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STATEWIDE WATER ASSESSMENT: GROUNDWATER RECHARGE ESTIMATE COMPILATION FOR THE STATE OF NEW MEXICO

FINAL REPORT ON PHASE I

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PHASE I REPORT

Introduction

The purpose of this document is to report the completion of Phase I of the recharge component of the New Mexico Statewide Water Assessment. The objectives of this phase of the project were to compile previous estimates of recharge and to present the findings in both tabular form and on an interactive GIS map. We have obtained and compiled all readily available recharge estimates made for the state of New Mexico. This data includes the study citation, location (individual basins, counties, and water resource planning regions), recharge estimate (typically in acre-feet per year, AFY), methodology used to conduct the study, and a link to the study cited online. All studies are georeferenced with an associated point that indicates either the location where the study was conducted or the center of the water resource planning region (WRPR) to which the recharge estimate applies.

Methodology

The compilation of previously conducted recharge estimates consists of around 130 individual estimates ranging in geographic scale from an entire WRPR (at least one county) to small basins, geologic formations, and individual mountain slopes. The data were found through the review of New Mexico-related water studies. The principal source of recharge estimates were the Water Resource Investigation Reports published by the United States Geological Survey (USGS), many of which are computerized models of groundwater flow. The New Mexico Office of the State Engineer (OSE) has documents posted online pertaining to each of New Mexico's 16 Water Resource Planning regions, many of which estimate the components of the water budget over the entire region, including recharge. These reports have typically been completed by private industry consultants.

	D	E	F	G	H	I	
1	WPR_ID	REGION	REGIONAL/SUB	ESTIMATE	AUTHOR	METHOD	LINK
17	3	Jemez y Sangre	SR	La Cienega: 0.7"/yr	Spiegel and Baldwin (1963)	water mass balance	http://pubs.usgs.gov/wsp/152
19	3	Jemez y Sangre	SR	Nambe-Pojoaque Drainage: 2700 AFY	Lee Wilson and Associates (1978)	streamflow and existing literature examination	https://nmgs.nmt.edu/publica
20	3	Jemez y Sangre	SR	Tesuque R. Drainage: 1500 AFY	Lee Wilson and Associates (1978)	streamflow and existing literature examination	https://nmgs.nmt.edu/publica
21	3	Jemez y Sangre	SR	Sta Fe R. Drainage: 3500	Lee Wilson and Associates (1978)	streamflow and existing literature examination	https://nmgs.nmt.edu/publica
22	3	Jemez y Sangre	SR	Sta. Fe R. Drainage: 2070	Hearne (1985)	simulations based on streamflow estimates of Reiland (1975)	http://pubs.usgs.gov/wsp/220
23	3	Jemez y Sangre	SR	Pojoaque R. Drainage: 2250 AFY	Hearne (1985)	simulations based on streamflow estimates of Reiland (1975)	http://pubs.usgs.gov/wsp/220
24	3	Jemez y Sangre	SR	R. Chupadero Drainage: 390 AFY	Hearne (1985)	simulations based on streamflow estimates of Reiland (1975)	http://pubs.usgs.gov/wsp/220
25	3	Jemez y Sangre	SR	Tesuque R. Drainage: 1800 AFY	Hearne (1985)	simulations based on streamflow estimates of Reiland (1975)	http://pubs.usgs.gov/wsp/220
26	3	Jemez y Sangre	SR	R. En Medio: 890 AFY	Hearne (1985)	simulations based on streamflow estimates of Reiland (1975)	http://pubs.usgs.gov/wsp/220
29	3	Jemez y Sangre	SR	Pojoaque R. Drainage: 2250 AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
30	3	Jemez y Sangre	SR	Mountain front recharge in Sta. F. R. Basin: 5390 AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
31	3	Jemez y Sangre	SR	Mountain front recharge in Pojoaque Basin: 6080 AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
33	3	Jemez y Sangre	SR	Mountain stream channel recharge to Sta. F. R. Basin: 5430 AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
34	3	Jemez y Sangre	SR	Mountain stream channel recharge to Pojoaque Basin: 5900AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
35	3	Jemez y Sangre	SR	Mountain stream channel recharge A. de los Chamisos: 1010 AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
36	3	Jemez y Sangre	SR	Mountain stream channel recharge A. Hondo: 510 AFY	McAda and Wasiolek (1988)	estimates based on streamflow estimates of Reiland (1975)	http://pubs.er.usgs.gov/public
38	3	Jemez y Sangre	SR	Grand Total: 32020 AFY	McAda and Wasiolek (1988)	based on precip infiltration coeff of (0.05-0.5) varying accordi	http://pubs.er.usgs.gov/public
39	3	Jemez y Sangre	SR	Total Direct Recharge: 7700 AFY	McAda and Wasiolek (1988)	based on precip infiltration coeff of (0.05-0.5) varying accordi	http://pubs.er.usgs.gov/public
40	3	Jemez y Sangre	SR	9200 AFY	Wasiolek (in press)	water balance method from Toendle and Leaf (1980)	in http://pubs.usgs.gov/wri/19
41	3	Jemez y Sangre	SR	MFR R. en Medio: 1710 AFY	Wasiolek (in press)	water balance method from Toendle and Leaf (1980)	in http://pubs.usgs.gov/wri/19
42	3	Jemez y Sangre	SR	MFR Tesuque Cr. Dranaige: 1530 AFY	Wasiolek (in press)	water balance method from Toendle and Leaf (1980)	in http://pubs.usgs.gov/wri/19
43	3	Jemez y Sangre	SR	MFR Sta. Fe R. Drainage: 4170 AFY	Wasiolek (in press)	water balance method from Toendle and Leaf (1980)	in http://pubs.usgs.gov/wri/19
44	3	Jemez y Sangre	SR	MFR Little Tesuque Cr. Drainage: 1790 AFY	Wasiolek (in press)	water balance method from Toendle and Leaf (1980)	in http://pubs.usgs.gov/wri/19
45	3	Jemez y Sangre	SR	MFR to Tesuque A. of Espanola B.: 14700 AFY	Wasiolek (1995)	from NMOSE water budgets (0.13)(annual precip)	in http://pubs.usgs.gov/wri/19
46	3	Jemez y Sangre	SR	stream channel recharge Sta Fe R.: 1.7cfs over 2.5 mi reach above La Bajada	Thomas et. Al. (2000)	measure loss of flow, 745 obs, and assumed (0.02-0.08)(flow)	in http://pubs.er.usgs.gov/pub
47	3	Jemez y Sangre	SR	Stream channel recharge to A. Hondo: 13 AF (2000), 200 AF (2001), 0 AF (2002)	Moore (2007)	inverse modeling of infiltration using flow gauges spaced 2km	http://pubs.usgs.gov/pp/pp17
48	3	Jemez y Sangre	SR	Galisteo Cr.: 3600 AFY	Kernodle, McAda, Thorne (1995)	Mass balance involving precipitation, evaporation, and surfac	http://pubs.usgs.gov/wri/1994
49	3	Jemez y Sangre	SR	Sta Fe River Drainage: 4000 AFY	Kernodle, McAda, Thorne (1995)	Mass balance involving precipitation, evaporation, and surfac	http://pubs.usgs.gov/wri/1994
50	4	SW New Mexico	R	224000 AFY	DBS&A (2005)	Precipitation infiltration coefficient estimate	http://www.ose.state.nm.us/P
51	4	SW New Mexico	SR	3932 AFY Stream Channel Reacharge between Feywood and Spaulding	Cuddy and Keyes (2011)	Measurement of flow-loss	http://www.ose.state.nm.us/P
52	4	SW New Mexico	SR	76000 AFY Upper Mimbres Basin from Mountain Front Runoff, Stream Infiltration and	Hanson et al (1994)	Analysis of mount-front runoff (Hearne and Dewey (1988), infil	http://pubs.er.usgs.gov/public
53	5	Tularosa - Sacram	R	45300 AFY	Waltemeyer (2001)	Basin Climatic Characteristics Model	http://pubs.er.usgs.gov/public
54	5	Tularosa - Sacram	R	67900 AFY	Mamer et al (2014)	Darcy Flow calculations (mean elev. Of each basin)(av. Annu	https://geoinfo.nmt.edu/public
55	5	Tularosa - Sacram	R	75000 AFY	Livingston and Shoemaker (2006)	Surplus Precipitation Estimate	http://ci.alamogordo.nm.us/A

Figure 1. Screenshot of a portion of the groundwater recharge estimate table, showing locations, estimates, citations, methods, and links to online content.

General Findings

Overall, academic studies have generally focused on the conceptual basis for estimating or modeling recharge, while the USGS and OSE have focused on quantifying the components of the water budget for modeling or planning purposes. The compilation revealed that the majority of estimates were made in the vicinity of the middle Rio Grande valley, the slopes of the Jemez Mountains, and the Sacramento Mountains/Pecos Slope aquifer. This is most likely due to the fact that most scientific institutions and human population centers are in proximity to these areas. It was found that the methodology used to estimate recharge varied greatly from study to study. There are many methods with which to conduct a groundwater recharge study. The simplest and most commonly employed is the water balance/mass balance method, where the outputs from a system (i.e. evaporation, transpiration, exfiltration to streams) are subtracted from the inputs to the system (i.e., precipitation, stream loss, and underflow). This method has the advantage of being calculated remotely without making field measurements of recharge through other means, though the recharge estimate is entirely dependent on the accuracy of other water budget components. Another common method that has been used in New Mexico is the Maxey-Eakin method. Maxey and Eakin (1949) postulated that precipitation was directly proportional to recharge in a semi-arid region and that with increasing precipitation over an area, an increasing proportion of that water infiltrates to become groundwater. This rough estimate is considered a good "first approximation" and has much precedent in the literature and use in the Southwest United States, so is often the method employed when a large area needs to be analyzed. The disadvantage is that this method assumes homogeneous conditions over a large surface area. Both the water balance and Maxey-Eakin approach are found incorporated into more nuanced methods of recharge estimation documented in this compilation, especially in the many modeled groundwater scenarios conducted by the USGS over the past 30 years. Modeled recharge estimates are common, though their existence is owed in great part to the need of recharge quantification during the process of model parameterization. The less employed but more scientifically rigorous methods include chloride mass balance, stream loss calculations, long-term aquifer tests, and Darcy calculations. In any case, since there is no method of measuring groundwater recharge directly aside from very difficult point measurements using lysimeters (a method typically employed at agricultural sites), recharge estimates are always heavily reliant on measurement of other components of the water budget.

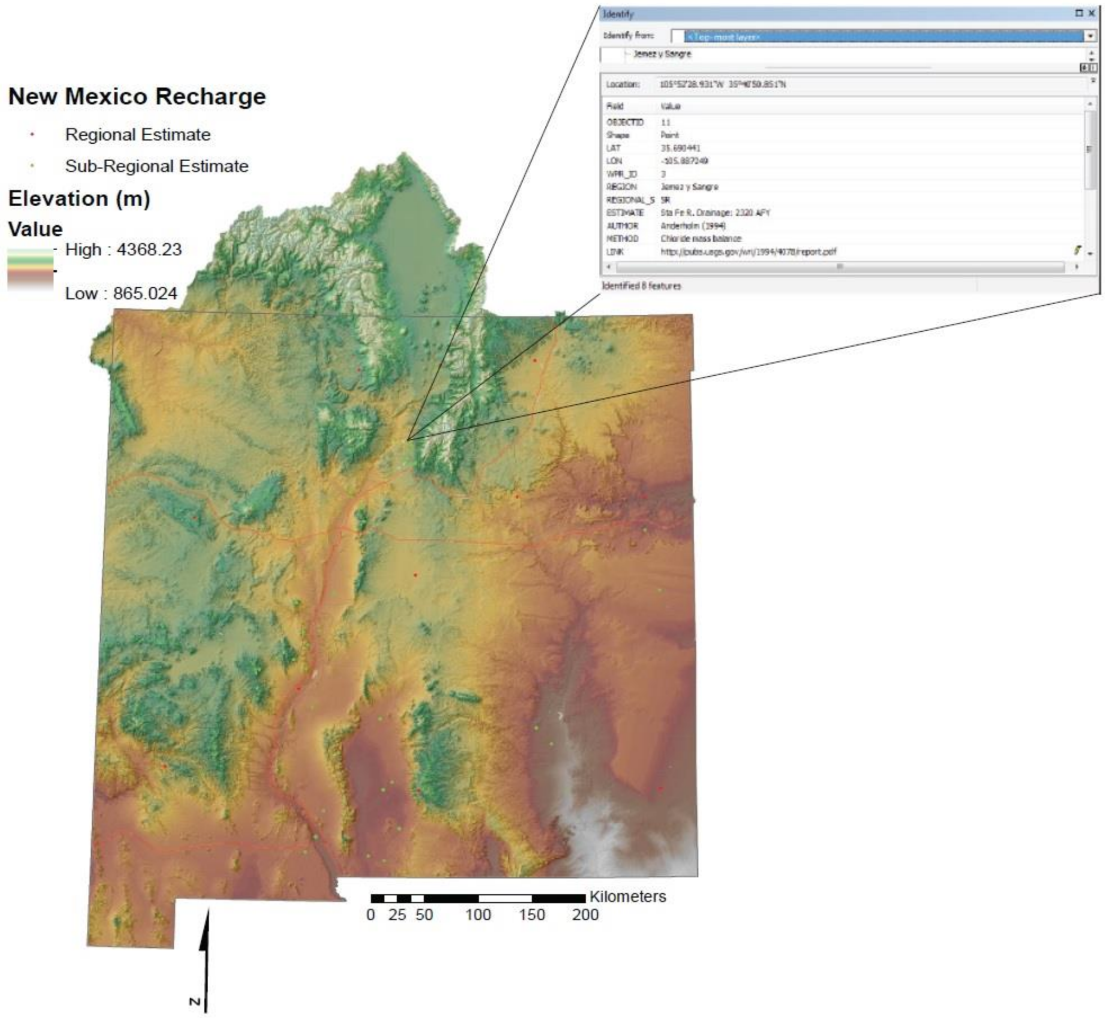

Figure 2. New Mexico and headwaters base map shows recharge estimate study points throughout the state. Selection of a point displays a window with pertinent information.

The map and tabular data have been uploaded to the New Mexico Water Resources Research Institute Statewide Water Assessment cloud site.

Future Work

The objective of Phase II is to identify areas of probable groundwater recharge using GIS analysis. A conceptual model will be constructed to represent the various factors that influence recharge; this model will be implemented in ArcGIS and a new map layer with polygons representing areas of likely recharge will be created. Results of Phase I will be used to verify results from this analysis. Contingent on continued support is the eventual completion of a statewide quantification of recharge based on a highly calibrated model based on climatic models using many years of data.

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