ANNUAL EVALUATION OF 2017 WATER-LEVEL MONITORING DATA FROM THE CITY OF LAS CRUCES WATER SUPPLY WELLS, NEW MEXICO

prepared by

JOHN SHOMAKER & ASSOCIATES, INC.
Water-Resource and Environmental Consultants
www.shomaker.com
505-345-3407

prepared for

LAS CRUCES UTILITIES
City of Las Cruces, New Mexico

MAY 2018
ANNUAL EVALUATION OF 2017 WATER-LEVEL MONITORING DATA FROM THE CITY OF LAS CRUCES WATER SUPPLY WELLS, NEW MEXICO

prepared by

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Las Cruces Utilities, New Mexico

May 2018
EXECUTIVE SUMMARY

Las Cruces Utilities (LCU) contracted John Shomaker & Associates, Inc. (JSAI) to assist with the City of Las Cruces water-level monitoring program. Under the monitoring program, groundwater-level data have been collected at the City’s supply wells based on a defined methodology and QA/QC process from mid-2011 to present. Since mid-2011, the monitoring program has used a consistent methodology for collecting hand-measurements of water levels from the majority of the City’s active and inactive supply wells on a monthly basis, and transducers have also recorded water levels on an hourly basis in twelve inactive wells plus the Jornada piezometers. The period of record for the monitoring program is now sufficiently long enough that long-term water-level trends are emerging for the majority of wells included in the program. Measured water-level data represents four regions:

1. Jornada Basin
   a. East Mesa
2. Mesilla Basin
   a. Interstate-25 Corridor
   b. Valley
   c. West Mesa

The water-level elevation data were contoured for the Las Cruces area (Fig. 4); there were not enough data points to develop water-level elevation contour maps for the East or West Mesa areas. Individual drawdown cones at pumping Wells 25, 27, 32, 35, 58, 62, and 70 can be inferred from the December 2017 water-level elevation contours. Outside of the pumping wells the hydraulic gradient is flat as observed between the 3,840- and 3,850-ft contours.

As of December 2017, long-term water-level declines have occurred at all inactive wells. On the East Mesa, active supply wells and inactive wells showed long-term declining trends for water levels with average rates ranging from 2.8 to 5.9 ft/yr.

Inactive supply wells along the Interstate-25 Corridor showed an average water-level decline of 0.7 ft/yr. The majority of wells in the Interstate-25 Corridor showed seasonal fluctuations in water levels influenced by nearby pumping within the Interstate-25 Corridor, as well as nearby pumping to the west in the Valley.

In the Griggs and Walnut plume area, water levels in the perched zone near Well 18 are not influenced by regional pumping. Water levels below the perched zone showed declines between 2013 and 2017 coinciding with Well 27 pumping.

Inactive wells in the Valley showed long-term declines ranging from 0.3 to 1.2 ft/yr. West Mesa water levels showed declines of 1.2 to 2.8 ft/yr, but more data are necessary to identify overall trends for this region.
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Figure 2. Aerial photograph of the Griggs and Walnut plume site showing locations of capture wells and monitoring well network, City of Las Cruces, New Mexico.

Figure 3. Schematic graph showing overall changes in water levels for active and inactive wells based on average trends defined by the water-level monitoring program, and pumping by area, City of Las Cruces, New Mexico.

Figure 4. Aerial photograph showing December 2017 water-level elevation contours for the City of Las Cruces area.

Figure 5. Aerial photograph showing average annual water-level decline rate for each region, and locations of City of Las Cruces supply wells and landfill monitoring wells, and City of Las Cruces and USGS-monitored observation wells, used for water-level monitoring program.
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(follow illustrations)

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1.0 INTRODUCTION

Las Cruces Utilities (LCU) contracted John Shomaker & Associates, Inc. (JSAI) to assist with the City of Las Cruces (City) water-level monitoring program by performing quality assurance and quality control (QA/QC) evaluation of monthly water-level measurements collected by LCU Staff, and preparing an annual report that integrates the City’s water-level data with data from other sources, such as the U.S. Geological Survey (USGS), to define short- and long-term trends.

The monitoring includes the Mesilla Basin and Jornada Basin. The City’s groundwater wells include active supply wells and inactive wells. The City’s supply wells are presented in Table 1 and Figure 1, and can be divided into four regions:

1. Jornada Basin
   a. East Mesa
2. Mesilla Basin
   a. Interstate-25 Corridor
   b. Valley
   c. West Mesa

Selected observation wells monitored by the USGS, and located near the City’s supply wells, are also discussed in this report. These wells are presented in Table 2 and Figure 1. Also included in this report are water-level data from Griggs and Walnut Superfund Site in the Interstate-25 Corridor area (Fig. 2), and Las Cruces Foothills Landfill monitoring wells (Table 3, Fig. 1), located in the transition between the Mesilla Basin and the Jornada Basin (East Mesa). Water-level data have been collected at Las Cruces Foothills Landfill monitoring wells on a monthly to annual basis since 1999 using consistent data collection methods and equipment.

Groundwater-level data collected at the City’s supply wells from mid-2011 to present are included in this report. Water-level measuring attempts prior to 2011 lacked defined methodology and QA/QC process, and would therefore be difficult to use to define water-level trends. Since mid-2011, the City’s water-level monitoring program has used a consistent methodology for collecting hand-measurements from supply wells on a monthly basis, and transducers have also recorded water levels on an hourly basis in twelve wells (in six wells since mid-2012, in three wells since mid-2013, and in three additional wells since early 2014). Las Cruces Utilities has also been monitoring water levels on an hourly basis with transducers in the Jornada Shallow, Middle, and Deep piezometers (City of Las Cruces (CLC) Shallow, Middle, and Deep), having taken over this monitoring task from USGS in early 2013.
Table 1. Summary of wells monitored by City of Las Cruces

<table>
<thead>
<tr>
<th>well</th>
<th>elevation, ft amsl</th>
<th>total depth, ft</th>
<th>screen interval, ft</th>
<th>current status</th>
<th>area</th>
</tr>
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<td>10</td>
<td>3,936.00</td>
<td>381</td>
<td>270 to 370</td>
<td>inactive T</td>
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<tr>
<td>18</td>
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<td>516</td>
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<td>Interstate-25</td>
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<td>4,065.51</td>
<td>612</td>
<td>348 to 363; 373 to 383; 393 to 460; 532 to 540; 564 to 604</td>
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<td>Interstate-25</td>
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<tr>
<td>20</td>
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<td>677</td>
<td>380 to 395; 415 to 525; 615 to 673</td>
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<td>632</td>
<td>366 to 620</td>
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<tr>
<td>23</td>
<td>4,069.40</td>
<td>592</td>
<td>452 to 592</td>
<td>active c</td>
<td>Interstate-25</td>
</tr>
<tr>
<td>24</td>
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<td>591</td>
<td>381 to 591</td>
<td>inactive T</td>
<td>Interstate-25</td>
</tr>
<tr>
<td>25</td>
<td>4,061.43</td>
<td>620</td>
<td>392 to 438; 460 to 620</td>
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<td>26</td>
<td>4,011.00</td>
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<td>410 to 510; 600 to 700</td>
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<tr>
<td>27</td>
<td>4,050.00</td>
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<td>430 to 455; 457 to 490; 500 to 524</td>
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<tr>
<td>28</td>
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<td>751</td>
<td>421 to 447; 455 to 489; 541 to 561; 599 to 617; 619 to 649; 667 to 697; 699 to 738</td>
<td>active</td>
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<td>29B</td>
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<td>880</td>
<td>440 to 860</td>
<td>active b</td>
<td>Valley</td>
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<td>30</td>
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<td>470</td>
<td>nd</td>
<td>inactive T</td>
<td>Valley</td>
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<tr>
<td>31B</td>
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<td>380 to 860</td>
<td>active b</td>
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<tr>
<td>35</td>
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<td>683</td>
<td>325 to 490; 510 to 575; 615 to 680</td>
<td>active</td>
<td>Valley</td>
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<tr>
<td>36</td>
<td>nd</td>
<td>1,210</td>
<td>710 to 820; 835 to 890; 970 to 1,020; 1,145 to 1,160; 1,180 to 1,210</td>
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<td>nd</td>
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<td>38</td>
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<td>280 to 580</td>
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</table>

*a Griggs and Walnut PCE plume capture well
b well replaced in 2016
c pump temporarily pulled in 2016

* too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels

ft amsl - feet above mean sea level
T transducer installed in well
nd - no data
### Table 1. Summary of wells monitored by City of Las Cruces (concluded)

<table>
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<tr>
<th>well</th>
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<th>screen interval, ft</th>
<th>current status</th>
<th>area</th>
</tr>
</thead>
<tbody>
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<td>700 to 1,150</td>
<td>active</td>
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<td>nd</td>
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<td>44</td>
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<td>CLC Deep</td>
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<td>1,000</td>
<td>960 to 1,000</td>
<td>mw T</td>
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** not accessible for water-level measurements

† transducer installed in well

*** too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels between Feb. 2013 and May 2016; pinched sounding tube preventing water-level measurements in 2017
Table 2. Summary of USGS-monitored wells

<table>
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<th>well</th>
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<td>Well C ***</td>
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<td>4,395.00</td>
<td>490</td>
<td>monitored well ***</td>
<td>East Mesa</td>
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*** monitoring by USGS ended in 2012; it appears that no further monitoring has been performed at the well since that time
USGS - U.S. Geological Survey
ft amsl - feet above mean sea level

Table 3. Summary of City of Las Cruces Foothills Landfill monitoring wells

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<th>total depth, ft</th>
<th>screen interval, ft</th>
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<td>434 to 454</td>
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<td>MW-2</td>
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<td>395 to 435</td>
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<td>MW-3</td>
<td>4,356.06</td>
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<td>299.5 to 339.5</td>
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<td>MW-4</td>
<td>4,313.20</td>
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<td>415 to 455</td>
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<td>MW-5</td>
<td>4,235.55</td>
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<td>375 to 435</td>
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<tr>
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<td>MW-8</td>
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<td>430</td>
<td>370 to 430</td>
</tr>
<tr>
<td>MW-9</td>
<td>4,212.58</td>
<td>415</td>
<td>355 to 415</td>
</tr>
</tbody>
</table>

ft amsl - feet above mean sea level
2.0 DATA COLLECTION METHODS

The City’s water-level monitoring program follows specific methodologies for data collection and QA/QC. For an explanation of how the monitoring program methodologies came about, see JSAI (2014).

Water-level collection methods include use of a field notebook and standardized field form, and use of hand tapes in combination with calibrated wireline well sounders to measure water levels. Numbers have been assigned to water-level measurement devices, and the effort is made to consistently use the same device at a given well. Information recorded on the field form includes the date and time of the measurement, the measurement device used, whether the measurement represents a pumping or non-pumping level, explanation for any missing data, and detailed comments such as meter readings, whether pump was operating prior to measurement, instantaneous pumping rate at the time of pumping level measurement, height of measuring point above ground level, description of measuring point, etc. Non-pumping levels are measured to the hundredth of a foot, whereas measurements of pumping levels may be to the nearest foot or tenth of a foot.

After information recorded in the field notebook has been entered into an electronic database, the data entries are reviewed for typographical errors. Water-level measurement devices are calibrated on a quarterly basis, or when stretching of the wire is known to have occurred. Since 2011, the City has been installing transducers in additional wells and addressing access issues at wells that were inaccessible for water-level measurements or had too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels.

3.0 RESULTS

Hydrographs for the City’s supply wells and USGS-monitored observation wells are presented in Appendices A through D, organized according to the four regions: East Mesa (Jornada Basin), Interstate-25 Corridor, Valley, and West Mesa. Hydrographs for Las Cruces Foothills Landfill monitoring wells, located in the transition zone between the Interstate-25 Corridor and East Mesa, are presented in Appendix E. Hydrographs for wells at the Griggs and Walnut Site in the Interstate-25 Corridor area are presented in Appendix F.

The City’s groundwater wells include active supply wells and inactive wells for which water levels are measured by hand on a monthly basis. Twelve inactive supply wells (Wells 10, 19, 20, 21, 24, 30, 37, 38, 44, 54, 57, and 60) have transducers that measure water levels on an hourly basis. Las
Cruces Utilities has measured water levels in Las Cruces Foothills Landfill monitoring wells on at least an annual basis since 1999. Las Cruces Utilities also monitors water levels on an hourly basis with transducers in the Jornada piezometers, having taken over the task from USGS in early 2013. Among the USGS-monitored wells, water levels were measured on a monthly basis in Valley nested observation wells, and semi-annually in Well C on the East Mesa through early 2012; it appears that no further monitoring has been performed at Well C since February 2012.

Table 1 identifies the City’s active and inactive supply wells. For active supply wells, some water-level measurements were collected while the wells were pumping. The pumping water-level data are plotted with a different symbol and color on hydrographs. USGS-monitored observation wells presented in Table 2 have not been pumped. Table 4 presents a summary of the City’s active wells and corresponding nearby observation (inactive) wells.

Pumping and non-pumping water-level measurements were collected on a monthly basis at the City’s supply wells since the monitoring program began in 2011, and continued on a monthly basis in 2017. QA/QC review found no apparent major outlier data points in the 2017 dataset. Some variation in hand-measured water levels can be explained by measurements with different wire-line sounders, which may have stretched to varying degrees, or replacement of reel on sounder. Hydrographs have been labeled accordingly in cases where this issue could be identified based on field notes.

Hydrographs show some discrepancies between hand-measured and transducer water-level data (e.g., the period November 2015 to April 2016 for Well 38 in Fig. B16, Well 54 in Fig. B21, and Well 57 in Fig. B23). These discrepancies are likely due to error in hand measurements associated with an out-of-calibration well sounder rather than transducer error. Comparison of hand measurements and the transducer dataset in some cases reveals noise in the hand measurement dataset that may be associated with a variety of factors including human factors, sounder stretch, or using different sounders, as opposed to natural variability in the water-level data (e.g., Figs. B5, B10, B19, and D3). Despite some discrepancies between hand-measured and transducer water-level data, transducer data are in general agreement with trends identified from hand-measured data. Some transducers may be experiencing instrument drift (e.g., Figs. B16, B23, and C2) on the order of a few feet. The transducer in Well 21 (Fig. B7) has been periodically malfunctioning since 2015, and that condition worsened in 2017. The transducer in Well 57 (Fig. B23) began to periodically malfunction in 2017. LCU Water Department has indicated that the issues with transducers at Wells 21 and 57 have now been corrected, and that they are working to calibrate transducers to hand measurement data.
Table 4. Summary of active supply wells and nearby observation wells by region, City of Las Cruces water-level monitoring program

<table>
<thead>
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<th>region</th>
<th>active well(s)</th>
<th>observation (inactive) well(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Mesa</td>
<td>40, 41, 42, 43</td>
<td>CLC Shallow, Middle, Deep</td>
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<tr>
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<td>68</td>
<td>Well C ***</td>
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<td>Interstate-25 Corridor</td>
<td>23, 25, 28, 39, 62</td>
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</tr>
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<td></td>
<td>18, 27, Paz Park</td>
<td>19, 20, 21, 54, 57, MW-SF10, MW-SF9</td>
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<td></td>
<td>61</td>
<td>24, 26, 38, 44, 60</td>
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<tr>
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</tr>
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<td>32B, 35, 58, 70</td>
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<tr>
<td></td>
<td>65, 71</td>
<td>LC-3(A-D)</td>
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<tr>
<td></td>
<td>59</td>
<td>LC-1(A-C); LC-2(A-C, F)</td>
</tr>
<tr>
<td>West Mesa</td>
<td>46 *, 63</td>
<td>36, 37, 64 **</td>
</tr>
<tr>
<td>Las Cruces Foothills Landfill</td>
<td>Jornada Basin</td>
<td>MW-3</td>
</tr>
<tr>
<td></td>
<td>Jornada Horst</td>
<td>MW-1, MW-2, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9</td>
</tr>
</tbody>
</table>

* too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels between February 2013 and May 2016; pinched sounding tube preventing water-level measurements in 2017

** not accessible for water-level measurements

*** monitoring by USGS ended in 2012; it appears no further monitoring performed at the well since 2012
Notable short-term water-level trends in 2017, including seasonal trends and overall rises or declines in water levels, are described by region in the following sections. Long-term trends since the beginning of the water-level monitoring program in mid-2011 are also described by region.

3.1 East Mesa

Non-pumping water levels at active supply wells on the East Mesa have varied over the short-term based on total monthly pumping in the area. This variability has been on the order of a few feet in recent years. In 2017, non-pumping water levels were relatively stable in Wells 40 and 41, and declined in Wells 43, 68, and 69 (Figs. A1 through A6). Well 42 appears to no longer be accessible for water-level measurements as of May 2017; the nature of the access issue is unclear. Active supply wells on the East Mesa showed long-term declining trends of 2.8 to 5.9 ft/yr.

Jornada piezometers completed to depths ranging from 485 to 1,000 ft showed steady declines in water levels in 2017 (Fig. A7). Jornada piezometers showed long-term declining trends of 2.8 ft/yr (Fig. A7). The water-level data from the Jornada piezometers illustrate that drawdown trends are generally not depth specific.

USGS-monitored Well C (USGS No. 322411106422801) showed a decline averaging 4 ft/yr between August 2010 and 2012, but no data have been available since then, and the USGS has indicated that it will not continue to measure water levels in this privately-owned well. Water levels at monitoring well MW-3 at Las Cruces Foothills Landfill within the East Mesa area showed a slight long-term declining trend of 0.2 ft/yr; this well is located within the East Mesa, but close to the western edge of the East Mesa (Fig. E3).

3.2 Interstate-25 Corridor

3.2.1 Active Supply Wells

Active supply Wells 23, 25, 28, 39, and 62, in the northern part of the Interstate-25 Corridor, do not have a nearby observation well for comparing water-level trends (Fig. 1). Non-pumping water levels in Well 62 showed fluctuation of 9.1 ft in early 2017 prior to a new pump being installed, and pumping resuming at the well (Fig. B27), suggesting that the well is affected by nearby pumping. Active supply wells in the northern part of the Interstate-25 Corridor showed long-term rises of 1.8 to 3.5 ft/yr (Figs. B11, B14, and B27). The pump was pulled at Well 23 in June 2016 and water-level measurements appear to have been discontinued at the well shortly thereafter (Fig. B8).
Wells 18 and 27 began actively pumping during April 2012 as capture wells for the Griggs and Walnut PCE plume (Figs. B1 and B13). Prior to pumping, water-level rises were observed at Wells 18 and 27. Pumping water levels in Well 18 fluctuated seasonally and are typically deepest in late Summer. Non-pumping water levels in Well 18 also show significant fluctuations, varying by 6.0 ft in 2017. These non-pumping water level measurements may represent varying periods of recovery following pumping. In 2017, pumping levels in Wells 18 and 27 showed overall declining trends. LCU Water Department has indicated that Wells 18 and 27 are scheduled to be equipped with transducers in 2018 to provide better datasets for non-pumping and pumping water-level trends. Non-pumping water levels in Paz Park Well showed fluctuation of 5.8 ft in 2017, varying according to monthly pumping at the well (Fig. B28). Non-pumping water levels at Wells 18 and 27, and Paz Park Well, showed long-term declining trends of 0.7 to 1.2 ft/yr.

Nearby Well 26 was off-line throughout 2017, and non-pumping water levels fluctuated by 8.8 ft in 2017 (Fig. B12). Despite relatively large short-term fluctuations, the long-term trend for non-pumping water levels in Well 26 has been flat. Non-pumping water levels at Well 61 remained relatively stable in 2017, and have shown little change over time, with a slight apparent long-term declining trend of 0.5 ft/yr (Fig. B26); Well 61 is screened deeper than other wells in the area (Table 1).

### 3.2.2 Inactive Wells

Water-level datasets for inactive supply wells in the southern part of the Interstate-25 Corridor showed declining trends ranging from 0.4 to 0.9 ft/yr. These wells have generally shown seasonal fluctuations with declines in Summer, and rises in Fall (Figs. B2 through B7, B9, B10, B15, B16, B18 through B25). These seasonal fluctuations of several feet to 15 ft have continued to occur despite relatively low pumping in the southern part of the Interstate-25 Corridor between March 2016 and February 2017, and August to December 2017, suggesting that these inactive wells are also affected by nearby pumping in the Valley (Fig. 1). Water-level measurements at Wells 24, 44, and 60, in the southwesternmost part of the Interstate-25 Corridor showed the highest-magnitude seasonal fluctuations of 10 to 15 ft (Figs. B10, B19, and B25). Hand measurement and transducer data demonstrate the value of the transducer data to identify short-term water-level trends (e.g., Figs. B5, B16, and B23). Transducer data for Well 21 between 2014 and 2017 are difficult to interpret due to periodic instrument malfunctioning; LCU Water Department has indicated that the issue with the transducer has now been corrected (Fig. B7).
3.2.3 Griggs and Walnut Site

Wells 18 and 27 began actively pumping during April 2012 as capture wells for the Griggs and Walnut PCE plume (Figs. B1 and B13). Inactive supply Wells 10, 19, 20, 21, 54, and 57 surround capture Wells 18 and 27. These inactive wells showed seasonal fluctuations in water levels influenced by regional pumping (Fig. F1). These wells also showed long-term declining trends in water levels ranging from 0.3 to 0.8 ft/yr likely due to pumping Wells 18 and 27.

The Griggs and Walnut site also includes numerous monitoring wells (Fig. 2). Some monitoring wells are representative of a perched zone from which PCE contaminated groundwater drains into Well 18 and is recovered. Other monitoring wells represent the PCE plume in the regional aquifer which is captured by Well 27. The MW-series wells around Well 18 (Fig. 2) represent the perched zone. Since plume capture pumping began in 2012, declining water-level trends have been observed in the MW-series wells (Fig. F2). Monitoring wells MW-SF9 and MW-SF10 represent the regional aquifer pumped by Well 27; these wells also show declining water-level trends since plume capture pumping began in 2012 (Fig. F3).

LCU Water Department has indicated that Wells 18 and 27 are scheduled to be equipped with transducers in 2018 to provide better datasets for non-pumping and pumping water-level trends. It is also recommended to equip GWMW16(S,D) with transducers, as part of the water-level monitoring program and to aid in understanding Griggs and Walnut plume capture; however, LCU Water Department has indicated that this monitoring well does not currently have access to power or SCADA.

3.3 Valley

3.3.1 Active Supply Wells

Active supply wells in the Valley region showed a variety of long-term trends for non-pumping water levels with declines ranging from 0.8 to 3.4 ft/yr at Wells 31, 32, 35, 59, and 70 (Figs. C6, C7, C9, C11, and C14). Wells 29, 31 and 32 have been replaced, and water levels are now being measured in the replacement wells. More data are needed to determine whether the long-term declining trends continue in the non-pumping water levels, and to identify trends for pumping water levels, in these replacement wells. Although there have been overall declines in non-pumping water levels at Wells 35, 59, and 70, pumping water levels have remained relatively stable at these wells; in fact, pumping water levels generally appear to have remained stable at all active supply wells in the Valley based on available data.
3.3.2 Inactive Wells

Wells 10 and 30 have been the only inactive supply wells in the Valley (Fig. 1). Well 10 is located along the east margin of the Valley region and showed seasonal fluctuations and a slight long-term declining trend of 0.3 ft/yr (Fig. C1). Well 30 is the southernmost well in the Valley and showed seasonal fluctuations and a long-term water-level decline trend (Fig. C4). Transducer data for Wells 10 and 30 reflected seasonal fluctuations in water levels of 10 to 20 ft corresponding to nearby pumping in the Valley (Figs. C2 and C5).

Water-level trends at the shallow nested observation Wells LC-1(A, B, and C) and LC-2(A, B, C, and F), close to the Rio Grande, were compared to the water levels and pumping at nearby active supply Well 59 (Figs. C16 and C17). Trends at the shallow nested observation Wells LC-3(A, B, C, and D) were compared to the water-levels observed at nearby active supply Well 65 and Valley pumping (Fig. C18). The water levels at the shallower wells close to the river (LC-1(A, B, C), LC-2(B, C)) showed responses to surface-water infiltration from the Rio Grande and associated irrigation ditches. Deeper wells close to the Rio Grande (LC-2(A, F), and LC-3(A, B, C, and D) farther from the river, showed water-level responses to nearby pumping. Long-term trends at nested observation wells included declines ranging from 0.3 to 1.2 ft/yr. At LC-1(A, B, and C), LC-2(A, B, C, and F), and LC-3(A, B, C, and D), deeper wells showed deeper water levels than the adjacent shallow wells. The vertical separation in depth to water between shallow and deep wells is a result of regional pumping removing groundwater storage and depressurizing the lower aquifer in relation to the water table. Although this separation appears to have increased slightly over the period of record 2010 to present, the increase in separation is not significant based on currently available data.

3.4 West Mesa

3.4.1 Active Supply Wells

Active West Mesa supply wells include Wells 46 and 63 (Fig. 1). There was too much oil to measure water levels at Well 46 between February 2013 and April 2016, and more recently a pinched sounding tube is preventing access for water-level measurements; more data are needed to identify water-level trends for this well. Non-pumping water levels in Well 63 showed a slight long-term decline at an average rate of 0.4 ft/yr (Fig. D5). However, a slight short-term rise in non-pumping water levels was observed in Well 63 in 2017.
3.4.2 Inactive Wells

Inactive West Mesa region supply wells include Wells 36, 37, and 64 (Fig. 1). Due to a welded cap, there has been no access for collecting water-level measurements from Well 64. Well 36 shows a long-term water-level decline trend of 2.8 ft/yr (Fig. D1). Well 37 showed a long-term declining trend of 1.2 ft/yr (Figs. D2 and D3). Slight short-term water-level rises were observed in Wells 36 and 37 in 2017. More data are needed to identify any relationship between West Mesa pumping and any short-term trends in inactive Wells 36 and 37.

3.5 Las Cruces Foothill Landfill

With the exception of monitoring wells MW-3 and MW-9, monitoring wells at Las Cruces Foothills Landfill represent a geologic transition between the East Mesa and Interstate-25 Corridor called the Jornada Horst (Fig. 1; MW-1, MW-2, and MW-4 through MW-8). Monitoring well MW-9 is located in the area between the Jornada Horst and the Interstate-25 Corridor, and MW-3 is on the East Mesa (in the Jornada Basin) on the eastern edge of the landfill.

Water levels at several monitoring wells on the Jornada Horst showed trends influenced by local management of storm water. Prior to completion of landfill reclamation, storm water ponded and infiltrated, causing water-level rises from 2007 to 2012 in MW-1, MW-2, and MW-4 through MW-8, creating a groundwater mound (Figs. E1, E2, and E4 through E8). Comparing the timing of this water-level mound from infiltrated storm water to monitoring well locations (Figs. E1, E4, and E5) indicates the westward migration and dissipation of the mound. Despite the short-term water-level rise associated with the groundwater mound, MW-4, MW-7, and MW-8 showed average long-term declining trends ranging from 0.4 to 1.2 ft/yr. Monitoring well MW-3 in the Jornada Basin to the east showed a slight long-term decline at an average rate of only 0.2 ft/yr (Fig. E3). Water levels at MW-9, between the Jornada Horst and the Interstate-25 Corridor, showed an average decline of 1.1 ft/yr (Fig. E6).
4.0 DISCUSSION

4.1 Water-Level Trends

A summary of the analysis of long-term average water-level trends is presented in Table 5 and Figure 3. These trends may change as more data become available, but as of 2017, long-term declines have occurred at all inactive wells. No long-term water-level rises were observed at inactive wells.

Active supply wells showed a variety of long-term trends in the monitoring program area, and relationships between trends at active and inactive wells also varied. On the East Mesa, active supply wells and the Jornada piezometers (CLC Shallow, Middle, and Deep) all showed long-term declining trends with average rates ranging from 2.8 to 5.9 ft/yr. No significant vertical hydraulic gradient has been observed in the Jornada piezometers.

Active supply wells in the Interstate-25 Corridor showed a variety of long-term water-level trends ranging from decline of 1.2 ft/yr to rise of 3.5 ft/yr. Inactive wells in the Interstate-25 Corridor generally showed long-term water-level declines ranging from 0.4 to 0.9 ft/yr and seasonal fluctuations with water levels rising in Winter and declining in Spring, influenced by nearby pumping within the Interstate-25 Corridor as well as nearby pumping to the west in the Valley. Overall declining trends in inactive Wells 19, 20, 21, and 24, near Griggs and Walnut PCE plume capture Wells 18 and 27, suggest that plume capture is occurring.

Active supply wells in the Valley showed a variety of long-term trends for non-pumping water levels ranging from a decline of 3.4 ft/yr to a rise of 1.7 ft/yr. Inactive wells and nested observation wells in the Valley showed long-term water-level declines ranging from 0.3 to 1.4 ft/yr. A number of inactive wells in the Valley also showed seasonal fluctuations in water levels, with water levels rising in Winter and declining in Spring, clearly in response to nearby pumping in the Valley. Lowest rates of decline among the nested observation wells in the Valley were in LC-1(A, B, C), the nested observation wells closest to the river, spanning depths of 41 to 305 ft, and LC-2C, another shallow (40 ft deep) observation well close to the river. The largest rates of decline were in LC-3(A, B, C), nested observation wells farther from the river, spanning depths of 50 to 332 ft. The rate of decline was somewhat lower in the 640 ft deep LC-3(D). A downward vertical hydraulic gradient was observed at LC-1 and LC-2, and also at LC-3 during periods of higher pumping in the Valley (generally in Summer).
Table 5. Summary of active supply wells and nearby observation wells by region with long-term average water-level trends, City of Las Cruces water-level monitoring program

<table>
<thead>
<tr>
<th>region</th>
<th>active well</th>
<th>average decline (-) or rise (+), ft/yr</th>
<th>observation (inactive well)</th>
<th>average decline (-) or rise (+), ft/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Mesa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>-3.3</td>
<td>CLC Shallow</td>
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<td>CLC Middle</td>
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<td></td>
<td>69</td>
<td>-2.8</td>
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<tr>
<td>Interstate-25 Corridor</td>
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<tr>
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<td>+3.5 (a)</td>
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</table>

(a) - apparent seasonal fluctuations in water levels
*   too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels between February 2013 and May 2016; pinched sounding tube preventing water-level measurements in 2017
**  not accessible for water-level measurements
*** monitoring by USGS ended in 2012; it appears no further monitoring performed at the well since 2012
na - no apparent average trend
Inactive wells on the West Mesa showed long-term water-level declines ranging from 1.2 to 2.8 ft/yr. More data are needed to identify any relationship between West Mesa pumping and any short-term trends in inactive wells on the West Mesa.

In general, fluctuations in pumping levels in active supply wells were related to variations in pumping rates at these wells, or at other nearby wells.

4.2 Water-Level Elevation Contours

Figure 4 presents a December 2017 water-level elevation contour map for the Valley and Interstate-25 Corridor areas. City of Las Cruces supply wells, and USGS-monitored wells completed to similar depths as supply wells, were used to contour water levels and illustrate the directions of groundwater flow. Monitoring program well networks on the East Mesa and West Mesa are too sparse to contour water levels in those areas. Water-level elevation contours for the Valley and Interstate-25 Corridor provide the following information:

- Groundwater continues to flow into the area from the Rio Grande Valley northwest of the monitoring program area.
- Pumping at Griggs and Walnut PCE plume capture Wells 18 and 27 is containing the PCE plume in the southern part of the Interstate-25 Corridor area.
- Pumping at Interstate-25 Corridor Wells 25 and 62 is creating a localized cone of depression in the northern part of the Interstate-25 Corridor area.
- Pumping at Valley Wells 32, 35, 58, and 70 is creating a localized cone of depression in the southern part of the Valley area.
- Well 10, which showed only a slight long-term water-level declining trend, is relatively distant from localized cones of depression in the Interstate-25 Corridor and Valley areas, and is in the area with a relatively flat hydraulic gradient between the 3,850 ft amsl contour line and the 3,840 ft amsl contour line.
5.0 CONCLUSIONS

The water level monitoring program established in 2011 includes the entire area that supplies groundwater to the City of Las Cruces. The area is divided into four regions, in which all regions show average declining water level trends from local and regional pumping (Fig. 5). Average water level declines are currently greatest in the East Mesa region (3 ft/yr). The Valley and Interstate-25 Corridor have the lowest average water level declines (0.7 ft/yr), but supply the largest quantity to the Las Cruces water system.

Long-term trends include overall declining trends for wells on the East Mesa and on the West Mesa, and declining trends for inactive wells throughout the monitoring program area. Active wells in the Valley and Interstate-25 Corridor show a variety of long-term trends. A number of inactive wells in the southern part of Interstate-25 Corridor are influenced by pumping of nearby wells in the Interstate-25 Corridor as well as the Valley.

Regional water level elevation contours (Fig. 4) developed from the monitoring program help identify areas of drawdown induced by pumping in the Valley and Interstate-25 Corridor areas. Actively pumped wells closest to the Rio Grande do not show a cone of depression. Actively pumped wells in the northern part of the Interstate-25 Corridor and at the Griggs and Walnut site have created individual areas of drawdown and groundwater capture.

Continued water-level monitoring will further define local and regional long-term trends that have emerged for the majority of wells after 7 years of consistent monitoring. The comparison of water level trends and monthly pumping will continue to provide a good assessment of the effects of local and regional pumping on water levels. The water level monitoring program is critical for actively managing each groundwater region and assessing performance of individual supply wells.
6.0 RECOMMENDATIONS

The following are recommended:

1. Address access issue at Well 46 on the West Mesa, so that water-level measurements may be resumed. Well 46 has a pinched sounding tube, and the well sounder cannot be lowered into the water. The sounding tube should be repaired or replaced during the next scheduled servicing of the well.

2. Report water-level measurements for Well 64 on the West Mesa. LCU Water Department has indicated that they have gained access to the well and began collecting hand measurements towards the end of 2017. These data will be incorporated into the 2018 annual report.

3. Address access issue at Well 42 on the East Mesa, so that water-level measurements may be resumed at this well. Following well servicing in April 2017, the sounding tube became detached. The sounding tube should be recovered or replaced during the next scheduled servicing of the well.

4. Report water-level measurements for Well 23 in the Interstate-25 Corridor area. LCU Water Department has indicated that hand measurements are being collected, and these data will be incorporated into the 2018 annual report.

5. Address access issue at Well 39 in the Interstate-25 Corridor area, so that water-level measurements may be resumed. Pump oil has been preventing water-level measurements at Well 39 since January 2013. Well 39 is scheduled for service in 2018, and access issue should be addressed at that time.

6. It has been noted to be worthwhile to equip Griggs and Walnut site monitoring well GWMW16(S,D) with transducers, as part of the water-level monitoring program and to aid in understanding Griggs and Walnut plume capture. However, LCU Water Department has indicated that this monitoring well does not currently have access to power or SCADA.

7. Hydrographs showed some discrepancies between hand-measured and transducer water-level data. It is important to set the transducer back to the same level after removal, and make note if its reference point has changed, so the dataset can be corrected. Some transducer equipment requires periodic factory re-calibration to prevent instrument drift; Las Cruces Utilities may want to check information regarding the transducer equipment to see if re-calibration may be necessary. This would be of particular interest for transducers at Wells 10 and 38, which appear to be experiencing instrument drift on the order of a few feet. LCU Water Department has indicated that they are working to calibrate transducers to hand measurement data.

8. Report water-level measurements for Well 72, completed in 2012 and located north of Well 69 on the East Mesa. This well is not yet pumping and will provide valuable data as an inactive supply well on the East Mesa. LCU Water Department has indicated that they began collecting hand measurements towards the end of 2017. These data will be incorporated into the 2018 annual report.
7.0 REFERENCE

ILLUSTRATIONS
Figure 1. Aerial photograph showing locations of City of Las Cruces supply wells and landfill monitoring wells, and City of Las Cruces and USGS-monitored observation wells, used for water-level monitoring program.
Figure 2. Aerial photograph of the Griggs and Walnut plume site showing locations of capture wells and monitoring well network, City of Las Cruces, New Mexico.
Figure 3. Schematic graph showing overall changes in water levels for active and inactive wells based on average trends defined by the water-level monitoring program, and pumping by area, City of Las Cruces, New Mexico.
Figure 4. Aerial photograph showing December 2017 water-level elevation contours for the City of Las Cruces area.
Figure 5. Aerial photograph showing average annual water-level decline rate for each region, and locations of City of Las Cruces supply wells and landfill monitoring wells, and City of Las Cruces and USGS-monitored observation wells, used for water-level monitoring program.
APPENDICES
Appendix A.

East Mesa hydrographs
Appendix A.

East Mesa hydrographs

Figure A1. Graph of water-level data collected by the City of Las Cruces for Well 40, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A2. Graph of water-level data collected by the City of Las Cruces for Well 41, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A3. Graph of water-level data collected by the City of Las Cruces for Well 42, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A4. Graph of water-level data collected by the City of Las Cruces for Well 43, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A5. Graph of water-level data collected by the City of Las Cruces for Well 68, and monthly pumping at Wells 68 and 69.

Figure A6. Graph of water-level data collected by the City of Las Cruces for Well 69, and monthly pumping at Wells 68 and 69.

Figure A7. Graph of water-level data for Jornada piezometers (CLC Shallow, Middle, and Deep), and monthly pumping at nearby active supply Wells 40, 41, 42, and 43.
Figure A1. Graph of water-level data collected by the City of Las Cruces for Well 40, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

average decline 3.3 ft/yr

TD 1,170 ft
screen 661-1,150 ft (multiple intervals)
pump set at 650 ft
Figure A2. Graph of water-level data collected by the City of Las Cruces for Well 41, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Average decline: 3.3 ft/yr

TD 980 ft
Screen 649-960 ft
Pump set at 640 ft
Figure A3. Graph of water-level data collected by the City of Las Cruces for Well 42, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

average decline
4.5 ft/yr
average decline 5.9 ft/yr

Figure A4. Graph of water-level data collected by the City of Las Cruces for Well 43, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.
Figure A5. Graph of water-level data collected by the City of Las Cruces for Well 68, and monthly pumping at Wells 68 and 69.
average decline 2.8 ft/yr

Figure A6. Graph of water-level data collected by the City of Las Cruces for Well 69, and monthly pumping at Wells 68 and 69.
Figure A7. Graph of water-level data for Jornada piezometers (CLC Shallow, Middle, and Deep), and monthly pumping at nearby active supply Wells 40, 41, 42, and 43.

average decline 2.8 ft/yr

suspect data

transducer malfunction

shallow piezometer screen 385-485 ft
middle piezometer screen 688 to 728 ft
deep piezometer screen 960 to 1,000 ft

OBSERVATION WELL

average decline 2.8 ft/yr
Appendix B.

Interstate-25 Corridor hydrographs
Appendix B.

Interstate-25 Corridor hydrographs

Figure B1. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 18.

Figure B2. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B3. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B4. Graph of water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B5. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B6. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B7. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 23.

Figure B9. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B10. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 25.

Figure B12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 26.

Figure B13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 27.

Figure B14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 28.
Appendix B.

Interstate-25 Corridor hydrographs

Figure B15. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B16. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B17. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 39.

Figure B18. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B19. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B20. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B21. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B22. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B23. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B24. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B25. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B26. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 61.

Figure B27. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 62.

Figure B28. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Paz Park Well.
Figure B1. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 18.
Figure B2. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B3. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B4. Graph of water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B5. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B6. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B7.  Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 23.
Figure B9. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B10. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 25.

average rise
3.5 ft/yr

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

TD 620 ft
screen 392-438; 460-620 ft
pump set at 360 ft

average rise
3.5 ft/yr

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

TD 620 ft
screen 392-438; 460-620 ft
pump set at 360 ft

average rise
3.5 ft/yr

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

TD 620 ft
screen 392-438; 460-620 ft
pump set at 360 ft

average rise
3.5 ft/yr

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

TD 620 ft
screen 392-438; 460-620 ft
pump set at 360 ft

average rise
3.5 ft/yr

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

TD 620 ft
screen 392-438; 460-620 ft
pump set at 360 ft
Figure B12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 26.

TD 700 ft
screen 410-510; 600-700 ft
pump set at 310 ft

(not accessible for water-level measurements prior to 2014)

(Flat linear trend)
Figure B13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 27.

- Average decline: 1.1 ft/yr
- TD 524 ft
- Screen 430-524 ft
- Pump setting unknown
- Griggs and Walnut Plume Capture Well
- Pumping for plume capture started in 2012
Figure B14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 28.
Figure B15. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B16. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B17. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 39.
Figure B18. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

- **Average decline**: 0.6 ft/yr
- **TD**: 620 ft
- **Screen**: 400-600 ft
- **Pump set at**: 380 ft
- **Inactive well**: Cessation of pumping at Well 61
Figure B19. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B20. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B21. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B22. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Average decline 0.7 ft/yr

Suspect data

Cessation of pumping at Well 61

Inactive well

TD 532 ft
Screen 408-516 ft
Pump setting unknown
Figure B23. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B24. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B25. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B26. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 61.
Figure B27. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 62.

average rise 1.9 ft/yr

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

eTD 640 ft
screen 400-620 ft
pump set at 365 ft
Figure B28. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Paz Park Well.
Appendix C.

Valley hydrographs
Appendix C.

Valley hydrographs

Figure C1. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

Figure C2. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

Figure C3. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 29.

Figure C4. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.

Figure C5. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.

Figure C6. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 31.

Figure C7. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 32.

Figure C8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 33.

Figure C9. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 35.

Figure C10. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 58.

Figure C11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 59.

Figure C12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 65.

Figure C13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 67.

Figure C14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 70.

Figure C15. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 71.

Figure C16. Graph of water-level data for nested observation Well LC-1(A-C) and City of Las Cruces Well 59, and monthly pumping at Well 59.

Figure C17. Graph of water-level data for nested observation Well LC-2 (A-C, and -F) and City of Las Cruces Well 59, and monthly pumping at Well 59.

Figure C18. Graph of water-level data for nested observation Well LC-3 (A-D) and City of Las Cruces Well 65, and monthly pumping in the Valley.
Figure C1. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

average decline 0.3 ft/yr

TD 381 ft
screen 270-370 ft
pump was set at 260 ft, but may have been removed

INACTIVE WELL
Figure C2. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

JOHN SHOMAKER & ASSOCIATES, INC.
Figure C3. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 29B.

average rise
0.5 ft/yr

(well replaced)

TD 880 ft
screen 440-860 ft
pump setting unknown

linear (non-pumping water level)
Figure C4. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.
Figure C5. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.

Average decline: 0.67 ft/yr
Figure C6. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 31B.

average decline 1.1 ft/yr

average decline 1.1 ft/yr

(Well replaced)

Non-pumping water level

Pumping water level

Monthly pumping

Linear (Non-pumping water level)

TD 880 ft
screen 380-860 ft
pump setting unknown

John Shomaker & Associates, Inc.
Figure C7. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 32B.

- Non-pumping water level
- Pumping water level
- Monthly pumping
- Linear (Non-pumping water level)

Average decline: 1.1 ft/yr

TD 920 ft
Screen 470-900 ft
Pump setting unknown

(Well replaced)
Figure C8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 33.
Figure C9. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 35.

Average decline: 3.4 ft/yr
Figure C10. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 58.

- Average decline: 1.4 ft/yr
- TD: 696 ft
- Screen: 412-514; 554-676 ft
- Pump set at 250 ft
Figure C11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 59.
Figure C12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 65.

average rise 1.7 ft/yr

TD 765 ft
screen 455-745 ft
pump setting unknown
Figure C13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 67. The graph shows the average rise of 0.7 ft/yr. The TD is 648 ft, with the screen ranging from 308-448 ft and 478-628 ft. The pump setting is unknown.
Figure C14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 70.

JOHN SHOMAKER & ASSOCIATES, INC.
Figure C15. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 71.
Figure C16. Graph of water-level data for nested observation Well LC-1(A-C) and City of Las Cruces Well 59, and monthly pumping at Well 59.
Figure C17. Graph of water-level data for nested observation Well LC-2 (A-C, and -F) and City of Las Cruces Well 59, and monthly pumping at Well 59.
Figure C18. Graph of water-level data for nested observation Well LC-3 (A-D) and City of Las Cruces Well 65, and monthly pumping in the Valley.
Appendix D.

West Mesa hydrographs
Appendix D.

West Mesa hydrographs

Figure D1. Graph of water-level data collected by the City of Las Cruces for Well 36, and monthly pumping on the West Mesa.

Figure D2. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.

Figure D3. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.

Figure D4. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 46.

Figure D5. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 63.
Figure D1. Graph of water-level data collected by the City of Las Cruces for Well 36, and monthly pumping on the West Mesa.

- Non-pumping water level
- West Mesa monthly pumping

Average decline: 2.8 ft/yr

TD 1,210 ft
Screen 710-1,210 ft (multiple intervals)
Pump set at 500 ft

Inactive Well
Figure D2. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.
Figure D3. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.
Figure D4. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 46.
Figure D5. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 63.

Average decline 0.4 ft/yr

TD 1,290 ft
screen 603-1,254 ft
pump set at 520 ft

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)
Appendix E.

Las Cruces Foothills Landfill hydrographs
Appendix E.

Las Cruces Foothills Landfill hydrographs

Figure E1. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-1.
Figure E2. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-2.
Figure E3. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-3.
Figure E4. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-4.
Figure E5. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-5.
Figure E6. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-6.
Figure E7. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-7.
Figure E8. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-8.
Figure E9. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-9, and monthly pumping in the I-25 Corridor.
Figure E1. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-1.

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Figure E2. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-2.

(no discernible linear trend)
Figure E3. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-3.

- Average decline: 0.2 ft/yr
- TD 340 ft
- Screen 300-340 ft
- Dedicated sample pump set at 338 ft

MONITORING WELL
Figure E4. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-4.

- TD 455 ft
- Screen 415-455 ft
- Dedicated sample pump set at 440 ft

Average decline 0.8 ft/yr
Figure E5. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-5.

- TD 455 ft
- Screen 390-450 ft
- Dedicated sample pump set at 422 ft

(no discernible linear trend)
Figure E6. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-6.
Figure E7. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-7.

平均下降速率为0.4 ft/yr

TD 443 ft

screen 378-438 ft
dedicated sample pump set at 409 ft

平均下降速率为0.4 ft/yr

MONITORING WELL
Figure E8. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-8.

average decline
1.2 ft/yr

TD 430 ft
screen 370-430 ft
dedicated sample pump set at 427 ft

MONITORING WELL
Figure E9. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-9, and monthly pumping in the I-25 Corridor.
Appendix F.

Griggs and Walnut Site hydrographs
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Griggs and Walnut Site hydrographs

Figure F1. Graph of water-level elevations for City of Las Cruces Wells 19, 20, 21, and 24, in the vicinity of the Griggs and Walnut site, New Mexico.

Figure F2. Graph of Griggs and Walnut site MW-1 through MW-5 observed water levels, City of Las Cruces, New Mexico.

Figure F3. Graph of Griggs and Walnut site MW-SF1 through MW-SF10 observed water levels, City of Las Cruces, New Mexico.
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