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INTERDEPARTMENTAL MEMORANDUM

TO: Butte County Water Commission Technical Advisory Committee

FROM: Christina Buck, Water Resources Scientist

SUBJECT: 2017 Groundwater Quality Trend Monitoring Update

DATE: August 18, 2017

Introduction and Background

The Butte County Department of Water and Resource Conservation (DW&RC) conducted its sixteenth year of groundwater quality trend monitoring within the county July 24-27 and August 3, 2017. As required by Chapter 33A, the parameters monitored were temperature, pH, and electrical conductivity (EC). These parameters are the basic water quality characteristics needed to evaluate a basin for evidence of saline intrusion. The groundwater quality trend monitoring serves to establish baseline levels for these parameters throughout the county so that any future changes can be identified and further investigation and/or monitoring can subsequently be developed. In 2017, all samples fell within the acceptable range of water quality values set forth by State and Federal agencies and alert stages defined in Chapter 33A.

Methodology and Results

In 2013, DW&RC purchased a Hach HQd portable meter with a pH and conductivity probe. This was the fifth year this meter was used to do the groundwater quality testing. The sites visited in Butte County are on private land and many of the wells are used for agricultural purposes (irrigating orchards, rice, or pasture). However, the two Thermalito wells, Chico Urban Area well, Vina well, and the Llano Seco well provide domestic water supply. The sampling grid spans from north of the Chico Urban Area (Vina sub-inventory unit), west towards the Sacramento River (Llano Seco and M&T sub-inventory units), east towards the foothills (Pentz sub-inventory unit), and south towards Gridley (Biggs-West Gridley sub-inventory unit). Figure 1 shows the approximate locations (township, range, and section) of the water quality wells in relation to wells monitored four times per year for groundwater level in the Basin Management Objectives Program.

As in previous years, we are fortunate to have support and permission from local property owners who coordinate timing of sampling and allow access to their wells. We have provided them with the preliminary results from this year's monitoring.

Twelve of the thirteen wells in the network were sampled this year. The Western Canal (West) well was inaccessible due to changes to the irrigation system that made it impossible to sample. It is expected that sampling at this location will resume next year. Following standard sampling procedure, a water sample is pulled from a discharge location at or near the well and values for temperature, pH and EC are recorded when the pH reading from the water sample stabilizes. Temperature is a standard parameter measured when assessing water quality, mostly to indicate that water being sampled is representative of aquifer water and not water standing in the well itself.

The US Environmental Protection Agency (US EPA) establishes drinking water quality standards using two categories, Primary Standards and Secondary Standards[1]. Primary Standards are based on health considerations and Secondary Standards are based on taste, odor, color, corrosivity, foaming, and staining properties of water. Secondary water quality thresholds for pH and EC compared to the range of 2017 values are presented in Table 1.

Table 1. US EPA Secondary Standards for measured parameters

Parameter	Secondary Standard or Secondary WQ Threshold	Range of 2017 Values	Notes re: Butte County Results
pH	6.5 to 8.5	7.0-7.7	Within range of secondary water quality thresholds.
Electrical Conductivity (EC)	< 900 µS/cm – drinking water < 700 µS/cm – ag water	136-498	Within range of secondary water quality thresholds.

Water quality data for specific wells is presented in tables and graphs on the following pages.

Temperature is an important parameter because it affects chemical reactions that may occur in groundwater. Also, considerable changes in temperature could be an indication of other source waters migrating into the aquifer system such as stream seepage or flow from a different aquifer system. To date, temperature has been relatively consistent in all wells. Chapter 33A states that “the BMO Alert Stage for temperature will be reached when the measurement is more than five (5) degrees outside of the historic range of measurements.” The 2017 measurements were all within 1.0 ^oC of the average temperature for each well. The 16 year temperature range for all wells is less than 5 ^oC (Table 3). The lowest temperature reading was in the M&T well (17.2 ^oC) and the high was in the Pentz well (21.6 ^oC).

Measurements for pH remained relatively stable compared to previous years (see attached graphs). The highest pH was found in the Llano Seco well (7.7) and the lowest in the Chico Urban Area and Western Canal (East) (7.0). All measurements for pH were well within the secondary water quality thresholds of 6.5-8.5 (Table 1, Table 4 and included graphs).

Electrical conductivity (EC) measures the ability of a solution to conduct an electrical current due to the presence of ions. Observed readings for electrical conductivity can have a large range, up to 447 µS/cm at a particular well (Western Canal-west), yet 2017 measurements were all well within the secondary water quality thresholds established by State and Federal regulatory agencies (Table 1, Table 6, and included graphs). The highest EC measurement was from the M&T well (498 µS/cm) and the lowest was from the Thermalito well (136 µS/cm).

Conclusions

This was the sixteenth season the DW&RC collected groundwater quality information. Overall, the results of the water quality sampling indicate no significant changes in groundwater quality with respect to temperature, pH, or electrical conductivity. The greatest change compared to 2016 EC levels occurred in the M&T well. This well has one of the largest ranges of observed EC levels over the period of record. When sampling this well this year, it was observed that the EC level dropped with subsequent samples even after the pH level had stabilized. It is possible this well takes longer to stabilize than the standard minimum 15 minutes that is allowed to purge the well before a sample is taken. Staff recommends that next year, this well be sampled with EC measurements recorded from start of the pump until EC levels stabilize to establish the minimum run time needed for this well to be monitored consistently. It is possible that the large range in observed EC values in this well is due to varying lengths of time the pump was running from

[1] http://www.epa.gov/safewater/consumer/2ndstandards.html

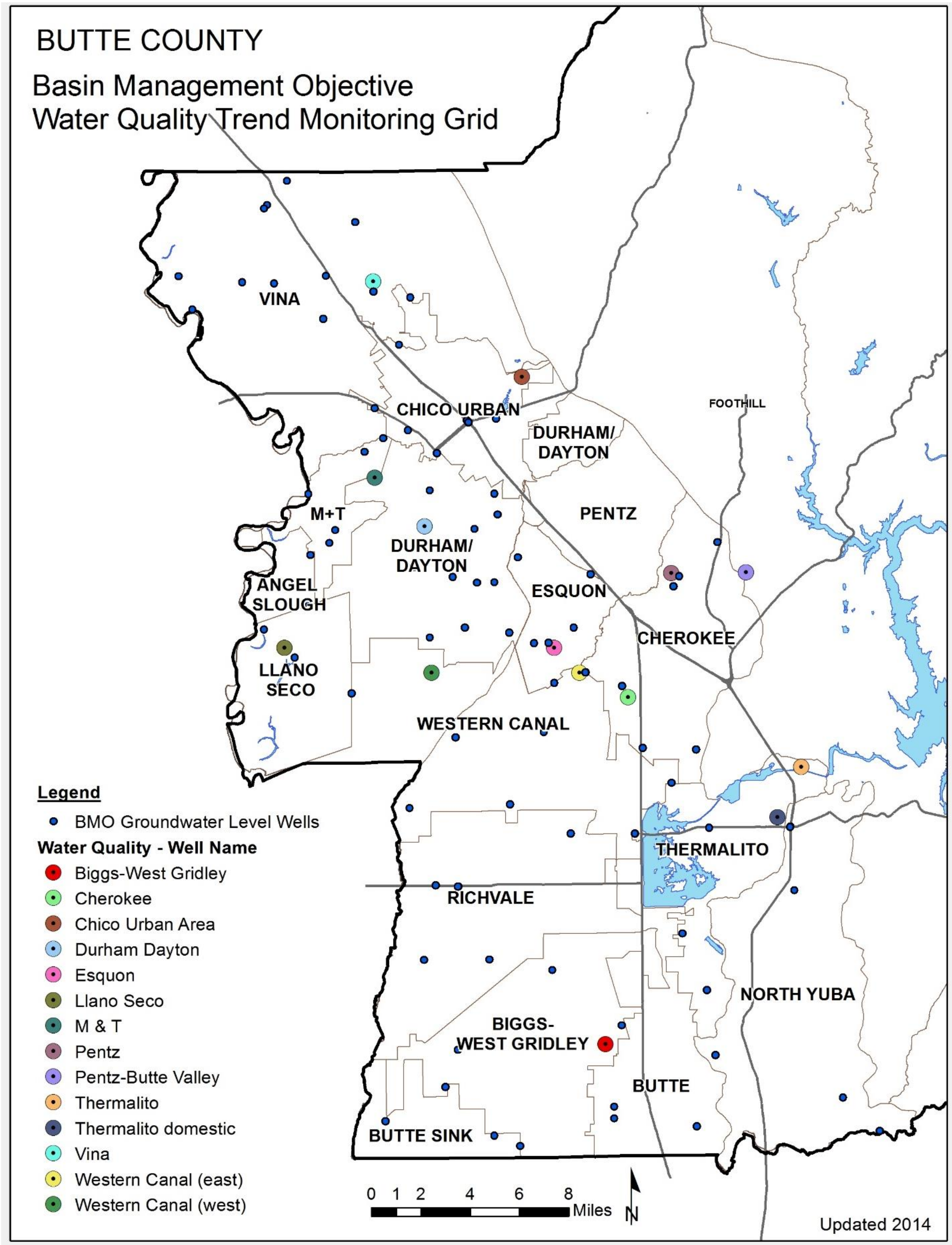
year to year before a sample was taken. This topic can be further discussed with the TAC at their upcoming meeting in November.

Water quality parameters have naturally occurring variability, so year to year changes are expected and nothing in this year's measurements gives cause for concern or immediate further investigation or analysis. Further investigation would be advisable if values were to fall outside of the acceptable range.

The focus of this trend monitoring program is to evaluate the basin for evidence of saline intrusion. No major shifts occurred in the EC measurements in the sampled wells and the basin appears to be free of saline intrusion. This data continues to help establish baseline levels for these parameters across the county so that any future changes in water quality can be evaluated and further investigation and/or monitoring can be developed.

Further information on water quality standards for different constituents can be found at www.swrcb.ca.gov or in the *Compilation of Water Quality Goals*, published by the State Water Resources Control Board.

Figure 1. Approximate well locations for water quality wells in relation to wells monitored annually (four times) for water level.



DATA TABLES AND GRAPHS

Table 2. Annual groundwater temperature (^oC)

Sub-Inventory Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Biggs-West Gridley	18.5	18.5	18.1	20.5	18.2	18.3	18.7	19.0	19.2	20.1	18.0	18.4	19.0	18.5	18.4	18.6
Cherokee	22.4	21.9	21.2	21.4	21.1	20.7	21.0	20.9	21.9	21.8	21.8	21.3	21.9	21.2	20.8	21.2
Chico Urban Area						18.4	20.1	18.2	18.8	19.5	21.6	18.0	NM	18.4	17.8	19.0
Durham Dayton	18.8	19.9	21.8	20.4	17.4	NM	19.3	NM	18.9	18.0	NM	18.5	19.1	18.1	18.0	18.8
Esquon	19.7	18.9	19.6	20.1	20.7	19.0	19.6	19.0	19.1	20.0	21.4	18.1	20.2	18.9	18.0	19.1
Llano Seco							20.8	20.6	20.7	20.6	21.7	20.4	23.5	19.9	20.0	19.9
M & T	17.6	18.2	17.8	19.2	18.6	18.0	17.7	18.6	17.8	NM	18.3	17.9	NM	17.1	17.2	17.2
Pentz						22.2	21.5	21.3	21.5	23.9	21.9	21.9	21.9	21.5	21.5	21.6
*Pentz-Butte Valley	27.0	26.4	26.7	23.2												
Thermalito	18.3	17.9	17.1	17.1	18.4	17.7	18.9	17.6	NM	NM	17.8	17.3	17.5	17.3	17.4	17.5
Thermalito domestic							19.4	19.4	19.4	NM	NM	19.8	NM	19.9	19.8	20.0
Vina	19.6	20.3	19.2	19.2	19.6	18.9	19.6	18.9	18.8	22.8	18.8	20.2	21.4	19.5	19.8	19.5
Western Canal (East)	18.4	18.2	19.9	20.5	18.8	18.6	19.1	19.0	18.8	19.0	NM	18.3	18.9	18.5	19.1	18.6
Western Canal (West)	19.0	18.1	19.8	20.8	18.5	20.6	21.8	18.5	19.1	20.5	20.1	19.1	20.2	18.6	18.8	NM

*Pentz-Butte Valley well discontinued in 2006

Table 3. Groundwater temperature average and range over 16 year sampling period (^oC)

Sub-Inventory Unit	Average	Range
Biggs-West Gridley	18.8	2.5
Cherokee	21.4	1.7
Chico Urban Area	19.0	3.8
Durham Dayton	19.0	4.4
Esquon	19.5	3.4
Llano Seco	20.8	3.6
M & T	17.9	2.1
Pentz	21.9	2.6
*Pentz-Butte Valley	25.8	3.8
Thermalito	17.7	1.8
Thermalito domestic	19.7	0.6
Vina	19.8	4.0
Western Canal (East)	18.9	2.3
Western Canal (West)	19.6	3.7

Table 4. Annual groundwater pH

Sub-Inventory Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Biggs-West Gridley	7.6	7.5	7.5	7.0	7.6	7.6	7.7	7.9	7.9	7.2	7.9	7.9	7.1	7.6	7.6	7.7
Cherokee	7.5	7.5	7.1	7.4	7.4	7.3	7.3	7.3	7.2	7.6	7.3	7.3	6.9	7.2	7.2	7.1
Chico Urban Area						6.9	6.9	6.9	7.0	7.5	7.3	7.1	NM	6.9	7.0	7.0
Durham Dayton	7.7	7.2	7.6	7.6	7.5	NM	7.5	NM	7.4	7.7	NM	7.5	NM	7.5	7.5	7.3
Esquon	7.3	7.5	7.1	7.4	7.5	7.4	7.2	7.4	7.4	7.6	7.2	7.3	5.9	7.4	7.2	7.3
Llano Seco							7.9	8.1	8.2	8.1	7.9	8.0	7.0	7.8	7.8	7.7
M & T	7.2	7.5	6.9	7.8	7.9	7.6	7.7	7.6	7.6	NM	7.2	7.9	NM	7.4	7.7	7.6
Pentz						7.6	7.4	7.5	7.4	7.3	7.8	7.5	6.7	7.0	7.4	7.2
*Pentz-Butte Valley	7.1	6.9	7.3	6.2												
Thermalito	7.0	6.5	7.1	7.1	7.9	7.4	7.4	7.4	NM	NM	8.0	7.7	7.5	7.1	7.1	7.1
Thermalito domestic							7.7	7.8	7.7	NM	NM	7.8	NM	6.9	7.6	7.6
Vina	7.5	7.6	6.9	6.2	7.7	7.5	7.5	7.4	7.6	8.0	7.3	7.8	7.9	7.1	7.4	7.3
Western Canal (East)	7.0	6.6	6.8	6.9	7.3	6.9	7.0	7.0	7.1	7.0	NM	7.2	6.5	7.1	7.0	7.0
Western Canal (West)	7.8	8.1	7.1	6.9	7.9	7.9	7.8	6.6	7.8	7.5	7.7	7.5	7.1	7.5	7.4	NM

Table 5. Groundwater pH average and range over 16 year sampling period

Sub-Inventory Unit	Average	Range
Biggs-West Gridley	7.6	0.9
Cherokee	7.3	0.7
Chico Urban Area	7.0	0.7
Durham Dayton	7.5	0.5
Esquon	7.3	1.6
Llano Seco	7.9	1.1
M & T	7.6	1.0
Pentz	7.3	1.1
*Pentz-Butte Valley	6.9	1.1
Thermalito	7.3	1.5
Thermalito domestic	7.6	1.0
Vina	7.4	1.8
Western Canal (East)	7.0	0.8
Western Canal (West)	7.5	1.5

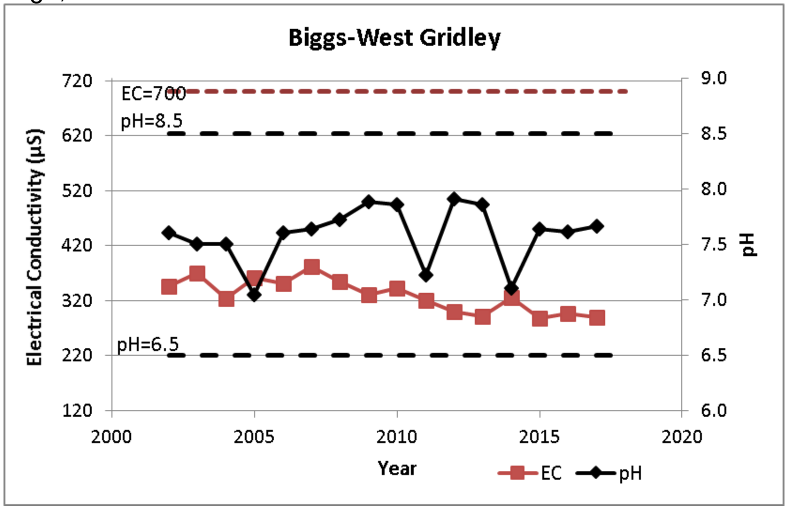
Table 6. Annual groundwater Electrical Conductivity (µS/cm)

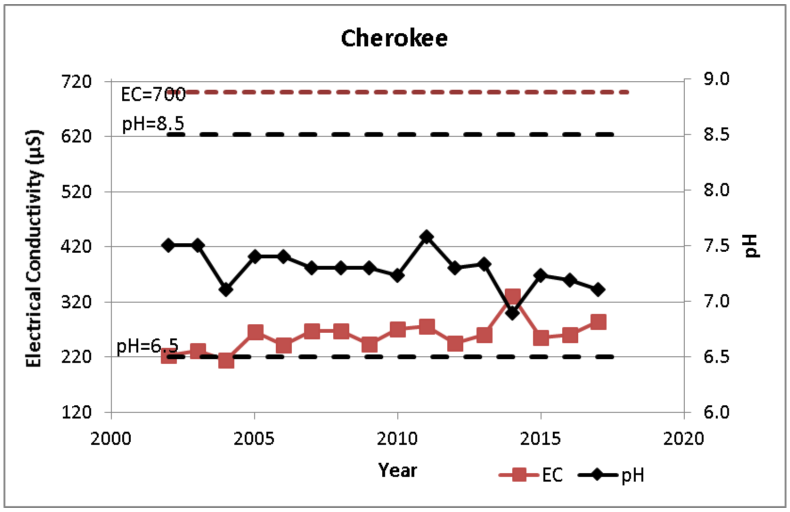
Sub-Inventory Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Biggs-West Gridley	346	370	323	361	351	382	354	331	343	320	300	291	326	288	296	290
Cherokee	222	232	215	266	242	267	268	243	270	275	245	260	330	255	261	284
Chico Urban Area						280	291	260	249	250	248	217	NM	214	221	254
Durham Dayton	315	348	259	340	322	NM	327	NM	307	315	NM	298	304	322	316	322
Esquon	388	526	470	557	507	480	439	419	427	415	408	512	443	417	499	416
Llano Seco							204	195	196	198	192	184	240	180	182	179
M & T	418	551	678	504	465	451	667	445	592	NM	427	391	NM	362	333	498
Pentz						218	229	227	225	224	204	204	231	210	204	207
*Pentz-Butte Valley	195	186	211	240												
Thermalito	132	164	149	150	152	242	205	158	NM	NM	292	179	181	136	159	136
Thermalito domestic							374	350	354	NM	NM	342	NM	320	324	327
Vina	197	225	180	216	192	224	203	200	199	194	174	188	201	200	186	181
Western Canal (East)	447	344	400	524	492	471	482	488	465	459	NM	447	442	449	444	441
Western Canal (West)	464	248	407	501	309	477	469	462	455	460	630	629	695	428	581	NM

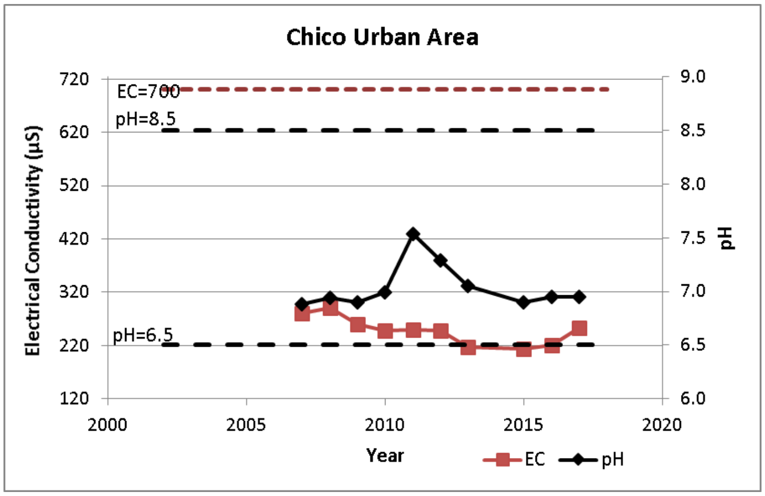
Table 7. Groundwater EC (µS/cm) average and range over 16 year sampling period

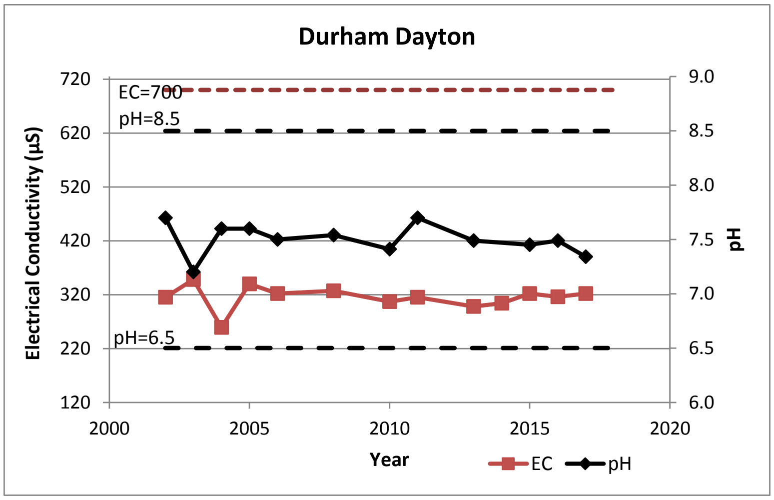
Sub-Inventory Unit	Average	Range
Biggs-West Gridley	330	94
Cherokee	258	115
Chico Urban Area	248	77
Durham Dayton	315	89
Esquon	458	169
Llano Seco	195	61
M & T	484	345
Pentz	217	27
*Pentz-Butte Valley	208	54
Thermalito	174	160
Thermalito domestic	342	54
Vina	197	51
Western Canal (East)	453	180
Western Canal (West)	481	447

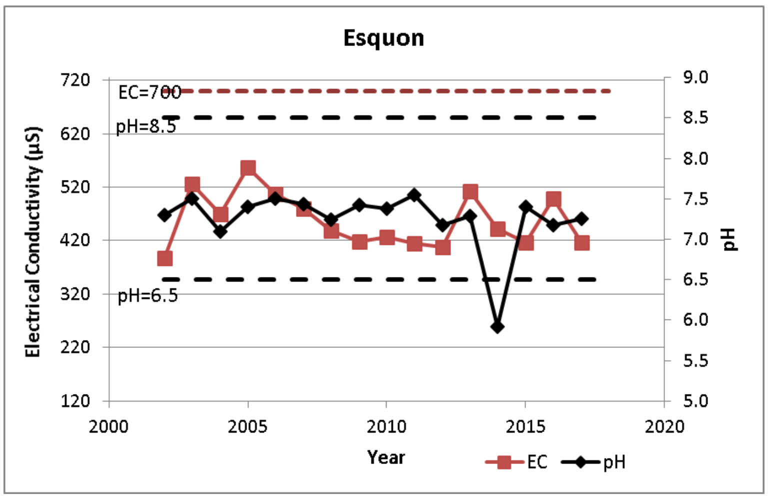
Annual Electrical Conductivity (µS/cm) and pH for each water quality sampling well. The red dashed line indicates the preferred maximum level for EC and the black dashed lines bound the acceptable pH range, 6.5-8.5. Therefore, when the red plot of EC values is below the red dashed line (as it always is), then measured EC is within the secondary standard for agricultural water (<700), which is more restrictive than for drinking water (<900). To be within the acceptable pH range, the black line should be within the black dashed lines.

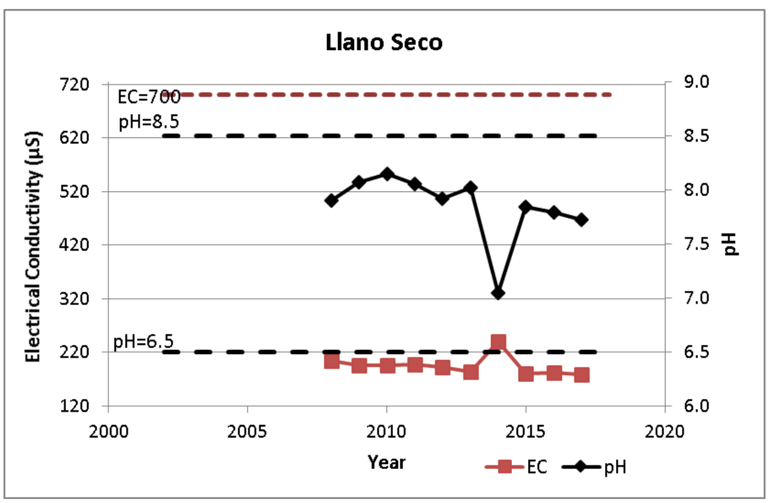




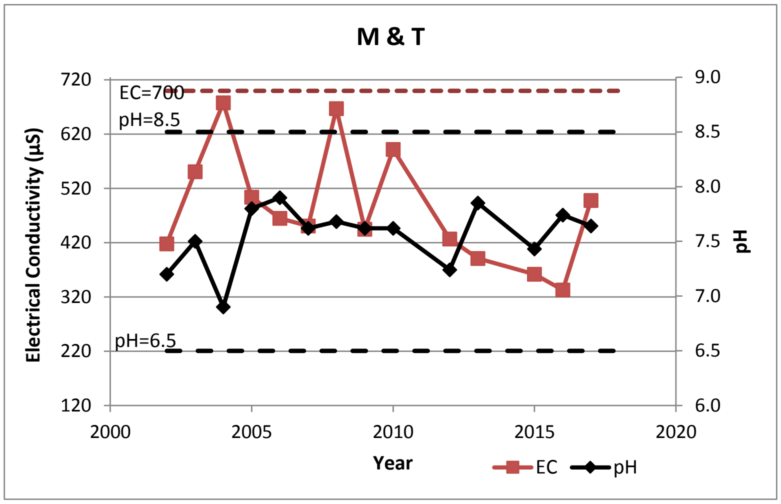


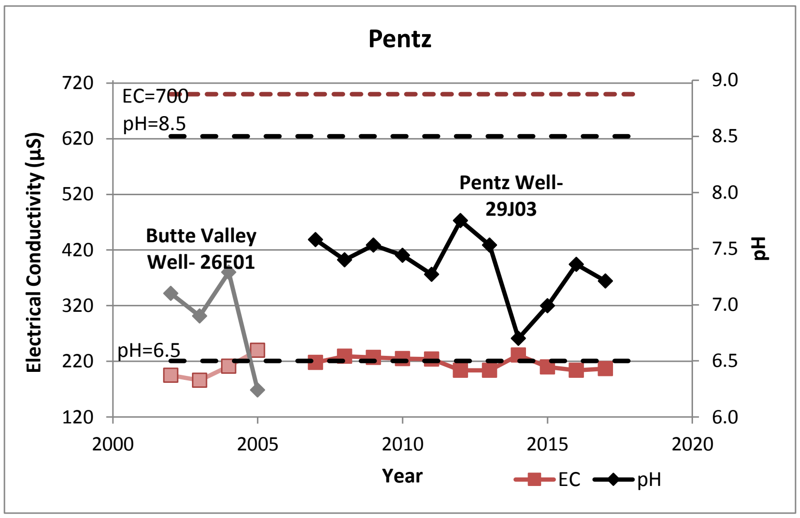


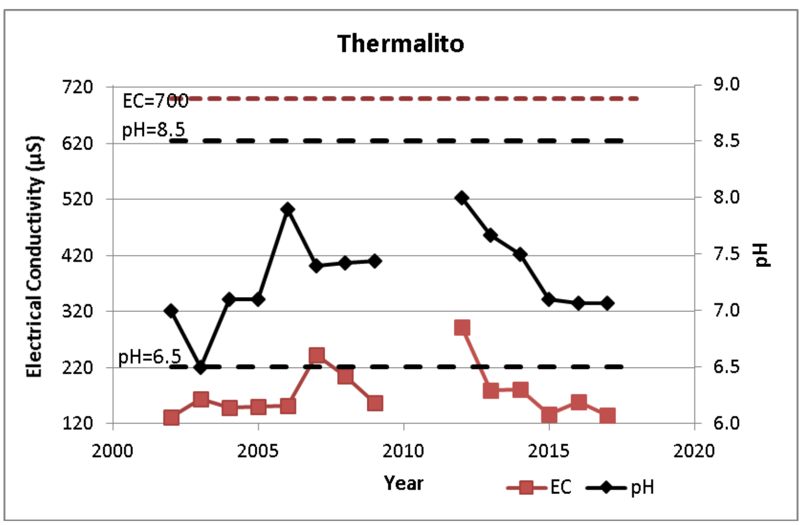




NOTE: The red dashed line indicates the preferred maximum level for EC and the black dashed lines bound the acceptable pH range, 6.5-8.5. Therefore, when the red plot of EC values is below the red dashed line (as it always is), then measured EC is within the secondary standard for agricultural water (<700), which is more restrictive than for drinking water (<900). To be within the acceptable pH range, the black line should be within the black dashed lines.







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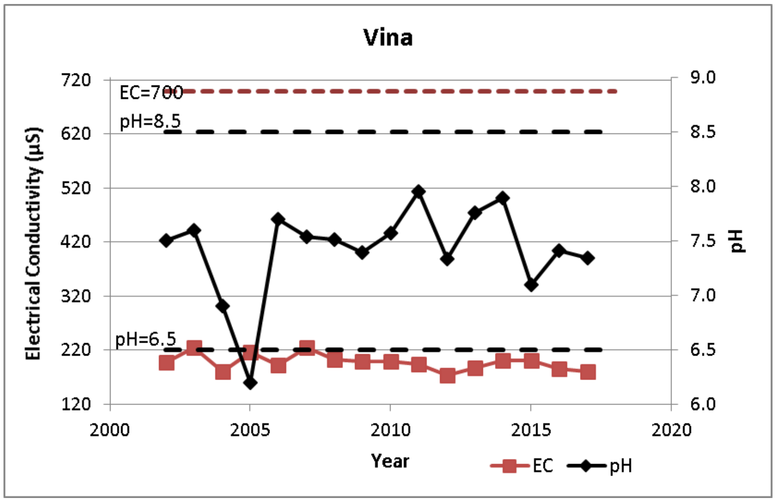

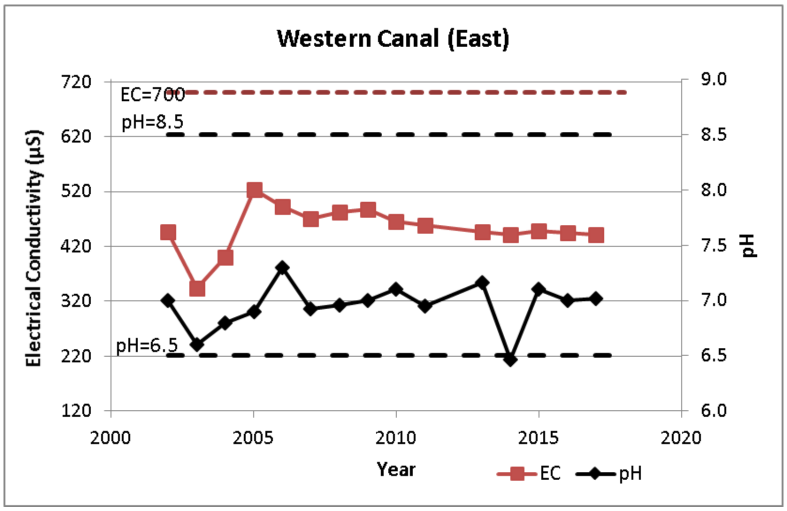

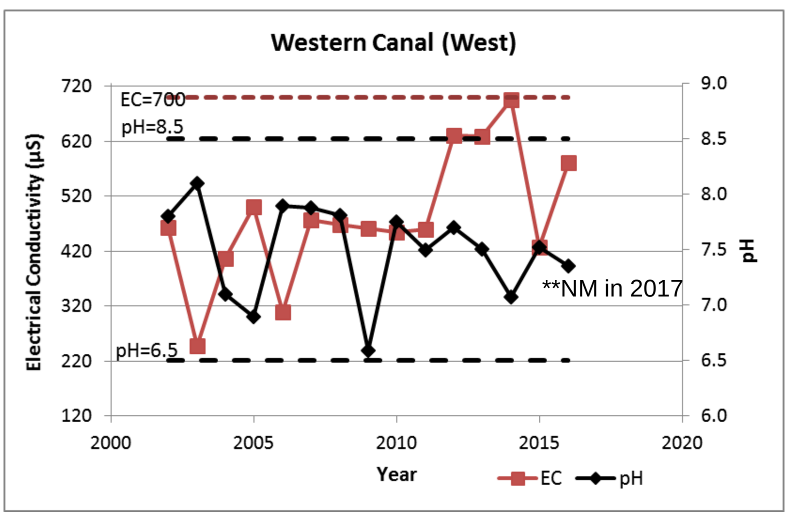

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