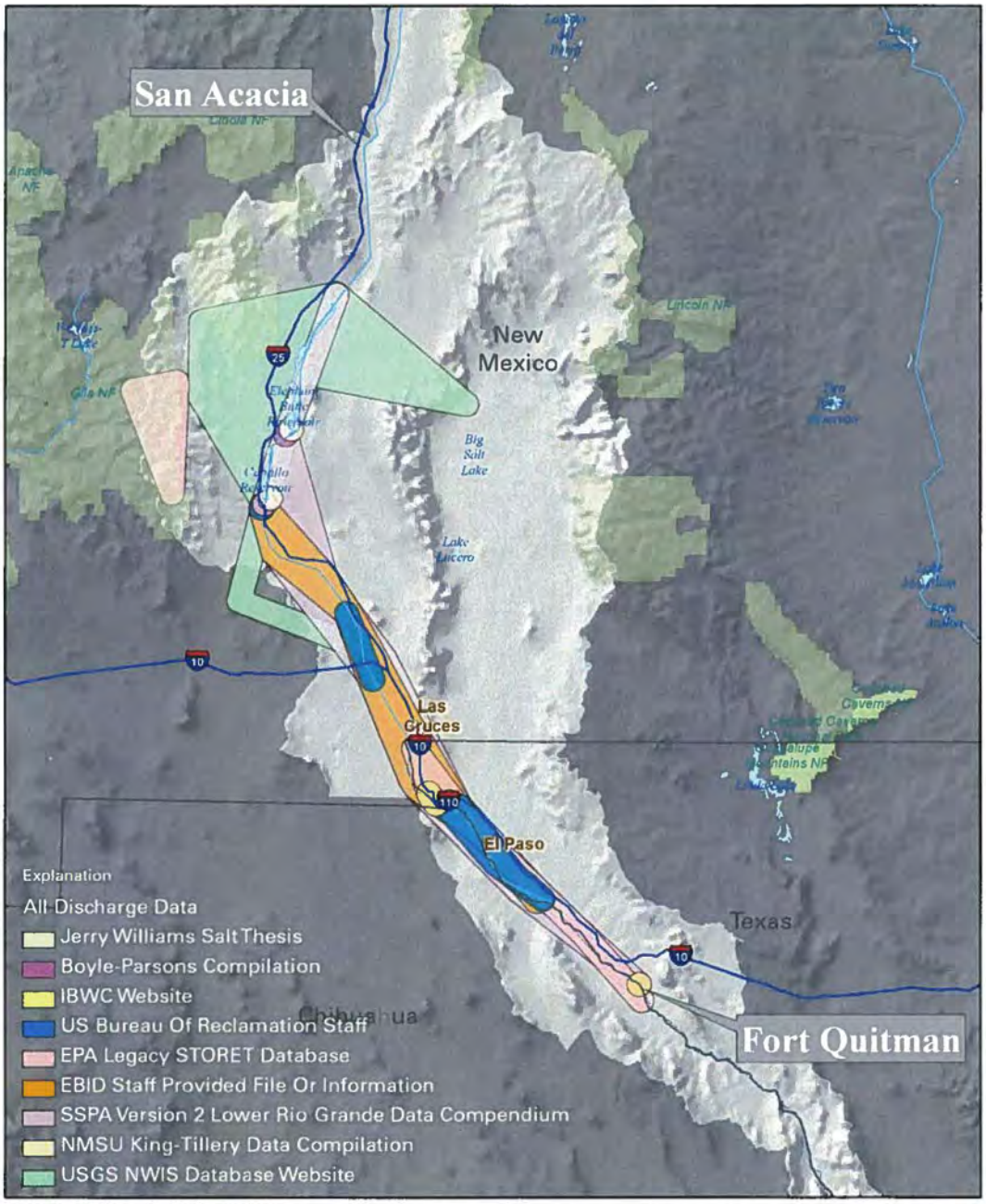


Extents for sites with water quality data by DocumentSource in the NMISC Surface Water geodatabase.

0 20 40 80 Miles

Figure 8. Map showing extents for sites with water quality data by DocumentSource in the NMISC Surface Water geodatabase.

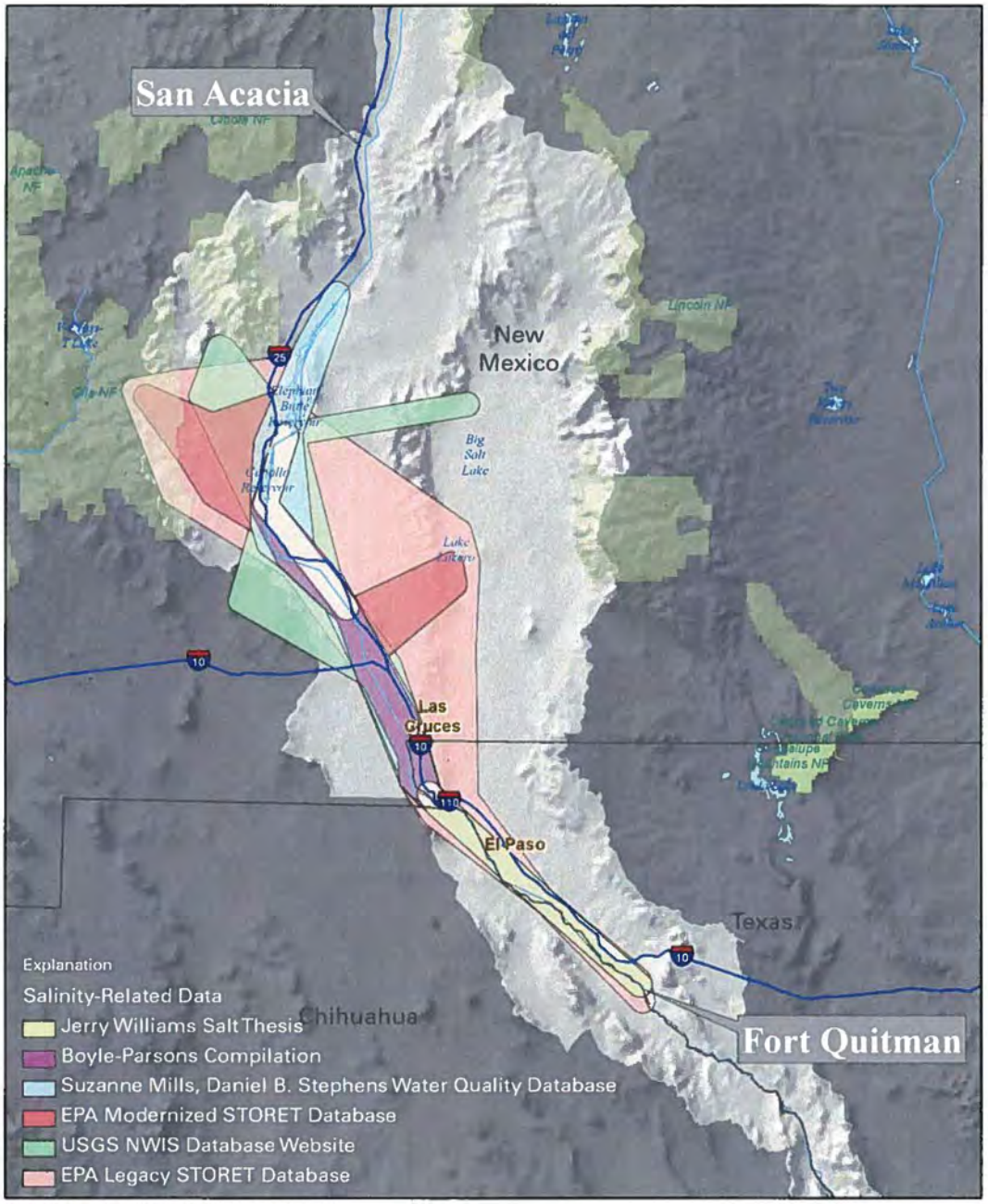
Extents for Sites with Discharge data in the NMISC Surface Water Geodatabase



Extents for sites with discharge data by DocumentSource in the NMISC Surface Water geodatabase. The Jerry Williams Salt Thesis extent was offset slightly to the northeast to allow the Boyle-Parsons Compilation extent to be visible.

Figure 9. Map showing extents for sites with discharge data by DocumentSource in the NMISC Surface Water geodatabase.

Extents for Sites with Salinity-Related data in the NMISC Surface Water Geodatabase



Extents for sites with salinity-related data by DocumentSource in the NMISC Surface Water geodatabase.

0 20 40 80 Miles

Figure 10. Map showing extents for sites with salinity-related data by DocumentSource in the NMISC Surface Water geodatabase.

Lower Rio Grande Salinity Geodatabase Preliminary Work Plan

NMISC Data Integration

The NMISC surface water database provides an excellent starting point for hard-to-find data sources. We suggest mining data associated with Boyle-Parsons Compilation, Jerry Williams Salt Thesis, and Suzanne Mills, Daniel B. Stephens Water Quality Database in the NMISC surface water database. Data from these original sources are in unique formats, and therefore, required significant data manipulation to integrate them into the database. In all, these data sources have data associated with 93 individual sites with 34,261 salinity-related records.

The three remaining data sources with salinity-related data are USGS NWIS, EPA STORET (Legacy), and EPA STORET (Modern). Since these agencies have standardized water quality data reporting and retrieval procedures, we suggest reloading original data directly from the agencies. By reloading the data, multiple site names for the same site can be integrated with the 93 sites present in the Boyle-Parsons Compilation, Jerry Williams Salt Thesis, and Suzanne Mills, Daniel B. Stephens Water Quality Database. Parameter codes, units, and reporting methods for non-detections can be verified and integrated. Furthermore, additional information, perhaps unavailable when the initial database compilation took place, can be researched and integrated. The sharp decline in the number of salinity-related records from the USGS and EPA around 1998 (fig. 5) indicates not all available data may have been incorporated into the NMISC database. Preliminary investigation into USGS data availability indicates there are additional salinity-related data. Downloading data directly from USGS and EPA would minimize duplicate records and typographical errors and likely include additional data.

Work Flow

Step 1: Develop Geodatabase Schema

- Use proposed data source file formats (NMISC, SAHRA, Paso Del Norte, USGS, EPA) to create a schema that will support multiple data sources.
- Create lookup tables to group data with similar parameter codes.
- Create domains to interpret coded values

Step 2: Load Data

- Integrate the selected hard-to-find salinity-related data from the NMISC Surface Water Geodatabase.
- Download and integrate salinity-related data from USGS NWIS and EPA STORET (Legacy and Modern).
- Extract and integrate hard-to-find salinity-related data not in the NMISC database from other databases such as SAHRA and Paso Del Norte.

Step 3: Refine Data

- Resolve duplicate sites at the same location.
- Check parameter codes for consistency and resolve differences in parameter coding methods between agencies using a lookup table.
- Search for duplicate records based on site, date and time, and parameter and resolve cases where multiple agencies report the same sample data.

Step 4: Data Delivery

- Prepare FGDC compliant metadata
- Finalize streamlined database structure for release
- Submit finalized database for outside review

Reference Cited

Liebermann, T.D., Middelburg, R.F. and Irvine, S.A., 1987, User's Manual for Estimation of Dissolved-Solids Concentrations and Loads in Surface Water: U.S. Geological Survey Water-Resources Investigations Report 86-4124, 51 p.