Excel for Hydrology

Section 3

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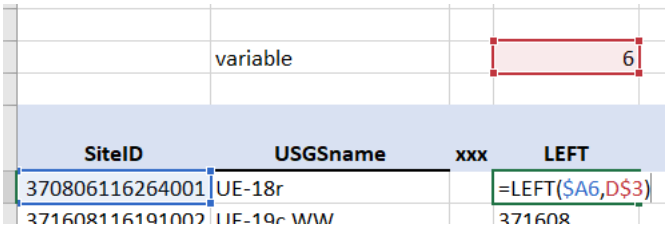
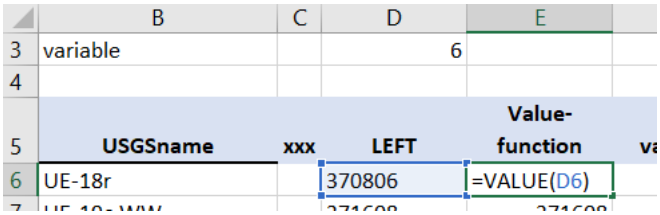
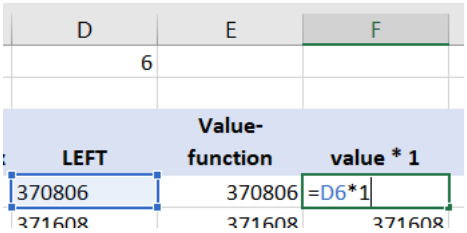
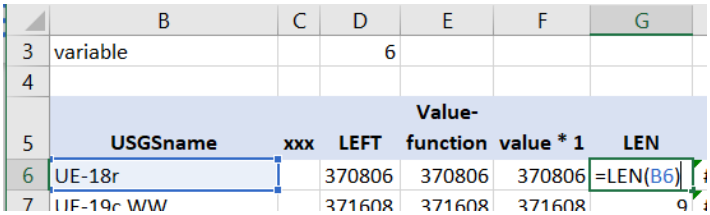
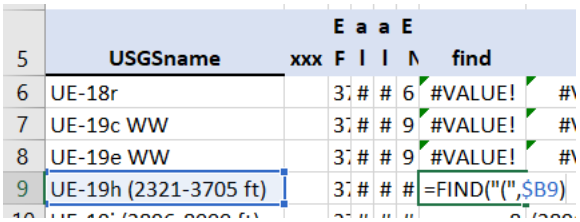
Text and Logic Functions

Table of Contents

03_Text+Logic_Functions

Text manipulation is convenient for automating labelling and is necessary many logical tests. Basic text functions are introduced in this section.

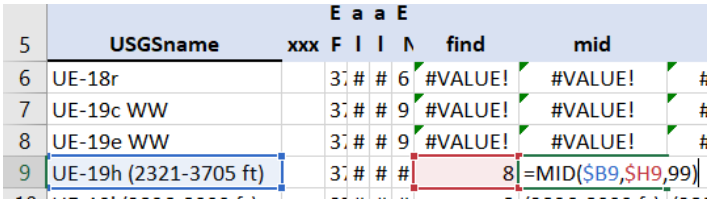
01_TextManipulate.xlsx – Basic functions

LEFT Sample N leftmost characters from number or a text string. Converts numbers to text.	
VALUE Converts text to numeric value if text can be interpreted as a number.	
Any math operation, + - / *, converts text to numeric value if text can be interpreted as a number.	
LEN Returns number of characters in a string.	
FIND Reports position of first character or sub-string being sought in a string. For example, "**(**" is the 8th character in the string "UE-19h (2321-3705 ft)."	

MID

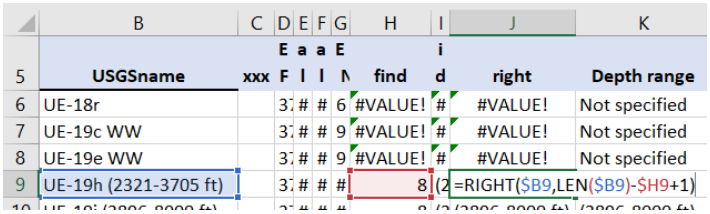
Sample from a user specified position a given number of characters. Converts numbers to text.

For example, Sampling 99 characters starting with the 8th character in the string “UE-19h (2321-3705 ft)” returns “(2321-3705 ft)”.



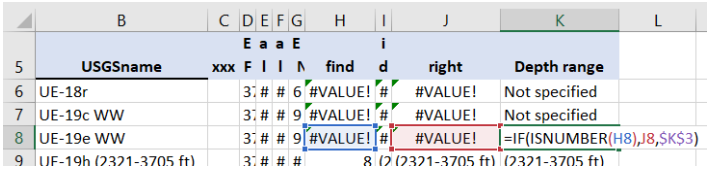
RIGHT

Sample N rightmost characters from number or a text string. Converts numbers to text.



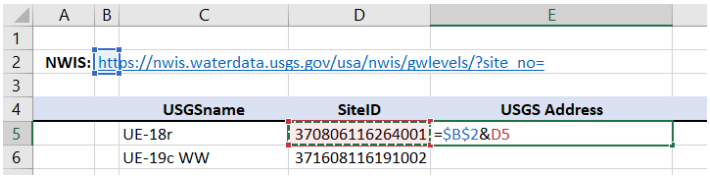
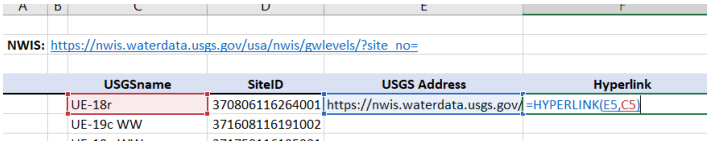
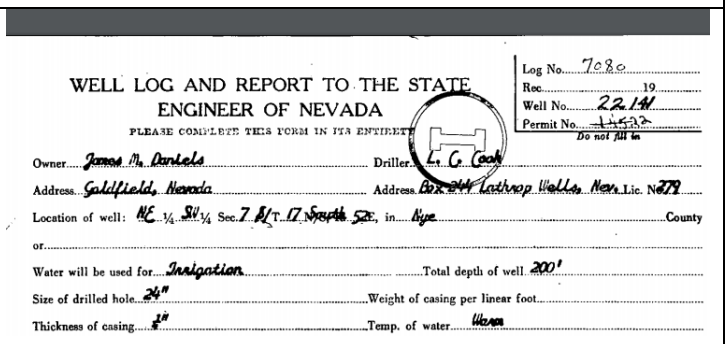
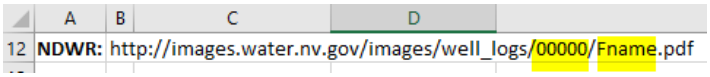
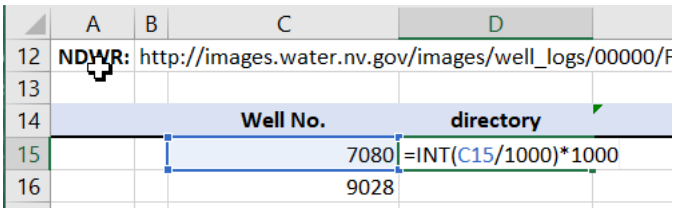
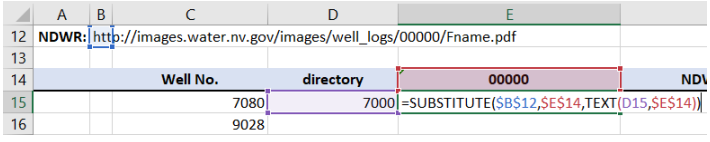
IF and ISNUMBER

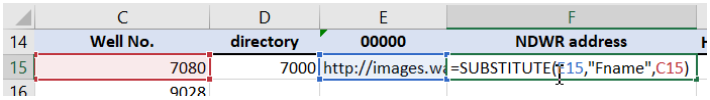
Capture errors with ISNUMBER function and return alternative result rather than an error such as “#VALUE!”.



Building and activating hyperlinks makes basic data more accessible and verifies site existence. Hyperlinks are created for USGS groundwater data and NDWR well logs in the following example.

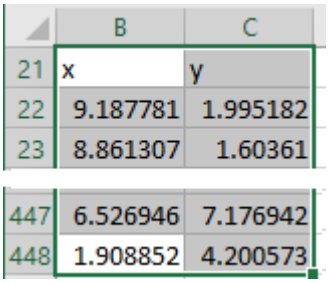
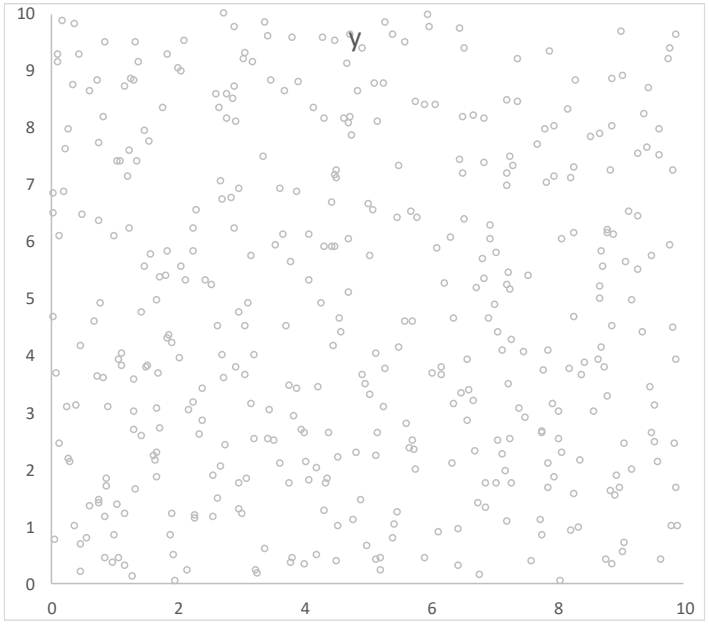
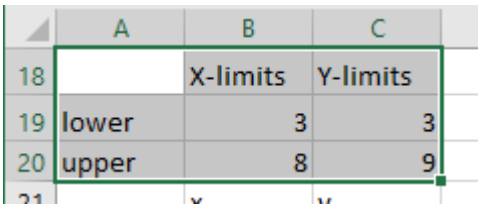
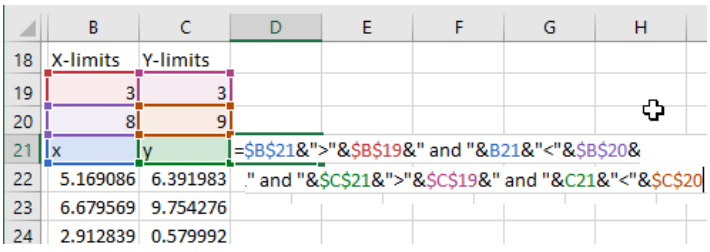
01_TextManipulate.xlsx – Text and hyperlinks

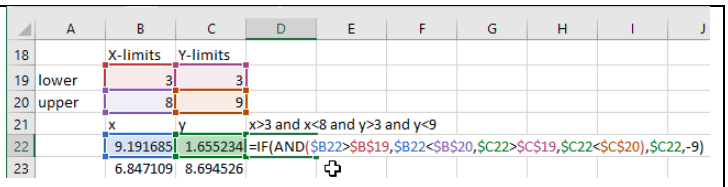
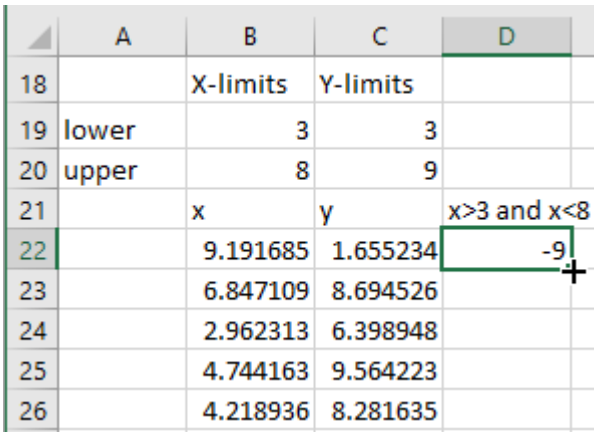
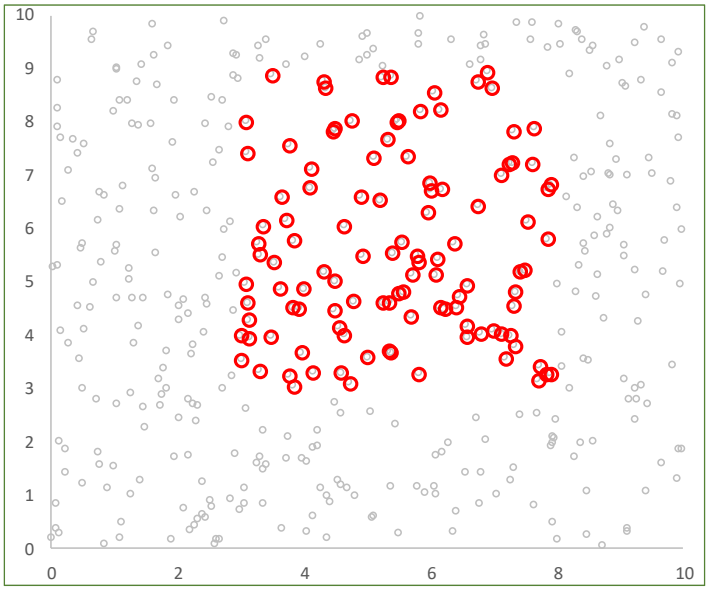
Hyperlinks to USGS for groundwater levels in NWIS use "https://nwis.waterdata.usgs.gov/usa/nwis/gwlevels/?site_no=" and the 15-digit site identifier. Build the address with "=$B$2&D5" where **&** concatenates text strings.	
URL is converted to an active link with =HYPERLINK(E5,$C5), where first entry is address and second entry is more readable text to display.	
Addresses for well logs from NDWR are more complex because PDFs are stored in subfolders for every 1000 logs. For example, http://images.water.nv.gov/images/well_logs/07000/7080.pdf Well log 7080 is in subfolder 07000.	
Root address for NDWR in cell B12 where subfolder and name generalized to **00000** and **Fname** which created and replaced for each well log.	
Calculate subdirectory in C15 with "=INT(C15/1000)*1000".	
Substitute **00000** with subfolder in =SUBSTITUTE($B$12,E$14,TEXT($D15,$E$14)) Subfolder 07000 was converted to text with format 00000 so that leading zero was added.	

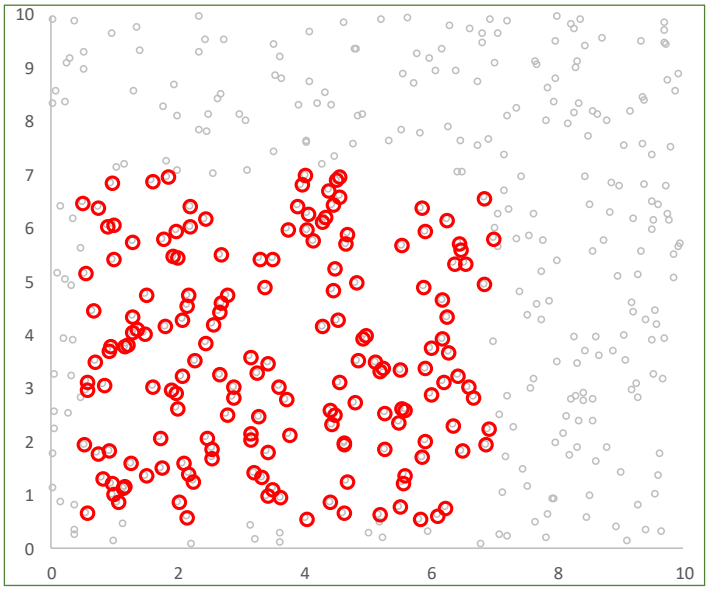
Substitute **Fname** with well log no. in =SUBSTITUTE(E15,F$13,TEXT(C15,"0")) Modified address in cell E15 is referenced instead of root address for NDWR in cell B12.	
URL is converted to an active link with =HYPERLINK(F15,C15), where first entry is address and second entry is more readable text to display.	

Bound range of plotted points with IF and AND functions.

02_IFplus.xlsx – Apply logic functions

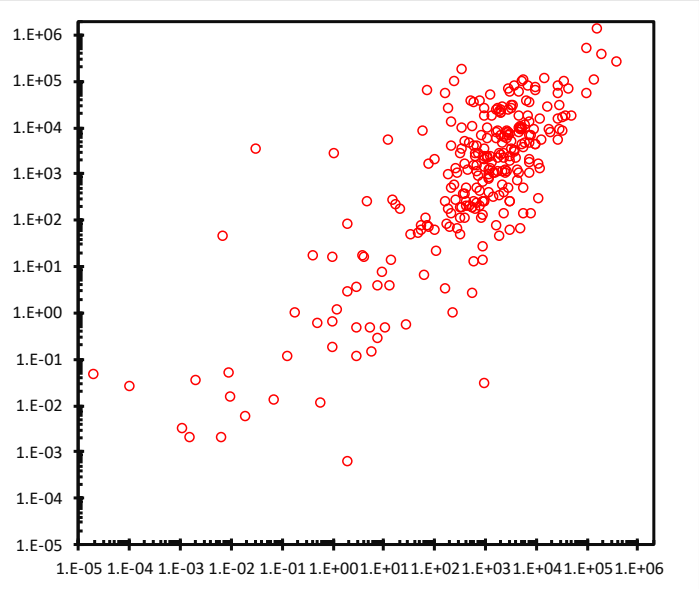
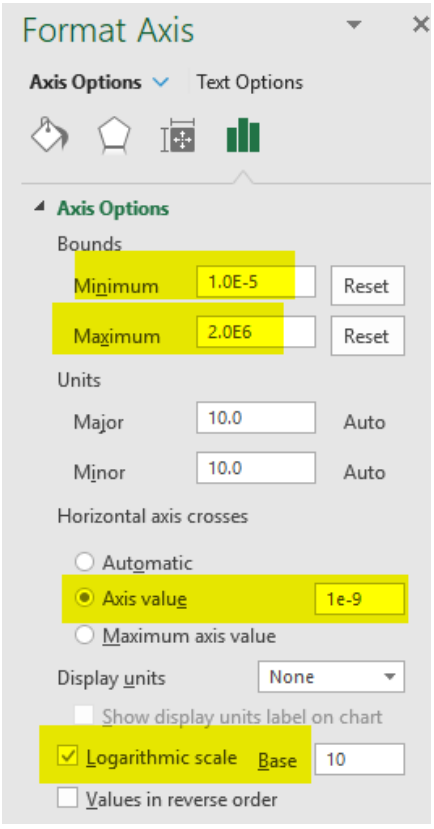
Highlight range B21:C448.	
Insert a XY scatter plot. Fix X and Y axes to range from 0 to 10. Set markers to size 4 open circles with grey outlines.	
Define limits for X and Y values to plot in a new series.	
Define heading in cell D21, =$B$21&">"&$B$19&" and "&B21&"<"&$B$20&" and "&$C$21&">"&$C$19&" and "&C21&"<"&$C$20	

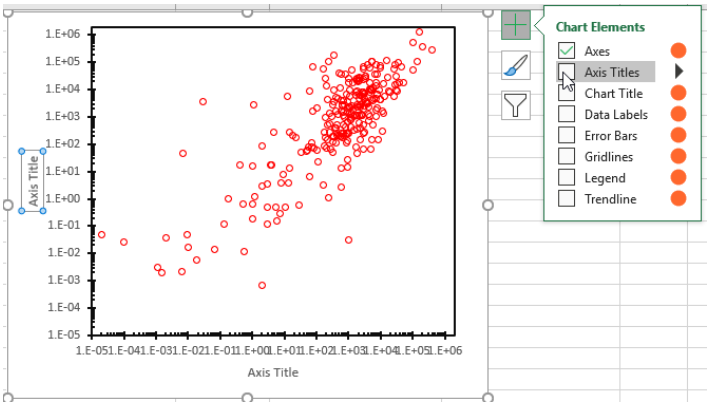
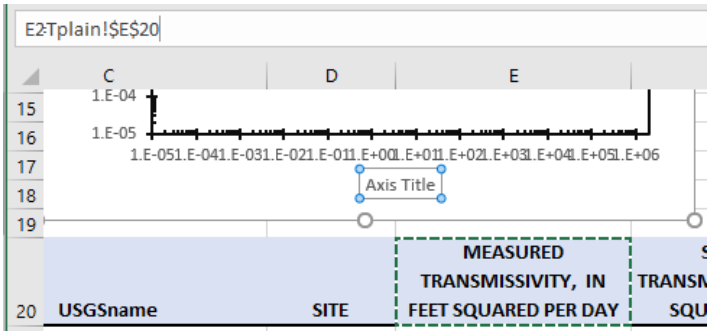
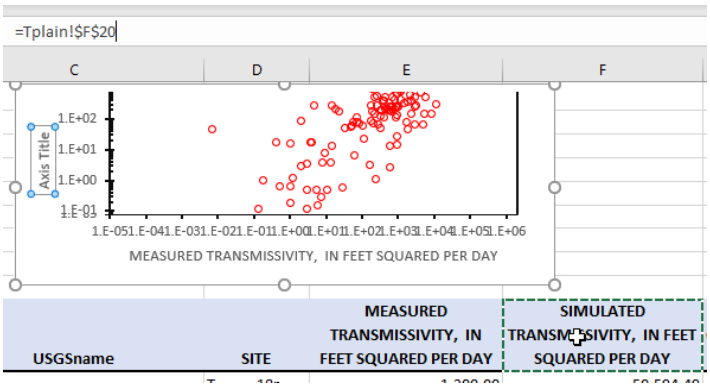
Add equation cell D22, =IF(AND($B22>$B$19,$B22<$B$20,$C22>$C$19,$C22<$C$20),$C22,-9)	
Select cell D22 and double-click lower, right corner of selected cell.	
Highlight range D21:D448. Add to scatter plot. Format series to a contrasting color.	

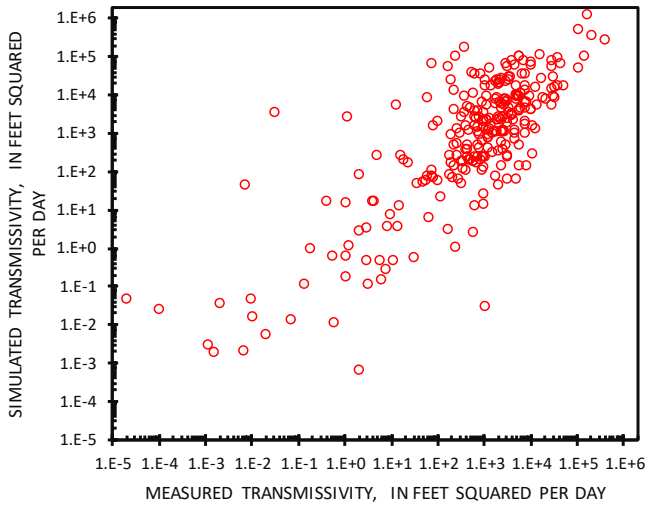
Vary entries in range B19:C20 to test effect of IF-AND statements.	

Differentiate aquifer-test results in scatter plots. Aquifer-test results and specific-capacity estimates are a basis and pumped volume is the other basis.

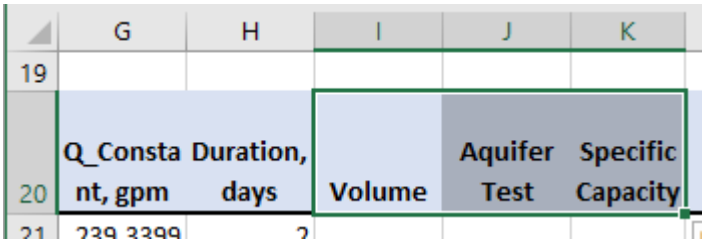
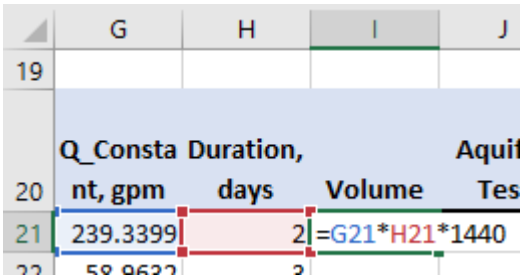
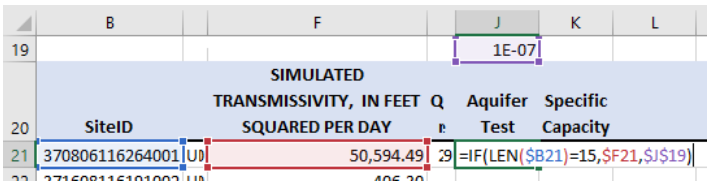
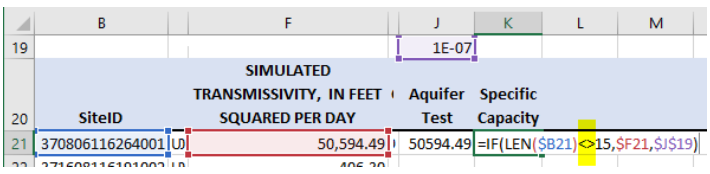
03_TransmissivityDV3.xlsx – Apply logic functions

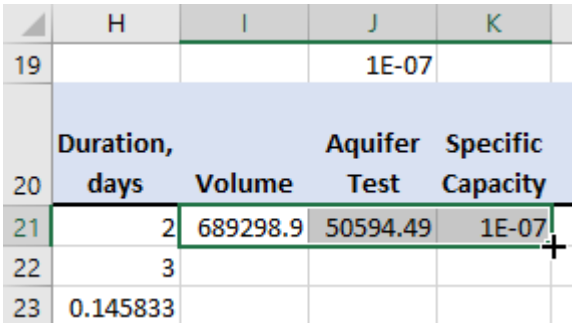
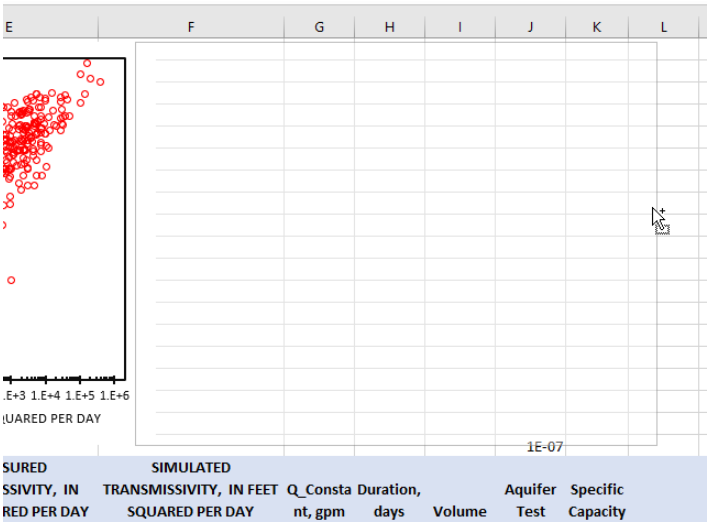
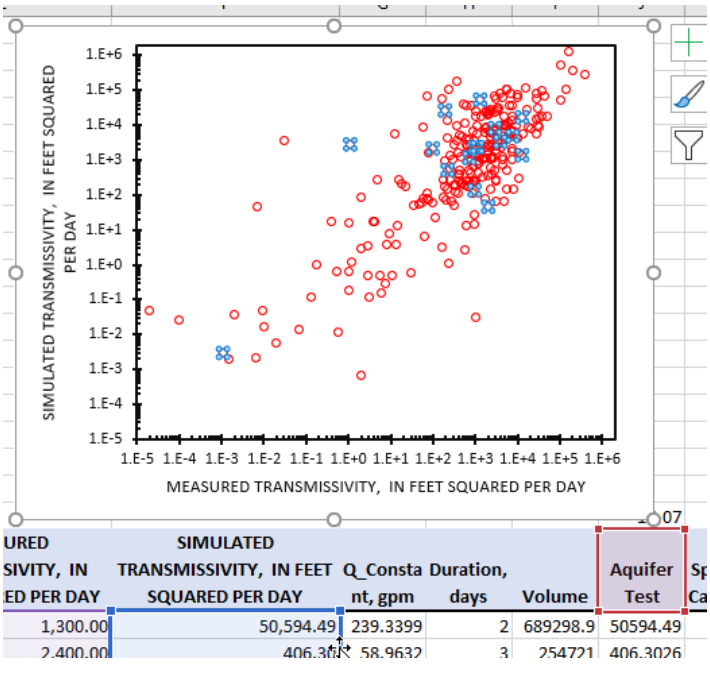
Highlight range E20:F291. Insert a XY scatter plot. Set markers to size 5 open circles with red, 0.75 pt outlines.	
Fix X and Y axes to range from 1E-5 to 2.E6. Set scales to logarithmic. Specify opposing axis crosses at 1.0E-9.	

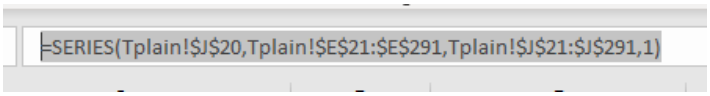
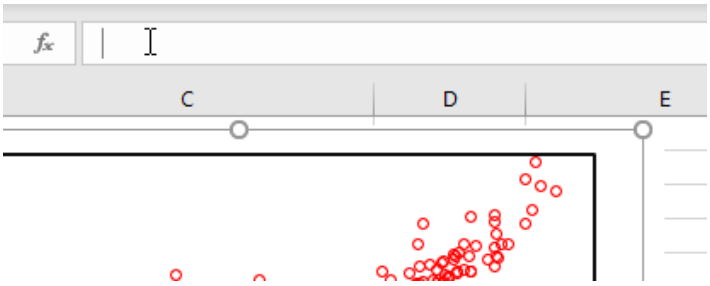
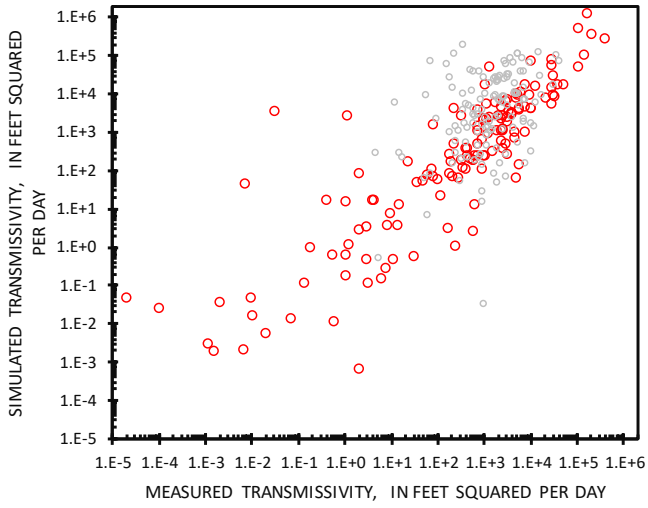
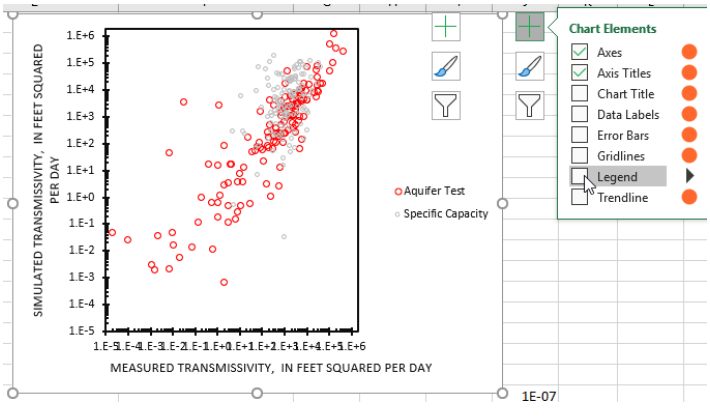
Add axis titles.	
Select X-axis title. Type = in formula bar. Select cell E20, MEASURED TRANSMISSIVITY, IN FEET SQUARED PER DAY, and return.	
Select Y-axis title. Type = in formula bar. Select cell F20, SIMULATED TRANSMISSIVITY, IN FEET SQUARED PER DAY, and return.	

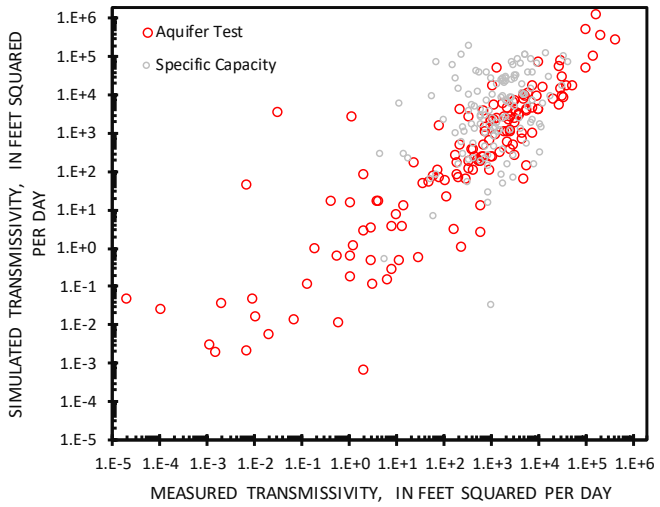
Plot shows undifferentiated measured and simulated transmissivities. Measured transmissivities are results from aquifer tests and estimates from specific capacities. Simulated transmissivities were sampled from a numerical flow model.	

CATEGORIZE RESULTS—Aquifer test or Specific Capacity

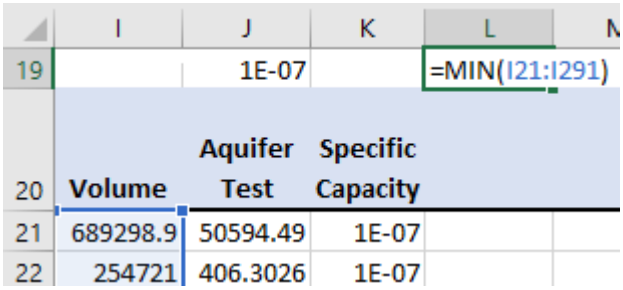
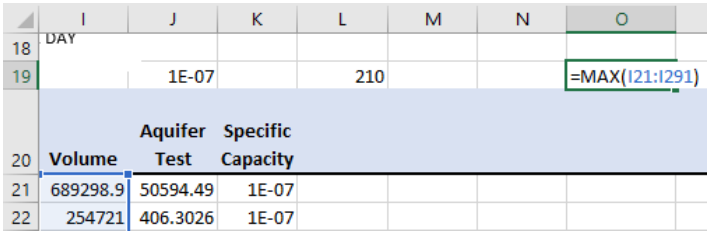
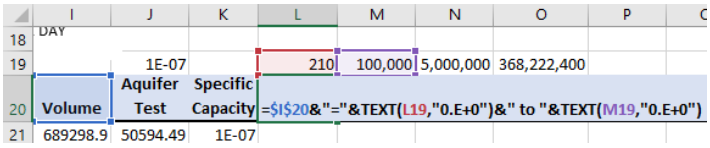
Add new columns for categorizing results. Label headings Volume, Aquifer Test, and Specific Capacity in calls I20, J20, and K20, respectively.	
Calculate volume pumped during aquifer test in cell I21 with =G21*H21*1440 Multiplier of 1440 converts gpm to gpd.	
All aquifer test results were assigned a USGS site identifier which is 15 digits. Filter based on length of SiteID. =IF(LEN($B21) **=** 15,$F21,$J$19)	
NDWR well logs are all less than 15 digits. Filter based on length of SiteID. =IF(LEN($B21) **<>** 15,$F21,$J$19) LEN($B21) **<** 15 also would work.	

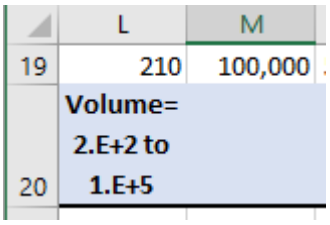
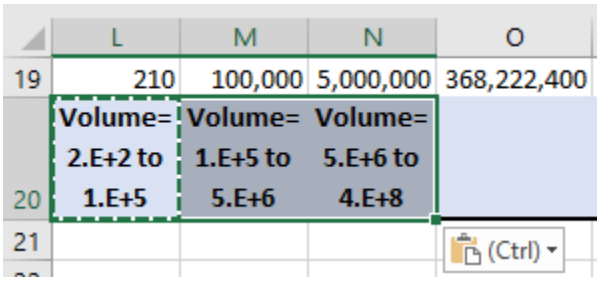
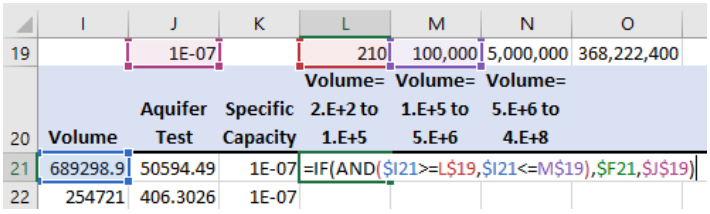
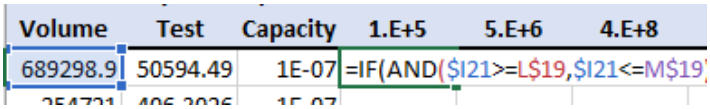
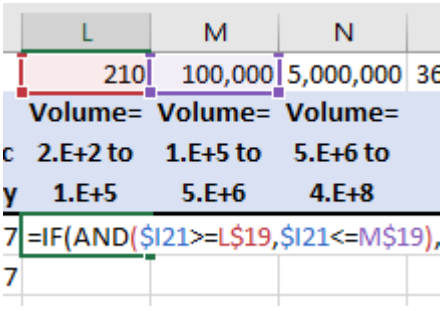
Select range I21:K21 and double-click lower, right corner of selected range.	
Copy the chart with Ctrl+Drag. Let go of left-mouse button where you want copy.	
Select series, Grab frames around highlighted ranges and move to “Aquifer Test” heading in cell J20 and simulated transmissivities from just aquifer tests in range J21:J291. Transmissivity estimates from specific capacities were assigned 1.E-7 and do not appear on the chart.	

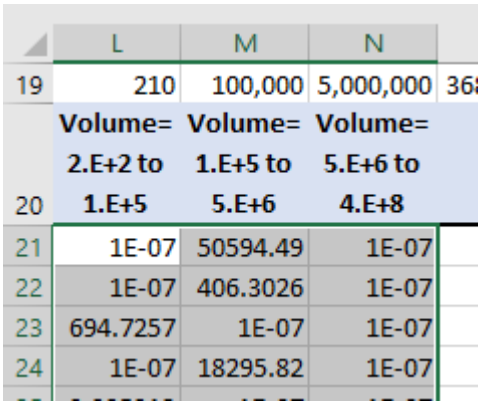
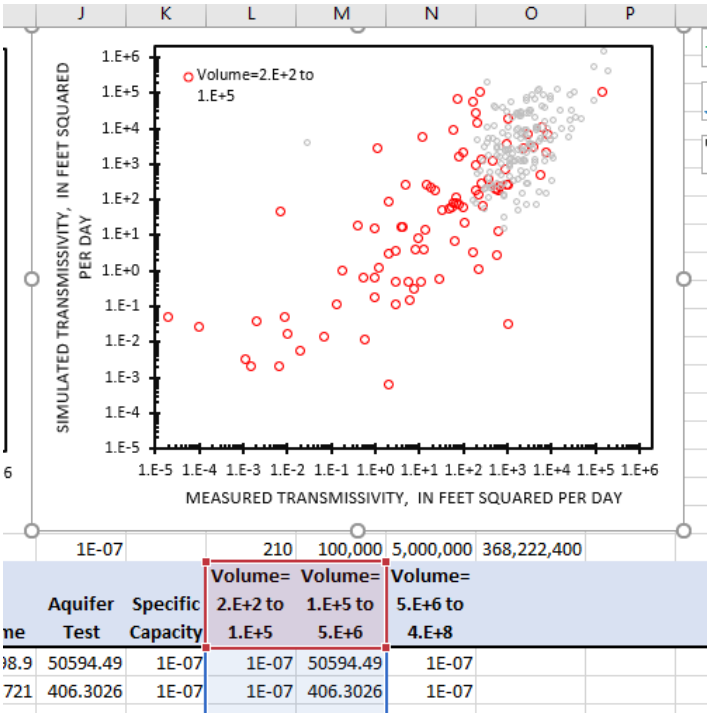
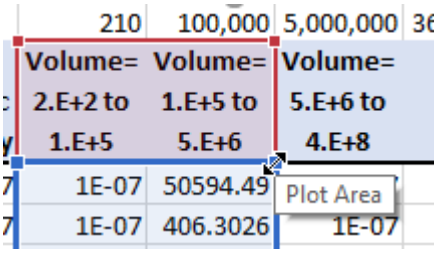
Copy series equation from formula bar.	
Select chart area and Paste series equation into empty formula bar.	
Edit **J** to **K** in pasted formula and Change last entry (series order) from **1** to **2**.	
Format new series Set marker to an unfilled, size 4 circle with a grey outline and a line weight of 1 pt.	
Add legend	

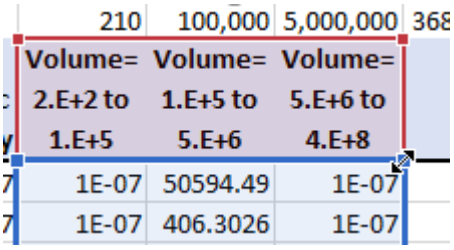
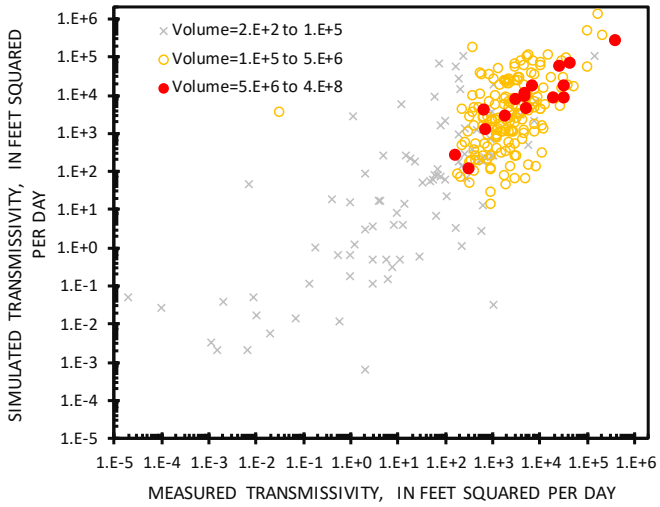
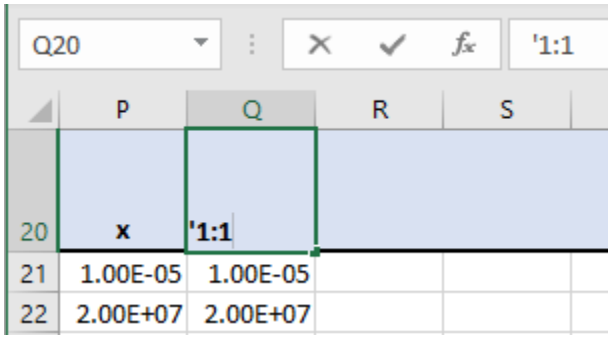
Move legend and resize plot area in chart.	

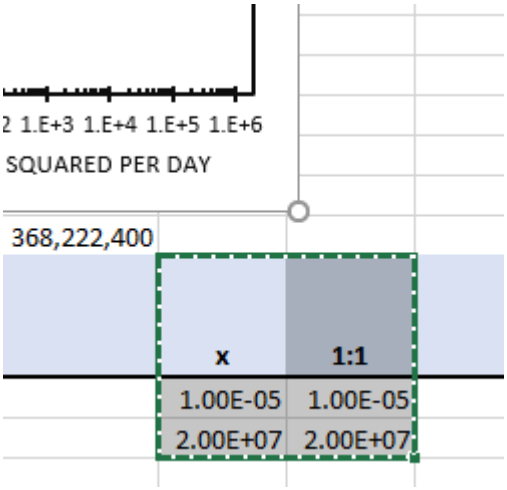
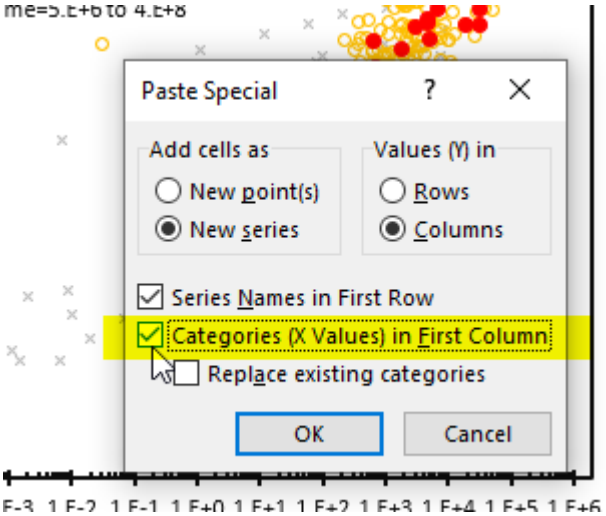
CATEGORIZE RESULTS—Pumped Volumes

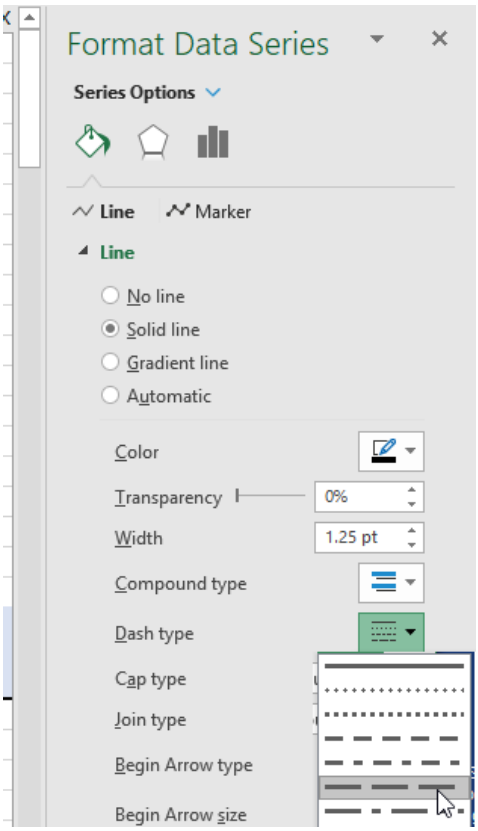
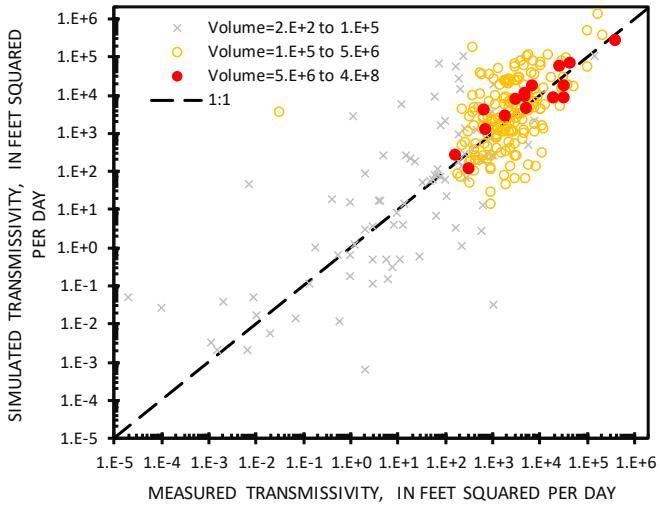
Define bins of pumped volumes in gallons to categorize results. Determine minimum volume pumped or displaced in cell L19.	
Determine maximum volume pumped or displaced in cell O19. Assign breaks of 100,000 and 5,000,000 in cells M19 and N19.	
Define headings with equations so that labels reflect assigned ranges. Equation for first heading in cell L20 is =$I$20&"="&TEXT(L19,"0.E+0")&" to "&TEXT(M19,"0.E+0")	

Resulting heading shows,	
Copy cell L20 to range M20:N20.	
Filter based on pumped volumes entered in cell L21 and is =IF(AND($I21>=L$19,$I21<=M$19),$F21,$J$19)	
Locking of cell references is variable and significant. References to volume pumped for each aquifer test are **$I**21 so column reference is fixed and row reference is relative.	
References to volume pumped for each category are L**$19** and M**$19** so row reference is fixed and column references are relative.	

Copy equation in cell L21 to range L21:N291.	
Copy the chart with Ctrl+Drag. Let go of left-mouse button where you want copy. Select Chart Area. Drag references to first 2 volume categories in columns **L** and **M**.	
Grab upper, right corner of data range for plot.	

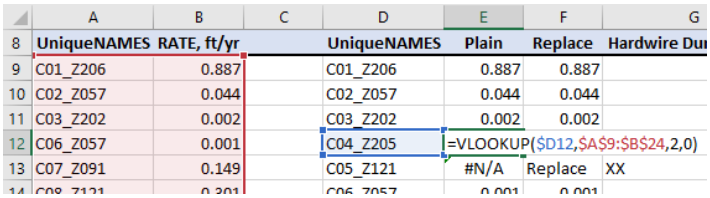
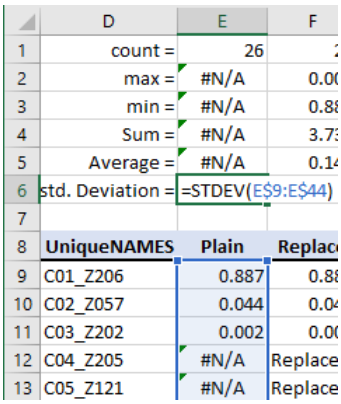
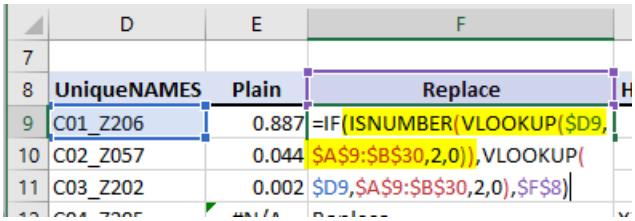
Drag so that data range expands from 2 columns to 3 columns.	
Format markers so that small volumes are obscure and large volumes are prominent.	
Create and add a 1:1 line. Note preceding apostrophe (‘) in cell Q20 so that entry is interpreted as text and not converted to a time value of 1:01.	

Copy range P20:Q22, Select chart area, and Paste special.	
Check New series and "Categories (X Values) in First Column." Select OK.	

Format 1:1 series with No markers, Solid, black line with long dashes.	
Final plot emphasizes larger pumped volumes.	

MAX, MIN, SUM, AVERAGE, STDEV and other numerical functions that calculate summary statistics from ranges of data return errors if an error exists in the target range. Identifying errors with an ***IS***... function such as ISNUMBER and replacing error with a text string will keep statistical functions working correctly.

04_ErrorHandling.xlsx – Trap errors so statistical functions work

VLOOKUP and MATCH functions return an error, #N/A, if an exact match is specified and the sought entry is missing from the lookup range.	
MAX, MIN, SUM, AVERAGE, STDEV functions that encounter a #N/A, #DIV/0!, #VALUE!, or any other error condition in a range echo the first error condition encountered in the target range.	
VLOOKUP in this example returns a number or #N/A. ISNUMBER says result is OK if true, so VLOOKP occurs on TRUE side of IF. Text string in cell F8, Replace, is reported if ISNUMBER is FALSE.	
MAX, MIN, SUM, AVERAGE, STDEV functions work correctly if text string is encountered.